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QUALITY OF PEPPER FRUITS (*Capsicum annuum* L.) UPON THE APPLICATION OF THE BIOFERTILISERS CULTIVATED UNDER THE CONDITIONS OF ORGANIC AGRICULTURE

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Abstract

Biofertilisers are a natural solution for the creation of a suitable feeding schedule for vegetables when cultivated under the conditions of organic agriculture. This experiment was carried out in 2009-2011 on the fields of the Agroecological Centre at the Agricultural University – Plovdiv, situated on the territory of the certified ecological farm. The research included pepper of the variety of “Kurtovska Kapiya 1619” cultivated as mid-early field production according to the principles of organic agriculture. The biofertilisers used into the study were Boneprot, Lumbrical and Seasol. The aim of the study was to examine the impact of fertilisation applied on the quality parameters of the red pepper (dry matter, total sugars and vitamin C). The results showed that the combined application of the biofertiliser Seasol on the basic fertilisation Boneprot ensured the higher values for total sugars of 8,48% (2009) and 8,50% (2011), and that the application of the Seasol biofertiliser on the basic fertilisation Lumbrical increased the vitamin C content - 216,6 mg% (2009) and 201,0 mg% (2011). The positive effect was observed for Boneprot applied in an optimum concentration by the increased content of the dry matter – 8,94% (2009) and 8,50% (2011). The biofertilisers used in the study showed their positive effect on the biochemical parameters of the pepper fruits.

Key words: *Capsicum annuum* L., organic agriculture, biofertilisers, quality, biochemical parameters

1. INTRODUCTION

Agricultural pollution reduction may be achieved through the science-grounded application of organic agriculture (Bencheva et al., 1997). Over the last several decades, organic agriculture has been deemed one of the fastest developing agricultural sectors on a worldwide scale (Panayotov, 2000; Svobodkov, 2002; Popov and Evstatieva, 2010). Organic agriculture has become a widely accepted sector of agricultural and food research (Niggli and Willer, 2000). In present days organic food is more and more popular especially in the midst of consumers (Świetlikowska et al., 2010).

Fertilisation is a very important stage of the technology of production (Boteva and Cholakov, 2011). Biofertilisers have been identified as an alternative to chemical fertilizers, which increase soil fertility and crop production in sustainable farming (Wu et al., 2004). Biofertilisers are the natural solution for the creation of a suitable feeding schedule for vegetables when cultivated under the conditions of organic agriculture (Tringovska, 2005). Biofertiliser is commonly referred to as the fertiliser that contains living microorganisms and it is expected that their activities will influence the soil ecosystem and produce supplementary substance for the plants (Ngampimol and Kunathigan, 2008).

Biofertilisers being essential components of organic farming play a vital role in maintaining long term soil fertility and sustainability by fixing atmospheric dinitrogen (N=N), mobilizing fixed macro and micro nutrients or convert insoluble P in the soil into forms available to plants, thus increasing their efficiency and availability (Mahdi et al., 2010). Red pepper (*Capsicum annuum*) is among the products with quality dependency on drying conditions (Alves- Filho et al., 2007). The total sugars contained in...
the long fleshy red pepper are an element of the nutritional value of fruits and affect their gustatory properties (Pevicharova et al., 2007.).

**Objectives**

The aim of the study was to examine the impact of the fertilisation applied on the quality parameters of the pepper (dry matter, total sugars and vitamin C).

2. MATERIALS AND METHODS

This experiment was carried out in 2009 - 2011 on the experimental fields of the Agroecological Centre at the Agricultural University - Plovdiv, situated on the territory of the certified ecological farm.

**Treatments:**

(1). Control (non-fertilised) denoted as \( T_1 \)

(2). Basic fertilisation with Boneprot (optimum concentration) denoted as \( T_2 \)

(3). Basic fertilisation with Boneprot (50 %) + Seasol denoted as \( T_3 \)

(4). Basic fertilisation with Lumbrical (optimum concentration) denoted as \( T_4 \)

(5). Basic fertilisation with Lumbrical (50 %) + Seasol denoted as \( T_5 \)

**Fertilisation**

Two basic fertilisations were used, namely: Lumbrical and Boneprot, applied into the soil through incorporation prior planting of the seedlings on the field. The biofertilisers were applied in two concentrations – optimum (corresponded to 400 l/da for the basic fertilisation with Lumbrical and 70 kg/da for the basic fertilisation with Boneprot) and reduced by 50 %. Biofertiliser Seasol was introduced as soil amendment in concentration 1: 500- 0,3 - 0,4 l/da during the vegetation at the plant growing stage ‘flower-bud’ and ‘mass fruitfulness’.

2.1. Materials

**Vegetable tested**

The research included pepper of the variety of “Kurtovska Kapiya 1619” cultivated as mid-early field production according to the principles of organic agriculture. The biofertilisers included into the study - Boneprot, Lumbrical and Seasol, were used in conformity with Commission Regulation (EC) No. 889/2008.

2.2. Characteristics of the biofertilisers included into the study

This study includes the following biofertilisers - Lumbrical, Boneprot and Seasol (Earthcare) which are included in the list of the biofertilisers according to Regulation (EC) No. 889/2008 (Enclosure No. 1).

**Lumbrical** (v. Kostievo - Plovdiv, Bulgaria) is a product obtained from the processing of natural fertiliser and other organic waste of the Californian red worms (*Lumbricus rubellus* and *Eisenia foetida*) and consists of their excrements. The commercial product has humidity of 45-55 % and organic substance content of 45-50%. Ammonium nitrogen (NH\(_4\)N)-33,0 ppm; nitrate nitrogen (NO\(_3\)-N)-30,5 ppm; P\(_2\)O\(_5\) and K\(_2\)O respectively 1410 ppm and 1910 ppm, MgO- 1,8 %. It contains useful microflora 2x10\(^{12}\) pce/g, humic and fulvic acids, nutritional substances. The product activity is 6,5- 7,0 (pH in H\(_2\)O).
Boneprot (Arkobaleno, Italy) it is pellet organic fertilisers, and has the composition: (organic nitrogen (N)- 4,5 %; phosphorus anhydride (P<sub>2</sub>O<sub>5</sub>) total-3,5 %; potassium (K<sub>2</sub>O)- 3,5 %; calcium (CaO)-5-8 %; magnesium (MgO)- 0,8-1 %; organic carbon (C) of biological origin- 30 %; humification rate (HR)- 10-13 %; degree of humification (DH)- 40 - 42 %; humification index (HI)-1,3 - 1,4 %; humidity-13-15%; pH in water- 6-8. Boneprot is an entirely organic fertiliser consisting exclusively of Cattle manure. These materials are collected from farms which do not use antibiotics and are subject to controlled fermentation for a period of about one year.

Seasol (Earthcare) Seasol International Pty Ltd. (Australia) - an extract of brown algae Durvillaea potatorum. Seasol is a 100% liquid natural seaweed extract. It contains 60 % of alginic acids. The commercial product contains as follows: raw protein (2,5±0,1 % w/w); alginates (6 ± 2 % w/w); total solidity (10,0±0,5 % w/w), and pH (10,5±0,5% w/w), and has a variety of mineral elements and traces of Ca (0,05 ± 0,03 % w/w), Mg (0,01 ± 0,005 % w/w), N (0,10 ± 0,05 % w/w), P (0,05 ± 0,02 % w/w), K (2,0 ± 0,5 % w/w), Cu (0,3 ± 0,2 % w/w), and cytokines.

The seedlings were planted on a permanent place during the third decade of May, on a high levelled seed-bed, according to the scheme 120+60x15 cm. The experiment was worked out according to the method of long plots, into four replications, with a size of the test plot of 9.6 m<sup>2</sup>.

2.3. Study Parameters

2.3.1. Production quality – biochemical analysis was carried out on an average sample of 20 fruits from each treatment on the following: dry matter (refractometrically - %), vitamin C (acc. to Tilman’s reaction - mg %) and total sugars (according to Schoorl - Regenbogen - %) (Genadiev et al. 1969).

3. RESULTS AND DISCUSSION

3.1. Quality of the pepper

The biofertilisers included into the experiment - Boneprot and Lumbrical, applied as basic fertilisation and the vegetative feeding with the biofertiliser Seasol had an influence on the change of the biochemical parameters - dry matter, total sugars and vitamin C in pepper fruits, the variety of “Kurtovska Kapiya 1619” in the experimental years of 2009 - 2011.

In the experimental year of 2009 the dry matter content of pepper fruits had the highest values for basic fertilisation Boneprot applied in optimum concentration (T<sub>2</sub>) - 8,94 % (Figure 1). The combination of the biofertiliser Seasol on basic fertilisation Boneprot (T<sub>3</sub>) resulted in the increase in the value 8,70 %, as there was an increase in the standard yield compared to the control by 35,07 % (Vlahova & Popov, 2013, in the press).

On the comparison of the combined treatments of both basic fertilisations with the independent application of basic fertilisation in an optimum concentration (T<sub>2</sub> and T<sub>3</sub>), it was found that the total sugars in the fruits of the plants of the combined treatments (T<sub>3</sub> and T<sub>5</sub>) were characterized with higher values - 8,48%. In comparison with the results of both basic fertilisations applied in an optimum concentration, it was found that the value of total sugars was higher with the basic fertilisation Lumbrical (T<sub>4</sub>) - 8,20%, as compared to the basic fertilisation Boneprot (T<sub>2</sub>) - 6,68 %, which was due to the rich content of an organic substance 45-50 % on the basic fertilisation Lumbrical and its impact on the sugar content in the fruits.

Furthermore, it was established that there was a better effect on the sugar content of the biofertiliser Seasol on the basic fertilisation Boneprot, thus confirming the positive combination of the impact of both biofertilisers.
The vitamin C content in the fruits was reported the highest upon the application of the biofertiliser Seasol on the basic fertilisation Lumbrical (T5) - 216.6 mg%, followed by the treatment that included the application of the biofertiliser Seasol on the basic fertilisation Boneprot (T3) - 200.8 mg%. It was found that the combined treatments additionally fed with biofertilisers were characterized with fruits having a higher vitamin C content in comparison with the independent application of the biofertilisers, as basic fertilisation in an optimum concentration. The values of all treatments exceeded the control.
(T₁), thus assessing the beneficial effect of biofertilisers with respect to the improvement of the quality of the pepper organic production.

In 2010, under the influence of the additional application of biofertilisers, the dry matter content slightly varied for the separate treatments, as the pepper fruits of the treatment on the basic fertilisation Lumbrical, applied in an optimum concentration (T₄), reported a slight increase of 8.00 % (Figure 2).

The content of total sugars in pepper fruits of the variety of “Kurtovska Kapiya 1619” was characterized with a maximum value upon the additional application of the biofertiliser Seasol on the basic fertilisation Boneprot (T₃) - 8.37 %.

The results concerning the vitamin C content in fruits showed their highest value upon the optimum concentration of the basic fertilisation Boneprot (T₂) - 191.3 mg%. On the basic fertilisation Lumbrical the higher value of vitamin C content was reported upon treatment with the applied biofertiliser Seasol on the basic fertilisation Lumbrical (T₅) - 182.9 mg%, thus determining the combination as beneficial to vegetative feeding.

In the experimental year of 2011 the data on the biochemical content of fruits of the variety of “Kurtovska Kapiya 1619” were presented in Figure 3. The highest value of dry matter was reported for the optimum concentration of the basic fertilisation Boneprot (T₂) - 8.50 %, thus confirming the result established in the year of 2009. A very good value was established on the basic fertilisation Lumbrical applied in an optimum concentration (T₄) - 8.10 %.

Upon comparison of the combined treatments of both basic fertilisations, the higher value of dry matter was found on the basic fertilisation Boneprot. The high values of dry matter clearly confirmed the usefulness of the application of the biofertiliser Boneprot. The values of all treatments exceeded the control (T₁) - 7.40 %, thus determining the usefulness of the application of the biofertilisers.

The values of total sugars in the pepper fruits were reported higher in the combined treatments (T₃ and T₅) in comparison with the independent application of the basic fertilisations in an optimum concentration (T₂ and T₄), as the maximum value was found in the biofertiliser Seasol on the basic fertilisation Boneprot (T₃) - 8.50 %. A positive effect of the combined application of the biofertiliser Seasol on both basic fertilisations was reported, thus confirming the result from the year of 2009. The values of all treatments exceeded the control (T₁).
The highest value of vitamin C content was reported in the fruits with the biofertiliser Seasol on the basic fertilisation Lumbrical (T₃) - 201.0 mg%, which was similar to the result from the year of 2009, thus proving their beneficial combination and the role of alginates contained in the biofertiliser Seasol. Upon comparison of the combined treatments of both basic fertilisations, the higher value was reported for the combined treatment of the biofertiliser Seasol on the basic fertilisation Lumbrical (T₅), in comparison with the application of the biofertiliser Seasol on the basic fertilisation Boneprot. The independent application of the basic fertilisation Boneprot in an optimum concentration (T₂) - 180.7 mg% was characterized with a higher value comparing to the optimum concentration of the basic fertilisation Lumbrical (T₄) - 172.0 mg%.

The combined treatments of both basic fertilisations had higher values of vitamin C content in comparison with the optimum concentrations, as the values of all treatments exceeded the control (T₁) - 163.0 mg%.

CONCLUSIONS
The biofertiliser Boneprot applied as optimum concentration had a positive effect on the dry matter content of the pepper fruits.

The combined application of the biofertiliser Seasol on the basic fertilisation Boneprot had a stronger effect on the content of total sugars as compared to the independent application of basic fertilisations in an optimum concentration, thus confirming that the combination of biofertilisers has a definite positive effect on the quality of the organic production.

The application of the biofertiliser Seasol on both basic fertilisations had a positive effect on the vitamin C content in the pepper fruits. It was found that the biofertilisers used in the experiment had a positive effect on the biochemical parameters of pepper fruits produced under the conditions of organic agriculture.
REFERENCE


INFLUENCE OF BIOFERTILISERS ON THE LEAF GAS-EXCHANGE OF PEPPER
(CAPSICUM ANNUUM L.) CULTIVATED UNDER THE CONDITIONS OF
ORGANIC AGRICULTURE

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Abstract
The experiment was carried out in 2009-2011 in the biological farm at the Agroecological Centre at the Agricultural University - Plovdiv. The research included pepper of the variety “Sofiiska kapiya”, as the following biofertilisers were tested: Seasol (Earthcare) (Seasol Intl. Australia), applied as two basic fertilisations, namely: Boneprot and Lumbrical, having their active substances entered into the approved list of the Regulation (EC) No. 889/2008. The aim of this study was to establish the effect of the selected biofertilisers on the changes in the physiological parameters of pepper. The physiological researches were carried out on the last normally developed leaves of the test cultures with the help of the photosynthetic system LCA-4 (ADC, England), as the following were determined: rate of net photosynthesis, intensity of transpiration, and stomatal conductance. The additional feeding with biofertilisers during vegetation provided a reserve of nutritional substances and improved the physiological status of the plants, thus giving us grounds to recommend the combined use of the biofertiliser Seasol on the basic fertilisation Boneprot.

Key words: pepper, organic agriculture, biofertilisers, net photosynthesis, leaf gas-exchange

1. INTRODUCTION
Organic farming is one of the most important elements of today’s Common Agricultural Policy of the European Union (Karova et al., 2010). In recent years there has been an increase in the demand for vegetables of high ecological value, which has contributed to the expanding use of organic fertilisers (Boteva and Cholakov, 2010). In recent decades the high biological value and the excellent gustatory and technological properties of pepper fruits have made this vegetable culture even more important (Cholakov et al., 1996). Organic and inorganic fertilisers applied to the soil supply plant nutrients for crop growth and affect the plant’s physiological processes, which serve as important instruments in yield development (Amujoyegbe, 2007). Photosynthesis is a primary assimilatory process which determines the growth and productivity of pepper plants and is closely dependent on various abiotic factors and applied fertilisation.

Objectives
The objective of this study was to found the influence of the biofertiliser Seasol applied during vegetation on the parameters of the leaf gas-exchange of pepper cultivated under the conditions of organic agriculture.

2. MATERIALS AND METHODS
The experiment was carried out in 2009-2011 in the biological farm at the Agroecological Centre at the Agricultural University - Plovdiv.
Treatments:
1. Control (non-fertilised)
2. Basic fertilisation with Boneprot (optimum concentration)
3. Basic fertilisation with Boneprot (50 %) + Seasol
4. Basic fertilisation with Lumbrical (optimum concentration)
5. Basic fertilisation with Lumbrical (50 %) + Seasol

Fertilisation

Two basic fertilisations were used, namely: Lumbrical and Boneprot, applied into the soil through incorporation prior planting of the seedlings on the field. The biofertilisers were applied in two concentrations – optimum (corresponded to 400 l/da for the basic fertilisation with Lumbrical and 70 kg/da for the basic fertilisation with Boneprot) and reduced by 50 %. Biofertiliser Seasol was introduced as soil amendment in concentration 1:500 - 0.3 - 0.4 l/da during the vegetation at the plant growing stage ‘flower-bud’ and ‘mass fruitfulness’.

2.1. Materials

Vegetable tested

Green pepper is the second most significant Bulgarian vegetable culture from an economic point of view (Cholakov and Todorov, 2007). The research included pepper of the variety “Sofiiska kapiya” used for mid-early and late field production.

Agrotechnology

The variety used in the study has been cultivated in conformity with the principles of organic agriculture, according to a technology for mid-early field production (Panayotov, 2000; Vlahova et al., 2011).

2.1.1. Characteristics of the biofertilisers included into the study

This study includes the following biofertilisers - Lumbrical, Boneprot and Seasol (Earthcare) which are included in the list of the biofertilisers according to Regulation (EC) No. 889/2008 (Enclosure No. 1).

Boneprot (Arkobaleno, Italy) it is pellet organic fertilisers, and has the composition: (organic nitrogen (N) - 4,5 %; phosphorus anhydride (P$_2$O$_5$) total-3,5 %; potassium (K$_2$O)- 3,5 %; calcium (CaO)-5-8 %; magnesium (MgO)- 0,8-1 %; organic carbon (C) of biological origin- 30 %; humification rate (HR)- 10-13 %; degree of humification (DH)- 40-42 %; humification index (HI)-1,3-1,4 %; humidity-13-15%; pH in water- 6-8. Boneprot is an entirely organic fertiliser consisting exclusively of Cattle manure. These materials are collected from farms which do not use antibiotics and are subject to controlled fermentation for a period of about one year.

Lumbrical (v. Kostievo- Plovdiv, Bulgaria) is a product obtained from the processing of natural fertiliser and other organic waste of the Californian red worms (Lumbricus rubellus and Eisenia foetida) and consists of their excrements. The commercial product has humidity of 45 - 55 % and organic substance content of 45-50%. Ammonium nitrogen (NH$_4$N)-33,0 ppm; nitrate nitrogen (NO$_3$-N)-30,5 ppm; P$_2$O$_5$ and K$_2$O respectively 1410 ppm and 1910 ppm, MgO- 1,8 %. It contains useful microflora 2x10$^{15}$ pce/g, humic and fulvic acids, nutritional substances. The product has an activity of 6,5 - 7,0 (pH in H$_2$O).

Seasol (Earthcare) Seasol International Pty Ltd. (Australia) – an extract of brown algae Durvillaea potatorum. Seasol is a 100% liquid natural seaweed extract. It contains 60 % of alginic acids. The
commercial product contains as follows: raw protein (2.5 ± 0.1 % w/w); alginates (6 ± 2 % w/w); total solidity (10.0 ± 0.5 % w/w), and pH (10.5 ± 0.5% w/w), and has a variety of mineral elements and traces of Ca (0.05 ± 0.03 % w/w), Mg (0.01 ± 0.005 % w/w), N (0.10 ± 0.05 % w/w), P (0.05 ± 0.02 % w/w), K (2.0 ± 0.5 % w/w), Cu (0.3 ± 0.2 % w/w), and cytokines.

The seedlings were planted on a permanent place during the third decade of May, on a high levelled seed -bed, according to the scheme 120 + 60x15 cm. The experiment was worked out according to the method of long plots, into four replications, with a size of the test plot of 9.6 m².

2.2. Study Parameters

Leaf gas - exchange

Leaf gas-exchange parameters are \( P_{\text{N}} \)- Net photosynthetic rate (µmol CO₂ m⁻² s⁻¹), E- Transpiration rate (mmol H₂O m⁻² s⁻¹) and \( g_{\text{s}} \)- Stomatal conductance (mol m⁻² s⁻¹), using a portable infrared gas analyser LCA-4 (Analytical Development Company Ltd., Hoddesdon, England). The system was used with the broad leaf chamber PLC4B. Measurements were made under a light intensity of 800 µmol m⁻² s⁻¹ PAR, at a temperature of 24 ± 2 ºC, an external CO₂ concentration of 390 µmol mol⁻¹ and relative air humidity of 70 %.

Measurements have been taken on normally developed leaves from the central floors of the plants, which are representative of each treatment. Two analyses were carried out on the leaf gas - exchange, as the first measurement was taken at the flower bud stage, 15-20 days after the application of the biofertiliser Seasol, and the second one - at the stage of mass fruitfulness. Measurements were taken at the moment of mass display for the different treatments.

2.3. Statistical data processing – Microsoft Office Excell 2007; SPSS (Duncan, 1955); BIOSTAT. One-way analysis of variance (ANOVA) was used to analyze the differences between treatments. A Duncan multiple-range test was also performed to identify the homogeneous type of the data sets among the different treatments. BIOSTAT was used to compare the results as compared to the control.

3. RESULTS AND DISCUSSION

3.1. Leaf Gas - Exchange Analyses

Figure 1 below presents the change in the speed of the net photosynthesis in the flower bud stage of pepper of the variety of “Sofiiska kapiya” in 2009, as the highest value was reported for the plants after treatment with applied the basic fertilisation Boneprot in an optimum concentration- 14.86 µmolCO₂ m⁻² s⁻¹, followed by treatment with an optimum concentration on the basic fertilisation Lumbrical-14.76 µmolCO₂ m⁻² s⁻¹. Upon comparison of the combined application of the biofertiliser Seasol on both basic fertilisations, the higher value of the speed of the net photosynthesis was reported on the basic fertilisation Lumbrical.

The intensity of the transpiration in the flower bud stage in 2009 had a well-expressed value upon the treatment with an optimum concentration on the basic fertilisation Boneprot - 2.59 mmolH₂O m⁻² s⁻¹, as the difference between the average ones in comparison with the control was proven for P1%. Upon comparison of the combinations with the biofertiliser Seasol on both basic fertilisations, the higher value was reported on the basic fertilisation Boneprot (Table 1).
Figure 1. P_N - Net photosynthetic rate (µmol CO₂ m⁻² s⁻¹) at flower bud stage – 2009

Table 1. Leaf gas-exchange at flower bud stage; E- Transpiration rate - (mmol H₂O m⁻² s⁻¹)
The stomatal conductance had a high value upon separate application on the basic fertilisation Boneprot-0,060 mol m⁻² s⁻¹, including a high intensity of transpiration, thus determining the stimulating effect of the biofertiliser Boneprot on the better water status of the pepper plants (Table 2).

Table 2. Leaf gas-exchange at flower bud stage; gₛ- Stomatal conductance (mol m² s⁻¹)

<table>
<thead>
<tr>
<th>№</th>
<th>Treatments</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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<tr>
<td></td>
<td></td>
<td>gₛ;</td>
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<td></td>
<td></td>
<td>Mean;</td>
<td>Mean;</td>
<td>Mean;</td>
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<tr>
<td>1.</td>
<td>Control</td>
<td>0.020 ± 0.010</td>
<td>0.030 ± 0.006</td>
<td>0.030 ± 0.003</td>
</tr>
<tr>
<td>2.</td>
<td>Boneprot (optimum)</td>
<td>0.060 ± 0.010</td>
<td>0.040 ± 0.010</td>
<td>0.035 ± 0.005</td>
</tr>
<tr>
<td>3.</td>
<td>Boneprot (50%) + Seasol</td>
<td>0.033 ± 0.006</td>
<td>0.040 ± 0.010</td>
<td>0.040 ± 0.005</td>
</tr>
<tr>
<td>4.</td>
<td>Lumbrical (optimum)</td>
<td>0.033 ± 0.006</td>
<td>0.030 ± 0.005</td>
<td>0.030 ± 0.005</td>
</tr>
<tr>
<td>5.</td>
<td>Lumbrical (50%) + Seasol</td>
<td>0.023 ± 0.006</td>
<td>0.040 ± 0.010</td>
<td>0.037 ± 0.006</td>
</tr>
</tbody>
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The highest value of the rate of the net photosynthesis in 2010 was reported for that treatment, on which the biofertiliser Seasol on the basic fertilisation Boneprot - 13,85 µmol CO₂ m⁻² s⁻¹ was applied vegetatively, as the difference between the average ones in comparison with the control was proven for P₀.1%. It was proven that the biofertiliser Seasol on the basic fertilisation Lumbrical - 11,75 µmol CO₂ m⁻² s⁻¹ had a very good effect, as the difference between both treatments was proven for P<0.05 (Duncan’s multiply range test). The rate of the net photosynthesis upon the optimum concentration on the basic fertilisation Boneprot was higher than the other basic fertilisation. Treatments on the basic fertilisation Boneprot had a higher rate of the net photosynthesis compared to the treatments on the basic fertilisation Lumbrical, as all of them exceeded the values of the control, thus determining the usefulness of the application of the biofertiliser Boneprot (Figure 2).
The intensity of the transpiration in the flower bud stage in 2010 had a high value upon the treatment with an optimum concentration on the basic fertilisation Boneprot - 1, 47 mmolH₂Om⁻²s⁻¹, as the difference between the average ones in comparison with the control was proven for P<0.05, (acc. Duncan’s multiply range test). Some very good results were achieved with respect to the combined application of Seasol on both basic fertilisations, as the Lumbrical value was the higher one, thus proving the positive effect of the combined application of the biofertiliser Seasol on the basic fertilisation Lumbrical. Upon comparison of both optimum concentrations, a higher intensity of the transpiration was proven to be present on the basic fertilisation Boneprot, which was analogous to the results from the year of 2009. The application of the biofertiliser Seasol on both basic fertilisations increased the stomatal conductance, as it also had a positive effect on the higher intensity of the transpiration, thus proving the better functioning of the photosynthetic apparatus (Table 2).

The rate of the net photosynthesis in the flower bud stage in 2011 had a high value for the treatment with combined application of the biofertiliser Seasol on the basic fertilisation Boneprot- 14,37 µmolCO₂ m⁻² s⁻¹, thus confirming the findings established in 2010. In addition, a very good effect was also established with respect to the combined application of Seasol on the basic fertilisation Lumbrical, as the difference between the treatments was proven for P<0,05 (acc. Duncan’s multiply range test). The statistical analysis showed that in all treatments compared with the control the difference between the average ones was proven for P<0.1% (Figure 3).

It was established that the way of introducing the biofertilisers (basic fertilization - as basic fertilisation and feeding fertilisation, as addition) had a positive effect on the rate of the net photosynthesis, as increased values were reported for all treatments compared to the control.

The combined application of the biofertiliser Seasol with both basic fertilisations ensured the higher rate of the net photosynthesis due to the separate application of the basic fertilisation in an optimum concentration. The rate of the net photosynthesis upon the optimum concentrations of both basic fertilisations was higher on the basic fertilisation Boneprot, which was analogous to the result obtained in 2009 and 2010, thus confirming the stimulating effect of the biofertiliser Boneprot.
The highest value of the intensity of the transpiration in the flower bud stage in 2011 was reported for those plants cultivated on the basic fertilisation Boneprot and being additionally fed with the biofertiliser Seasol - 1.91 mmolH₂O₂m⁻²s⁻¹ (Table 1). The difference between the average ones in comparison with the control was proven for P₁%. A very good effect on the intensity of the transpiration was reported for the biofertiliser Seasol on the basic fertilisation Lumbrical. Upon comparison of both optimum concentrations, the higher level of intensity of the transpiration was established in the plants cultivated on the basic fertilisation Boneprot, thus confirming the findings established in 2009 and 2010. The stomatal conductance had a high value for the treatment with the biofertiliser Seasol on the basic fertilisation Boneprot - 0.040 molm⁻²s⁻¹, where the highest intensity of the transpiration was also measured, thus ensuring the good water status of the plants. The combined application of biofertilisers has a better effect on the stomatal conductance in comparison with the separate application of the basic fertilisation.

During the second vegetative measurement in the stage mass fruitfulness in 2009, the highest rate of the net photosynthesis was reported for the treatment being additionally fed with the biofertiliser Seasol on the basic fertilisation Lumbrical - 13.72, followed by Seasol on the basic fertilisation Boneprot (Figure 4).
The combined application of biofertilisers resulted in the increase in the rate of the net photosynthesis, in comparison with the optimum concentration on the basic fertilisation, thus proving the positive effect of the application of biofertilisers. Upon comparison of the results regarding the rate of the net photosynthesis upon the optimum concentrations of both basic fertilisations, the higher value reported was on the basic fertilisation Boneprot as a result of the nutritional substances of the basic fertilisation being released for a longer period of time in the pepper vegetation, thus providing assimilates that gave good opportunity for the proper physiological condition of the plants. All treatments with applied biofertilisers had a unidirectional positive effect on the rate of the net photosynthesis, in comparison with the control and the difference between the average ones compared to the control was proven for P<0.1%.

Upon measurement of the physiological activity of the plants in the stage mass fruitfulness in 2009 the highest intensity of the transpiration was reported for the combined application of the biofertiliser Seasol on the basic fertilisation Boneprot - 1.61 mmolH₂O m⁻² s⁻¹ (Table 3).

Combined treatments on both basic fertilisations had higher values compared to the optimum concentration on the basic fertilisation. The statistical analysis showed that in the treatments with an optimum concentration the difference between the average ones in comparison with the control was proven for P<0.1%. The stomatal conductance had its maximum values in the plants of the combined treatment of biofertiliser Seasol on the basic fertilisation Lumbrical - 0.040 mol m⁻² s⁻¹ (Table 4).

In 2010 the highest value of the rate of the net photosynthesis was reported upon the optimum concentration on the basic fertilisation Lumbrical - 13.35 µmol CO₂ m⁻² s⁻¹, as the difference between the average ones in comparison with the control was proven for P<0.1% (Figure 5).
Table 3. Leaf gas-exchange at the stage of mass fruitfulness; E - Transpiration rate - (mmol H_2O m^{-2} s^{-1})

<table>
<thead>
<tr>
<th>No</th>
<th>Treatments</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E</td>
<td>Mean; St. Dev.</td>
<td>E</td>
<td>Mean; St. Dev.</td>
</tr>
<tr>
<td></td>
<td>GD</td>
<td>Base</td>
<td>GD</td>
<td>Base</td>
</tr>
<tr>
<td>1</td>
<td>Control</td>
<td>1.60 ± 0.015</td>
<td>1.21 ± 0.072</td>
<td>1.33 ± 0.021</td>
</tr>
<tr>
<td></td>
<td>(ab)</td>
<td>Base</td>
<td>(f)</td>
<td>Base</td>
</tr>
<tr>
<td>2</td>
<td>Boneprot (optimum)</td>
<td>1.35 ± 0.045</td>
<td>1.44 ± 0.026</td>
<td>1.62 ± 0.015</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>+++</td>
<td>(cd)</td>
<td>++</td>
</tr>
<tr>
<td>3</td>
<td>Boneprot (50%) + Seasol</td>
<td>1.61 ± 0.031</td>
<td>1.43 ± 0.010</td>
<td>1.79 ± 0.031</td>
</tr>
<tr>
<td></td>
<td>(ab)</td>
<td>ns</td>
<td>(cd)</td>
<td>+++</td>
</tr>
<tr>
<td>4</td>
<td>Lumbrica (optimum)</td>
<td>1.20 ± 0.035</td>
<td>1.35 ± 0.017</td>
<td>1.94 ± 0.026</td>
</tr>
<tr>
<td></td>
<td>(d)</td>
<td>+++</td>
<td>(de)</td>
<td>+++</td>
</tr>
<tr>
<td>5</td>
<td>Lumbrica (50%) + Seasol</td>
<td>1.51 ± 0.025</td>
<td>1.31 ± 0.065</td>
<td>1.52 ± 0.047</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>ns</td>
<td>(de)</td>
<td>+++</td>
</tr>
</tbody>
</table>

The intensity of the transpiration in the the stage mass fruitfulness in 2010 was found as having a higher value upon the optimum concentration on the basic fertilisation Boneprot - 1.44 mmolH_2O m^{-2} s^{-1}, thus confirming the findings in flower bud stage established in 2010 (Table 3). Upon comparison of the optimum concentrations on both basic fertilisations, the higher value of the intensity of the transpiration was reported on the basic fertilisation Boneprot, thus confirming the findings in flower bud stage found in 2010. Upon the application of the biofertiliser Seasol on the basic fertilisation Boneprot, it was established that there was a high intensity of the transpiration, as well as a high level of stomatal conductance - 0.040 molm^{-2} s^{-1} (Table 4).
Figure 5. $P_N$ - Net photosynthetic rate ($\mu$mol CO$_2$m$^{-2}$ s$^{-1}$) at the stage of mass fruitfulness – 2010

Table 4. Leaf gas-exchange at the stage of mass fruitfulness; $g_s$ - Stomatal conductance (mol m$^{-2}$ s$^{-1}$)

<table>
<thead>
<tr>
<th>№</th>
<th>Treatments</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$g_s$ Mean; St. Dev.</td>
<td>$g_s$ Mean; St. Dev.</td>
<td>$g_s$ Mean; St. Dev.</td>
</tr>
<tr>
<td>1</td>
<td>Control</td>
<td>0.025 ± 0.005</td>
<td>0.020 ± 0.005</td>
<td>0.020 ± 0.000</td>
</tr>
<tr>
<td>2</td>
<td>Boneprot (optimum)</td>
<td>0.030 ± 0.000</td>
<td>0.030 ± 0.005</td>
<td>0.030 ± 0.005</td>
</tr>
<tr>
<td>3</td>
<td>Boneprot (50%) + Seasol</td>
<td>0.030 ± 0.005</td>
<td>0.040 ± 0.005</td>
<td>0.040 ± 0.000</td>
</tr>
<tr>
<td>4</td>
<td>Lumbrical (optimum)</td>
<td>0.020 ± 0.000</td>
<td>0.030 ± 0.005</td>
<td>0.045 ± 0.005</td>
</tr>
<tr>
<td>5</td>
<td>Lumbrical (50%) + Seasol</td>
<td>0.040 ± 0.005</td>
<td>0.030 ± 0.000</td>
<td>0.035 ± 0.005</td>
</tr>
</tbody>
</table>

In 2011 the rate of the net photosynthesis in the mass fruitfulness was characterized with the highest value in those plants cultivated on the basic fertilisation Boneprot and being additionally fed with the biofertiliser Seasol. The higher rate of the net photosynthesis was connected with the increased assimilation of nutritional substances under the influence of the additional feeding and provision of very good physiological functioning of the pepper. A very good result was reported for the pepper cultivated on the basic fertilisation Lumbrical and being vegetatively fed with Seasol, as in both treatments the difference between the average ones in comparison with the control was proven for
It was found that the combined application of Seasol on the basic fertilisation Boneprot had a positive effect on the rate of the net photosynthesis in the mass fruitfulness, thus confirming the result of the flower bud stage found in 2011 (Figure 6).

The intensity of the transpiration in the mass fruitfulness stage in 2011 was characterized with its highest value for those plants cultivated on the basic fertilisation Lumbrical in an optimum concentration - 1.94 mmolH₂O m⁻² s⁻¹ (Table 2). The combined application of the biofertiliser Seasol on the basic fertilisation Boneprot had a positive effect on the intensity of the transpiration and the stomatal conductance, thus confirming the result of the flower bud stage found in 2011 and the result of the mass fruitfulness stage established in 2009 and 2010.

**CONCLUSIONS**

The application of biofertilisers separately or combined had a positive effect on the parameters of the leaf gas-exchange, thus determining the efficiency of their application. The additional feeding with biofertilisers during vegetation provided a reserve of nutritional substances and improved the physiological status of the plants, thus giving us grounds to recommend the combined use of the biofertiliser Seasol on the basic fertilisation Boneprot.

**REFERENCES**


LANDSCAPE PROTECTION IN LESS DEVELOPED REGIONS
WITH A FOCUS ON WETLANDS
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Abstract
Van province has a rich diversity of natural landscape and wetlands due to the combination of natural features such as inactive volcanic mountains, dynamic topography, rich hydrological system and harsh climate. This paper discusses the importance and the need for the integration of natural landscape dimension on the wetland ecosystems case to the regional and local scale plans on the example of Van Province. In this context, natural landscape components with a focus on wetlands and ongoing wetland management efforts in Van, and current development plans and strategies for the province and the region were analysed. Results indicate that natural landscape in general terms and wetlands in particular are neglected themes in the development plans and strategies for the region, and in the reflections to the local scale plans and practices. It is suggested that an integrated framework for development goals in different sectors, landscape protection and wetland management would be more functional in terms of ecologically sustainable development and quality of life in Van.

Key words: landscape protection, wetlands, Van (Turkey), regional development plans, developing regions

1. INTRODUCTION
Wetland landscapes deliver a wide range of critical and important services such as provisioning, regulating, supporting and cultural which are vital for human well-being. Maintaining the natural functioning of wetland landscapes will enable them to continue to deliver these services and to function as one of the key life supporting system of Earth (Durigon et al. 2012; Ramsar Convention Secretariat 2010). The degradation and loss of wetlands is more rapid than that for other ecosystems on the Earth. Losses tend to be more rapid where populations are increasing most, where demands for increased economic development are greatest (Ramsar Convention Secretariat 2010) and where wetlands perceived almost useless. The projected continued loss and degradation of wetlands will result in further reduction in human well-being, especially for poorer people in less developed countries and regions where technological solutions are not as readily available, environmental awareness among public is very low and rapid economic development is the leading priority for public. In this framework, policy intervention failures that are due to the lack of consistency among government policies in economics, environment, natural resource management, physical planning (Turner et al. 2000) are some of the most important reasons of threats to ecological sustainability of wetland landscapes. Lack of consistency among policies is related with the different priorities of the development strategies as well as with the lack of awareness on various benefits of wetland landscapes to society in different levels and contexts. Planners and decision-makers at many levels are frequently not fully aware of and not consider the connections among wetland condition and the provision of wetland services and, landscape planning and spatial planning and, the consequent benefits for people. This lack of understanding and recognition leads to ill-informed, short- termed and narrow-scoped
decisions on regional and local development, which contribute to the rapid loss, conversion and degradation of wetland landscapes and their natural and cultural functions (De Groot et al. 2006).

In Turkey, there is a range of mechanisms including statutory designations, national planning policies and international conventions for the protection of natural and cultural components of landscapes and wetland ecosystems. For wetlands in particular, government planning regulations provide strong measures to help support the management and protection of these ecosystems. Some of the measures are; Ramsar Convention, national wetlands regulation related with Ramsar Convention and, local and national wetland commissions. Furthermore, ELC and attempts for the implementation of ELC are also promising means for the protection of wetland landscapes in Turkey. However, these mechanisms and measures are rarely and adequately included into the regional and local planning processes during the preparation and formulation of development plans and strategies in the country. As a result, despite various attempts in international and national levels for protection and sustainability of wetland landscapes, these landscapes are under threat of current human activities as well as regional and local development plans which gives priority to economic development. This is the case especially in the less developed regions of Turkey such as eastern and south-eastern Anatolia.

The paper attempts to display the current status of wetlands in Van Province, to display the attached roles to wetlands in the local development plans and strategies and to discuss the landscape protection process with a focus on wetlands in the Province on the case of Van Basin Development Plan (2010-2013).

2. NATURAL AND CULTURAL FEATURES OF RESEARCH AREA

2.1 The geographical position

The research area Van Province is located on the Closed Basin of Lake Van, Upper Murat-Van Section and lies between longitudes 42º 40’ and 44º 30’ E and latitudes 37º 43’ and 39º 26’ N (Figure 1). There are high mountains in the north and south and high plateaus in the East of the area. The west of the province is covered by Lake Van. The land area of Van is 19,069 km$^2$, while the whole area is 21,823 km$^2$ including Lake Van. Accordingly, Van comprises %2.5 of the total area of Turkey (Van, 2010). The province which is surrounded by volcanic mountains has an average altitude of approximately 2000 m. The mountains surrounding the largest part of the province constitute about the %53.4 of its area. As the second great land form, the plateaus comprise the %32.9 of the area after the mountains. The plains among the mountainous volcanic formations and fluvial environments comprise the %13.7 of the total area of the province (Alaeddinoğlu 2006).

On the shores of Lake Van, alluvium drifted by the rivers has filled the plains which have lower altitudes compared to environs (Yurt Ansiklopedisi 1985). There has been no formation of broad rivers as a result of an increasing steep slope from north to south in the topography of the west, the north-west and the south sides of Lake Van and the current rivers are short. While almost all of the rivers running constantly and temporarily during the year are discharging their water to Lake Van, Memedik Stream empties into Lake Erçek (Yurt Ansiklopedisi 1985). The main flora is steppe notably in the east side and in the west and north sides of Lake Van and in the province (Gürbüz 1994).

2.2 The socio-cultural and economic characteristics

Van had contained many cultures in the past due to its geographical position. Thus, as for natural landscape, it has many historic and cultural landscape features which are rich and various in content (Güler et al. 2011).

%66 of the total land size of Van consists of meadows and ranges. The short periods of vegetation in Van raise the importance of an agricultural economy rather than an industrial one and put forward
livestock farming in other agricultural activities because of wide meadow-range fields and high forage crop plantations. Therefore the province has the characteristics of a typical agricultural zone with regard to vegetable and animal production value (Güler et al. 2011).

According to 2001 data of TUIK, Van is ranked as the 72th of 81 provinces in per capita GDP (Gross Domestic Product). The rate of unemployment is above the country’s average with %15.6 to %14 according to TUIK data of 2009. Van is ranked as the 77th of 81 provinces in terms of the level of education and the resources of educational opportunities (Güler et al. 2011).

Van is ranked 75th among 81 provinces in terms of the development level based on the analyses of 2003. In this respect, the province is in the fifth degree developed provinces status according to the development index and there is a big gap between the country average and the province’s level with regard to development and competitiveness (Güler et al. 2011).

2.3 Lake Van and its surrounding wetlands

Lake Van, which is the largest wetland in Turkey, is in the boundaries of the province of Van. Being the largest lake of Turkey with an area of 371,300 hectare square, Lake Van is like an inland sea in the middle of the high mountains surrounding it. Lake Van and its surroundings are quite rich in wetlands, especially where rivers empty into the Lake. The primary rivers which feed the Lake are Karasu, Keşiş Stream and Hoşap Stream in the west, Bendimahi Brook in the north-east and Zilan Stream and Deliçay Stream in the North. But, there are also many small rivers pouring into the Lake in the south, the west and partially in the northern sides of the Lake. There are not significant reeds and delta areas
especially in the western and southern sides of the Lake because in these areas rivers and streams are short and don’t carry enough water and material. But most of the rivers in the east, the northeast and partially in the north are leaving much of their material at the entry of the Lake and make reeds in shallow plains and small deltas. In these reeds nest many species of water fowl. While the greater part of these water fowl species are composed of migrant birds, another part is “Mid-winter Water Fowls”.

Of 28 species, 6433 water fowls and 1641 Lake Van gulls have been counted in the Lake which does not freeze in the winter and therefore is of rich bird diversity. Accordingly, Lake Van is considered as the most important breeding area in Turkey. The Lake Van Basin is rather close to the northeast-south migration route, which is one of the three most important routes in the West Palaearctic. The number of bird species is reported as 213 in the Lake Van Basin according to the observations and researches to date but it is expected that the number may exceed 300 with the growing ornithological researches (Adızel 1998; Dürmuş 2008). Of these species, 77 are natives (%37.8), 18 are winter visitors, 89 (%43.2) are migrants and 20 (%6.1) are transit migrants. 14 of the observed species are in critically endangered, 33 are in endangered, 50 are in vulnerable, 21 are in declining, 18 are in near threatened
and 25 are in least concern categories. Besides there are 13 species which are globally endangered (Durmuş et al. 2011). Consequently, some of the main areas with high potential in terms of wetland ecosystems around Lake Van and in the borders of Van Province are: Bendimahi Delta, Çelebağı Reedbeds, Dönemeç Delta, Ereğ Lake, Edremit Reedbeds (Figure 2).

Edremit Reed Beds: Is located in Edremit bay in the southeast of Lake Van. It is a shallow area with small lagoons, covered with reedbeds and is separated from the Van Lake by strands of sand next to Van Airlines. It is likely to see many species of water fowl in the reeds and a substantial amount of these birds breed in these reed beds (Yıldırım 1999). Many birds and water fowls visit the area in migration seasons in flocks. There are many marsh areas covered densely with small plants and reeds. Many birds choose this area because of its shallow water, its conditions of sunlight, wind and food (Z Karakoç 2013, pers.comm., 6 February). There is less number of species and amount of birds than the other wetlands in the basin as a result of the close location to Airport and settlements and, the noise of the surrounding recreational activities. Almost all of its surrounding reed areas are destructed (Z Karakoç 2013, pers.comm., 6 February).

Dönemeç Delta: It is located on the southeast shores of the Van Lake in the boundaries of Çiçekli Town, Edremit, Van. The Van- Gevaş highway divides the delta into two. The delta is covered with reeds, dunes and mud flats. Fruit growing, agriculture and livestock farming are activities on the meadows and agricultural fields. The zone has become an ideal place for many species of fish, birds and water fowls due to its good conditions for feeding, nesting and breeding. Thus, many birds and water fowl visit the area in coveys during migration periods. Many birds and waterfowl breed and stay in the area. *Marmaronetta angustirostris* (VU), *Aythya nyroca* (VU), *Phalacrocorax aristotelis*, *Larus michahellis* (NT) are some of them. The delta and its surrounding is an important breeding area for globally endangered *Oxyura leucocephala* (EN). Recent researches showed that Caspian tern (*Sterna caspia*) breeds in the area (Adızel and Durmuş 2007; Z Karakoç 2013, pers.comm., 6 February).

Dönemeç Delta is also an important river mouth for pearl mullet (*Chalcaburnus tarichi*) living in Lake Van for breeding. It is also detected that fresh water fish species *Capoeta kosswigi* live here. The area is also important for carp (*Cyprinus carpio*) (Z Karakoç 2013, pers.comm., 6 February).

Çelebağı Reedbeds: It is a reed and mud area covering approximately 990 ha on the coast where Ilıca Stream empties into Lake Van on the southwest of Erciş district. The area hosts many waterfowl species. It is an important breeding and nesting area for many bird species, especially seagull species. Among the others *Tadorna ferruginea* (LC), *Marmaronetta angustirostris* are the IBA trigger species recorded in the area (Birdlife International 2013a). *Aythya nyroca*, *Grus grus* (VU) ve *Himantopus himantopus* (VU) are among the main bird species breeding in the area. 1,500 flamingos (*Phoenicopterus ruber*) stay here for two months during their migration period. *Cygnus cygnus* and goose coveys give satisfying views for bird watchers (Z Karakoç 2013, pers.comm., 6 February). The area is also among important home ranges for pearl mullet (TC Orman ve Su İşleri Bakanlığı 2013).

There are agricultural and settlement areas in the close vicinity and thus the area is exposed to negative impacts of the human activities (Z Karakoç 2013, pers.comm., 6 February).

Bendimahi Delta: The 370 ha delta is formed on the northeast of Lake Van due to decreasing slope where Bendimahi Creek reaches to the lake. There are meadows and reeds on both sides of the creek flowing through the delta. On the mouth of the delta, where the creek connects to Lake Van, there are mud islands and reeds. Some part of Van-Erciş Highway passes through the area (Yıldırım 1999).

Bendimahi reed is a home range for many birds. Endangered species *Marmaronetta angustirostris*, *Aythya nyroca* and *Oxyura leucocephala* breed and feed here. *Phalacrocorax pygmeus*, *Sterna albifrons* (D) and *Gelochelidon nilotica* (NT) also leave here. High numbers of *Larus michahellis*,
Sterna caspia, Pelecanus onocrotalus and Grus grus feed in Bendimahi Delta and reeds in the summer months (Z. Karakoç 2013, pers.comm., 6 February).

**Erçek Lake**: It is an alkali lake formed in a tectonic subsidence area blocked by lava flow on the north-west on 20 km east of Lake Van. Erçek Lake is an inland wetland; with the standing fresh water and water fringe vegetation features (Birdlife International 2013b).

The deepest part is 30 metres and there is no outflow. It covers 20,380 ha and has an altitude of 1890 metres. Northern and western coasts are surrounded by escarpments, southern and eastern coasts by shallow coasts and wide mud plains. There is a small delta with some reeds and wet meadows in the location where Memedik River enters the lake on the east. Moreover, there is a small peat bed adjacent to the southeast end of the lake. There are agricultural areas and steps around the area (Z. Karakoç 2013, pers.comm., 6 February).

South and the east of the lake are rich in terms of bird species. Reeds and marsh are located mostly in these areas. According to the results of ornithological observations in 1996, 180 bird species were detected in the reeds. Most of the bird species breed in this reed bed. Breeding species are: Podiceps nigricollis (NT), Tachybaptus ruficollis (D), Egretta garzetta (D), Himantopus himantopus, Tringa ochropus (EN), Burhinus oedicnemus (EN), Recurvirostra avosetta (NT), Charadrius leschenaultia (EN), Podiceps grisegena (VU), Oxyura leucocephala (EN), Charadrius alexandrinus, Tringa totanus (NT) and Acrocephalus agricola. Podiceps nigricollis (NT) and Tadorna ferruginea (NT) are observed in significant numbers in the lake. Owners of the area are flamingos. 1,000 flamingos, which are envisaged to breed on Urumiye Lake in Iran spend summer and autumn on Erçek Lake (Yıldırım 1999).

Animal husbandry is carried out on the marshes and pastures around the lake. Tourism and bird watching activities have started to increase recently. Lake shore is also used for picnic and side seeing purposes (Z. Karakoç 2013, pers.comm., 6 February).

Other than these wetlands, there are some small size wetlands on riversides in the research area and at the points where these rivers reach to Lake Van, such as Akdamar Reedbed and Horkum Reedbed. Other than reed beds and marshes, there are many small size lakes in the area. Main small lakes are Çenge Lake on 3 km west of Erçek Lake, Turna Lake, Ak Göl on the south of Ozalp district, Sor Lake on the south of Saray District, Kaz Lake on the east and Cengen Lake, 20 km south of Saray district, Sultan Lake on the east of Muradiye plateau, Hidrirmenteş Lake on the west of Çaldırın district, Kaz Lake on the north of Çaldırın, where Tendürek Mountain meets the plateau, and a couple of small lakes close to Iran border (Yıldırım 1999).

Main information obtained in the research on some wetlands in the Province is presented in Table 1. Wetlands with no available data are not given in the table.

### 2.4 Main problems and threats on the wetlands in the research area

Wetlands in Van Province are affected from the human activities carried out in the vicinity directly and indirectly both in the short run and the long run. Main problems and threats affecting ecological sustainability of the wetlands in the research area are as follows:

- Lack of updated and accessible data base for each of the wetlands located in the Province and near surrounding,
- Insufficient resources for environmental awareness and sensitivity in the society, among decision makers and practitioners,
- Insufficient human resources for protection and management of wetlands in the local government units,
- Insufficient knowledge among local decision makers and practitioners on the importance of wetland landscapes,
- Lack of coordination among institutions and jurisdictional dispute,
- Insufficient number of solid waste storage, sewerage and waste water treatment plants in the province,
- Consideration and usage of Lake Van and other wetlands in the province as discharge areas for any kind of polluters and waste,
- Transportation of excessively used chemicals and fertilizers in the agricultural areas with surface water to the wetlands,
- Withering with the purpose of agricultural and settlement usages,
- Deposition of eroded soil in the wetlands,

Table 1. Some of the wetlands and their main features in Van Province (developed from Durmuş and Adızel 2007; Durmuş 2008).

<table>
<thead>
<tr>
<th>Wetland name</th>
<th>Approx. height from sea level (m)</th>
<th>Area (ha)</th>
<th>Town</th>
<th>Conservation status (National/International)</th>
<th>Management plan</th>
<th>Breeding, nesting red list waterfowl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bendimahi Delta</td>
<td>1700</td>
<td>370</td>
<td>Muradiye</td>
<td>None</td>
<td>x</td>
<td>M/VU, M/EN, M/NT, R/NT, TM/D</td>
</tr>
<tr>
<td>Çaldıran wetland</td>
<td>2020</td>
<td>2000</td>
<td>Çaldıran</td>
<td>None</td>
<td>x</td>
<td>M/VU, M/D, R/NT, R/D, M/VU, V+/M/LC, WV/NT, WV/LC, R/LC</td>
</tr>
<tr>
<td>Çelebibağı Reed beds</td>
<td>1750</td>
<td>900</td>
<td>Erciş</td>
<td>None</td>
<td>x</td>
<td>TM/D, M/VU WV/ VU</td>
</tr>
<tr>
<td>Dönemeç Delta</td>
<td>1662</td>
<td>3000</td>
<td>National</td>
<td>None</td>
<td>x</td>
<td>M/EN, M/VU, R/NT, M/EN</td>
</tr>
<tr>
<td>Edremit Reed beds</td>
<td>1650</td>
<td>1855</td>
<td>Edremit</td>
<td>None</td>
<td>x</td>
<td>R/NT, R/LC M/VU, M/EN, M/D, M/LC, M/NT, TM/VU, P/NT WV/EN</td>
</tr>
<tr>
<td>Erçek Lake</td>
<td>1803</td>
<td>9520</td>
<td>Merkez</td>
<td>None</td>
<td>x</td>
<td>R/EN, TM/EN, M/EN, M/VU, M/NT, R/NT, WV/NT, R/D, TM/D, WV/LC, R/LC, R/LC</td>
</tr>
</tbody>
</table>
3. ROLES AND EXPECTATIONS IMPOSED ON THE WETLANDS IN VAN PROVINCE IN THE REGIONAL PLANS

1/100.000 scale Muş–Bitlis–Van Environmental Plan aims at “taking special measures for conservation of internationally important wetlands and other areas without a legal status” for the wetlands in the province. It is envisaged in the plan to consider wetlands as conservation areas of natural characters. It is mentioned that the Regulation on Conservation of Wetlands will be followed during the activities in this area. However, conservation zones for the wetlands in the province are not determined, but just ecological impact zone borders are determined. As a part of the plan, wetlands in the province are assigned the role of developing eco-tourism and the activities within this concept (Egeplan Planlama Ltd. Şti. 2011).

The other plan determining usage and conservation of wetlands in Van Province today and in the near future is TRB2 Region 2011-2013 Regional plan. The plan covers Van district and neighbouring Bitlis, Hakkari and Muş Provinces. The plan emphasizes “…being a region in peace with the nature…” in addition to socio-economic development in the determined development vision (Güler et al. 2011). However, within the frame of targets determined for the region, conservation of wetlands and other landscapes are not handled directly. Natural landscape and wetlands are considered as sources for development of tourism sector for socio-economic development in non-agricultural sectors (Güler et al. 2011). The plan considers the wetlands as one of the natural resources that will take a place in revival of tourism. Accordingly, in wetlands in Van and other regions, the role of developing alternative tourism activities in the natural areas is assigned.

One of the targets of 2011-2013 Regional Plan, that might indirectly contribute to conservation of wetlands and other natural landscapes, is development of “environmental awareness” in the region. As a part of this target, the plan foresees “development of environmental conservation awareness for
development of social life awareness” in relation to the development of human and social capital in the region (Güler et al. 2011). In addition to this target, it is aimed to improve environmental end energy infrastructure with the strategies of “provision of sustainable waste water management” and “sustainable disposal of solid and hazardous waste” within the framework of “improvement of urban and rural infrastructure” aim in the region within the planned period (Güler et al. 2011). Despite this, no indicators are determined regarding the ecological features and conditions of the wetlands and/or other natural areas as a part of performance indicators of targets and strategies determined in the regional plan.

4. CONCLUSION AND DISCUSSION

Emphasis and priority given to landscape protection and ecosystem conservation are growing around the world. However, emphasis and priority given to these theme areas are being affected and shaped by the main approaches and policies of development plans and strategies in various scales as well as by the development levels and priorities in different regions of a country. In developed regions, it has been observed that landscape quality is regarded as among the main indicators of development so as the life quality. While landscape quality is a multi-dimensional concept, ecological sustainability and landscape protection constitute vital components of this concept. However, in less developed regions, especially in less developed rural areas sustainability of ecosystems and landscape protection are often neglected among stakeholders and in the development plans. This is also the case that wetland landscapes confronted with in Van according to the review on current status of wetland ecosystems in the province. The role, as a material for ecotourism, attached to wetlands in development plans for the Province shows that these landscapes regarded as resources to consume for economic development. Threats and problems, wetland landscapes are confronted with in Van also show and prove that these areas only important for economic value for national, regional and local stakeholders. Furthermore, among all the wetlands which are rich in biodiversity and the wetlands important for IBA species, only one of these (Dönemeç Delta) has national conservation statute but none of them is designated as a RAMSAR area. To overcome these issues for the ecological sustainability of the wetland landscapes in Van, improvement of human resources capacity and institutional capacity in local units of General Directorate of Nature Conservation and National Parks of Ministry Forest and Water Works of Turkey appears as the leading priority. Efforts in these contexts should be supported by the awareness rising activities on wetlands among local decision makers and local people as well as preparation the integrated wetland management plans. In this context, formulation of strategies and action plans which support landscape protection and economic development at the same time at the regional and local planning processes are another priority for the ecological sustainability of the wetlands in Van and near surrounding. Accordingly, wetlands in the Province should have appropriate conservation statues. Erçek Lake, Bendimahi Delta, Çelebiğağ Reedbeds, Dönemeç Delta and Çaldıran Wetlands are among the areas that should have conservation statues at national level as well as at international level according to the RAMSAR Convention. Furthermore, for the protection of wetland landscapes in the Province ELC should be regarded as another guiding and supporting tool in regional and local development plans. Consequently, institutional collaboration in various scales appears as one of the main requirement during the protection of wetland landscapes in Van.

REFERENCES


Yıldırım A 1999, ‘Van Gölü ve Çevresindeki Sulak Alanlar ve Başlıca Sorunları’ Doktora Tezi (Basılmamış), Ankara
ECOLOGICAL MONITORING OF NATURE MANAGEMENT IN THE REGION

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Abstract

When evaluating the nature management the resource conception of the production-natural relations which are an essence of nature management is most acceptable and objective. Its essence lies in the fact that, as a result of economical activity on certain territory, there are not only immediate withdrawal and use of natural resources but also their qualitative and quantitative transformation as a consequence of waste discharge into the environment.

An analysis carried out on the Primorsky Krai territory showed that, after the major recession in the extraction of resources, its rise is observed since 2000 but a share of resources exportation exceeds that of domestic processing.

The study carried out allowed to identify the districts in which the further development of the existent territorial-economic structure is limited, partially limited and districts quite successful from the environmental point of view. This makes possible to work out a strategy of the further economical development with due account of environmental factors.

Key words: sustainable development, sustainable nature management, production-natural relations, ecology of nature management.

INTRODUCTION.

Developments and estimations performed at the regional level are of great value. Accounting of diversity and peculiarities of the natural systems in the environmental management planning and practices becomes possible only at regional level (Regional nature management... Edit. by Baklanov P.Ya. and Karakin V.P. 2002). A mesolevel is base for investigations because it allows to acquire an information of the natural-resource potential, its use, forms and directions of the action on the territorial natural- resources systems and production-natural relations (Regional nature management... Edit. by Baklanov and Karakin V.P. 2002). In the Ecological doctrine of the Russian Federation, a necessity to improve the mechanism of environmental expertise and strengthening its role in the estimation of impact on the environment.

Methodology of research. V.I. Danilov-Danilyan supposes to mean by the sustainable development such a course of human events which does not destroy the natural base of this development, i.e. the environment suited for the human existence is reproduced and sufficient resource base is maintained (Danilov-Danilyan, 1977). In I.P. Glazyrina’s opinion, the sustainable development is one that does not result in reduction in the natural capital (Glazyrina, 2005). A study of the sustainable development at the regional level is characterized by certain specificity. So, in V.A. Koptyug’s opinion, one can take into account the specific, regional peculiarities, priorities and shortcomings when determining the premises and prospects of the sustainable development (Koptyug et al., 1997). I.M. Aleksandrovich points also to a necessity of investigating “…the exchange processes between the Society and Nature at the regional level” where the sustainable innovative regional
development is one of the most significant ecological imperatives (Aleksandrovich, 2003). Within the framework of the sustainable development, the sustainable nature management is the recognition of the equal significance of two characteristics – anthropocentric and biospherecentric – and their interdependence. “Organization of economical activity not destroying the biosphere but keeping it, i.e. a creation of the biosphere-compatible economy non-going beyond the environmental capacity of the ecosystems is one of the central tasks of the establishing the future “sustainable” society” (Moiseev, 1995). Therefore, the sustainable nature management is the use of the natural diversity components that does not result in its depletion. In speaking of the nature management sustainability, we imply the inexhaustibility, environmental opportuneness of this process. And if sustainability implies a lack of detrimental effect on the environment then, according to our reckoning, one can suggest sustainability of the nature management.

When evaluating the nature management for regions of the resource orientation, the resource conception of the production-natural relations which are an essence of nature management is most acceptable and objective. Its essence lies in the fact that, as a result of economical activity on certain territory, there are not only immediate withdrawal and use of natural resources but also their qualitative and quantitative transformation as a consequence of waste discharge into the environment (Baklanov 1979).

In opinion of many researchers, the nature management includes the practical activities related to immediate use of the natural resources and conditions of the territorial complexes or to action on them which consists not only in involvement of these resources and conditions in the economically efficient production but also provides for their restoration and transformation (Mikhailov 1980, Regional nature management … Edit. by Baklanov and Karakin V.P. 2002, Rodoman 1978, Shiroky 2008 and others). Therefore, the estimate of influence of the territorial-operating structure on the natural environment or production-natural relations can be divided into four components: 1. estimating of resources consumption; 2. estimating of rationality (or sustainability) of nature management (water and air contamination, land disturbance); 3. determining the ratio in the “disturbed-restored” system of the region; 4. integral estimating of the territory’s ecological state as a result of the existing nature management.

DATA AND METHODS

An analysis carried out on the Primorsky Krai territory showed that, after the major recession in the extraction of resources, its rise is observed since 2000 but a share of resources exportation exceeds that of domestic processing. Within the framework of the identified groups of the territorial natural-resources carcass of Primorsky Krai, the natural resources of the first and second groups which are attributed to territories of the high provision with natural-resource potential, territorial natural-resources centre are extensively developed and determine the basic industry-specific development (Stepanko, Tkachenko 2010). At the same time, such kinds of resources in this group as mineral waters and therapeutic muds belonging to the recreational potential are insufficiently used due to low development of tourism including recreational one. In recent times, the use of biological and non-wood forest resources is increasing, however, a degree of their use is inconsistent with the overall potential value. The remaining kinds of resources of Primorsky Krai are used in proportion to value of their relative natural-resources potential (NRP). Therefore, the existing unfavorable environmental situation in Primorye is largely related to the impact of industrial production that should (and can) be estimated using the land disturbance extent ($K_{\text{land}} = \text{area of disturbed lands/total area of lands}$), water contamination extent ($K_{\text{water}} = \text{volume of contaminated waste water/volume of waste water}$), air contamination extent ($K_{\text{air}} = \text{volume of contaminated air emissions (discharges)/volume of air emissions}$ while an average coefficient ($K_{\text{aver}}$) can be considered as the sustainability of nature management in towns and districts of the Krai. The objectivity of such approach
is confirmed by investigations of other researchers. D.V. Shiroky, for example, believes that from theoretical point of view, it is necessary for sustainable development that increment rates in the anthropogenic load were equal to zero, which assumes the parity of the levels of anthropogenic impact and measures for its decrease (Shiroky, 2008).

Taking into account the territorial-economic reformations occurred in Primorsky Krai (Moshkov, 2008), we obtained the indices characterizing the sustainability of the existent nature management in the areas with similar industrial specialization. Within the framework of identified groups, both individual components of the nature management and nature management as a whole are calculated as an arithmetical mean of the sum of the above-mentioned indexes. In what connection, the higher is $K_{\text{aver}}$ value, the less rational is nature management and the worse is the ecological state of the territory under consideration. By way of examples, some graphical illustrations of estimated indices are presented below in Figures 1-3.

RESULTS

The ecological state of territory as one of the economy limitations by total contamination per capita a year can be classified as follows: “no limit” (NL), “partially limited” (PL) and “limited” (L). The above gradation is only approximately and its further correction is possible. Among indices used in the estimation of the ecological state and affecting the general environment condition are air contamination per capita; water contamination per capita and total contamination per capita (Natural resources and..., 2010). The analysis of the obtained results allowed us to determine a pattern of the environmental state of the Primorye administrative districts territories. The studies showed that the changes in the impact of the industrial production have happened but not everywhere in the same degree and not everywhere to the best. A considerable improvement in the environmental situation took place in Dalnegorsky and Ussuriisky districts and lesser changes were observed in Kirovsky, Lesozavodsky and Nadezhdinsky districts. Deterioration occurred in Anuchinsky, Oktyabrsky, Pogranichny, Khorolsky, Shkotovsky and Khanaisky districts while a situation worsened to a considerable extent in Kavalerovsky, Terneisky, Chernigovsky, Olginsky ans Spassky districts. This is explained by the specificity of the territorial-sectorial reconstruction taking place in the districts, environmental protection policy as well as the structure of investments in the environment protection and sustainable nature management.

Extraction and processing of mineral raw materials

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Fig. 1. Degree of land disturbance ($K_{\text{land}}$)

Administrative districts: 1-Dalnegorsky, 2-Kavalerovsky, 3-Krasnoarmeisky, 4-Khorolsky
An unfavorable ecological state is largely caused by the contamination of water and air. This is explained by the fact that existent treatment facilities (centralized and within the enterprises) were technically out of fashion while, in some districts Kirovsky, Krasnoarmeisky, Lazovsky districts etc.), a treatment is not made at all. Thus, in some districts, the complete limitation should be introduced while the rest of territory was approximately divided into two halves (Fig.4). It should be noted that, though Pozharsky district is fully attributed to category L (by all parameters considered), only western part adjacent to the urban-type settlement of Luchegorsk where the coal mining industry and energetic are concentrated must be considered. To category of the partial and complete limitation, those territories were attributed where the extractive enterprises as well as enterprises for production and distribution of electric power, gas and water are of great importance. In spite of the structural changes in the territorial-economic formations, the components of the production-natural relations remain constantly low: dynamics of tendencies of these processes for a period of 1997-2007 has
changed insignificantly or has not changed at all in the most districts of Primorye whereas a situation in some districts became worse.

The ecological-economical characteristic of settlements (especially the cities) – one of the most important aspects of researches since in them production and social structures, the population, transport, production and transport communications, selitebny buildings are concentrated, considerable reduction of a green zone and, as a result, are concentrated anthropogenous impacts on environment. In Primorsky Krai there is a number of the cities having in the submission certain territories. All of them - the centers with various industrial structure. But, nevertheless, each of them has the specialization which defines an ecological condition of the cities.

All large cities of edge are characterized by adverse ecological conditions, but the most critical situation is observed in Vladivostok, Dalnegorsk, Spassk-Dalny, Artem. This situation was created because: first, negative anthropoecological "capital" for previous years was saved up, secondly, shifts in branch structure in these cities practically didn't change the production and natural relations. In structure of the production and natural relations considerable changes are observed in Ussuriisk, noticeable – in the cities of Spassk-Dalny, Nakhodka, Dalnegorsk and Arsenyev. In other cities these indicators practically didn't change.

The carried-out analysis of main parameters of an ecological condition of the cities of Primorsky Krai allowed to draw a conclusion that an ecological condition of the cities as well as edges as a whole form pollution of waters and atmospheric air. Condition of land resources in the cities of Primorsky Krai the steadily satisfactory.

CONCLUSION

The proposed way of the nature management sustainability estimation allows to evaluate the ecological state of territory formed by the territorial-economic structure, to reveal the causes, to determine the limitation degree and lines of the further development from the viewpoint of balance of the ecologo-economic interests based on available information. The study carried out on the Primorsky Krai territory allowed to identify the districts in which the further development of the existent territorial-economic structure is limited, partially limited, i.e. possible in case of carrying out the necessary environmental protection measures and technical reconstructions and districts quite successful from the environmental point of view. This makes possible to determine the “trouble spots” and to work out a strategy of the further economical development with due account of environmental factors.

Resume. One of the basic ecological factors of comfortable life of population is ecologically pure foodstuff, pure air, pure water, pure reservoirs and a comfortable anthropological landscape. The very person forms all these factors, i.e. their quality, mainly by his industrial activity, because the basic influence and changes in natural components occur at the level of the developed industrial-natural relations. It is connected with the fact that natural resources are the basis of economic development and at the same time - the elements of the environmental, the condition of which is defined by ecological factors. The interrelation and interdependence between economy and ecology is obvious and nobody has doubts of it any more.
The analysis of the ecological condition of Primorsky Krai areas as a result of anthropogenic impact and the factors defining and forming this condition allows us to draw the following conclusions:

- as a whole, Primorsky Krai still remains the region of the resource orientation;
- anthropogenic influence in extracting branches will increase that is connected with a considerable share of these branches in Primorsky Krai in perspective;
- there are distinctions among the areas both by separate components and by an average indicator of an ecological condition, but for the entire territory of Primorsky Krai it is defined, first of all by water and air pollution;
- there are the areas over the territory of Primorsky Krai’s territory where it is demanded to restrict partially or completely available economic activities;
corresponding financing of nature protection actions, the structure of investments necessary for the investigating period in Environment Protection and the modern system of technological processes of production, clearing and recycling of wastes should become the basic direction in optimization of industrial-natural relations and, as a result, in improvement of an ecological condition of Primorsky Krai’s territory;

- constant monitoring of not only the environment, but also that of functioning of existing territorial-economic structures and industrial-natural relations reflecting the character, directions and the degree of anthropogenic influence on the environment is necessary.

REFERENCES


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SYNTHESIS, CHARACTERIZATION AND CATALYTIC ACTIVITY OF NOVEL Ni-Ce-OXIDE SYSTEMS FOR REMOVAL OF CARBON MONOXIDE FROM TOBACCO SMOKE AND INDUSTRIAL WASTE GASES

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Abstract

A non-conventional ultrasound assisted method for the synthesis of novel Ni - Ce - oxide catalytic systems was applied to obtain nanosized catalytic materials. The catalytic activity of the as-prepared catalysts for low-temperature oxidation of carbon monoxide in tobacco smoke and gas emissions from industrial processes was studied. Results showed that Ni - Ce - oxide systems exhibited high activity for CO oxidation with the complete conversion even at relative low temperatures. The studied catalytic samples could be used as an active phase of catalysts for removal of carbon monoxide.

Key words: Ni-Ce oxide system, heterogeneous catalytic oxidation, CO, tobacco smoke, waste gases

1. INTRODUCTION

Gaseous emissions from a variety of chemical industries such as the production of formaldehyde, formaldehyde resins, synthetic fibers and others contain volatile organic compounds and carbon monoxide (CO), whose uncontrolled release into the atmosphere cause significant and in most cases irreversible damage to the environment. Therefore, treatment of such waste gases before they are discharged into the atmosphere is an important issue and needs highly efficient low cost processes.

It is known that the exhaust gases from the formalin production industry contain around 1.4% CO, 0.3 - 0.5% of dimethyl ether, and about 0.2% methanol (Tatibouët 1997; Soares et al. 2001). Another source of air pollution with CO is a tobacco smoke. Carbon monoxide (CO) is present in the vapour phase and typically accounts for 4% of the total smoke weight (Hoffman et al. 1979). The total amount of carbon monoxide formed during smoking comes from a combination of three main sources: thermal decomposition (about 30%), combustion (about 36%) and reduction of carbon dioxide with carbonized tobacco (at least 23%) (Li et al. 2004). The control and treatment of emissions from industry as well as from tobacco smoke belong to the priorities of the society.

Over the years, many empirical approaches have been proposed and tried to remove CO in the mainstream smoke. These approaches include dilution, filtration, direct oxidation and catalytic oxidation. The selective filtration of CO from mainstream smoke has been a topic of research for many years. It is generally accepted that adsorption and complexation are not viable options due to the large amount of material required (Figgler 2000). Catalytic conversion of CO to CO₂ seems to be the most viable abatement route. Since a cigarette filter is typically near ambient temperature, and an excess of oxygen is present in mainstream smoke, low temperature CO oxidation is the most obvious
choice. Prior art indicates that a variety of materials have been studied for the low temperature oxidation of CO in mainstream smoke (Andreeva et al. 2002; Bollinger et al. 1996; Tabakova et al. 2004; Grunwaldt et al. 1999a; 1999b; Wang et al. 2003). The majority of these materials are mixed metal oxides and mono / bi-metallic mixtures of platinum group metals or transition metals supported on an appropriate metal oxide support (Qiao & Deng 2003; Moreau et al. 2004; Wang et al. 2003). Transition metal oxides are widely used as catalysts or catalytic supports due to their unique redox properties (Zhang et al. 2012). It is well established that catalytic performance of these oxides is dependent on their electronic properties as well as on their size and morphology (Xie & Shen 2009; Xie et al. 2009). Among the transitions metal oxides, the catalysts on the basis of Ni and Co oxides are proven to be very effective with respect to many reactions of complete catalytic oxidation (Wang et al. 2007; Rivas et al. 2011; Yan et al. 2002; Pollard et al. 2008; Miao & Deng 2001).

The purpose of this study was to synthesize nanostructured bulk, mixed and supported Ni-and Ni - Ce oxide systems (non containing precious metals) and to investigate their catalytic activity in processes of special concern for environment protection such as low-temperature oxidation of CO in tobacco smoke and in industrial waste gas emissions.

2. EXPERIMENTAL PART

2.1. Preparation and characterization of bulk NiO, mixed Ni-Ce and supported NiO/ CeO 2 catalytic systems

The bulk NiO x catalyst was synthesized using the precipitation-oxidation method with a reverse order of precipitation in combination with ultrasound stimulation realized by ultrasound homogenizer UP100H. The stimulation of the synthesis by ultrasound cavitation creates, from the one side, conditions for more efficient homogenization of the reaction mixture, and from the other, is a prerequisite for the preparation of highly dispersive and nano-sized systems with higher specific surface. The latter contributes to increasing the number of accessible catalytic centres for substrate adsorption and catalyst activation, which in its turn favors the reaction kinetics. The precipitation of the precursor (Ni(OH)2) was carried out at t = 15°C under continuous stirring by an ultrasonic homogenizer for 30 minutes followed by the addition of the oxidizer - NaOCl. The obtained black precipitate was kept in the mother solution for 24 hours followed by washing with distilled water to neutral pH and negative reaction for Cl⁻ ions. The precipitate was dried at 110°C to constant mass (NiO x). Part of the resulting catalytic system was calcined at 450°C in program-controlled electric furnace LM312.11C at a heating rate of 2°C/min. The thermally-treated sample was marked as NiO x – 450.

The mixed Ni-Ce – oxide system was synthesized by co-precipitation of Ni and Ce hydroxides in oxidative environment generated by NaOCl. For the purpose, a mixture of 0.1 M solution of Ni – and Ce – nitrate salts (atomic ratio of Ni/Ce=1) was added in portions to 0.2 M NaOH and NaOCl at constant stirring by ultrasonic homogenizer. The resulting precipitate was kept in the mother solution for 24 hours followed by washing with distilled water to neutral pH and negative reaction for Cl⁻ ions. The precipitate was dried at 110°C to constant mass (NiO x). Part of the resulting catalytic system was calcined at 450°C in program-controlled electric furnace LM312.11C at a heating rate of 2°C/min. The thermally-treated sample was marked as NiO x – 450.

The immobilization of NiO x on the surface of the CeO 2 support was carried out by the method of deposition-precipitation. CeO 2 (Merck) was added to fixed volume of 0.1 M solution of Ni(NO3)2·6H2O, so as to keep an atomic ratio of Ni:Ce=1, followed by addition of a mixture of NaOH and NaOCl at constant stirring by the ultrasonic homogenizer. The precipitate obtained was kept in the mother solution for 24 hours followed by filtration, washing and drying at 105°C. The resulting catalytic system was marked as Ni-Ce. Part of it was calcined at 450°C for 4 hours (denoted as Ni-Ce – 450).

The immobilization of NiO x on the surface of the CeO 2 support was carried out by the method of deposition-precipitation. CeO 2 (Merck) was added to fixed volume of 0.1 M solution of Ni(NO3)2·6H2O, so as to keep an atomic ratio of Ni:Ce=1, followed by addition of a mixture of NaOH and NaOCl at constant stirring by the ultrasonic homogenizer. The precipitate obtained was kept in the mother solution for 24 hours followed by filtration, washing with distilled water to neutral pH and drying at 105°C to constant mass. The resulting catalytic system was marked as NiO x/CeO 2, and part of it was thermally treated at 450°C (NiO x/CeO 2 – 450).
The principal schemes for the synthesis of the catalytic systems are illustrated in Figure 1.

The chemical analysis of the synthesized catalysts includes determination of the total active oxygen ($O^*$), expressed in % and in g-at.g$^{-1}$. Active oxygen is defined as the amount of excess oxygen in the oxide above that required by the lowest stable valency state. The $O^*$ content in the samples was determined iodometrically (Nakagava et al. 1962). A specified amount of catalyst (0.1 g ± 0.001) was added to 25 cm$^3$ dilute (1:10) sulphuric acid containing 2g of potassium iodide in a flask supplied with a ground stopper. After complete dissolution of the sample, the solution is allowed to stand for 10 min and the liberated iodine is titrated with 0.1 N sodium thiosulfate solution using starch as indicator. The relative standard deviation of the method is 4.71%. The total active oxygen content in g-at.g$^{-1}$ and % was determined according to the equations:

\[
O^* = \frac{N \times V \times mgE_{O_2}}{m \times 16} \text{ g-at-g}^{-1}, \quad O^* = \frac{N \times V \times mgE_{O_2}}{m} \times 100, \%
\]

where: $N$ – the normality of the sodium thiosulfate solution; $V$– the volume of the titrant used; cm$^3$; $m$ – catalyst amount, g; $mgE_{O_2} = 0.008$.

2.2. Catalytic activity measurements

The catalytic oxidation of CO was measured conducted in continuous flow equipment with fixed bed stainless steel isothermal reactor at atmospheric pressure. Experimental runs were performed with three different feed gas compositions, namely:
- inlet CO concentration – 2.0 ± 0.1 vol. % balanced with air
- inlet CO concentration – 2.0 ± 0.1 vol. % balanced with nitrogen (depletive oxidation)
- inlet CO concentration – 2.0 ± 0.1 vol. % and 1 vol. % O₂ balanced with nitrogen

The conditions for conducting the catalytic tests are listed in Table 1.

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<th>Table 1. The oxidation process parameters</th>
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<td>Space velocity, ( h^{-1} )</td>
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<td>Contact time, ( s )</td>
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<tr>
<td>Catalyst bed volume, ( cm^3 )</td>
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<tr>
<td>Catalyst particle size, ( mm )</td>
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<tr>
<td>Temperature of the catalyst layer, ( ^oC )</td>
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<tr>
<td>-catalytic oxidation</td>
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<td>-depletive oxidation</td>
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The inlet and outlet CO concentrations were analyzed by HP 5890 Series II gas chromatograph, equipped with thermal conductivity detector. The activity of the catalytic system was evaluated on the basis of CO conversion degree \((\alpha, \%)\), calculated by the equation:

\[
\alpha = \frac{C^o - C}{C^o} \times 100, \%
\]

where \( C^o \) and \( C \) are the inlet and outlet concentration of CO, respectively.

3. RESULTS AND DISCUSSION

3.1.1 Chemical analysis of the catalyst samples

The results of the chemical analysis of the synthesized catalyst systems, including the determination of the total active oxygen, are presented in Table 2.

| Table 2. Total active oxygen content in the synthesized catalysts – \( O^* \) |
|---------------------------------|--------------|-----------|
| Catalytic samples              | \( O^* \) %  | g-at.g⁻¹ 10⁻³ |
| NiO₆                           | 7.36         | 4.60      |
| NiO₆-450                       | 0.54         | 0.34      |
| Ni-Ce                          | 3.4          | 2.13      |
| Ni-Ce-450                      | 1.01         | 0.60      |
| NiO₆/CeO₂                      | 2.5          | 1.56      |
| NiO₆/CeO₂-450                  | 0.49         | 0.3       |
| CeO₂                           | 1.54         | 0.96      |

The data show that the fresh oxide systems, not subjected to thermal reduction at 450°C, have different content of active oxygen, being the highest for the individual NiO₆ catalytic system. The immobilization of the active phase on CeO₂, as well as the preparation of the catalyst via co-
precipitation of Ni and Ce hydroxides in the oxidizing environment results in lower content of active oxygen in the catalytic systems. This is due to the fact that the amount of the active phase of NiO in Ni-Ce and NiO/ CeO₂ systems is significantly lower than that in the individual Ni-oxide system. The data show also that the content of active oxygen substantially decreases at the thermally treated systems, which confirms its high mobility.

3.1.2 Oxidation of CO using fresh Ni-oxide catalytic systems

The results of the catalytic oxidation of CO with air on the synthesized catalytic systems, as well as on the CeO₂ support are presented in table 3 and figures 2 - 4.

Table 3. Temperature dependence of the degree of CO conversion over the studied catalysts

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<th>t,°C</th>
<th>Degree of CO conversion, α (%)</th>
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<td>20</td>
<td>1.9</td>
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<td>40</td>
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<tr>
<td>140</td>
<td>27.0</td>
</tr>
<tr>
<td>160</td>
<td>22.0</td>
</tr>
<tr>
<td>180</td>
<td>32.0</td>
</tr>
<tr>
<td>200</td>
<td>83.0</td>
</tr>
<tr>
<td>220</td>
<td>92.0</td>
</tr>
<tr>
<td>240</td>
<td>98.0</td>
</tr>
</tbody>
</table>

The data of Table 3 show that complete oxidation of CO (α ~100 %) is observed for all tested catalytic systems under the experimental conditions used, but at different temperatures. The oxidation process starts at room temperature, and in the low-temperature range 20-120°C the highest degree of conversion (30-32%) is achieved using the bulk NiO, catalyst while on the mixed and deposited catalysts the conversion is ~15%. The comparison of these results with the data for the content of active oxygen in the samples gives us ground to assume that the CO oxidation in the low-temperature range is carried out only with its participation. The lower catalytic activity of Ni-Ce and NiO/ CeO₂ correlates well with their smaller content of active oxygen (Table 2). The results in Table 3 are also supported by the conducted depletive oxidation of CO in the temperature range 20-160°C, illustrated in Fig.2.
It is seen that in the absence of oxidizer (air), maximal degree of conversion is registered at temperatures between 60 and 80°C. At further increase in the reaction temperature the CO conversion gradually decreases and falls to 3-4% at 160°C. In previous investigations it was established that 70% of the active oxygen of NiO are localized on the surface of the oxide system (Christoskova et al. 2006). This surface-active oxygen is highly mobile and at temperatures higher than 120°C is desorbed from the catalyst surface. The results demonstrate that the studied catalyst systems can be effectively used for CO oxidation at relatively low temperatures and in the absence of oxidizer which makes them suitable for CO removal from cigarette smoke. Another advantage of the catalyst samples is that the catalytically-active component does not contain noble metals, which is economically profitable.
Considering that the CO level in the cigarette smoke is much less than 2% (there are data that from 20 cigarettes are swallowed 20 ppm CO), some additional studies were conducted on model gas system with another composition (0.5% CO and 1% oxygen) at other equal conditions. The results obtained from the study on the activity of fresh and thermally treated at 200°C NiOx system for the catalytic oxidation of CO by molecular oxygen and in an inert atmosphere (depletive oxidation) in the temperature range 20-200°C are illustrated in Figs. 3 and 4.

Fig. 3. Conversion of CO as a function of temperature in the course of catalytic oxidation over NiOx(a) and NiOx-200°C(b)
Fig.4. CO conversion as a function of temperature during depletive oxidation over NiOx (a) and NiOx-200°C (b)

The profile of the temperature dependences of the degree of CO conversion up to ~ 80°C using the fresh and thermally-reduced at 200°C catalyst sample reveals substantial difference. However, the tendency is similar to that of the oxidation process in the presence and in the absence of oxygen. The thermally-treated catalyst does not show any activity until 80°C, while the oxidation on the fresh Ni-oxide system starts even at 25°C in the course of depletive oxidation and at 50°C in the presence of an oxidizer, reaching a maximum conversion of 83% at 80°C and 100°C, respectively, even in the third minute.

The data of Table 3 show also that in the temperature range of 140-240°C the catalytic activity of the synthesized samples changes in the following sequence: NiOx/CeO2>Ni-Ce>NiOx. The better catalytic performance of the deposited and mixed samples with respect to the massive active phase, although the two-fold lower content of NiOx in them, conclusively proves the role of CeO2 in promotion of the activity of the catalytically-active phase despite that the neat support does not oxidize CO under the conditions used. This probably is due to the unique properties of CeO2. It is known that CeO2 is used as oxygen storage promoters in automotive three-way catalyst system. At reduction conditions cerium forms non-stoichiometric oxides with general formula CeO2-x, where 0<x<0.5 (Rao & Mishra 2003). The non-stoichiometric phases formed in the course of the oxidation processes are easily re-oxidized to CeO2 by the atmospheric oxygen at mild conditions. The redox cycle in this process Ce4+/Ce3+ can be presented by the following equation:

$$ CeO_2 = CeO_{2-x} + x/2O_2 $$

It is reported in the scientific literature that CeO2 is widely used as a support of catalysts for oxidation processes (Yi et al. 2010; Luo et al. 2010). It is established that CeO2 affects the electron and catalytic properties of supported oxides by the transition $O^2- \leftarrow Ce^{4+}$. In addition, this support favors the dispersing of the active phase on its surface and protects it from sintering.

3.1.3. Catalytic activity of thermally treated Ni–oxide systems in CO oxidation

As we have shown in Introduction, CO is a component of vehicle exhausts and gas emissions from various industrial productions. The catalytic systems in these matrices have to manifest high activity and selectivity at high temperatures. For this purpose, the catalytic oxidation of CO was studied on preliminary thermally-reduced samples of the fresh catalyst at temperature of 450°C. The experimental conditions of the oxidation were the same as that for the fresh samples and the results are shown in Fig.5.
Comparing the activity of the fresh and thermally-treated at 450°C catalytic systems it is seen that the latter do not manifest catalytic activity in the temperature range of 20-120°C. This is due, from the one side, to the absence of active oxygen in the thermally-reduced samples, and, on the other, to the fact that the activation of atmospheric oxygen is achieved at higher temperatures. As a result these samples can not be used for depletive oxidation of CO at relatively low temperatures. The catalytic oxidation of CO on thermally-treated samples is initiated at temperatures higher than 140°C, and a complete conversion is achieved at 200°C on NiOx-CeO2-450 and Ni-Ce-450, and on the non-promoted catalyst– at ~ 260°C. These results confirm once again the crucial role of CeO2 on the catalytic behavior of mixed and supported samples. The latter can be used as potential catalysts for the removal of CO from gas emissions with high temperatures, such as vehicle exhausts and industrial gas emissions.

CONCLUSIONS
A non-conventional method accompanied by ultrasonic stimulation for of obtaining of nano-sized bulk (NiOx), supported (NiOx/CeO2) and mixed (Ni-Ce) oxide catalytic systems (without noble metals in the chemical composition), suitable for the complete oxidation of CO in various matrices (cigarette smoke and gas emissions from industrial productions) and different temperatures is proposed. The synthesized non-stoichiometric NiOx, NiOx/CeO2 and Ni-Ce oxide catalytic systems are characterized by high content of active oxygen and high level of oxidation of the metal ions, as a result of the precipitation-oxidation method used. The results show that:

- the catalytic systems oxidize completely CO at relatively low temperatures both in the presence and in the absence of oxygen (depletive);
- the spent catalytic systems regenerate easily their active oxygen by treating with liquid oxidizer;
- keep their catalytic activity after thermal reduction at 450°C.

It has been established that the use of CeO2 as a support or promoter of the active NiOx phase improves its catalytic properties in the temperature range 140-240°C, although the catalytic inertness of the support.

Authors gratefully acknowledge financial support by the National Science Fund (Projects DDVU 02-7/10, DFNI-E01/7,) and by the University of Plovdiv Research Fund (Project NI HF-2013).
REFERENCES


A CRITICALLY ENDANGERED STACHYS BUTTLERI: ITS ECOLOGICAL FEATURES AND CONSERVATION STATUS

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Abstract

*Stachys buttleri* R.Mill is Turkish stenoendemic species, east Mediterranean element and known only from Antalya Düden. In this study, its ecological features are determined, and conservation status is reevaluated based on IUCN red list criteria. According to the results, this species should be classified as “Critically Endangered” in the light of its population size, actual and potential threats.

**Key words:** *Stachys buttleri*, Lamiaceae, IUCN, Turkey

1. INTRODUCTION

*Stachys* L., with about 300 species worldwide (Harley et al., 2004), is the largest genus of subfamily Lamioideae and among the largest genera of Lamiaceae. The genus consists of annual and perennial creeping to ascending herbs or cushion-like subshrubs. The highest number of taxa known in the genus is reported mainly from the Mediterranean and Irano-Turanian regions (Bhattacharjee, 1980).

Due to their high content of secondary compounds, several species are widely used in traditional medicine, e.g. as tea (e.g. *S. lavandulifolia* Vahl and *S. pilifera* Benth.) (Salmaki et al., 2012). The aerial parts of some stachys taxa are orally used as herbal tea in the treatment of various infections, asthmatic, antibacterial, antioxidant rheumatic and other inflammatory disorders (Couladis et al., 2003, Grujic-Jovanovic et al., 2004, Matkowski and Piotrowska 2006, Jovanovic et al., 2008, Ebrahimabadi et al., 2010). *Stachys* species are known in Anatolia as Ada çayı and Dağ çayı and used as sage and in popular medicines to treat genital tumours, sclerosis of the spleen, inflame-matory tumours, coughs and ulcers (Potoğlu-Erkaya and Koyuncu, 2007). Teas prepared from the whole plant or leaves are used in phytotherapy, possessing sedative, antispasmodic, diuretic and emmenagogue activities (Jovanovic et al., 2008).

*The genus Stachys* in Turkey was firstly studied by Bhattacharjee (1982). Seventy two species were reported in the revision that R. Bhattacharjee conducted for the Flora of Turkey After the study, 19 new species have been described from Turkey. *Stachys* has 91 species (116 taxa) belonging to 15 sections and 2 subgenera in Turkey. Of the 116 taxa, 55 (47.4 %) are endemic to Turkey (Bhattacharjee, 1982, Davis et al. 1988, Sümbül 1990, Gemici and Leblebici 1998, Duman 2000, Dinç and Doğan 2006, İnç et al. 2009, Daşım et al. 2009, Akçiçek 2010, Yıldırımli 2010, Yılmaz et al. 2010, Dirmenci et al. 2011, Özhatay et al. 2011). The endemic taxa are mostly eastern Mediterranean elements. With 91 species (116 taxa) including 55 endemic, Turkey is rich country with regard to *Stachys* diversity. However, there are many *Stachys* taxa are under threatened (Duman 2000, Ekim et al., 2000, Dinç and Doğan 2006, İnç et al., 2008, Daşım et al., 2009, Akçiçek, 2010, Yılmaz et al., 2010, Yıldırımli, 2010, Dirmenci et al., 2011).
The subsection *Fragiles* of the genus *Stachys* is described by Bhattacharjeth with characteristics as follows: suffrutescent saxatile perennials without basal rosettes; Flowering stems fragile below, pendent; indumentum patent-pilose; leaves orbicular to ovate, ±cordate at base; verticillasters (2-)6-10(-16)-flowered; bracteoles inconspicuous, setaceous, few; calyx ± regular, infundibular to subcampanulate; teeth triangular to triangular-lanceolate, softly spinescent at apex; corolla tube exserted; Nutlets oblong-elliptic, apiculate, unwinged. This section forms a coherent group of closely allied chasmophytes of the eastern Mediterranean region of Anatolia, and contains 7 species in Turkey (Bhattacharjee, 1980). *Stachys buttleri* is a narrow Turkish endemic species belonging to this section. This species was classified as endangered by (Ekim et al., 2000). In this study, it is aimed that the updated threat category and habitat features of the species is determined.

2. MATERIALS AND METHODS

The field trips have been carried out on the type locality of *Stachys buttleri* (Fig.1.) in 2010-2011. During the trips, habitat features of this species such as main rocks and the growing species around the habitat have been recorded. The photos reflecting the general features of the habitat have been taken and presented. The threat category of *Stachys buttleri* have been updated using IUCN red list criteria, basen on our observations on the population, possible threats and distributional data obtained from this study, Turkish Herbaria and Flora of Turkey (Ekim et al., 2000, IUCN 2001).

3. RESULTS

3.1. Description

Perennial suffruticose herbs. Flowering stems 50-80 cm, pendent, fragile at base, very densely patent-villous with short glandular hairs. Cauline leaves widely ovate, 47-93 x 40-75 mm, margin dentate to crenate-dentate, apex obtuse, usually cordate, rarely subcordate at base, thin and herbaceous, villous, petiolate; petiole 1-6 cm, patent-villous and short glandular hairs. Floral leaves ± dissimilar to cauline leaves but smaller, 10-12 x 6-6.5 mm, obscurely crenate to entire, apex acute, usually turuncate to
subcordate, rarely widely cuneate at base, sparsely villous, petiolate to subsessile; petiole 1-13 mm. Verticillasters usually remote throughout, 2-flowered (lowest rarely 3-4-flowered), lower ones 12-16 mm apart, ebracteolate. Pedicels 1-3 mm, patent-villous with, capitate and peltate glandular hairs, rigid, erecto-patent. Calyx campanulate, mouth without hairy ring, 7-8 mm at flowering, up to 9 mm and scarcely broadening at fruting, herbaceous, densely glandular and patent-villous with minutely sessile glands; teeth ± equal, 1/3 x tube, triangular-ovate to triangular lanceolate, glabrescent and spinescent tipped, 0.4-0.6 mm. Corolla white, 13-17 mm; upper lip 3.1 mm and lower one 5.3 mm long; tube clearly exserted, exannulate, minutely hairy upper half inside and outside, Nutlets elongate, blackish, triangular-ovate, 2.9-3.1 x 2-2.1 mm, apex rounded (Fig. 2.).

Fig. 2. Herbarium specimen of Satchys buttleri

3.2. Ecological features

Stachys buttleri is one of the highly local endemic species. It has been known only from the type locality at Düden Şelalesi in Antalya, that is densely visited by domestic and foreign tourists. Stachys buttleri grows on the naked vertical limestone rocks (Figs 3-4). The leaking water from rock crevices provide shady condition for surviving of the species. There is no species near to Stachys buttleri in the habitat. However, some species grow the place surrounding the habitat. Such as Cymbalaria longipes, Veronica campylopoda, Hedera helix, Platanus orientalis, Nerium oleander, Ficus sp., Ulmus sp., Rubus sp.
Fig. 3. Stachys buttleri in its habitat

Stachys buttleri was classified under endanged catagory according to the IUCN Red List Categories and criteria (Ekim et al., 2000). However, Stachys buttleri is only known from type locality. According to the literate and the records in Turkish herbaria, it does not grow another locality. In addition, its extent of occurance and area of occupancy is less than 10 km² (criterion B). The present population from type locality inculudes about 60 individuals (criterion C). In addition, we can say that the potential and actual threats on the habitat and population (criterion D) as follows.

- Being frequently visited by the domestic and foreign tourists
- Probable decrease in water leak feeding the habitat
- The fact that global warming and evaporation affect damp conditions
- Probable increase in tourism density
- Habitat’s existing in urban
- Impossible spreading of the species.
Fig. 4. A photograph illustrating a tourist and Stachys buttleri individuals in Düden Şelalesi. (Arrow show Stachys buttleri individuals)
4. CONCLUSIONS

The present study showed that Stachys buttleri should be classified under “Critically Endangered (CR)” based on the criteria of the IUCN Red List Categories (IUCN 2001), not endangered as previously stated (Ekim et al., 2000). The precautions should be taken for conservation of the species as follows;

- The fact that the seeds spilling out of the plant have no chance of germination
- Düden Waterfalls, which is visited by domestic and foreign tourists and habitat of Stachys buttleri must be protected more effectively.
- The seeds of the genus must definitely be reserved in national seedbanks to be used in protecting the ex-situ.
- Habitat conditions must be protected for the living on of the plant.
- Government officers’, who have the control of plant habitat, awareness of biological wealth and endemic plants in order to prevent the plant becoming extinct

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REFERENCES


THE ECONOMETRIC APPROACHES UNDER MODELING
HEALTH RISK FACTORS IN RUSSIA
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Abstract

The article analyzes particular reasons (risk factors) that cause the deterioration of public health. Most attention is paid to the ecological factor. The maximum permissible concentration of harmful substances in the atmosphere and water reservoirs is exceeded in practically all the cities in Russia. The present research attempts to give not only analytical but also quantitative assessment of the influence of various factors (with the help of regression analysis) on the health condition of Russian citizens. With the help of model complex, a forecast for the ecological-economic development of the Russian Federation by the year 2015 has been made. The forecast helped to estimate the influence of the ecological factor on a sickness rate.

Key words: health risk factors, a forecast for the Russian ecological-economic development, regression analysis of morbidity.

1. REGRESSION ANALYSIS OF MORBIDITY

In order to study the dynamics of sickness rate of the Russian population, we carried out a multi-factor analysis of indices that characterize health problems of the Russian population depending on climatic, infrastructural, social, economic, and ecological factors. For this purpose, an information base for the years 2005-2008 was constructed. It included 80 subjects of the Russian Federation (oblasts, regions, and republics).

Here is the list of sickness rate explanatory factors:

- Climatic: difference between average temperatures in July and January (degrees C), average monthly precipitation in July and January (mm);
- Medico-infrastructural: an average number of hospital beds per 1000 people (by year end), number of doctors per 10,000 people (by year end), capacities of polyclinics (sick people’ attendance at a polyclinic per a shift), the state’s expenditure on healthcare in budget (%), expenditure on healthcare per capita (rubles at the prices in 2005);
- Social: a expenditure on alcoholic drinks in consumers’ expenditure (%), level of criminalization (number of registered crimes per 10,000);
- Economic: GDP per capita (rubles), a health care expenditure in consumer expenditure (%), the ratio of an average per capita income to the subsistence level (%), ratio of consumers’ health care expenditure to the subsistence level (%), a share (%) of poor population (people, whose income is less than the subsistence level) in the total amount of population;
- Ecological: average per capita disposal of contaminated waste waters (cubic meters per person), average per capita atmospheric emissions (kg per person), average per capita emission of greenhouse gases (tones CO₂ – equivalent per person), greenhouse gases accumulation in the atmosphere per capita (tones CO₂ – equivalent per person).
To characterize the health of the population the following indices have been taken: death rate (including infant mortality rate) and birthrate, life expectancy, general sickness rate, and morbidity per type of disease (the number of the sick whose diagnosis was registered for the first time, per 1,000 people). The following kinds of diseases were studied: new growths, endocrines, immunity and nutrition disorders, metabolic disturbances; infectious and parasitic diseases; diseases of blood circulatory system; diseases of the respiratory and digestive system; skin and hypodermic tissue diseases; diseases of bone, muscular and connective tissues; and diseases of the central nervous system. All the data has been taken from statistical reports of the Federal Statistical Service of the Russian Federation.

The panel regressions have been constructed. We present the equation, which describes sickness rate of the whole population of the Russian Federation (its characteristics are presented in Table 1):

\[ SICK = 980.64 - 5.28*\text{BUD} - 23.63*\text{HEALTH} - 6.67*\text{POOR} + 1.45* \text{MED} + 0.92*\text{AIR}, \]

where \( SICK \) - common morbidity of Russian population (number of registered cases of sicknesses per 1,000 persons);

\( \text{BUD} \) - the state’s expenditure on healthcare in region’s budget (%);

\( \text{HEALTH} \) - a ratio of consumers’ health care expenditure to the subsistence level (%);

\( \text{POOR} \) - a share (%) of poor population (people, whose income is less than the subsistence level) in the total amount of population;

\( \text{MED} \) - number of doctors per 10,000 people (by year end);

\( \text{AIR} \) - greenhouse gases accumulation in the atmosphere per capita (tones CO\(_2\) – equivalent per person).

Table 1. Equation of sickness rate of the whole population of the Russian Federation

<table>
<thead>
<tr>
<th>No</th>
<th>Variable</th>
<th>Measurement unit</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>Validity level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Constant</td>
<td></td>
<td>980.64</td>
<td>67.81</td>
<td>99.9</td>
</tr>
<tr>
<td>2</td>
<td>State’s expenditure on healthcare in region’s budget</td>
<td>%</td>
<td>-5.28</td>
<td>2.39</td>
<td>97.2</td>
</tr>
<tr>
<td>3</td>
<td>Ratio of consumers’ health care expenditure to the subsistence level</td>
<td>%</td>
<td>-23.63</td>
<td>4.01</td>
<td>99.9</td>
</tr>
<tr>
<td>4</td>
<td>Share of poor population</td>
<td>%</td>
<td>-6.67</td>
<td>1.22</td>
<td>99.9</td>
</tr>
<tr>
<td>5</td>
<td>Number of doctors per 10,000 people</td>
<td>persons</td>
<td>1.45</td>
<td>0.74</td>
<td>95.0</td>
</tr>
<tr>
<td>6</td>
<td>Greenhouse gases accumulation in the atmosphere per capita</td>
<td>tones CO(_2) – equivalent</td>
<td>0.92</td>
<td>0.12</td>
<td>99.9</td>
</tr>
</tbody>
</table>

\( R^2 = 34.2\% \), reliability level = 99.9%, normality of residual distribution = 99.9%, F-statistic = 33.5

As shown in Table 1, in the course of regression analysis we managed to receive a statistically meaningful regression equation that satisfies all the premises of regression analysis and explains of the 34.2% difference in sickness rate between regions. A relatively low value of determination coefficient
is due to the fact that the index “sickness rate of total population” takes into account the registered cases of diseases in the whole spectrum of illnesses, each of them having their own specificity and causes.

Nevertheless, the analysis made it possible to identify the major factors that have a statistically important influence on the sickness rate of the population as a whole. The sickness rate of the population as a whole decreases in case the state’s expenditure on healthcare in region’s budget grow as well as when the ratio of consumers’ health care expenditure to the subsistence level increases. Thus it is possible to speak about a statistically significant negative influence of environmental pollution on health.

Interesting by enough, the sickness rate of the Russian population demonstrates a statistically significant decrease in the case of growth of number of poor people and demonstrates an increase in the case of growth of number of doctors.

These facts are explained rather easily: we consider only registered sicknesses. Usually the poor working people who are sick prefer self-treatment without going to the doctor because they are afraid to lose their job. Also when numbers of doctors is increasing – the sickness exposure is growing up too.

2. FORECASTING THE ECOLOGICAL-ECONOMIC DEVELOPMENT IN RUSSIA

The next stage of our research was concerned with constructing a forecast of ecological-economic development of the Russian Federation for 2011 - 2015. To do this the CAIIN (Comprehensive Analysis of Intersectoral Information) System with an environmental unit was used. The CAIIN was developed by an Interindustry research department at the Institute of Economics and Industrial Engineering of the Siberian Branch of the Russian Academy of Sciences under the guidance of Professor V. N. Pavlov. Figure 1 presents a brief diagram of a variant of the CAIIN system, functioning with an environmental protection block (EP block).

In addition to traditional sectors of the economy, elements, which represent natural resources, are allocated here, and one-to-one correspondence is expected between each of these elements and the areas of environmental protection (air protection, water conservation, etc.). At this stage, one natural resource is studied — atmospheric air – is studied. For the environmental activity, the reproduction processes of the main environmental funds and the formation of environmental costs are modeled into the DIOM (Dynamic Input-Output Model). The EP block describes the tangible indicators of ecological processes. Depending on the volume of manufactured goods in the traditional sectors of economy (Xj), the volume of pollutants generated during the production process is determined. Thus, this model system allows us to forecast the level of pollution formation in the industrial production depending on the economic development of Russia, with help of coefficients of formation of atmosphere polluting substances per unit of gross production output. The estimates of the expenditures for reducing water and air pollution help to determine volumes of pollution trapping. The difference between formation and pollution trapping gives us volumes of emissions.

---

1 Here and later the level of reliability of statistical significance is considered to be 90%.
This is a description of the EP block:

\[
x(t) = (x_1(t), x_2(t), x_{n+1}(t), \ldots, x_{n+m}(t)) - \text{vector of gross outputs, where}
\]

\[
x_i(t), i = 1, \ldots, n - \text{gross output of industry } i \text{ in the year } t,
\]

\[
x_{n+h}(t), h = 1, \ldots, m - \text{current environmental protection cost for natural resource } h.
\]

The volume of pollutants generated in the production process is described by formula:

\[
V_h^g(t) = \sum_{i=1}^{n} w_{ih}(t)x_i(t) + D_h(t), \text{ where}
\]

where \(w_{ih}\) – coefficient of pollutant \(h\) generation (volume of polluted natural resource \(h\), referring to manufacturing of a unit of production of industry \(i\));

\(D_h(t)\) - output of pollutant \(h\) (volume of pollution or destruction of a natural resource) in a household.

The volume of current environmental protection cost for natural resource \(h\) or product of environmental protection industry \(h\) is determined by equation:

\[
x_{n+h}(t) = \sum_{i=1}^{n} v_{ih}(t)V_{ih}^l(t), \quad V_{ih}^l(t) = \sum_{i=1}^{n} V_{ih}^l(t), \quad \text{where}
\]

\(v_{ih}(t)\) – current cost to recover a unit of natural resource \(h\) (to destroy or to trap a unit of pollutant \(h\)) in industry \(i\);

\(V_{ih}^l(t)\) - volume of a recovered natural resource (liquidated or trapped pollutant) of type \(h\).

The volume of pollutant \(h\) (a polluted natural resource), which gets into the natural environment without purification (or by volume of destroyed but not reproduced natural resource), is described by formula:

\[
V_h^p(t) = V_h^g(t) - V_h^l(t).
\]
A more detailed description of economic and ecological units of the model complex and of the method initial information is formed appears in [Baranov et al., 1997, 2010]. Tables 2-4 show indexes of two scenarios of Russian development in 2011-2015, which were worked out for forecast calculations; one is pessimistic and the other, optimistic. In both scenarios we assume that the government support of national economy will not be reduced, and the economic policy will be mild till elections in several large countries (USA, Russian Federation, France, etc.). Key factors which will influence Russian domestic markets are the Presidential election in 2012, Russia’s possible joining the WTO in 2011, and Olympic Games in Sochi in 2014. In both scenarios we assume that the Russian government will adopt an active anti-inflationary policy, using administrative and anti-trust measures till the Election.

The pessimistic scenario assumes that the post-crisis recovery in 2010-2011 will not be steady, and growing government debts will lead national government to implementing strict budget economy. The optimistic scenario assumes that efforts of national administrations to avoid economic stagnation and to solve their debt problems will be effective. High oil prices on the world market will allow the Russian government to increase state productive and social spending.

The dynamics of key indicators that will affect Russian economy in 2011-2015 are shown in Table 2. More detailed hypotheses of scenarios is described in [Baranov et al., 2012].

<table>
<thead>
<tr>
<th>Table 2. Key factors of national economy in Russia in 2011-2015</th>
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<tr>
<td></td>
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<tr>
<td>2011</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
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<tr>
<td><strong>Pessimistic scenario</strong></td>
</tr>
<tr>
<td>Real interest rate (in %)</td>
</tr>
<tr>
<td>Change in real wages (in %)</td>
</tr>
<tr>
<td>Change in real exchange rate</td>
</tr>
<tr>
<td>RBL/USD (in %)</td>
</tr>
<tr>
<td>Urals price (in USD per barrel)</td>
</tr>
<tr>
<td>Change in GDP (in %)</td>
</tr>
<tr>
<td>Change in gross output (in %)</td>
</tr>
<tr>
<td><strong>Optimistic scenario</strong></td>
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<tr>
<td>Real interest rate (in %)</td>
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<td>Change in real exchange rate</td>
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<tr>
<td>RBL/USD (in %)</td>
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<tr>
<td>Urals price (in USD per barrel)</td>
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<tr>
<td>Change in GDP (in %)</td>
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<tr>
<td>Change in gross output (in %)</td>
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</table>
### Table 3. Industry outputs in 2011-2015 according to the pessimistic scenario (growth rate, %)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Power engineering</td>
<td>98.9</td>
<td>98.6</td>
<td>101.3</td>
<td>100.2</td>
<td>99.2</td>
</tr>
<tr>
<td>Fuel industry</td>
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<td>101.8</td>
<td>101.3</td>
<td>101.2</td>
<td>101.0</td>
</tr>
<tr>
<td>Ferrous metallurgy</td>
<td>95.6</td>
<td>95.7</td>
<td>102.8</td>
<td>100.6</td>
<td>98.4</td>
</tr>
<tr>
<td>Non-ferrous metallurgy</td>
<td>100.5</td>
<td>100.1</td>
<td>100.7</td>
<td>99.3</td>
<td>97.9</td>
</tr>
<tr>
<td>Chemical and petrochemical industry</td>
<td>93.6</td>
<td>93.6</td>
<td>103.9</td>
<td>101.6</td>
<td>99.2</td>
</tr>
<tr>
<td>Machine-building and metal-working industry</td>
<td>106.8</td>
<td>106.7</td>
<td>109.2</td>
<td>105.6</td>
<td>101.9</td>
</tr>
<tr>
<td>Logging, wood-working, pulp and paper industry</td>
<td>94.5</td>
<td>94.5</td>
<td>99.0</td>
<td>95.7</td>
<td>92.5</td>
</tr>
<tr>
<td>Building materials industry</td>
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<td>98.0</td>
<td>94.4</td>
<td>90.9</td>
</tr>
<tr>
<td>Light industry</td>
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<td>101.0</td>
<td>103.7</td>
<td>101.4</td>
<td>99.1</td>
</tr>
<tr>
<td>Food industry</td>
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<td>100.2</td>
<td>100.7</td>
<td>99.7</td>
<td>98.7</td>
</tr>
<tr>
<td>Other industries</td>
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<td>93.9</td>
<td>98.4</td>
<td>95.5</td>
<td>92.7</td>
</tr>
<tr>
<td>Construction</td>
<td>105.4</td>
<td>104.8</td>
<td>100.3</td>
<td>98.8</td>
<td>97.4</td>
</tr>
<tr>
<td>Agriculture</td>
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<td>98.2</td>
<td>99.3</td>
<td>98.8</td>
<td>98.3</td>
</tr>
<tr>
<td>Transport</td>
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<td>99.0</td>
<td>100.6</td>
<td>100.0</td>
<td>99.4</td>
</tr>
<tr>
<td>Trade</td>
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<td>109.1</td>
<td>105.2</td>
<td>104.9</td>
<td>104.5</td>
</tr>
<tr>
<td>Other branches of material production</td>
<td>101.6</td>
<td>100.8</td>
<td>99.4</td>
<td>98.6</td>
<td>97.8</td>
</tr>
<tr>
<td>Non-material service</td>
<td>106.2</td>
<td>105.6</td>
<td>102.7</td>
<td>102.3</td>
<td>101.9</td>
</tr>
</tbody>
</table>

### Table 4. Industry outputs in 2011-2015 according to the optimistic scenario (growth rate, %)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power engineering</td>
<td>100.8</td>
<td>99.9</td>
<td>98.0</td>
<td>98.4</td>
<td>98.8</td>
</tr>
<tr>
<td>Fuel industry</td>
<td>102.1</td>
<td>102.8</td>
<td>101.9</td>
<td>101.9</td>
<td>102.0</td>
</tr>
<tr>
<td>Ferrous metallurgy</td>
<td>96.9</td>
<td>98.0</td>
<td>96.2</td>
<td>97.2</td>
<td>98.2</td>
</tr>
<tr>
<td>Non-ferrous metallurgy</td>
<td>100.6</td>
<td>102.1</td>
<td>97.5</td>
<td>97.9</td>
<td>98.5</td>
</tr>
<tr>
<td>Chemical and petrochemical industry</td>
<td>98.4</td>
<td>99.1</td>
<td>98.7</td>
<td>100.0</td>
<td>101.0</td>
</tr>
<tr>
<td>Machine-building and metal-working industry</td>
<td>113.1</td>
<td>116.3</td>
<td>106.4</td>
<td>107.4</td>
<td>109.3</td>
</tr>
<tr>
<td>Logging, wood-working, pulp and paper industry</td>
<td>101.3</td>
<td>105.0</td>
<td>97.8</td>
<td>98.9</td>
<td>100.6</td>
</tr>
</tbody>
</table>
Forecast estimates make it possible to assess the amount of emission of polluting substances into the atmosphere (see Fig. 2). The ecological block estimates based on the hypothesis that pollutant generation coefficients as well as environmental protection expenditures will stay at the level of 2009. It means that there is no radical replacement of production technologies from the point of view of their influence on environmental quality.

We can see that the second scenario, which is more optimistic from the viewpoint of economic development, is more pessimistic from the ecological viewpoint because of growing environmental pressure. According to the first scenario, emissions will increase by 3.5% in 2010-2015; according to the second scenario, by 20% in the same period.

Having studied the most interesting results of the econometric analysis of sickness rate in Russia and having estimates of the pollution for the period being forecast, let us now evaluate the effect of ecological factors on the health of the population in Russia in 2010-2015. For this purpose we will use regression that will model the sickness rate of the Russian population (see Table 1) and construct an interval estimate of the part environmental pollution plays in the population sickness rate.

<table>
<thead>
<tr>
<th>industry</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building materials industry</td>
<td>103.5</td>
<td>108.4</td>
<td>98.9</td>
<td>99.8</td>
<td>101.9</td>
<td></td>
</tr>
<tr>
<td>Light industry</td>
<td>102.4</td>
<td>105.4</td>
<td>101.0</td>
<td>101.7</td>
<td>103.1</td>
<td></td>
</tr>
<tr>
<td>Food industry</td>
<td>105.9</td>
<td>106.8</td>
<td>105.1</td>
<td>105.4</td>
<td>106.1</td>
<td></td>
</tr>
<tr>
<td>Other industries</td>
<td>100.1</td>
<td>103.0</td>
<td>97.1</td>
<td>98.1</td>
<td>99.5</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>114.9</td>
<td>118.6</td>
<td>109.3</td>
<td>109.4</td>
<td>110.2</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>103.6</td>
<td>103.6</td>
<td>102.5</td>
<td>102.7</td>
<td>102.9</td>
<td></td>
</tr>
<tr>
<td>Transport</td>
<td>103.0</td>
<td>103.6</td>
<td>102.4</td>
<td>102.7</td>
<td>102.9</td>
<td></td>
</tr>
<tr>
<td>Trade</td>
<td>115.9</td>
<td>119.3</td>
<td>115.2</td>
<td>115.0</td>
<td>115.2</td>
<td></td>
</tr>
<tr>
<td>Other branches of material production</td>
<td>107.0</td>
<td>108.4</td>
<td>103.7</td>
<td>103.7</td>
<td>104.0</td>
<td></td>
</tr>
<tr>
<td>Non-material service</td>
<td>112.4</td>
<td>113.0</td>
<td>109.0</td>
<td>108.8</td>
<td>108.9</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 2. Amount of emissions polluting the atmosphere (thousand tons) according to the forecast estimates
The value of the coefficient under the variable “Greenhouse gases accumulation in the atmosphere per capita” accounts for 0.92 and its standard error is equal to 0.1187. It means that the increase of per capita greenhouse gases accumulation per one tone will lead to the growth of sickness rate from 0.724 to 1.116 of all the registered cases per one thousand people with the probability of 90%. Taking into account the estimate of gases accumulation dynamics for 2011-2015, let us evaluate a change in the population sickness rate during this period, under the influence of ecological factors, assuming that the population size in Russia will not change (see Table 5).

Table 5. Average per capita emissions and the number of first-time sick people in Russia in 2011-2015 by optimistic scenario

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase of average per capita greenhouse gases accumulation (tones per person in comparison with the previous year)</td>
<td>+1.024</td>
<td>+2.681</td>
<td>+1.132</td>
<td>+1.359</td>
<td>+1.696</td>
</tr>
<tr>
<td>Growth in the number of the first-time sick for the ecological reason (persons per 1,000 people in comparison with the previous year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>low limit</td>
<td>0.741</td>
<td>1.941</td>
<td>0.819</td>
<td>0.984</td>
<td>1.228</td>
</tr>
<tr>
<td>high limit</td>
<td>1.143</td>
<td>2.992</td>
<td>1.263</td>
<td>1.517</td>
<td>1.893</td>
</tr>
<tr>
<td>Growth in the number of the first-time sick for the ecological reason (thousand people in comparison with the previous year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>low limit</td>
<td>105.9</td>
<td>277.4</td>
<td>117.0</td>
<td>140.6</td>
<td>175.5</td>
</tr>
<tr>
<td>high limit</td>
<td>163.3</td>
<td>427.6</td>
<td>180.5</td>
<td>216.8</td>
<td>270.5</td>
</tr>
</tbody>
</table>

Thus, the optimistic scenario forecasts that between the years 2010 and 2015 the emissions in Russia are expected to reach 7.9 tones CO₂-equivalent per capita, which might lead to growing numbers of the first-time sick, namely from 816.4 to 1258.7 thousand people. Attempts to estimate the influence of ecological factor on the health are occurring in articles of other authors, but often this researches are executed on regional level or use subjective estimations in regression analysis. Research results presented here give a numerical estimate of the influence of various factors on the health of the Russian population; they also make a forecast of the effect of ecological factors on total sickness rate. The set of dynamic intersectoral models used in the forecast makes it possible to take into account the influence of structural biases in the Russian economy (which occurred as a result of the world economic crisis) on the ecological situation and on the number of the first-time sick. The proposed approach combines the application of the advantages of intersectoral modeling methods and econometric methods in order to analyze and forecast ecological-economic processes.

REFERENCES


SUPERVISION: OPPORTUNITIES FOR IMPLEMENTATION MEASURES OF OCCUPATIONAL HEALTH IN THE CASE OF PROFESSIONAL BURNOUT AMONG SOCIAL EDUCATORS

Zenija Truskovska, Velta Lubkina

Personality Socialization Research Institute of Rezekne Higher Education Institution

Abstract

The topic is explored in the framework of the concepts of systemic and environmental approaches, the "model of life space" and the use of dialogue in solving the problem of professional burnout among social educators (Broks, 2000; Bronfenbrenner, 2005; Katane, 2007, 2009; Каган, 1991; Даниелян, 2004 et al.). The paper deals with the concept of professional burnout, typical manifestations and types of professional burnout among social educators, the essence of supervision and its supporting function, allowing to detect risk factors of professional burnout and contribute to the development of professional's self-help (Āboltiņa, 2012; Balušīte, 2012; Caspi & Reid, 2002; Elkjer, 2004; Hawkins & Shohet, 2002; Kadushin, 1982; Rats & Kliftons, 2007; Rodžers, 2001; Shulman, 2003; Certo, 2008; Мардахаев, 2005; Осухова & Кожевникова, 2006 INTRES; Салтыкова-Волкович, 2004 INTRES) The results of a research are offered. The research was carried out in Latvia as part of the promotion work, which allows to identify the risk factors of professional burnout among social educators, clarifies meaningful value of supervision's preventive nature and reveals demand for supervision (Truskovska, 2008-2013).

Key words: systemic and environmental approach, social educator, professional burnout, risk factors of professional burnout, supervision, preventive measures.

1. INTRODUCTION

Global and national problems, which led to globalization, are characterized within the development of modern society, affecting all spheres of human life, including education. In order to discover global level problem solutions, realization of new thinking is required - ecological thinking and integration of all fields of human activity. A human being should move away from a self-centered worldview and perception to an eco-centered view in the context of sustainable development. This stems from a systemic view of a person, being part of the nature and the universe or ecosystem. A. Subeto (Субето, 1999, 2001). The idea of correlation between eco-civilization, eco-economy, eco-society and eco-education is emphasized in the social and educational context. Eco-civilization can only exist as an intellectually informative way of civilization, but eco-education is a criterion of educated and educational civilization, in which the pre-emptive law of development works. It is the most important rule, ensuring management options of the society and the natural harmony. Human ecology is defined as an integrative and interdisciplinary science course of the natural, social, human, art, etc. sciences that explores an interaction between humans, social systems and environment in its entirety's perspective (Pēks, 2002:4). Education ecology is one of human ecology courses: integrative inter branch of natural, social and human sciences that explores a human's as an individual's and/or social systems' development in interaction with the multi-dimensional environment in the entirety perspective, providing a multi-aspect perspective on education (Katane, 2007, 2009). Nowadays two forms of the use of systems theory are traditionally distinguished in social and social pedagogical work: the use of provisions of general systems theory and the development and use of ecological
systems theory. Both approaches are used nowadays for training prospective specialists of helping professions, ensuring sustainability of specialist's professional activities (Baltušīte, 2012; Juhna, 2001, Katane, 2007, 2009; Мардахаев, 2005) in both terms of professional burnout and its prevention (Мардахаев, 2005), including supervision or a system of professional development and support (Ābolīņs, 2012).

2. THEORETICAL ASPECTS OF THE PROBLEM

Ecological approach is a conceptual approach in theory and practice, as well as in research activities, providing entire approach that includes (Katane, 2007): 1) wholeness approach (perception and research of individual cases and phenomena in holistic perspective, a "puzzle" effect), 2) system approach (systemic thinking, which allows seeing correlation and causation of things and phenomena, a system's structure and functioning in time and space), 3) multi-dimensional (complex) approach (it allows exploring things and phenomena in various views, creating a "spatial" multi-aspect entirety perspective on the essence of things and phenomena). Founders of modern ecological approach are Bernard, 1925; Большаков, Криничный, Кржимский, Мартине - Рика,1996, Bronfenbrenner, 1979; 1989, Johnson, 2008, Capra, 1999, 2005, Morrison, 1974, Sterling, 2001, Субетто, 1999, 2001, Верждаский, 2004 from Baltušīte, 2012. Researches, based on ecological approach in education, are carried out in Latvia - Бертайтис, Бридзе, Пешс, 2011; Katane & Baltušīte, 2007; Katane & Krugļija, 2009; Katane & Лаиза, 2012; Roga, 2008, etc. A socio-environmental paradigm has a close connection with a systems theory paradigm, because social ecology discusses mainly the interaction between the human and multi-dimensional environmental factors, but the main essence of systems theory is connected to researching systems that influence the human (Juhna, 2001). Structure of the system is a universal feature of the systems, which is characterized by fixed mutual arrangement of system components (Broks, 2000). Systems approach is a universal tool of cognitive activity; a system method is indispensable for cognizing and designing dynamic integrity (Каран, 1991); systems approach provides a research of specially organized and existing system components' integrative communication and relationship (Даниелян, 2004). The concept of the ecology of human development and ecological systems theory developed by U. Bronfenbrenner (2005) has affected the development of human ecology, including the development of new environmental concepts, theories and environmental models. Environment is the main category in education ecology. The human, being a part of environment, develops through the continuous interaction with environment (Baltušīte, 2012; Ness, 2004; Truskovska, 2010b).

The central concept of ecological systems theory in social work is the category of "model of living space" (the model as a relative system, and the dialogue as a mean of environmental development of a conflict) (Chess & Norlin, 1988; Juhna, 2001; Фирсов & Студенова, 2001). This model offers a look at people as systematically organized subjects of life that constantly adapt their interactions to the variety of conditions of existence. It comes from the fact that there is a mutual adaptation, where a person can develop through a change and he/she is supported by environment. Social problems complicate the conditions of life, reduce the possibility of mutual adaptation. According to the theory of ecosystems, live systems (people and their associations) should try to maintain a good balance with their environment (Фирсов, & Студенова, 2001). The basis of adaptation is a collection of adaptive abilities of a person in a particular environment, as well as predisposition of environment, promoting a human's adaptation to it (Chess & Norlin, 1988; Juhna, 2001). Person's ability and potential to achieve the desired quality of life are assessed by the adaptive abilities of a person. Within this theoretical research, these provisions can be attributed to the client, as well as to the social worker and social educator. Problems of helping professions specialists' are analyzed in the context of a professional's personality system- performance of professional duties: asystems' client - a social worker/educator, a systems' social worker/teacher - other professionals, a systems' social worker/educator - institutions, as
well as a systems' social worker/educator - the nearest social environment in the context. This principle is considered as one of the fundamental principles of ecological systems theory - *focus on client system* (Juhna, 2001: 44). The aim of social and socio-pedagogical work in the theory of ecosystems is proclaimed strengthening adaptive abilities of people, the impact on their environment so as to make compromises between a human and his environment more adaptive. In this approach of solving client’s problems, asocial worker or a social educator not only affects him/her, but also his/her environment.

Any activity changes the personality of the performer. The range of changes is wide. They can be progressive (from German lang. progressiv - a movement forward, success - gradually strengthened, increasing) or regressive (from German lang. regressiv - returning, a movement back - the decline in the development of anything, a movement backward, the opposite of the progressive). *Progressive* changes as a result of professional human activity - it is an improvement of personal and behavioural qualities, an ability to perform the duties. A person has positive changes in relation to himself/herself and to the object of activity, professional activity, its results and other people. It is also a specialist's personal and behavioural change. Regression affects his/her attitude toward himself/herself, the object of activity, professional activity, its results, and other people in a negative way. The nature and intensity of the changes depend on the type of activity, attitude and specialist's activity to it (Мардахаев, 2005). A social educator is a specialist of helping professions, working in a person - a person system (Мардахаев, 2005). He/she exercises his/her profession through interaction and influence, using dialogue at different levels of the social environment - individual, social groups, social institutions, etc. Therefore, he/she is included in the risk group when *professional burnout* is discussed. In this research the types of professional burnout and professional activities of a social worker and educator are seen in the context of human ecology and occupational health, in order to identify ways to prevent professional burnout of a social worker and a social educator.

The analysis of theoretical approaches to the problem of regression influence of professional activity on the identity of the employee reveals the following definitions of the phenomenon:

- **Burnout syndrome** manifests as increasing emotional exhaustion, burnout. It may be a psychological defence mechanism in the form of partial or complete exclusion of emotion in response to the traumatic impact; it results in personality changes in communication with people (Freundenberger & Richelson, 1980).

- It is distress or the third stage of the general adaptation syndrome - the stage of exhaustion, viewing it from the point of view of the stress concept (Селье from Осухова & Кожевникова-2006 -intres).

- Overfatigue or burnout syndrome. It manifests as the growing indifference to own responsibilities and what is happening at work, dehumanization in the form of negativity in relation to both the customers and colleagues, a sense of own professional incompetence, the phenomena of depersonalization, a sharp deterioration in the quality of life. In the future, it can develop into neurotic disorders and psychosomatic diseases.

- **Professional burnout** is a mental state of emotional exhaustion that is often accompanied by extreme cynicism. It is common for people working in the field of helping professions (Schaufeli, Maslach & Marek, 1993).

- Professional burnout is a syndrome that develops due to chronic stress and leads to exhaustion of emotions, energy and personal resources of a specialist (Осухова & Кожевникова, 2006 -intres).

- A professional deformation at the level of emotions and will and personal behavioural areas is defined as regressive effects of professional activity on the social identity of the educator. It is
driven by complex mental disorders, and it significantly affects a specialist's vital activities (Мардахаев, 2005).

Within the framework of this research, the term 'professional burnout' will be used as the most common term in scientific and popular science literature. Burnout syndrome is the most dangerous disease among those who work with people, as it has already been mentioned in the person-person system. It is specially common among people of helping professions, who have to work in close contact with those, to whom they provide services. Often they work in very stressful and difficult situations. Those people are social workers and social educators, teachers, police officers, nurses, therapists (Schaufeli, Maslach & Marek, 1993); leaders, sales managers, health professionals, lecturers, journalists, psychologists, counsellors, business men, politicians, etc. (Осухова & Кожевникова, 2006 -intres). Risk group includes the following people as well: 1) Employees of the introverted type of character. Their individually psychological characteristics are not consistent with the professional requirements of communication professions. They do not have a surplus of vital energy; they have a tendency to isolation and concentration on the subject of professional activity; they are modest and shy. 2) People, experiencing constant internal conflict in relation to the work. 3) Women, experiencing internal contradictions between work and family, as well as the pressure, due to the need to prove constantly their professional abilities in competition with men. 4) Professionals, working under conditions of acute and chronic instability, fear of job loss (Осухова & Кожевникова, 2006 -intres). 5) People, working hard and spending all their energy to achieve almost unattainable goal and not achieving success (Freudenberger & Richelson, 1980). 6) People, working in low-paid subordinate positions that cannot react to sometimes appearing unworthy attitude towards them during the working process (Holt, 1982).

Subjective and objective reasons for regressive impact on the professional activity of the specialist's personality are characterized by a number of authors: burnout is a fee for the sympathy, the result of internal accumulation of negative emotions without a proper discharge or release from them (Maslach, 1982); emotional instability, negative emotional background, lack of will power and activity (Мардахаев, 2005: 448); idealistic worldview, high motivation and competence (Chance, 1981); excessively high level of ambition and inability to achieve a set target (Мардахаев, 2005: 492); need to work in an intense rhythm, with lots of emotional stress when interacting with a difficult client who can reject aid (Мардахаев, 2005:492; Freudenberger & Richelson, 1980); disappointment in a profession, because of lack of attractiveness, social value in society, material dissatisfaction and lack of maintenance fees and appreciation (Мардахаев, 2005: 496-497; Chance, 1981; Rats & Kliftons, 2007); disparity between the specialist training requirements for professional activities; difficulties and problems arising in connection with the performance of own duties; career crisis (Мардахаев, 2005: 496-497); staggering scale of problems to be solved, the complexity of the problems to be solved by specialists of helping professions, a large amount of bureaucratic papers that take away time and energy from a specialist (Maslach & Goldberg, 1998). These are just some of many other causes of professional burnout.

The syndrome of professional burnout develops gradually. There are three stages that characterize the changes in the emotional - will and personal - behavioural spheres and in vital activities of a specialist (Maslach, 1982; Мардахаев, 2005: 496-497, Certo, 2008: 355).

L.V.Mardahaev (2005: 498) defines a kind of professional deformation - the destruction of the personality, which reflects changes in the personality of a specialist most deeply, leading to psychological somatisation. The author believes this is the most dangerous type of professional deformation (professional burnout), overcoming of which requires a focused, individual support of specialists (health workers, psychologists, psychiatrists, etc.). The analysis of theoretical positions and views on the problem leads to the conclusion that it is crucial to notice early manifestations of changes
and provide specialist's help and support, preventing complete burnout, destruction of personality and professional incompetence.

Some authors emphasize the need for prevention and psychological support to avert and avoid complete burnout and professional incompetence (Осухова & Кожевникова, 2006 -intres; Мардахаев, 2005). There is a need for timely diagnosis of the specialist's state, acquiring of general methods of self-management, self-improvement and self-prevention are recommended (Мардахаев, 2005: 501-503). It is important to take care of oneself, reduce stress level, transform negative beliefs, improve professional skills and work with the supervisor (Осухова & Кожевникова, 2006 -intres).

Table 1. Stages of professional burnout (by Maslach, 1982)

<table>
<thead>
<tr>
<th>Stage I</th>
<th>Stage II</th>
<th>Stage III</th>
</tr>
</thead>
<tbody>
<tr>
<td>· Muting emotions;</td>
<td>· Misunderstanding with customers (scornful attitude, reluctance, antipathy);</td>
<td>· Blunting idea of the value of life;</td>
</tr>
<tr>
<td>· Smoothing keenness of emotions and freshness of feelings;</td>
<td>· Outbreaks of irritation as a manifestation of unconscious feelings of self-preservation in communication that exceeds safe levels for the body</td>
<td>· Indifference to everything, even to own life;</td>
</tr>
<tr>
<td>· A certain alienation in relationships with family members, anxiety</td>
<td></td>
<td>· External respectability and some aplomb stay, but eyes lose their shine of interest;</td>
</tr>
<tr>
<td></td>
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<td>· Nearly physically tangible cold and indifference in the soul</td>
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In this article, supervision is described as one of the possible approaches for prevention professional burnout of specialists working in the field of helping professions, including social workers and social educators. The attention is paid to a specialist's support in the early stages of entering the profession and support of university students in the development of professional competence and passage of social and pedagogical practices. Currently there is a trend in Latvia to use various terms connected with specialists' professional development and growth in different professional fields - supervision, coaching and mentoring. There is not established yet a single opinion in the scientific community, answering the question - which certain professional field shall use any of these terms (Āboltiņa, 2012; Majore-Dūšele, 2010; Mārtinsone, et al, 2012; Truskovska, 2010a) the idea of cooperation and responsibility for the outcome of the process is different in divers contexts and countries (Ehmer, 2009).In general terms, supervision stands for occupational counselling and further education connected with the profession (Horšers, 2007); the aim of supervision is to promote professional development of specialists (also the prospective ones) or participants of supervision (Caspi & Reid, 2002; Kadushin, 1992; Rodžerss, 2001; Ховкинс & Шохет, 2002). Under supervision, its members, most often together with a supervisor, analyze and evaluate theoretical, practical (including legal and ethical ones) and emotional aspects of their professional activity (Āboltiņa, 2012; Majore-Dūšele, 2010; Mihailova & Zakriţevska, 2010; Mihailovs, 2010; Supervižija sociālajā darbā: Supervižora rokasgrāmata, 2007), and contribute to the development of professional competence. Generally there are two approaches. On the one hand, it is teaching and learning situation from own experience, including in working place, study practice, and it has a significant impact on an individual's sense of security and insecurity (Elkjer, 2004; Sebre & Bite, 2003: 68-81; Салтыкова-Волкович, 2004-intres). On the other hand, it is therapeutic, because the work is carried out in a deeply personal context of an individual supervision's
Experience of Hawkin and Shonet (2002) shows that supervision is a very important opportunity to satisfy the desire for knowledge and concern for oneself, and one of the helpers continuous self-development opportunities. Lack of supervision can lead to roughness, dead and advocacy feelings that can very easily happen in professions that require a very high devotion. Supervision is aimed for social workers, social educators, who tend to educate, develop, and understand the supportive and helping role of supervision in developing professional competence and strengthening the professional identity (Truskovska & Zavadska, 2005). Many scientists (Finemans, 1985; Hawkin & Shohet, 2002; Apine, 2004) emphasize the reasons and causes, why representatives of helping professions, including social educators, should seek to obtain supervision timely. Participants of supervision often are social educators, whose protective feelings towards the clients stimulate the syndrome that was found in the theoretical research, and it is called professional burnout. Duty of the supervision participant is to take responsibility for ensuring that timely notice that his/her systems are overwrought, help for coping with stress should be looked for, and its causes should be identified and eliminated (Finemans, 1985). Authors (Abolitna, 2012, Austin, 1957; Kadushin, 1976, 1992; Munson, 2002; Schulman, 2003) emphasize the supportive role of supervision and express the idea of maintaining harmonious labour relations and unity of spirit and body. Supervision participant can obtain support through social educator's supervision that is qualitative and relevant to participant's needs. "Supervision participants are asked to look on their motivation to work in the helping profession, learn stress management, take care to be important, have enjoyable and physically active life outside the helper's role, organize a sound support system, take advantage of the opportunity to receive professional support in the form of supervision" (Truskovska & Zavadska, 2005). E. Apine (2004) points to several reasons, why social educators should strive for supervision: 1) supervision is the main form of support, where you can focus on own difficulties in dealing with the client/person, as well as to share some responsibility for this work with a supervisor; 2) supervision is a part of the professional development and continuation to learn; 3) researches show that there is a link between good supervision and satisfaction with work. Tasks of supervision are as following: 1) increasing purposefulness of specialist's professional activities; 2) advanced training; 3) increasing specialist's satisfaction with own work; 4) motivation for the analysis of perceived and unconscious potential opportunities of a specialist (Салтыкова-Волкович, 2004-intres).

Supervision is legitimized in binding documents (professional standards, regulations) for social workers and social educators working at social services in local governments in Latvia. Personal social worker's and social educator's experience of the author allows to express a theoretically supported opinion that it is important for professionals to have regular supervision, and, preferably, it should be provided directly at the beginning of professional activities and during the study period. Supervision should be close to the real professional situation. It would allow to create environment that promotes supportive and professional development of the perspective specialist within the studies. This would facilitate the learning outcomes, development of social educator's professional competence. It would also be a precondition for the subsequent professional habit to take care of oneself in time and prevent professional burnout.

3. METHODOLOGY AND RESULTS OF THE RESEARCH

Some aspects are offered from a qualitative quantitative empirical research that was carried out in Rezekne Higher Education Institution (Latvia) within the framework of the doctoral thesis. This research fortifies and clarifies the theoretical knowledge of the paper's topic. Total number of respondents, participating in the research (2008-2013), is 138. Practicing social workers' in Latvia (17 respondents) need for supervision and understanding of its content were established (2012). These
results, in conjunction with others, were taken as the basis for developing the conceptual model showing social workers’ professional competence and readiness for professional activity in the process of supervision. The results of the survey were coded processed in program SPSS and presented in Figure 1.

The results show that all offered needs of various levels are represented in four out of five groups that need supervision. Respondents have understanding of supervision as the form and process where they can share experience, receiving a professional feedback, and get experience. It was found out in theoretical views that experience can be get from both the supervisor (in individual and group supervisions) and the participants of supervision (group supervisions), thus improving the professional competence (Āboliņa, 2012; Hawkins & Shohet, 2002; Mihailova & Zakriževska, 2010; Paipare, 2010; Truskovska, 2009).

Needs of the average level prevailed in four out of the five groups of needs: needs for experience exchange, needs for support, needs related to methodological issues and self-awareness as a professional. This indicator was lower only in the group of needs, related to modeling of professional behavior. The results suggest respondents’ adequate understanding and reasonable expectations of supervision.

Statistically significant differences of results were found out according to work experience (Kruskal - Wallis H test). Differences were established in three groups of needs: needs related to modeling of professional behavior (p = 0.012), needs related to self-awareness as a professional (p = 0.019), needs for experience exchange (p = 0.036). This suggests that supervision participants’ length in service shall be taken into consideration for effective organization of supervision and achievement of a higher level of professional competence. Significant differences were established also in needs “Help me to focus on new alternative strategies that can be used in work with customers” (p=0.042). Social educators with work experience from five to seven years (Mean Rank = 16,50) and up to two years (Mean Rank = 15,00) have the highest need. In theoretical views, the period of 5-7 years is marked as a critical time when the professional burnout syndrome may set in (Hawkins & Shohet, 2002; Ramâne & Rebaine,
This may happen due to certain routine, feeling of being stuck in uniformity of applied approaches and methods, lack of positive achievements at work, with strong clients' resistance and avoidance of cooperation. The period of first three years can also be critical to the new specialist. This may relate to the lack of experience in transferring knowledge and skills of university education environment to the real professional environment, being not confident about the proper choice of profession, etc. It was clarified within the research that practising social workers take a supervision an opportunity to develop instrumental competence, social competence and reflexive competence (Plaude, 2003: 177-180). Specialists see an opportunity to obtain emotional support, share experience, be understood and accepted, speak frankly about the difficulties and doubts about oneself, and their careers, get a professional perspective on the problem in the customer-related systems in a safe and supportive collegial environment. The majority of respondents expressed the need for supervision once a month (individual, group supervisions). They also realize that participation in supervision is an opportunity to prevent professional burnout and maintain professional sustainability. However, need for supervision is not provided in accordance with professional demands in the present situation in Latvia, thus the preventive aspect of supervision is not used.

The author (Truskovska, 2008-2013) developed and approbated a conceptual model for prospective social workers' professional competence as readiness to develop professional activity in supervision within the framework of doctoral thesis at Rezekne Higher Education Institution (Latvia). This model introduced changes in the structure and content in educational system of social educators at Rezekne Higher Education Institution: 1) a theoretical course with practical training "Supervision in Social Pedagogy" is elaborated and developed (it provides knowledge and understanding of supervision, its content and methods, specifically simulated situations, role plays, etc. during practical lectures form professional skills); 2) training supervision sessions within social workers' undergraduate practice are introduced (6 sessions in 12 weeks) (reflexive thinking, reflexive speaking, reflexive learning, etc., bringing a problem situation from the professional environment in learning environment, discussion of alternatives in the form of dialogue); 3) assessment system of learning outcomes in this course is offered under an integrative assessment form - a scientific essay (self-assessment, reflexive writing, lecturer's feedback on learning outcomes), encouraging active participation of students in the study process and responsibility for its results. Thus, an innovative approach to modelling of educational environment was realized, according to the needs of social educator's profession and social context, based on the application of ecological and systems theory guidelines.

4th year students (15 respondents) of the 2nd level professional study program "Social Educator" at Rezekne Higher Education Institution (Academic year 2012/2013) conducted a self-assessment before and after undergraduate practice within the framework of the research, using the criteria of professional competence as readiness (personal, theoretical, operationally instrumental readiness) to professional activity and their levels of 10-point system (self-evaluation questionnaire) that was developed by the author. Comparing the indicators of self-assessment criteria before and after the practice, there have been positive changes (results were processed in program SPSS 20.0). Experience gained at the theoretical course "Supervision in Social Pedagogy" and other courses, related to professional development, professional environment and supervision sessions during the practice contributed to the positive dynamics of all criteria (Table 2).

The results show that there is a statistically significant difference (p = 0.000) in dynamics of personal readiness and operationally instrumental readiness. It is concluded in the analysis that the students' self-assessments have both the positive and negative dynamics. Not all students were able to adequately perform self-assessment before the practice. The original idea of oneself as a professional change under the influence of practice and supervision sessions. It became more adequate, different ranks indicate data validity.
In order for researchers to confirm the validity of findings of the questionnaire and conclusions, the same set of respondents wrote scientific essays after the theoretical course "Supervision in Social Pedagogy" and before the undergraduate practice and supervision sessions and reflected on supervision's impact on professional competence as readiness to professional activity during the study process at university (reflexive writing). The content analysis was carried out to scientific essays of 15 respondents. Acquired data was coded and processed in AQUAD 7. The analysis of the code frequency showed that the code "pg" designating the personality readiness was used 58 times, the code "tg" designating the theoretical readiness was used 26 times, the code "oig" designating operationally instrumental readiness was used 86 times.

Table 2. Self-assessment of Readiness to Professional Activity of Students of Social Pedagogy.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Average self-assessment</th>
<th>Ranks</th>
<th>p</th>
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<tbody>
<tr>
<td></td>
<td>Before the practice</td>
<td>After the practice</td>
<td></td>
</tr>
<tr>
<td>Personal readiness</td>
<td>7,39</td>
<td>7,73</td>
<td></td>
</tr>
<tr>
<td>Theoretical readiness</td>
<td>6,78</td>
<td>6,88</td>
<td></td>
</tr>
<tr>
<td>Operationally instrumental readiness</td>
<td>6,33</td>
<td>7,72</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Negative Ranks - 154</td>
<td>Positive Ranks - 390</td>
<td>Ties - 536</td>
</tr>
<tr>
<td></td>
<td>Negative Ranks - 149</td>
<td>Positive Ranks - 340</td>
<td>Ties - 291</td>
</tr>
<tr>
<td></td>
<td>Negative Ranks - 116</td>
<td>Positive Ranks - 212</td>
<td>Ties - 332</td>
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</tbody>
</table>

This suggests that the training supervision sessions have positively affected students' theoretical readiness and essentially affected personal readiness and operationally instrumental readiness for professional activities. Frequency of code usage (code "refl", used 35 times), reflecting on the learning environment in supervision shows that supervision: 1) contributed to the sense of confidence and security ("During supervision, you can listen to colleagues, observe their behavior, express your opinion, compare and find a common answer and solve problems." "Supervision gave me understanding, solace and reassurance that I am doing everything correctly"); 2) provided leadership and support ("Supervisions gave overwhelming support, how to cope with stressful situations, a variety of client reactions." "There was a feeling that I am not alone, who faces the challenges of uncertainty and anxiety"); 3) provided reflexive learning ("During supervision, you can listen to colleagues, observe their behavior, express your opinion, compare and find a common answer and solve problems." "I had a number of issues and uncertainties relating to clients, but, when I came to group supervision, group members just said instead of me most of my uncertainties, reflecting their case, and I was able to find an answer."); 4) promoted reflexive thinking, and 5) provided motivation for professional growth and creativity.

We can conclude that the results confirm the links with the theoretical knowledge about the positive effects of supervision, promoting social educators' professional competence as readiness to professional preparation, creating the preconditions for the future habit to take care of oneselfs.
timely, encouraging professional development, preventing professional burn-out through various forms of preventives, including supervision.

4. CONCLUSIONS

Theoretical background of education of professionals of helping professions, sustainability of specialists' professional activities, professional development and supporting activities for ensuring supervision in connection to professional burnout and its prevention is derived from systems and ecological approaches.

1. Environment is seen as a major category of education ecology and a human is its integral part, a human develops in a continuous interaction with environment. As a result, this interaction can have progressive and regressive character that can take the form of professional burnout in specialists of helping professions.

2. Professional burnout is characteristical to the professionals who work in a person - a person systems. Most commonly it affects the representatives of helping professions, leading to emotional burnout syndrome that contributes to psychosomatic disorders and illnesses, negative impact on personal, professional and other activities; it may manifest as loss of professional and vital activities' quality.

3. Supervision is a form of assistance of professional development and counselling, that is, specific supportive collegial environment that allows its participants to avoid internal and external obstacles and blocks, avoid professional burnout, enhance their professional competence to carry out activities in an effective, qualitative way, and gain satisfaction from the profession.

4. The research carried out at Rezekne Higher Education Institution (Latvia) in 2008-2013 within the framework of doctoral thesis shows the connection with the theoretical knowledge about the positive impact of supervision on formation of social workers' professional competence and development, promoting professional career development and professional sustainability, avoiding professional burnout in a preventive way.

Acknowledgements

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REFERENCES


Ness, Ā 2004, Dzīves filozofija, Rīga, Norden AB


Plaude, I 2003, Sociālā pedagoģija, Rīga, RaKa.


Rats, T & Kliftons, DO 2007, Cik pilns ir jāsu spanītīs? Pozitīvas stratēģijas darbam un dzīvei, Rīga, Izdevniecības nams „Trīs”.


Truskovska, Z 2010,b, ‘Insight into Philosophical Aspects of the Improvement of Social Pedagogy Social Competences’, Education Reform in Comprehensive School: Education Content Research and
Implementation Problems/The collection of scientific papers, Rezekne, Rezekne Higher Education Institution, pp. 84-93.


Truskovska, Ž & Zavadska, I 2005, Sociālā darba specialīstu neatkarīgas supervīzijas metodēs, formas un satura Rēzeknes pilsētā, Maģistra darbs, Rīga, SDSP Augstskola „Attīstība”.


Булюбаш, ИД 2003, Основы супервизии в гештальт-терапии, Москва, Изд-во Института Психотерапии.


Каган, М 1991, Системный подход и гуманитарное знание, Ленинград.


Abstract

Examination of the current land usage of the research area, Bursa Nilüfer Creek and its subbasins, reveal that functional areas such as settlements and industrial areas, located on first class agricultural lands and on rock formation with geologically high permeability, create pollutions on the natural resources forming the basin, over acceptable parameters of international standards, as a result of governmental decisions. Therefore, the pollution seen in the research area was considered with a 20-year period. Then, spread of these pollutions was associated with physical geography features, pollutions were discussed by comparisons with international standards, Geographical Information Systems were used as a tool and findings were reflected to maps. In this context, it was aimed to establish what kind of environmental problems are caused by the changes in land usage at the research area, and the significance of ecological analysis, to emphasize the importance of planning in the paper.

Key words: Basin, Ecological Planning, Ecological Risk Assessment, Land Use

1. INTRODUCTION

It is observed that Bursa Nilüfer Stream Başköy - Kestel section and lower basins are under a large scale of environmental pollution due to the fact that these areas have faced a very intense phenomenon of urbanization in the last twenty years and wrong land utilization. Therefore, environmental pollution seen in the research area has been considered over a period of 20 years and findings have been evaluated, and assessments have been conducted to determine type and dimension of the ecological risks according to international parameters. Surface waters which are directed by the features of catchment basin’s ecological system appear in the form of underground and surface water pollution. Detection reports drawn up by respective departments of the local municipalities (BUSKI 2009; Bursa Metropolitan Municipality 2002a; Bursa Metropolitan Municipality 2002b), public agencies (TUBITAK 2005; DSI 1984; DSI 2000), Uludağ and Boğaziçi Universities (Bogazici University 1992; Dedeoglu 2000; Kestioglu and Karaer 1994; Küçükballı 2003; Kaynak 2002) which deal with the chemical pollution related to water pollution of water catchment basin have been used in the analytic section of the study. By taking advantage of these reports, chemical features of pollution, correlation of spread of pollution and physical geographical feature, consideration of pollution by comparing them to the international standards, and by using GIS as a tool, findings derived have been transferred to maps.

Social – economical decisions made by the Turkish governments since 1950s for the purpose of development reflect upon the physical space and zoning decisions are made within this framework. The fact that area planning concept has not been addressed with necessary content and technique so far in our country and environmental arrangement and zoning plans gains without analyzing on a parametrical scale the ecological sensitivity and potentials of natural resources related to all areas across the country and harmony or lack of harmony of their social – economical functions give rise to
environmental problems with various contents in water catchment basins that have important natural resource features and high agricultural potential such as Bursa Plain, Adana Plain, Adapazarı Plain, Konya Plain, South Eastern Anatolia Basin. Land utilization decisions included in the zoning plans managing the urbanization phenomenon inside the water catchment basins of the areas conflict with the factors such as geological structure, morphological features, climate, and soil characteristics of basins.

Natural resources of every catchment basin are different and their relationships with one another are different too. Thus, planning must be considered in a holistic method with natural structure features and social-economical decisions. Physical planning is an approach based on the fact that characteristics of natural environment are directive. By taking this as starting point, physical planning studies of every research area should be conducted based on the ecological relationships of the catchment basin it is contained depending on the physical characteristics of the area. However, there is no planning procedure in our country, and pursuant to Zoning Law numbered 3194, area plans are conducted through a classic method when it is deemed necessary.

However, “in order for economic development to be balanced and comply with the principle of usefulness, an understanding of planning integrated with the natural space dimension must be defined, adopted and such understanding must be integrated without country’s development plans and policies” (Atabay 1991).

In this context, by conducting a research on the lower catchment basins of Bursa / Nilüfer in order to emphasize importance of the planning, it has been planned to reveal which environmental problems are caused by the land use and importance of ecological analyses.

2. MATERIAL AND METHODS

2.1 Study area

Borders of study area is composed of Bağköy - Kestel section and lower catchment basins within catchment basin of Nilüfer Stream (stems form south of the Mount Uludağ and joining Susurluk Stream in Karacabey Plain and then reaches the Marmara Sea) which is 1.288,96 square kilometers large and flows through province of Bursa (northern latitudes of 28°10’ and 30°00’ and eastern latitudes of 40°40’ and 39°35’) (Figure 1).

Due to physical geographical features of the study area, pollutions appear as above the ground water pollution carried with the surface waters directed by the hydrological characteristics, soil pollution and underground water pollution. With regards to this issue, local municipalities, respective public agencies and universities have been conducting pollution studies in respect of the Stream Nilüfer in particular.

Also, causality and relations between soil and air pollutions as well as changes in water quality have been revealed in this study. With such purpose in mind, water quality analyses conducted by DSİ (State Hydraulic Works), BUSKİ (Bursa Hydraulic Works) and universities have been considered under the light of Ecological Risk Assessment starting from lower catchment basins and continuing with the study area formed by these lower catchment basins, and group of relationships between water qualities measured at the main branches of catchment basins and crossroads by using universal parameters (and the other respective factors such as air pollution) and industries and land uses peculiar to them have been revealed.
While conducting ecological risk assessment for the Stream Nilüfer catchment basin, steps such as problem formulation, analysis and risk detection, the main frame of the Ecological Risk Assessment model of the US Conservation Agency have been taken as basis. Additionally, pressures and effects terminology of Water Framework Directive (WDF) model of EU where natural conditions linked with the geographical characteristics are evaluated apart from chemical analyses have been included in the evaluation. As a consequence, positive aspects of these analyses have been evaluated together and a mixed Ecological Risk Analysis method possessing a catchment basin approach has been configured.

A short summary of the risk analysis method configured is as follows;

I. Phase: Definition of problem:

- Definition of geographical space components
- Assessment of the data so gained according to natural resources of water catchment basin, existing and past land uses and master plans
- Formation of ecological conceptual model which lays down relationships between activities which are called source of pressure and cause these pressures and ecological effects of these pressures and ecological values that need to be preserved in order to define the risks

II. Phase: Analysis:

- Assessment of the pressure resources (pressures linked with industries such as agriculture, industry, services, settlement, transportation, commerce, recreation and functions and ecological pressures such as geological, atmospheric, hydrological) and pollutions caused by these resources

Figure 1. Research area boundaries
III. Phase: Evaluation of Risks:

- Overlaying all data derived according to risk factor weights depending on the features of physical geographical features and creation of risk maps as a result
- Assessment of risks caused by the changes related to current and past land uses and risks caused by the planned and unplanned developments depending on the zoning plans.

Results derived from analysis conducted by taking this as a starting point have been revealed within framework of holistic cause – effect relations (existing pollution and risks of pollution). Thus, zoning studies and synthesis maps where ecological thresholds have been determined have been gained.

3. RESULTS AND DISCUSSION

When looking into current and use of Bursa Stream Nilüfer Başköy – Kestel section and lower catchment basins (Figure 2.), it has been observed that, as a result of decisions made by the governments, function areas such as housing and industry located on the first class agriculture land and areas composed of rocks with geologically high permeability give rise to pollutions on the natural resources which comprise the water catchment basin at a scale that is above the acceptable limits according to the international standards.

Discharging of fertilizers and pesticides used in the agricultural areas and process wastes of industrial fields into the stream Nilüfer, soil and underground water by means of wells, duping of domestic wastes steming from housing areas into the Stream Nilüfer or the wells, and leakages in the sewerage system of some areas and emissions caused by transportation cause pollution in the underground and surface waters.

Since section of stream Nilüfer from its source in the Mountain Uludağ to the city center of Bursa which is used for irrigation in Bursa Plain is deemed unpolluted since it demonstrates high dissolved oxygen (DO), low biological oxygen requirement (BOR₅) and chemical oxygen requirement (COR) value. However, in those portions of stream which pass through city center and move towards Bursa Plain, DO value of Stream Nilüfer drops, and a increased rates of BOR₅ and COR values and high concentrations of lead, nickel, zinc, chrome and copper are worth attention.

When assessed in respect of water quality, although at the source of Stream Nilüfer, water quality is the 1st class water according to parameters, water gets polluted 500 times at the 4th km (Figure 2: M14), 10.000 times at the 14th km (F18) and 65.000 times at the 38th km (E6) and turns into the 3rd and 4th class water quality. Major reason of this phenomenon is the fact that physical – biological and ecological characteristics of the natural resources of the study area have been ignored, and water, soil and air pollution caused by industrial and urban or rural settlements located in the study area as a result of the negative effects caused by the decisions on land use. It is seen that only 10% of such pollution is caused by domestic wastes while the remaining major part of it is pollutions caused by the industrial wastes.
Bursa Plain is one of the most important agricultural areas around the region and the entire country, and since it caters for food requirement of a large population, pollutions directly affect all live beings and humans as a result of water taken from the Stream Nilüfer being used as irrigation water on agriculture fields (especially, sodium, boron and heavy metals). Due to irrigation water containing heavy metals, toxic substances find their way into the food chain via plants and give rise to major health problems.

Activities caused by the industrial use on the study area seem to give rise to air, water and soil pollution. Industrial uses causing pollutions in the study area enterprises, mining operations (Figure 2: E26, K13, O21, O23), storage areas (E26, F12, K13), textile (K8, F14, G12-14, H14, E19-20, I24, J12, J24-27) automotive (F19-20, H14-15, I13, J6-9-12), leather (K19, H19-20), cement (H20, J15), metal (G11-12), food (G14-15, I13, K7), rubber and plastic industries (H12-13), tan yards (I18-19), dyeing plants (H19, J20), mineral processing workshops (I20, K11, N19) and quarries (E26, K13, O21, O23).

Industrial establishments founded along the stream Nilüfer pollute the Stream Nilüfer with waste waters on one side, and settlement areas create air pollution over agricultural fields and the Stream Nilüfer on the other side. This air pollution reach the agricultural fields and surface waters as a result of inversion movements. In the study area, the single most important effect giving rise to pollution in the water quality of the stream Nilüfer as a result of the industrial activities is discharging of industrial wastewaters into the Stream Nilüfer.

Characteristics of the industrial wastewaters vary depending on the industry type, and chemical contents caused by different processes wastes are available in the industries that engage themselves
with the same sector. Since chemical characteristics of the pollution components are different, effect of every industry on the water quality of the Stream Nilüfer is different.

The Organized Industrial Sites operating in Bursa have their own treatment plants, yet these plants are not operated at adequate level and efficiency, and wastewaters treated chemically and physically are discharged into the Stream Nilüfer before being biologically treated.

Besides, air pollution occurs as a result of discharging of the chimney gases of Orhaneli Thermal Power Plant without proper treatment, and chimney gases created by use of low quality coals for heating in downtown Bursa and rural settlement areas and exhaust emissions of the vehicles. Therefore, since dominating wind direction is north east, polluted air that is unable to climb over the Mount Uludağ which is the natural threshold area to the south of the study area suspends in the over the city center, and soil, water sources and vegetation are negatively affected by the inversion and acid rains.

Apart from the pollutions caused by agricultural applications and industrial activities, pollutions caused by the settlement areas have been detected in the study area. Looking into space distribution of the different types of houses in the study area, we see that majority of them is composed of areas irregularly developed. Part of these areas have been legalized once again through improvement plans (Figure 2: D13, F15, G15), and part of them is composed of settlement areas developed in the form of multiple housing (Figure 2: G9, H8, K9). Looking into relationship of the housing areas with the water catchment basin, some of them are located inside Bursa Plain containing fertile agriculture fields and forest areas.

Until 1997, domestic waste water of the settlements located in the catchment basing used to be discharged into the Stream Nilüfer. There are still settlements which discharge their domestic wastes into the stream Nilüfer without getting connected to BUSKI waste water collection collector. In the rural settlements, since infrastructure has not been completed yet, domestic waste waters are discharged into Stream Nilüfer by means of small creeks or into underground water via illegal wells. In this way, pollutions reach the underground water, and waters taken from the wells opened in Bursa Plain are used as irrigation water for agriculture. Besides, pollutions that reach the stream Nilüfer from the underground water contact the soil with the irrigation water taken from the stream Nilüfer and reach the food chain.

When looking into pollutions caused by the transportation in the study area, although there is no scientific study conducted about this issue in the study area, analyses conducted show that solid particles and polluting gases emitted by the vehicles reach the stream Nilüfer by air or soil, underground waters and the stream Nilüfer by means of inversion. Heavy metals stemming from exhaust fumes of the vehicles passing through the orbital road, a portion of which is on viaducts, (lead, asbestos, cadmium and the others) spread to the agricultural areas in the vicinity, and the agricultural fields are under pressure in respect of pollution in a large range due to air movements. Also, polluting particles that lift of the ground due to abrasion of car tires as a result of friction become part of the food chain after reaching the surface waters, undergrounds waters and soil as a result of inversion. Also, characteristics of the fuel consumed by vehicles (solvents etc.), profile depth of the tires are not in compliance with the conditions specified in the European Environment Legislation. Especially orbital road that is located along the Stream Nilüfer gives rise to pollution risk in respect of dense traffic. Also, when looking into pollution risks caused by the fact that landing and take-off routes of the airlines being above the agricultural fields, dense plane fuel wastes discharged by the planes at the time of take-off in particular merge with Stream Nilüfer or soil, and thereby, the underground waters. Location of Bursa Yenişehir Airport posses the same risks in respect of the nearby agricultural fields.

Land use reports issued without taking into consideration ecological – biological – physical characteristics of the natural resources give rise to the results derived from this study Planning and
planning phases are of paramount importance.

The Law on Zoning numbered 3194, planning process of our country is defined as follows: This processes is defined with area plan, environmental plan, master plan and tentative plan phases. In this order, area plan and environmental plan create upper scale plans. In our country, area plan is done in order to reflect the social-economical plans on the space. However, apart from social-economical decisions, an area planning understanding that contains and take into consideration the ecological and biological characteristics of the natural resources has not matured in our national planning practice. Those plans which take into consideration the social - economical decisions alone as proven by the considerations contained in the thesis, give rise to destruction of natural resources and environmental pollution.

Upper scale planning offers an opportunity in terms of conserving the resources; however, catchment basins or another natural criterion have not been rendered decisive for the parameters that will be the basis of the existing plan definitions. Also, the fact that area planning is not compulsory in the legal platform causes omission of planning stage in practice. It has been only a short time since the environmental plans have started to be prepared across the country. Potential for understanding ecological integrities of adoption of a environmental plan in our country’s planning practice as an upper scale plan is inadequate, and it is obvious that environmental problems are caused by the fact that these plans have been drawn up by taking into consideration boundaries of provinces. In the absence of upper scale plans, environmental plans are being executed in the city scale with master and tentative plans in our country’s planning activity, and these plans are not made with foregoing characteristics, qualities and phases, and do not contain adequate ecological considerations. Likewise, master plan and tentative plans of the lower scale do not lay down physical and ecological characteristics of the natural resources and potentials of the natural resources. For water catchment basins that are of importance in terms of nature, it is obvious that Ecological Master Plan must be drawn up prior to the abovementioned area plan and such plan must be decisive in planning of the natural resources according to conservation – use characteristics.

In the water catchment basin planning suggested, in order for the geographical – physical structure of the water catchment basins and their ecological characteristics to be reflected upon planning decisions, legislation that will direct and support the planning must be developed in this direction and international conventions must be put into force and effect. Since existing laws and regulations regarding water catchment basins (environment law, zoning law, law on conservation of soil and use of land, regulation on control of water pollution, regulation on conservation of water resources, regulation on conservation of water catchment basins, regulation on environmental impact assessment and the others ) do not have adequate conservation precautions, conservation precautions related to pollution must be established and applied separately for each and every catchment basin that has specific ecological conditions and natural resource potential (Küçükali 2012).

**4. CONCLUSIONS**

Ecological Planning and catchment basing planning related to the same is a planning approach, at a scale above the space planning, which lays down principles of conserving biological and ecological characteristics of the natural resources and assuring balance of conservation – utilization, ensure that resources are managed wisely, and the issues are addressed within integrity.

If planning is directed by implementing projects of reviewing and gentrification of those land uses which are not ecologically appropriate in the settlement areas according to “Ecological Planning” containing an original systematic and by thinking together with Ecological Master Plan which guides land uses in those rural areas which are not inhabited yet, it is obvious that natural resources of our country and water catchment basins will be rendered sustainable.
REFERENCES


Bursa Metropolitan Municipality 2002a, Bursa wastewater master plan, Environment technical report no:18, GIBB Tabar, Bursa, Turkey.

Bursa Metropolitan Municipality 2002b, Bursa water resources and current quality, Environment technical report no:37, Bursa, Turkey.

BUSK1 2009, Bursa environment, water supply and sewerage project, Bursa Water and Sewage Administration, Environment technical report no:22, Bursa, Turkey.


Abstract

Importance of ecological risk assessment gradually increases for areas with planned and unplanned urban development and for unsettled areas. Especially, pursuant to national, AB and international laws, as well as improvement works and sanctions by laws, legislations and agreements for existing pollutions, the issue of determining the risk values possible future pollutions by scientific methodologies gets more importance day by day. Either methodological approach or points of view and priorities vary by every country in ecological risk assessment. In the Article, various ecological risk assessment models are discussed with their strengths and weaknesses.

Key words: Ecological Risk Assessment, Environmental Risk Evaluation, Human Health Risk Assessment, Risk Assessment Models, Risk Management

1. INTRODUCTION

Increase in environmental pollution due to rapid industrialization in developed countries has revealed that pollution control operations in environmental management works cost cheaper that cleaning works made after the pollution (UNEP 1992). Based on this fact, Ecological Risk Assessment is being used since the end of 1980s as a tool in environment management. This tool is used for understanding and estimating the relations between human activities and the negative ecological effects caused by these activities. This way, Ecological Risk Assessment creates a basis for decisions in environmental management and in this scope, current data, estimations, uncertainties are assessed systematically (Küçükali 2009). Ecological Risk Assessment gets its basis from Environmental Risk Assessment method (Holmes & Singh 1993).

2. MATERIALS AND METHODS

There are certain operation steps common in all Environmental Risk Evaluation models. These are:

1. Finding out the problem
2. Identifying the damages
3. Evaluation of the spread
4. Evaluation of impacts
5. Evaluation of findings
6. Risk estimation

Many Ecological Risk Assessment models have been developed in different countries according to their characteristics. When we examine these models, we can have a classification in two top titles, which display methodologically different features (Fig.1.):
1. Ecological Risk Assessment models that focus on chemical analysis

2. Ecological Risk Assessment models that evaluate natural conditions and socio-economical impacts as well as chemical analysis

In order to determine the risks on human health caused by chemicals from industrial facilities, National Science Academy (NAS) made an Environmental Risk Assessment study in USA in 1983, and a model has been developed. This method has been improved by taking European Union’s New and Existing Chemical Substances legislations as basis. It is also the improved version of the risk assessment methodology specific for the field and the operations performed (Adams & Power 1997).
First documents that define and establish the process of Ecological Risk Assessment were prepared by U.S. Environmental Protection Agency (EPA), which are: Guidelines for Ecological Risk Assessment (US EPA 1998), Ecological Risk Assessment Guidance for Superfund (US EPA 1989) and Ecological Risk Assessment and Risk Management Principles for Superfund Sites. At the same time, Suter’s books, named “Risk Characterization for Ecological Risk Assessment of Contaminated Sites” and “Guide for Developing Conceptual Models for ERA” (Suter 1999) have important position in Ecological Risk Assessment literature.

2.1 U.S. Environmental Protection Agency

U.S. Environmental Protection Agency (EPA) focuses on chemical analysis in Ecological Risk Assessment. EPA methodology; focusing especially on pollution risk assessment studies, evaluate the risks created by chemicals on organisms. At the same time, based on Water Quality Standards Regulations and Clear Water Act covered in U.S.A environmental legislations, risk assessment is again made by focusing on chemical analysis. EPA -Ecological Risk Assessment methodology is, generally, as follows.

Ecological Risk Assessment is a process that evaluates the possibility and capability of being exposed to one or multiple negative ecological impacts (US EPA 1992). For environmental decision-making process; it systematically detects and evaluates the relations between data, assumptions, uncertainties and negative impact sources, and ecological impacts. The assessment can include chemical, physical and biological impact sources; one or more impact sources can be evaluated. There are 3 main stages in Ecological Risk Assessment; identification of problem, determining of the analysis and risk.

Below, assessments of chemical analysis based on parametric parameters in EPA’s Ecological Risk Assessment methodology are given. Acquired results are discussed with risk managers (relevant public institutions and municipalities) and they become influential in governing resolutions, shape planning and give a direction to the policies that are created as a result.

![General diagram of ecological risk assessment (U.S. EPA, 1992)](image)
Considering some studies that use the Ecological Risk Evaluation methodology of U.S. EPA, who focuses on chemical analysis;

In the study “Impacts of Physical Deteriorations on Water Quality and the Function of Urban Wetlands for Improving Water Quality” (US EPA 1994) performed at 8 counties at St. Paul Metropolitan district in Minneapolis, U.S.A; human-sourced physical and chemical impacts were assessed with Ecological Risk Assessment methods under the cause-effect relations over the water quality of 33 wetlands, and a conceptual model and control list was constructed.

Besides, the study “Bolsa Chica Reserve Ecological Risk Assessment” (US Fish and Wildlife Service 2003), performed in California, U.S.A, establishes the risks on land, sea and transition ecosystems and ecosystem functions caused by changes in water quality, and how these risks impact the fish population in the reserve. Data acquired in the end, aims to reduce pollutions and is included in the planning by improving the risk management process.

Regarding these studies focusing on chemical analysis, there are many examples of applications, such as those in; water basins (Bogazici University 1992, US EPA 1996, Serveiss 2002), rivers (Wenger et al. 2000), wetlands (Lemly 1997), agricultural lands, areas under intense threat of chemical wastes, areas and forests losing natural characteristics as a result of uncontrolled urbanization, (Hogsett et al. 1997), coves (Harris & Wenger 1994), valleys (US EPA 1996b), flood and overflow areas (Kooistra & Leuven 2001, Turoğlu & Özdemir 2004, Özdemir 2007, Turoğlu 2007, Turoğlu 2010).

As you see, there are incomplete points in EPA methodology in terms of the process of assessment for the ecological risks over natural resources with all their components. Based on these points, EU countries and some international organizations have developed their own risk assessment methodologies.

Although the ecological risk assessment methodology developed by U.S. EPA focused on chemical analysis, it has become the basis for later developed similar methodologies. With the completion of seemingly incomplete aspects and with the addition of new points of view, many different ecological risk assessment methodologies have been developed.

2.2 World Health Organization

World Health Organization (WHO) has reformed the EPA frame in terms of human health and Ecological Risk Assessment. The difference of this frame from EPA’s is that the contribution of risk managers and stakeholders occur in parallel with risk assessment process. Each process performs its function within its own internal dynamics while there can be interactions, feedbacks and connections between two processes at any point (Don Maughan 1972).

In the same manner, the OECD model, which is constructed on considering socio-economical structure in parallel Ecological Risk Assessment stage, displays a structure similar to the WHO model.

2.3 European Union

In EU countries, two approaches follow each other. Although the Ecological Risk Assessment is based on chemical analysis in the EU legislation on the Assessment of New and Existing Chemicals; the DPSIR frame, which is based on the later adopted Water Framework Directive (WFD), at river basins scale, includes other natural conditions and socio- economical structure in its risk assessment.

EU commission developed “New Chemicals Policy” for the protection of human health and environment from chemicals hazards (Kleinschmid & Wagner 1997). By replacing 40 existing laws, REA CH has been developed to create a single system for all chemical articles. This system, taking year 1981 as basis, differs from the current chemical legislations in effect for substances known as “existing” and “new” chemicals. 100,106 chemical substances launched before 1981 are defined as
“existing” chemicals. Chemicals introduced after 1981 (more than 4300) are defined as “new”. It is mandatory to apply very strict tests to new chemicals under current laws, while for existing chemicals, there are no such measures (ISO 2007).

![Diagram](Fig. 3. A framework for the integrated assessment of human health and ecological risks (WHO 2001))

Legal legislations in EU on environment started in 1973 with EU Action. As of this date, risk management and risk assessment frame have been defined by many regulations in the European Commission (EC). At the same time, with Technical Guidance Documents (TGD), pollutant assessment criteria were defined and have been adopted by all EU member states as of 1995. U.S. National Research Council takes EU risk assessment frame as basis for “Federal Government Risk Assessment: Process Management” report, also known as the Red Book (NRC 1983). Although this framework was first prepared to assess human health, it was later adapted to the Ecological Risk Assessment (Barnthouse & Suter 1986, US EPA 1992). Technical Guidance Documents define scientific, political and social parameters as important parts of the general assessment process.

Exposure status may vary greatly in different countries due to differences such as topography and climatology, etc. (Toope 2003). At this point, standards have been developed for EU countries by considering average environmental characteristics and possible exposures. These standards can be revised specifically for the study area by appropriate measurable data and area-specific emission values.
Table 1 Existing and new chemicals regulation of the European Union (EC 1996)

<table>
<thead>
<tr>
<th>Identification of New and Existing Chemicals</th>
<th>New Chemicals</th>
<th>Existing Chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Since 1981 the European Union are not included in the previous 10 years</td>
<td>Located in the European Commercial Chemical Substances</td>
<td></td>
</tr>
</tbody>
</table>

WFD (2000/60/EC) is the basic EU legislation that establishes the Environmental Quality Standards (EQSs) for chemicals and creating risks for aquatic ecosystems, covering risk management issues on river basins scale. Over Europe, WFD was formed within the framework of integrated river basin management (IRBM) paradigm (Kirby et al. 1994).

According to WFD, EU countries shall bring the environmental quality standards of their water surfaces up to a certain standard until 2015 and accomplish improvement. Quality of water sources are
affected by many different pressure elements. These are; point-source discharges, non-point sourced common sourced discharges, water abstractions, flow formations, morphologic deteriorations.

3 risk classes are defined according to WFD:
1. water surface not under risk (if WFD quality standards are met according to pressure/impact analysis),
2. water surface under potential risk (if there is no sufficient data),
3. water surface under risk (if WFD quality standards are not met according to pressure/impact analysis),

All these pressures and the impacts they cause are grouped in four risk categories:
1. Organic pollution
2. Hazardous substances
3. Nutrients

4. Hydromorphological alterations / deteriorations

DPSIR (driving forces, pressures, state, impacts, responses) framework, which is based on the WFD and which defines application areas and method, was developed by European Environment Agency (EEA 1999). In the first stage of DPSIR framework, the driving force and pressures are defined and the potential impacts they cause (hazards) are established. To this end; socioeconomic data, trends, environmental data, current water quality data and sensitive regions are defined. In the second stage, current chemical water quality data are evaluated within the framework of Environmental Quality Standards. In stage three, impacts and causal relations are revealed and assessed. Various quality data (biological, physiochemical, chemical and hydro-morphological data) are integrated. At last stage, responses are evaluated. Technical measures and policies are set to improve or protect the water quality.

![DPSIR framework](Fig. 5. DPSIR framework (ISO 2007))
At this stage, when countries are generally considered in terms of Ecological Risk Assessment methodology, Holland’s risk management approach (Program for Environmental Management of the Dutch Government) was first developed between 1986 and 1990, by using Germany’s Environmental Management Program. According to this concept, in addition to source-based approach in risk management (emission standards), importance of impact-based approach (environmental quality standards and impact standards) was emphasized. Previous risk evaluations were based on only chemical analysis (Jorgensen 1991).

2.4 Other Countries

UK and Canada have formed their own ecological risk assessment models (CCME 1997). UK’s Ecological Risk Assessment model is based on assessing lands under potential pollution risk together with legal legislations (Wood & Jones 1997).

Canadian model shows the exact opposite of the approach in the American risk evaluation model, which is based on the idea stated by NRC committee as “Although risk assessment and risk management process are analytically independent from each other, they are and must be in interaction in practice. If they progress independently and separately from each other, it will be hard for risk manager to take correct decisions in time.” (NRC 1983). In Canadian model, risk assessment and management processes are regulated separately. At the same time, Canadian model is contrary to U.S. and EU models in terms of process sequence. Canadian model has risk management as the first step, and then makes the risk assessment. In U.S. and EU models, risk assessment is the first step.

Australia applies a versatile, combined approach method. Besides chemical analysis, it assesses natural source analysis together, according to data status.

3. RESULTS AND DISCUSSION

U.S. EPA’s Ecological Risk Evaluation process handles risk management and technical evaluation processes separately. Following the risk assessment, which is fully a technical evaluation, it allows discussions with stakeholders (industrial institutions, NGOs and public institutions) at risk management stage. In other frameworks, such as; revised NRC framework, EU Risk Assessment Framework for New and Existing Chemicals, risk assessment and management frameworks of FAO / WHO for food additives (WHO 2001), risk managers and stakeholder requests play a greater and more important role in risk assessment. If risk managers and stakeholders are closely involved in the process, they can have an effective role in the selection of scenarios, models and parameters. On the other hand, if they are not involved in the process, there can be critically wrong decisions in risk assessment processes.

Other than the level of interaction between risk management and stakeholders; all risk evaluation paradigms basically follow the same logic. There is a terminological difference in the basis between human health and Ecological Risk Assessment processes. A significant difference is seen in hazard identification process. “Hazard” identification is used by NRC (NRC 1983) in the stage of evaluating problem formulation data evaluation and impact resource selection; it is used in other frameworks in stages where impacts and impact causing capacities are assessed within the characterization of effects - effects assessment (WHO 2001).

A great improvement is seen risk evaluations performed for environmental problems caused by point-pollution sources. It becomes important to take non-point pollution sources under control for environmental improvement. To solve pollution and habitat deterioration problems, basin approach must be adopted instead of assessing each water source or pollutant one by one. The Watershed Approach Framework establishes the interaction between natural resources (geographical data) and public/private sector activities (human impacts on surface and underground water systems, etc.).
Many states in U.S.A. have developed a strategy in accordance with Clean Water Action Plan, and are rehabilitating their basins. Not only one environment (water, air etc.) is evaluated in this basin-based approach; relations between these environments are also assessed. In the same manner, the application area of Water Framework Directive, the legal legislation that is the basis for water management European Union countries, is shifting from local scale to basin scale.

Various pressures (pollution, morphologic pressures, climate changes, regional and global economic structure, etc) impact various ecosystems in various manners. Therefore, risk analysis models, using ecosystems that have complex structures as an object, cannot be applied for all times, situations and locations as a constant pattern. Every place-time duo has varieties according to their specific pressure situations and must have flexible structure open for innovations.

4. CONCLUSIONS

According to some authors who approach critically to Ecological Risk Assessment (Power & Mccarthy 1997) Ecological Risk Assessment has many uncertainties due to the incomplete understanding of the operation of ecosystems, due to the inability to establish regular relations between parameters of this mechanism, and due to discussions on which of the legal, technical or socioeconomic contexts will have a higher priority in assessments.

Also, in another study (Power & Adams 1997) the authors discussed the differences of U.S. Environmental Protection Agency’s Ecological Risk Assessment framework, which is based on chemical analysis and treats risk management as a secondary process in order to have a scientific approach, from the Canadian framework, which puts risk management to the core of risk assessment process.

According to another author (Tal 1997), risk assessment was developed by risk assessors as a part of risk management to overcome the adversities in environmental actions. Environmentalists believe that risk assessment cannot be sufficient to fully establish the characteristics of environmental damages and hazards over humans and ecosystems. According to environmentalists, risk assessment is an effort only to quantify and sort risks instead of removing them. They also believe that risk assessment uncertainties cannot be successfully eliminated and that risk assessments can be manipulated according to point of view of the assessor. Despite this, the author adds that some environmentalist groups leave this approach and accept risk assessment approach.

Despite this negative point of view of environmentalist movement against risk assessment, Ecological Risk Assessment has been adopted by many countries and successfully applied although there are approach, priority and methodology differences.

There are methodology differences between U.S. – EPA framework, which focuses on chemical analysis, and Canadian framework, which focuses risk management, and EU- WDF framework, which includes natural circumstances and socioeconomic structure. The approach to be chosen must be decided according to the Ecological Risk Assessment research area.

When the above criticisms are evaluated; the inability to fully understand the mechanism of ecosystems does not mean that causality relations cannot be established between the subcomponents that form this mechanism. Despite however complex is the cluster of relations between subcomponents, it is possible to measure, quantify and assess the impact levels of these relations. It is a matter of time, facilities and technology to make uncertainties become measurable and assessable.
REFERENCES


BRYOZOA OF THE RUSSIAN SEA SHORE OF THE BALTIC SEA.

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Abstract

*The Bryozoa fauna of the Russian sea shores of the Baltic Sea is very poor. In the south-western part of the Baltic Sea were found five species only: Einhornia crustulenta baltica, Electra pilosa dentata, Callopora aurita, Alcyonidium polyom, Victorella pavida. The first one is registered in the Gulf of Riga, the Gulf of Finland and the Gulf of Bothnia only. Decrease in the number of Bryozoa species having taken place in the sea from west to east is due to a gradual decrease in the salinity in the same direction.*

**Key words:** Bryozoa, fauna, ecology, barrier salinity, endemic

1. INTRODUCTION

«It is necessary to notice that nowadays there is reappraisal of present views on biodiversity of brackish and freshwater seas and lakes of our planet. Conception of native and xeno biodiversity of the Baltic Sea, the Black Sea and the Sea of Azov, the Caspian and the Aral seas is continuously expanding and supplemented.

Earlier suppositions that the indicated water bodies cannot be regarded as poor are being justified. Their native and xeno biodiversity are considerably higher than earlier was supposed, but trying to revise obsolescent views one must not carry to an absurdity. Both original native and xeno biodiversity are under pressure of not only changing natural factors (temperature, salinity, etc.) but also anthropogenic ones.

The Baltic Sea is young and being a cold lake in glacial times. It still retains many features of a lake. It is a semi-closed, shallow, brackish water body with a smooth salinity gradient, and unique fauna and flora. The biodiversity of Baltic Sea is relatively low but is also unique.

Rivers play an important role in the water balance of the Baltic Sea. There are oligohaline and mesohaline water zones in the Baltic Sea, each with its own specific flora and fauna. The areas with the most freshwater characteristics are the Gulf of Finland and Gulf of Bothnia. The central water zone of the Baltic Sea has a pronounced mesohaline character. Polyhaline conditions can only be found in the Kattegat and the Sound. The biodiversity of this young sea was formed in postglacial times.

All the Baltic Sea biodiversity is extremely heterogeneous. The western corner of Baltic, Kattegat, etc. is sharply different from the eastern corner of the Neva Bay. Full–saline marine waters coming from the Northern Sea and their biodiversity have nothing in common with biodiversity of practically fresh water discharged by the Neva River, the Luga and Narova rivers. The central Baltic with its saline conditions and biodiversity also is unlike aforementioned the Kattegat and the Neva Bay. In the boundaries of one sea having arisen only recently on a glacial shield that then became a glacial lake, there are clearly distinguishable three associated microcosms (marine, brackish and freshwater), each one with unique biodiversity» (Aladin, Plotnikov, 2011).
Peculiarities of geographical distribution of different marine invertebrates groups depend on their common organization giving them of more or less possibilities for adaptive changes to appropriate biotopes. Naturally, a mode of distribution, for instance, of mobile animals such as fishes or cephalopods which has capabilities of keen reaction to environmental changes and which can move active to avoid negative influences, is significantly different from distributional pattern, for instance, Bryozoa, adult colonies of which have not a capability to active changing of biotope and they are closely connected to bottom of the sea.

Differences in osmoregulatory capabilities of some groups of invertebrates and in particular of Bryozoa, have influence on a potential in a distribution of different invertebrates groups.

2. MATERIAL

Two Russian papers have described Bryozoa of the Russian sea shores of the Baltic Sea: Knipovich N.M.(1909)–Bryozoa has determined by Kluge G.A. who identified three species for whole sea and E.A. Androsova (1962). The Bryozoan fauna of the Baltic Sea have had not enough description in Russian scientific literature until Androsova paper (1962) was published.

An abundant collection was gathered by Knipovitch in the Gulf of Finland and near the Aland Islands, Saaremaa and Hiiumaa (the Moonsund or the West Estonian Archipelago), near Liepāja (Libau), along southern marine coast of Sweden and in an entrance of the Sound. The Kurshsky Bay and adjacent regions were unexplored.

Androsova collected Bryozoa in the Kurshsky Bay in the summer of 1961. The collection and her more early bryozoan collection near Tallinn and Narva-Jõesuu of the Gulf of Finland and collections of Pavlovich S.A. (1907 near the Aland Islands), Sadokova A.P. (1909 near Liepāja), Butakova A.I. (Moonsund strait), Kluge G.A. (1955, the Pärnu Bay) have permitted to describe the Bryozoan fauna of these regions. Androsova has described four bryozoan species of coastal waters of above mentioned regions and especially near Rybachy, Zelenogradsk, Svetlogorsk in the Kurshsky Bay and one species in the Gulf of Finland. There are three cheilostomate species and one ctenostomate species between them.

The Kurshsky Bay has water with low salinity which does not exceed 8 ‰. The Bay has shallow depths with average depth approximately 3,7m. The most narrow and shallow part of the Bay is northern one where depths do not exceed 2 m. The deepest part is a region near southern–eastern coast of Rybachy, where depths are 5,5–6,0m. Many rivers flow to the Bay and the largest of them is Neman. An input of fresh water exceeds volume of the bay in four times yearly and a level of the bay is higher than the Baltic Sea level on 12–15cm. A difference of water volumes comes through a strait to the Baltic Sea.

Salinity distribution in the Gulf of Finland is determined by an interaction between river flow (for the most part due to rivers Neva, Narova, Luga) and deep brackish waters of the Bay. General characteristics of salinity regime in the eastern part of the Gulf of Finland are the following (Nekrasov et al., 1997):

– an existence of vertical gradient of water saltiness everywhere except the Neva Bay;
– an increase of salinity from eastern region to western part (especially at upper layers);
– an increase of salinity from northern region to southern part of the bay

Water salinity during a year has noticeable seasonal changes. Spring salinity has minimal value because of ice-melting input. Surface salinity in this period increases from the eastern part toward western one from 0,5–1,8 ‰ near Kroonstad until 4,5–4,7 ‰ in Gogland region. Bottom salinity
grows in same direction from 3.5 until 5–6 ‰ (even 7.2–7.6 ‰ in the depth region of 40–50m). In summer a surface salinity increases until 0.5–1.0 ‰, although it is the same value of a salinity as in spring at deeper layers. Vertical mixing equalizes vertical salinity gradient and a salinity increases until 4.9–5.1‰ in surface water of western parts in the Gulf of Finland with respective salinity increase in bottom water layers until 6.7–6.85‰.

Figure 1. To the left–the Koporsky Bay; to the right–underwater landscape in the Saaristomeri

Our samples were collected near Saint Petersburg region in the Koporsky Bay of the Gulf of Finland and represented by only *Einhornia crustulenta baltica*. Other new findings of the same species were collected by finnish researcher in Saaristomeri near Finland.

Androsova has found three cheilostomate species and one ctenostomate species in the Kurshsky Bay: *Einhornia (Electra) crustulenta baltica*, *Electra pilosa dentata*, *Callopora aurita* и *Aleyonidium polyoum*. She has met *Einhornia (Electra) crustulenta baltica* in the Gulf of Finland only.

Species number decrease has taken place together with decrease from oceanic water salinity to brackish one. Especially interesting are marginal zones. Here is an interosculation of marine and brackish water faunas on the one hand and freshwater on the other hand is pronounced (Remane, 1934, 1969; Remane, Schlieper, 1971; Khlebovich, 1974; Kinne, 1971).

Androsova has divided the Baltic Sea into three parts, which is based on bryozoan distribution: the first is the Great Belt (33 bryozoan species).

Recent German researchers informed of 46 species cheilostomate, cyclostomate and ctenostomate Bryozoa in the western part of the Baltic Sea and of four freshwater species. Nikulina (2008) was described new species *Electra moskvikvendi* for western part of the Baltic Sea and later described new genus *Einhornia* for species with one horn.

Salinity near Lolland and Falster and Môn is 8 ‰ in August only. Five species of Bryozoa inhabit the second south–western region which is characterized by a decreasing of salinity (7–8‰ in August). Two of them are typical brackish water species, i.e. *Einhornia (Electra) crustulenta baltica* and *Victorella pavida*, the last of them has had an origination in Ponto–Caspian region and later has invaded in the Baltic Sea.

The third central region (according to Androsova) of the Baltic Sea with the Gulf of Riga, the Gulf of Finland and the Gulf of Bothnia is characterized by only bryozoan species *Einhornia (Electra) crustulenta baltica*. The central region of the sea has substantial desalination in comparison with western region. Substantial desalination of this part of the Baltic Sea is confirmed by a penetration to these bays of freshwater bryozoan species *Plumatella fungosa*.

Well–known scientist Segerstråle (1953) has explained a distribution of marine species in the Baltic Sea by gradual increase of water salinity during the last thirty years before 1953. The salinity was extremely high during the 1950s. It then dropped to an all-time minimum in 1992–1993, but is now back at the same level as at the beginning of the century.

«Water salinity is one of major environmental factors influencing on hydrobionts. Finding-out of peculiarities of relation of aquatic animals and plants to this factor is important for understanding both autoecological and synecological laws.

The Concept of relativity and plurality of barrier salinity zones has been formulated more 20 years ago within the school of V.V. Khlebovich (Aladin, 1986). Its substantive theses have been published in «Journal of General Biology» (Aladin, 1988).
Two main statements have been stated: zones of barrier salinities are relative, on the one hand, to the degree of hydrobionts osmoregulatory capacities perfection and, on the other hand, to the water chemical composition.

All hydrosphere could be divided into freshwater brackish water, marine and hyperhaline salinity zones. Marine zone covers more than 95% of hydrosphere. Portion of freshwater zone is less than 3%. Portion of brackish water and hyperhaline zones is less than 0.5%. Between these four basic zones there are transitional ones and the portion each of them is less than 0.5%. Approximate boundaries and corresponding barrier salinities for all of these zones are defined.

There are several zones of barrier salinities and they are unequal in their importance.

Position and wide of barrier salinities cannot depend only on physicochemical characteristics of aquatic environment. Values of barrier salinities can change with evolution of salinity adaptations and osmoregulatory capacities of hydrobionts (Aladin, Plotnikov, 2011).

«We distinguish between four barrier salinities or horohalinicums for marine and continental waters: \( \alpha \sim (5–8\%o) \), \( \beta \sim (22–26\%o) \), \( \gamma \sim (45–50\%o) \) and \( \gamma^* \sim (0.5–2\%o) \). In metamorphized continental waters, barrier salinities are shifted to higher concentrations» (Aladin, Plotnikov, 2009). It is possible to distinguish all three basic and two intermediate zones in the Baltic Sea (Fig. 3). The basic zones are fresh water,
brackish water, and marine. The intermediate zones are the following: (5) transitional between freshwater and brackish water; (2) transitional between brackish water and (Legend as Fig. 2 and 3).

Table 1. Values for salinity zones of oceanic, Caspian and Aral waters according to the basic concept of barrier salinities (Aladin, Plotnikov, 2009)

<table>
<thead>
<tr>
<th>Zones</th>
<th>Ocean</th>
<th>Caspian</th>
<th>Aral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic freshwater</td>
<td>0-2‰</td>
<td>0-2.5‰</td>
<td>0-3‰</td>
</tr>
<tr>
<td>Transitional freshwater-brackishwater</td>
<td>2-5‰</td>
<td>2.5-7‰</td>
<td>3-8‰</td>
</tr>
<tr>
<td>Basic brackishwater</td>
<td>5-8‰</td>
<td>7-11‰</td>
<td>8-13‰</td>
</tr>
<tr>
<td>Transitional brackishwater-marine</td>
<td>8-26‰</td>
<td>11-28‰</td>
<td>13-29‰</td>
</tr>
<tr>
<td>Basic marine</td>
<td>26-40‰</td>
<td>28-41‰</td>
<td>29-42‰</td>
</tr>
<tr>
<td>Transitional marine-hyperhaline</td>
<td>40-50‰</td>
<td>41-50.5‰</td>
<td>42-51‰</td>
</tr>
<tr>
<td>Basic hyperhaline</td>
<td>&gt; 50‰</td>
<td>&gt; 50.5‰</td>
<td>&gt; 51‰</td>
</tr>
</tbody>
</table>

*Einhornia crustulenta baltica* is extremely interesting species in this point of view.

Figure 4. *Einhornia crustulenta baltica*. The Gulf of Finland, the Koporsky Bay (on stone in 2007)
There is only species, which can overcome a $\alpha$–horohalinicum barrier and can live at salinity lower than 5‰. Perhaps, it is unique species among cheilostomate bryozoa because they are predominant marine group and prefer typically marine conditions of life. Origination of *Einhornia crustulenta baltica* is a question for separate research because it was found in the Arctic Chuckchee Sea and in the Bering Sea in the Far East.

Other typical brackish water species *Victorella pavida* of Ponto–Caspian origin had not overcome the $\alpha$–horohalinicum barrier as it can see above. Ponto-Caspian fauna evolved over millions of years in a series of large lakes and seas with widely varying salinities and water levels and alternating periods of isolation and open connections between the Caspian Sea and Black Sea depressions and between these basins and the Mediterranean Basin and the World Ocean. These conditions probably resulted in selection of Ponto–Caspian endemic species for the broad environmental tolerances and euryhalinity many exhibit. The Baltic Sea is geologically young and presents much lower levels of endemism. The high tolerance of Ponto–Caspian fauna to changeable environmental conditions, their ability to survive exposure to a range of salinities, and the similarity in environmental conditions available in the Baltic Sea probably contribute to the invasion success of the bryozoan species.

Ecological conditions of life in the Gulf of Finland play a key role in ecological conditions of the central part of the Baltic Sea. Marine Bryozoa can serve as bioindicator species of pure and aerated water.

REFERENCES


Aladin N.V. (1996) Adaptions to salinity of Ostracoda и Branchiopoda. Tr. Zoological Institute RAS, T. 265. [In Russian]


TOURISM INFRASTRUCTURE, A PREREQUISITE FOR SUSTAINABLE DEVELOPMENT: CASE STUDY OF THE NATIONAL PARKS OF EVROS, GREECE

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Abstract

The establishment and improvement of infrastructure can result in increasing the efficiency of economic activities in the countryside. In addition, it is an important factor for sustainable tourism around National Parks. Therefore, the visitors’ assessment of the local facilities and services can lead us to very useful conclusions about the quality of the experience they receive, and also define the future of the area. The present study was conducted at the National Parks of Evros Prefecture, namely Dadia and the Evros Delta, where the visitors stated their views about the existing infrastructure. A structured questionnaire was used and the cluster sampling method was applied in both cases. The results of the study indicate that visitors are quite satisfied with their experience at the National Parks, although the public transport and recreation facilities proven be insufficient in both cases.

Key words: Tourism infrastructure, National Parks, sustainable development, Evros, problems and improvement of infrastructure

1. INTRODUCTION

National Parks offer various types of recreation and sightseeing activities and are a catalyst in attracting large numbers of visitors (Boyd and Hall 2005; Saarinen, 2001). According to Rigall-Torrent and Fluvia (2007, 2011), cultural legacy, public safety, and public infrastructure are some of the social benefits that arise through sustainable tourism development. Intrinsically, tourism development is closely affiliated with environmental (Gerberich 2005; Zeppel 2006), economic (Lemelin & Bennett 2010), social, cultural, political and psychological benefits (Scheyvens, 2002; Zeppel 2006; Butler & Hinch 2007) which are delivered to gateway communities. For this reason, the development and improvement of infrastructure is an essential pre-requisite, in order to address the competition imposed by other equally famous destinations with high visitor numbers (Sheykhi 2009).

The establishment and improvement of infrastructure is one of the most important factors that can contribute to local and regional development. The implementation of development plans and infrastructure improvements can result in reducing production costs and increase the effectiveness and efficiency of economic activities in a rural environment (Shen et al 2012). However, as Elliot (1997) notes, governmental plans and actions are the ones that are able to provide the basic infrastructure for rural development. Moreover, as Reihanian et al. (2012) complement, infrastructure deficiencies are connected with a lack of interest on the part of the local government.

It should also be noted that visitors’ views on the local facilities, services and infrastructure provide crucial information about the quality of the experience they receive. The latter leads us to the conclusion, that information data about visitors can contribute to the effective management of National Parks and Protected Areas (Lindberg & Veisten 2012).
Any plans for the management of a protected area should at first focus on creating a link between ecotourism and the relevant work-related and economic benefits that arise for the local population, in order to ensure both the ecological and economic viability of the region (Skanavis and Giannoulis 2010). At a later stage, the local authorities should focus on the creation or improvement of the relevant infrastructure, such as parking areas, and on providing tourist attractions, e.g. by enhancing archaeological sites and promoting local cultural events. Other projects which promote tourism can also play an important role, such as the setting up of Internet websites by the prefectural authorities, and the establishment of portals for e-trade (Getz 1986; Haywood 1988; Long & Nuckolls 1994; Walle 1996; Wynne et al 2001).

1.1 Sustainable development via tourism in National Parks

In regions around National Parks, prohibitions exist which affect certain economic activities, such as fishing, stock breeding and agriculture, a fact which impacts on the living conditions of the local population (Tsachalidis & Tsantopoulos 2000; Lemelin & McIntyre 2011). However, the development of sustainable tourism offers an alternative solution in such cases (Walpole & Goodwin 2001; Lai & Nepal 2006) and provides opportunities for rural development (Good, 2000) and for the protection of nature (Ban Picart & Vincent 2008). According to Carr (2007), a conservation ethic must be created within the gateway communities in order for them to preserve tourist attractions, such as traditional sites, landscapes and resources. Tourism offers the basic framework that can deliver benefits to the gateway communities and consequently create a strong commitment within these communities for the preservation of the areas in question. Increased employment, financial gains, infrastructure creation, cultural revitalization and environmental protection are the most important positive impacts of tourism development (Zeppel 2006; Butler & Hinch 2007; Benett et al 2012).

More specifically, the local community can benefit from the creation of employment opportunities in transport, in public works for infrastructure improvement, such as the construction and maintenance of road networks, and through staff requirements at hotel facilities, catering areas and recreation facilities, or at the National Parks themselves, and in any service provision sector, which is a result of tourism development. Moreover, a source of additional finance is thus created for the financing of National Parks, through the various activities organized on-site (Buultjens et al 2004) and from visitation fees (Wellings 2007).

Thus, high-quality services and infrastructure improvements for visitors are some of the most important policy planning measures for the management of National Parks. Aiming to achieve this goal, an enhanced visitors’ experience can maximize the stakeholders’ benefits, regarding the long-term environmental, social and cultural integrity of protected areas (Kimbu & Ngoasong 2012). According to Andrea et al. (2011), the participation of the local population in decision-making processes and having access to information about visitors’ views and attitudes are the key tools to achieve effective management (Andrea et al 2012a).

In Greece, the search for a holiday destination which offers a range of nature-based activities and excursions has been a priority for many tourists in recent years. The growth of rural tourism (ecotourism or agro-tourism in general) is already a fact in Northern Europe. In the Mediterranean basin, the dominant trend of mass tourism has caused a delay as regards the development of new alternative types of vacation. Nevertheless, visitor demand for new forms of tourism has urged all countries to focus on a variety of novel activities. The development of agro-tourism in Greece began thanks to the encouragement of the EU and the projects financed by the LEADER programme. Since then, the interest of investors has continued undiminished and today its ultimate objective is to enhance Greek rural areas and provide innovative services and a range of activities to visitors searching for a different holiday experience (Hellenic Ministry of Rural Development & Food).
Visitors’ views, about a protected area which has been chosen as a destination, provide important information and constitute useful data for the effective management of protected areas as tourist destinations (Watson et al 2000; Eagles 2002; Hendee & Dawson 2002; Wardell & Moore 2004). The assessment of the local infrastructure leads to very useful conclusions about the quality of the experience the visitors receive (Cessford & Muhar 2003), as it defines the future of the area. Conclusions regarding the visitors’ views can be used for the effective management of protected areas and services, for infrastructure improvement and to enhance administrative operations (Andrea et al 2012a). In addition, according to Rolston (2002), the natural beauty of a specific area is closely affiliated with a sense of duty, which affects the visitors’ psychology, to preserve the area in question. Thereby, visitors’ attitudes play a crucial role regarding management plans both for protection and sustainable development purposes.

At present, managers are facing a great challenge in the effort to balance ecological preservation with recreational use (Cole & Daniel 2003). As Watson et al. (2000) underline, the development and implementation of such strategic plans should focus on research regarding visitor attributes, e.g. their needs, preferences and time and space distribution in a specific area (Eagles 2002; Hendee & Dawson 2002).

In cases where there are several protected areas in close proximity, it is possible to promote a developmental perspective based on their interaction and attractiveness to tourists. In such cases, the main goal should be the development of all the protected areas in question, in a way that reinforces the benefits of the connection between them. It is also important for a cooperation framework to be formed amongst the various stakeholder groups (Andrea et al 2012b). The work of the various interest groups, who participate in the decision-making processes for Protected Areas, should focus on supporting and guiding the businesses involved in tourism, with the aim of developing and improving the local tourism infrastructure (Andrea et al 2012a).

2. STUDY AREA

The research area includes the National Park of Dadia – Lefkimi – Soufli and the National Park of the Evros Delta. Two management bodies have been established for both National Parks respectively, while the research areas administratively belong to the Region of Eastern Macedonia and Thrace.

The National Park of Dadia is one of the most important habitats in Europe, and has been officially characterised through JMD 35633 OGG D’911/13-10-2006, as the “National Park of Dadia – Lefkimi – Soufli Forests”. It is one of the country’s areas managed in the most integrated manner. The forest of Dadia is the only habitat in Greece that is a breeding ground for the Black Vulture (Aegypius monachus) (Vlachos et al 1999; Skartsi 2002), which is a rare bird of prey, that is globally in danger of extinction (Collar et al 1994; Poirazidis 2004). In addition, the National Park of Dadia is included in the Greek catalogue NATURA 2000. The total size of the area included in the NATURA 2000 network is 43,000 hectares, which, according to the Joint Ministerial Decision of 1980, encompass two strictly protected areas (7,290 hectares).

The National Park of Evros Delta is an ecosystem of great international value, located in the southeastern part of Evros Prefecture. Evros River is the second longest river in Eastern Europe and the longest in the Balkans, creating a natural border between Greece, Bulgaria and Turkey. The Evros Delta Wetlands are included in the Ramsar Convention list, due to the important species that take shelter there. Moreover, part of the Delta has been characterised as a Special Protection Area (SPA) and has also been recommended as a Site of Community Interest (SCI) in the Natura 2000 Network. The total size of the area is 500,000 hectares, 100,000 of which belong to Turkey. The National Park
of the Evros Delta is home to rare species of flora and fauna. It is also an area of immense interest regarding ornithological issues, as it is the habitat of many endangered species of birds which face a very high risk of extinction (Evros Delta).

In the region of Evros Prefecture, where the two Parks are located, alternative forms of tourism have been developed which involve related activities and cover a broad range of visitor preferences. They include therapeutic tourism in two parts of the Prefecture, namely at the thermal springs of Traianoupolis and Samothrace, climbing tourism in Samothrace, religious tourism in Ferres, Didymoteicho and Dadia, ecotourism at the Evros Delta and Dadia Forest, congress tourism in Alexandroupoli, hiking and nature trail tourism at Dadia forest, school tourism at the Environmental Education Centre in Soufli, agro-tourism in the broader Evros area, hunting tourism, adventure tourism with activities such as canoeing on Tychero Lake, cycling along the Makri-Mesimvria-Maroneia waterfront route, as well as cycle rides at the Evros Delta and at the Ecotourism Centre in Dadia; finally, boat trips are also organized along Evros river to the Evros Delta, as well as bird-watching at Dadia Forest (Evros Prefecture).

2. RESEARCH METHODOLOGY

Two independent studies were conducted within the framework of this research. The first involved the visitors of Dadia National Forest and the second was addressed at the visitors of Evros Delta National Park. The research was conducted through face-to-face interviews. The lack of and inability to create a framework for the visitors before beginning the sampling, led us to choose the cluster sampling method (Damianou 1999; Siardos 1999; Kalamatianou 2000; Matis 2001). In cluster sampling, only one list of groups-clusters is required, along with the data from the selected clusters (Benos 1991; Farmakis 1992; Tryfos 1996; Charisis & Kiochos 1997; Filias et al 2000). The division of the population into clusters leads to reduced sampling costs (Farmakis 1992). The selected clusters were the weekends of the year during which the research was conducted (Matsiori 2001), which was the year 2010. In order to implement this method, the population is divided into N clusters (52 weekends), of which we take a random sample of n clusters. From these, we collect observations coming from all units of the selected clusters. The estimation of the population proportion and the standard error \( s_p \) are given by the cluster sampling formulae. Prior to the final sampling, pre-sampling was carried out on five selected clusters. The pre-sampling data was used to calculate the size of the final sample (no of clusters), with \( d = 0.07 \) for probability \( (1-\alpha) = 95\% \) (therefore, a corresponding value \( z_{0.025} = 1.96 \)). The maximum sample size was calculated as being 16 clusters (weekends) for visitors to Dadia. In this way, the most frequently changing variable is estimated to the desired accuracy, while the others are estimated with a greater accuracy than initially defined (Matis 2001).

In both studies, all the questions which concern the assessment of tourism infrastructure constitute a polythematic variable, related to the reliability analysis. More specifically, Cronbach’s \( \alpha \) reliability coefficient is used to identify the internal reliability of a questionnaire (Frangos 2004), i.e. if the data has the tendency to measure the same thing (Howitt & Gramer 2003). An \( \alpha \) coefficient that is equal to or higher than 0.70 is considered satisfactory (Howitt & Gramer 2003); when it is higher than 0.80 it is considered very satisfactory, but very often, in practice, lower reliability coefficients are accepted, with values up to 0.60 (Siardos 1999).

Any test must be reliable in order to be useful. However, reliability does not suffice, it should also be valid, and this is checked through factor analysis (Siardos 1999). Factor analysis is a statistical method which aims to identify the existence of factors which are common within a group of variables (Sharma 1996). Moreover, the former analysis attempts to interpret structure rather than variability (Djoufras & Karlis 2001). The selection of the number of factors is a dynamic process, which presupposes the
evaluation of the model in a repeating fashion. More specifically, we can use Kaiser’s Rule, the variance percentage that can be explained or the screen plot (Karlis 2005).

3. RESULTS AND DISCUSSION

The views of Dadia visitors regarding tourism infrastructure in the broader region of Evros are presented in Table 1. In particular, we observe that the visitors consider the hotel facilities satisfactory (19.1% regard them as very good, while 34.5% as good); their evaluation of the catering areas is also quite similar (14.4% regard them as very good, while 37.5% as good). Their views are more positive regarding the National Parks, the road network and the beaches, since over half the respondents regard them as good or very good. On the other hand, they assess the public transport as marginally satisfactory (30.7% regard it as good, while 16.4% as average) and the recreation facilities also (30.2% regard them as good, while 17.4% as average), which means that in the visitors’ opinion they need to be improved.

Similarly, the views of visitors to the Evros Delta concerning tourism infrastructure in the broader Evros region are shown in Table 2. The visitors’ views are relatively positive concerning the hotel facilities (14.6% very good, 37% good), catering areas (10.1% very good, 43.6% good), the road network (20.9% very good, 32.5% good) and the beaches (16.4% very good, 30.5% good), since over half of them consider the above mentioned infrastructure to be good or very good. The visitors appear marginally satisfied with the public transport (25.9% regard it as good, while 18.1% as average) and the recreation facilities (31.7% regard them as good, while 20.4% as average). Finally, they seem to be more satisfied with the National Parks, as approximately six out of ten grade them as being good or very good (25.4% very good, 36% good).

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Very good</th>
<th>Good</th>
<th>Average</th>
<th>Bad</th>
<th>Very bad</th>
<th>No answer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p%</td>
<td>s_p</td>
<td>p%</td>
<td>s_p</td>
<td>p%</td>
<td>s_p</td>
</tr>
<tr>
<td>Road network</td>
<td>20.9</td>
<td>0.0211</td>
<td>32.5</td>
<td>0.0246</td>
<td>17.4</td>
<td>0.0118</td>
</tr>
<tr>
<td>Public transport</td>
<td>7.8</td>
<td>0.0137</td>
<td>25.9</td>
<td>0.0253</td>
<td>18.1</td>
<td>0.0161</td>
</tr>
<tr>
<td>Hotel facilities</td>
<td>14.6</td>
<td>0.0209</td>
<td>37.0</td>
<td>0.0341</td>
<td>17.9</td>
<td>0.0210</td>
</tr>
<tr>
<td>Catering areas</td>
<td>10.0</td>
<td>0.0127</td>
<td>43.6</td>
<td>0.0346</td>
<td>15.1</td>
<td>0.0144</td>
</tr>
<tr>
<td>Recreation facilities</td>
<td>7.3</td>
<td>0.0131</td>
<td>31.7</td>
<td>0.0303</td>
<td>20.4</td>
<td>0.0168</td>
</tr>
<tr>
<td>National Parks</td>
<td>25.4</td>
<td>0.0234</td>
<td>36.0</td>
<td>0.0177</td>
<td>10.1</td>
<td>0.0149</td>
</tr>
<tr>
<td>Beaches</td>
<td>16.4</td>
<td>0.0205</td>
<td>30.5</td>
<td>0.0275</td>
<td>18.9</td>
<td>0.0184</td>
</tr>
</tbody>
</table>

Table 1. The views of Dadia visitors on the local tourism infrastructure.
After completing all the necessary checks, we used reliability analysis with the above questions. The value of the α reliability coefficient is 0.850 for the data pertaining to the Dadia visitors and 0.861 for the data pertaining to the visitors of the Evros Delta. This is a strong indication of the fact that the degrees of scale are logically consistent, i.e. the data from the two studies has the tendency to measure the same thing. In fact, this is also supported by the significantly high partial alpha reliability coefficients after the deletion of any infrastructure type, since no increase of the reliability coefficient is observed even in that case.

Also, before proceeding with the application of factor analysis, we conducted all necessary checks. The value of the Keiser-Meyer-Olkin indicator is 0.830 and 0.822, for the visitors to Dadia and the Delta respectively. It is suggested that the KMO indicator should be higher than 0.80 but values higher than 0.60 are also acceptable (Sharma 1996). Also, Bartlett’s test of sphericity rejects the null hypothesis that the correlation table is unitary and that the partial correlation coefficients are low. Furthermore, the fact that the measures of sampling adequacy (MSA) have high to very high values, supports the view that the factor analysis model is acceptable.

After the application of factor analysis and in order to examine the existence of common factors in the infrastructure as a whole, two factors were extracted from both studies (eigenvalue higher than 1). Table 3 provides the loadings, which are the partial correlation coefficients of the seven variables with each of the two factors that have emerged from the analysis. The higher the loading of a variable to a factor, the more this factor is responsible for the total variance of values in the variable under study. The variables which “belong” to each factor are those for which the loading (columns 1 and 2) is higher than 0.5 for that factor (Frangos 2004).

For the Dadia visitors, the first factor includes the following variables: beaches, road network and public transport system, and can be termed “accessibility of the destination”. The second factor includes the variables: hotel facilities, catering areas, recreation facilities and National Parks, and can be termed “recreation at the destination”. It is obvious that Dadia visitors make a distinction, regarding the quality of their experience, between the accessibility of the beaches, which is a characteristic of mass tourism, and the recreation opportunities when visiting the National Parks, which seem to be the motivation for their journey. It should also be noted that Dadia area is located far from the seaside, which means that the transportation system is a prerequisite in order to reach any beaches.

Table 2. The views of Delta visitors on the local tourism infrastructure

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Very good</th>
<th>Good</th>
<th>Average</th>
<th>Bad</th>
<th>Very bad</th>
<th>No answer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p% s_p</td>
<td>p% s_p</td>
<td>p% s_p</td>
<td>p% s_p</td>
<td>p% s_p</td>
<td>p% s_p</td>
</tr>
<tr>
<td>Road network</td>
<td>21.4 0.0166</td>
<td>34.3 0.0173</td>
<td>15.1 0.0155</td>
<td>7.1 0.0099</td>
<td>3.8 0.0105</td>
<td>18.4 0.0133</td>
</tr>
<tr>
<td>Public transport</td>
<td>11.8 0.0166</td>
<td>30.7 0.0171</td>
<td>16.4 0.0238</td>
<td>1.5 0.0050</td>
<td>3.8 0.0120</td>
<td>35.8 0.0189</td>
</tr>
<tr>
<td>Hotel facilities</td>
<td>19.1 0.0177</td>
<td>34.5 0.242</td>
<td>13.4 0.0113</td>
<td>2.0 0.0052</td>
<td>3.8 0.0120</td>
<td>35.8 0.0189</td>
</tr>
<tr>
<td>Catering areas</td>
<td>14.4 0.0162</td>
<td>37.5 0.0258</td>
<td>11.6 0.0153</td>
<td>1.8 0.0061</td>
<td>0.3 0.0021</td>
<td>34.5 0.0203</td>
</tr>
<tr>
<td>Recreation facilities</td>
<td>9.8 0.0119</td>
<td>30.2 0.0191</td>
<td>17.4 0.0130</td>
<td>2.3 0.0064</td>
<td>0.5 0.0028</td>
<td>39.8 0.0234</td>
</tr>
<tr>
<td>National Parks</td>
<td>25.4 0.0196</td>
<td>32.7 0.0138</td>
<td>11.8 0.0148</td>
<td>2.5 0.0063</td>
<td>2.5 0.0059</td>
<td>33.5 0.0208</td>
</tr>
<tr>
<td>Beaches</td>
<td>11.8 0.0172</td>
<td>32.2 0.0169</td>
<td>19.6 0.0187</td>
<td>2.5 0.0059</td>
<td>0.3 0.0021</td>
<td>33.5 0.0208</td>
</tr>
</tbody>
</table>
Variable | After rotation (Dadia) | After rotation (Delta)
---|---|---
Road network | 0.203 | 0.899 | 0.874 | 0.222
Public transport | 0.347 | 0.811 | 0.892 | 0.147
Hotel facilities | 0.720 | 0.375 | 0.617 | 0.438
Catering areas | 0.856 | 0.179 | 0.379 | 0.705
Recreation facilities | 0.801 | 0.295 | 0.270 | 0.852
National parks | 0.614 | 0.338 | 0.525 | 0.475
Beaches | 0.418 | 0.543 | 0.108 | 0.805

Table 3. Table with factor loadings after rotation

For Delta visitors there is a differentiation in the two factors. The first one includes the following variables: road network, public transport system, hotel facilities and National Parks, and can be termed “recreation infrastructure”. The second factor includes the variables: catering areas, recreation facilities and beaches and can be termed “mass tourism infrastructure”. Delta visitors relate the term accessibility to the National Parks, potentially due to the fact that in order to reach the Delta they have to get an entry permit from the Management Body (MB), and the trip along the river requires the presence of a specialist eco-guide from the MB. The role of tour-guides is an important one, according to Weiler & Ham (2001), since they can encourage pro-environmental behaviour and therefore have a significant impact on the visitors’ experience. Moreover, the Delta is located at close proximity to the coast (Thracian Sea). Thus, managers can exploit this advantage and use the beaches, which are a feature of mass tourism, in order to promote sustainable tourism at the National Park of the Evros Delta.

In a relevant study, conducted in the same region addressing local people of both areas, the residents’ opinion is that the infrastructure, which can be directly affected by the local community through its activities, such as hotel facilities, catering areas, recreation facilities, National Parks and beaches, is acceptable, even though there is room for improvement. On the other hand, the road network and public transport system, which are factors dependent on the actions and decisions of the regional authorities and government, are regarded as insufficient (Andrea et al 2012a). As Tampakis et al. (2012) note, local people are those who are better aware of the problems of their region than any other party, since they have to deal with them on a daily basis. This is why their judgment of the quality of the infrastructure is stricter.

4. CONCLUSIONS

National Parks and protected areas can serve as a useful tool for the economic development of adjacent communities (Good 2000; Walpole & Goodwin 2001; Lai & Nepal 2006; Mayer et al 2010). This also seems to be the case for both National Parks of Evros Prefecture, as most of the visitors to Dadia and the Evros Delta view the National Parks under a positive light. In addition, most of the visitors have a good opinion of the local beaches too, a characteristic of mass tourism. According to
Reihanian et al. (2012), in order to pursue effective management in protected areas, it is useful to combine a form of mass tourism, such as beach tourism, with ecotourism, especially when the relevant areas favour such a combination.

Nevertheless, a significant percentage of the respondents consider the public transport and recreation facilities to be insufficient in both cases. This observation leads to the conclusion that in order to enhance the quality of the visitors’ experience, improvements to the infrastructure are required. Any strategic plans focused on this objective, should also involve local entrepreneurs providing goods and services affiliated with tourism, as well as the regional and central authorities who are responsible for improving the above-mentioned infrastructure. The visitors’ views, concerning the goods and services provided in such areas, can constitute a source of information for decision-makers and managers, and ensure that any effective management plans will incorporate essential improvements related to the areas’ recreational and tourism-related functions (Juutinen et al 2011). Another important observation is that the accessibility of a National Park or recreation area in general is the main parameter which influences visitors, when choosing a specific type of excursion. Furthermore, the public transport available and the road network are elements that define the quality of the journey, while the available options and ease of accessibility to a specific area determine what means of transport will be used. The latter along with the road network are elements that determine the quality of any trip (Andrea et al 2011).

To conclude, the traveler’s experience appears to be divided into two elements, the first concerning accessibility and the second concerning recreation. For visitors to Dadia, there is a connection between recreation and National Parks, which means that the incentive for their trip is the visit to the National Park itself. However, there is a differentiation in the way visitors to the Delta classify National Parks, since they seem to associate National Parks with the element of accessibility. This can be explained by the fact that visitors to the Delta have to take part in a scheduled trip along the river, which must be supervised by the MB. The way in which visitors rate their satisfaction is a complex process influenced by internal and external factors. Nevertheless, approaches which aim at an understanding of the destination and service attributes that enhance tourist satisfaction can provide useful data for an effective re-planning of the whole experience (Coghlan 2012).

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REFERENCES


Eagles, P.F.J. 2002. Tourism use measurement and reporting in parks and protected areas. Parks, vol. 12, pp. 3-10


WEBITES
ADMINISTRATIVE BODIES AND EFFECTIVE MANAGEMENT
OF EVROS DELTA NATIONAL PARK, GREECE: STAKEHOLDERS VIEWS

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Abstract

The management effectiveness of protected areas is linked to the type and form of administration used in each country, within the framework of its environmental policy implemented. The stakeholders involved in the administration and management of the National Park, namely the Management Body, the Municipality of Alexandroupolis and the Regional Authorities of Evros Prefecture, as well as the local residents and visitors, were asked about the effectiveness of the administration and management of the Evros Delta National Park. The development endeavours of the broader area were also examined. Simple random sampling and cluster sampling were applied for the locals and the visitors respectively and the statistical package SPSS was used for the data analysis. The results of the study indicate that although the visitors are quite satisfied from their experience, there are weaknesses affecting the collaboration processes between the administrative bodies of the Park. The locals are neither satisfied with the quality of life nor well informed about issues concerning the Park and there are problems that the Management Body faces, such as irregular funding and personnel deficiencies that influence management effectiveness.

Key words: Administration, management, stakeholders, National Park of Evros Delta, environmental policy, participatory management.

1. INTRODUCTION

The protection of the natural environment is a mandate, ensured among other environmental policy strategies, with the establishment of protected areas (Pietzyk - Kaszyńska et al 2012). Due to the fact that adjacent communities are highly dependent on natural resources (Dzerefos and Witkowski 2001; An et al 2002; Pote et al 2006) controversies invoke in the balance between development and protection (Maikhuri et al 2000; Oltremari and Jackson 2006). On the other hand, protected areas designation constitutes an ambiguous ground for sustainable development (Pinton 2008; Bryan 2012). Thus their existence entails the opportunities such as offering tourist attractions for visitors (Boyd and Hall 2005; Saarinen 2001) and motivations for local people to adopt an environmental-friendly and responsible behavior (Skanavis and Sakellari 2012), within the scope of sustainable development (Andrea et al 2012a). Whilst, as Nepal (2002) underscores, the main reason for conflicts between stakeholders in the management of protected areas is closely affiliated with lack of locals’ participation and their exclusion from planning, management and decision – making processes.

The pivotal challenge for natural resource managers focuses on the balancing endeavours in order to comprise public acceptance on decision – making, to operate multiple stakes and technically complex issues (Sayce et al 2012), within a dissention and distrust environment (Jasanoff 2005). Towards this direction, Reed (2008) addresses flexible and transparent decision – making procedures, as a key tool to confront such challenges, involving as well stakeholders’ participation. Traditionally public participation was regarded as one-way dialogue between stakeholders and decision – makers (Innes
and Booher 2004), although this approach did not offer the public the opportunity to influence policy decision and their implementation (Sayce at al 2012).

Environmental legislation in many countries worldwide, has incorporated public’s involvement and access to policy information (Buchy and Race 2001; Nylen 2002; Creighton 2005). This evolves a new model for stakeholder participation in a two – way interaction patterns between managers and stakeholders, in order to increase the decision quality (Abelson et al 2003; Daley 2007) so that strategic plans keep up with local interests (Innes and Booher 2004). The allocation of social benefits in a fairly way, understanding of the unique characteristics of a region and the local communities, involving stakeholders in decision – making and new participation strategies, are some of the valuable tools according to Sayce et al. (2012) to address effective management of protected areas.

Thus, administrative bodies of protected areas should adopt these guidelines so as conflicts be alleviated and management become more efficient. The administration of National Parks and protected areas includes regional authorities, management bodies and competent ministries, as well as academic institutions or environment non-governmental organisations (Thompson 2005; Lockwood 2010; Mauerhofer 2011). Collaboration between them and initiative formation for stakeholder participation should be their blueprint for governance. Moreover as Pulina and Meleddu (2012) state, legislative mandate, political will and adequate capacity for regular funding are some of the main factors able to promote successful management of protected areas.

The aim of this paper is to present the existing situation and address the problems of the administrative bodies of the National Park of Evros Delta, Greece and the stakeholders’ opinions and views, as a starting point for the improvement of management effectiveness and the promotion of the area.

2. RESEARCH AREA

The research area is the National Park of Evros Delta, Greece, an ecosystem with a great environmental value, located in the southeast of Evros Prefecture. Evros River is the second longest river of East Europe and the longest in the Balkans, defining the natural border between Greece, Bulgaria and Turkey. The Evros Delta Wetland is listed in the Ramsar Convention list due to the important bird species that reside in it. Moreover part of the Delta is being characterised as Special Protected Area (SPA) and is recommended as Site of Community Interest (SCI) in the Natura 2000 Network. The total size of the area is 500.000 hectares, while 100.000 of them belong to Turkey. Phytogeographical interest is of great importance, as it homes species that are rare in Greece. The area is also of pivotal interest on ornithological issues as it is a biotope for many rare or endangered species, such as Phalacrocorax aristotelis, Phoenicopterus ruber, Aquila heliaca, Aquila chrysaetos, Cygnus bewickii, Cygnus Cygnus and others. Overall, 28 amphibian and reptile, 40 mammal and 46 marine species are encountered in the area (www.evros-delta.gr). The establishment of the National Park affects approximately 10.000 local residents of the gateway communities (Ferres, Monastiraki, Loutros Village and others), that administratively belong to the Municipality of Alexandroupolis. The locals’ main occupation is agriculture and public services staffing (Jones, et al 2012).

3. RESEARCH METHODOLOGY

The present research was conducted using a structured questionnaire addressed to residents and visitors of the National Park of Evros Delta. Simple random sampling was used with the residents, due to its simplicity and the fact that it requires the least possible knowledge of the population compared to any other method (Damianou 1999; Kalamatianou 2000; Matis 2001); the sampling framework used were the municipal rolls. The estimation of the population proportion and the standard error \( s_p \), are given by the formulae of simple random sampling. In order to calculate the size of the sample, pre-
sampling was required on a sample size of 50 people. The sample size was estimated for each variable, based on the formulae of simple random sampling for probability \((1-\alpha) 100=95\%\), \(e = 0.05\) (Pagano and Gauvreau 2000; Kalamatianou 2000 Matis 2001).

The lack of and difficulty to create a framework for the visitors before sampling, led to the use of cluster sampling method (Siardos 1999; Damianou 1999; Kalamatianou 2000; Matis 2001). In cluster sampling, only one list of groups-clusters is required, along with the data from the selected clusters (Benos 1991; Farmakis 1992; Tryfos 1996; Charissis and Kiochos 1997; Filias et al 2000). The division of the population into clusters leads to reduced sampling costs (Farmakis, 1992). The selected clusters were the weekends of the year during which the research was conducted (Matsiori 2001), which was the year 2010. In order to implement this method, the population is divided into \(N\) clusters (52 weekends), of which we take a random sample of \(n\) clusters. From these, we collect observations coming from all units of the selected clusters. The estimation of the population proportion and the standard error \(s_p\), are given by the cluster sampling formulae. Prior to the final sampling, pre-sampling was carried out on five selected clusters. The pre-sampling data was used to calculate the size of the final sample (no of clusters), with \(d=0.07\) for a probability \((1-\alpha) = 95\%\) (therefore, a corresponding value \(z_{\alpha/2} = z_{0.025} = 1.96\)). The maximum sample size was calculated as being 16 clusters (weekends) for visitors of Delta. In this way, the most frequently changing variable is estimated to the desired accuracy, while the others are estimated with a greater accuracy than initially defined (Matis 2001).

Visitors of the National Park were asked about their motivation and reasons for visiting the National Park, their satisfaction from the visit, their intention to encourage others to make the same visit, who they consider responsible for applying the protection status, whether they intend to visit the neighboring National Park of the Dadia-Leukimi-Soufli, and the reasons for which they do not aim to do so.

The local residents were asked their views concerning their satisfaction with their quality of life, the level of information they receive on National Park issues, whether it is possible for them to take part in the relevant decision-making processes, who they consider responsible for applying the protection status, and whether they are satisfied with its application, their satisfaction with the promotion of the area’s historical and cultural heritage, and with the promotion of the National Park of their region by the Local and Central Administration, and the effect of the neighboring National Park of the Dadia-Leukimi-Soufli; they were also asked to evaluate the subsidies provided by the Central Administration and the way they are used, and to state their views on the valorization of investments by various groups of people. Also examined were the views of the MB, the Local Authorities and the Regional Authorities, through face-to-face interviews and using a non-structured questionnaire, regarding the management problems of the National Park and its promotion, its interaction with the neighbouring National Park of the Dadia-Leukimi-Soufli and the development of the broader area. More specifically, those interviewed were the Deputy Regional Head of Evros Prefecture, representing the Regional Authorities, the Mayor of Alexandroupolis, representing the Municipality, and the Responsible for the supervision, protection and managerial operations officer of the MB of Evros delta representing the latter.

The data for the local residents and visitors were collected in 2010, and its analysis was carried out using the statistical package SPSS. The collection of the data for the MB, the Municipality and the Regional Authorities was conducted in 2011.
4. RESULTS

4.1. The Visitors’ views

Those visiting the Evros Delta National Park (Table 1) are mainly women (55.4%), over 50 years (46.9%), university (41.3%) or Upper Secondary School graduates (22.7%), married (72.5%), with two children (38.3%, \(s_p=0.0190\)), pensioners (25.4%) and civil servants (19.6%), who do not have any connection with Evros (83.1%), and come from other parts of Greece (61%); the majority are visiting Evros Delta for the first time (87.9%, \(s_p=0.011\)), on a trip lasting more than one day (61.3%).

<table>
<thead>
<tr>
<th>1. Gender</th>
<th>Male</th>
<th>Female</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>44.3% ((s_p=0.0261))</td>
<td>55.4% ((s_p=0.0261))</td>
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<th>&gt;50</th>
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<tr>
<td></td>
<td>11.8% ((s_p=0.0181))</td>
<td>16.4% ((s_p=0.0241))</td>
<td>21.9% ((s_p=0.0201))</td>
<td>46.9% ((s_p=0.0340))</td>
<td>3.0% ((s_p=0.0062))</td>
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<thead>
<tr>
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<th>married</th>
<th>divorced or widowed</th>
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<tr>
<td></td>
<td>20.9% ((s_p=0.0322))</td>
<td>72.5% ((s_p=0.0319))</td>
<td>4.8% ((s_p=0.0071))</td>
<td>1.8% ((s_p=0.0072))</td>
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<th>three children</th>
<th>more than three children</th>
<th>no answer</th>
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<td>24.2% ((s_p=0.0293))</td>
<td>8.3% ((s_p=0.0160))</td>
<td>38.3% ((s_p=0.0190))</td>
<td>11.6% ((s_p=0.0180))</td>
<td>3.5% ((s_p=0.0084))</td>
<td>14.4% ((s_p=0.0114))</td>
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<tbody>
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<td></td>
<td>13.1% ((s_p=0.0150))</td>
<td>9.3% ((s_p=0.0122))</td>
<td>4.5% ((s_p=0.0099))</td>
<td>22.7% ((s_p=0.0225))</td>
<td>6.3% ((s_p=0.0068))</td>
<td>41.3% ((s_p=0.0334))</td>
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<th>public servants</th>
<th>self-employed</th>
<th>students</th>
<th>pensioners</th>
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<tbody>
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<td>14.9% ((s_p=0.0145))</td>
<td>19.6% ((s_p=0.0245))</td>
<td>16.9% ((s_p=0.0184))</td>
<td>3.8% ((s_p=0.0077))</td>
<td>25.4% ((s_p=0.0332))</td>
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<th>7. Affiliation with Evros</th>
<th>Indigenous</th>
<th>Foreigner</th>
<th>Spouse form Evros</th>
<th>no answer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12.3% ((s_p=0.0152))</td>
<td>83.1% ((s_p=0.0161))</td>
<td>2.3% ((s_p=0.0051))</td>
<td>2.3% ((s_p=0.0060))</td>
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<tr>
<th>8. Permanent Residence</th>
<th>Evros</th>
<th>Thrace</th>
<th>Macedonia</th>
<th>Other parts of Greece</th>
<th>Abroad</th>
<th>no answer</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>8.3% ((s_p=0.0150))</td>
<td>0.8% ((s_p=0.0035))</td>
<td>14.9% ((s_p=0.0288))</td>
<td>61.0% ((s_p=0.0409))</td>
<td>3.0% ((s_p=0.0093))</td>
<td>12.1% ((s_p=0.0214))</td>
</tr>
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</table>

9. Visitation Frequency
The results show that visitors of Delta seem to be satisfied from their visit to the National Park (Figure 1). More specifically, 72.3% of visitors state that they are fully and very satisfied, 16.6% are satisfied, while 3.8% are less to not at all satisfied and 7.3% of visitors did not answer the question.

![Figure 1. Visitors’ satisfaction from their visit to the National Park of Evros Delta](image)

Table 1. Socio-demographic profile the visitors of The National Park of Evros Delta

<table>
<thead>
<tr>
<th>First Time</th>
<th>Second Time</th>
<th>Many Times</th>
<th>no answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>87.9% (s_p=0.0111)</td>
<td>8.1% (s_p=0.0125)</td>
<td>2.5% (s_p=0.0052)</td>
<td>1.5% (s_p=0.0054)</td>
</tr>
</tbody>
</table>

10. Trip Duration

<table>
<thead>
<tr>
<th>Few Hours</th>
<th>One Day</th>
<th>More than one day</th>
<th>no answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.4% (s_p=0.0208)</td>
<td>17.1% (s_p=0.0216)</td>
<td>61.2% (s_p=0.0278)</td>
<td>1.3% (s_p=0.0040)</td>
</tr>
</tbody>
</table>

The visitors’ satisfaction from their visit to the National Park can also be seen in their intention to encourage others to visit the National Park of Evros Delta; in fact, 88.2% intend to do so (s_p=0.0178), while only 0.5% (s_p=0.0029) of visitors do not. The question was not answered by 11.3% (s_p=0.0181) of visitors.

Visitors consider the body responsible for applying the protection status to be mainly the Local Authorities (51.1%, s_p=0.0182), and the Management Body (50.1%); they are potentially not aware of the latter’s competencies regarding the management of the National Park. Furthermore, a small number equal to 25.4% believe the competent body is the Forest Service, 29.2% the Central Administration, 20.2% the local residents, 10.8% the visitors themselves, 14.9% the volunteers and 3.5% some other body (Figure 2).
Regarding the reason for their visit, about four out of ten (39.3%) of the visitors of Evros Delta were encouraged by friends or acquaintances to visit the region for the first time, 9.8% by the TV or radio, 13.1% by advertising leaflets, 5.5% by the Internet, 12.1% by the Press or books, and approximately three out of ten (28.7%) by other factors (Figure 3). There is a significant percentage concerning the last variable. The visitors selecting this category are motivated to visit the National Park mainly by various clubs they are members, in the grounds of an organized trip.

The main purpose of their visit, according to about half of them, was for entertainment or recreation (50.9%), while approximately four out of ten (44.6%) cited wildlife observation as the reason. Fishing or hunting, educational reasons, hiking, or other activities, such as photography, video making or painting and other purposes follow with lower percentages (Figure 4).
In an effort to examine possible synergy or competition that exists between the National Park of Evros Delta and the National Park of Dadia, visitors of Evros Delta were asked to state their intention to visit Dadia. The National Park of Dadia is one of the most important habitats for the Black Vulture (Aegypius monachus) (Vlachos et al., 1999; Skartsi, 2002) in Europe, a rare bird of prey, that is globally in danger of extinction (Collar et al., 1994; Poirazidis, 2004). The National Park of Dadia – Lefkimi – Soufli Forest is one of the country’s areas subjected to integrated management and is included in the Greek NATURA 2000 catalogue. The National Park of Dadia is only a few kilometers far from the National Park of Evros Delta. The visitors of Evros Delta who intended to visit the National Park of Dadia during the same trip amounted to 46.6% (s_p=0.0248), 22.4% said they would make a future visit (s_p=0.0225), while 16.6% (s_p=0.0116) had already visited the Delta in the past. The question was not answered by 14.4% (s_p=0.0181).

The Agrotourism Women’s Cooperative of Dadia “Gerakina” manages a recreation area, which is located at a distance of 9 km from Dadia village, in a forest-covered expanse of land covering 74 hectares in the heart of the forest. There is a café and restaurant, where visitors can sample local traditional food and sweets. Only 26.7% (s_p=0.0232) of the visitors intend to visit this recreation area, while 35.5% (s_p=0.0163) do not aim to visit it, which shows that the visitors’ interest is mainly focused on knowing better the region’s natural beauty and cultural identity. In addition, 37.8% (s_p=0.0270) of the Delta visitors did not answer the question, which potentially means that they were not informed about the existence of a recreation area by the Information Centre, which is run by the Management Body of Dadia. Moreover, the reasons mentioned by Delta visitors for which they did not visit or do not intend to visit the National Park of Dadia are: lack of time –22.2% (s_p=0.0203), insufficient information –7.6% (s_p=0.0127), distance –5.3% (s_p=0.0093), cost of trip –1% (s_p=0.0038), lack of interest –1.8% (s_p=0.0070), other reasons –1.3% (s_p=0.0040).

4.2 The Residents’ Views

The residents of Evros Delta are mainly women (51.2%), between 31-40 years of age (26.8%), Upper Secondary School graduates (34.8%), married (69.1%) with two children (42.9%), mainly businessmen (26.2%), and civil servants (19.7%) (Table 2).
Table 2. Socio-demographic profile of the locals of the National Pak or Evros Delta.

As regards their satisfaction with their quality of life, only 3.6% are fully satisfied, while 7.3% say they are very satisfied, 36.4% are satisfied, and approximately half of them less to not at all satisfied with their quality of life (Figure 5).
Regarding the application of the protection status, 24.4% of Evros Delta residents say they are not at all satisfied, 41.8% are less satisfied, 23.1% (s_p=0.0215) satisfied, 2.1% very satisfied and 2.1% fully satisfied with the protection status of Evros Delta (Figure 6).

The population of Evros Delta seem to mainly consider the Local Authorities responsible for the application of the protection status, at a percentage of 68.3%, while 23.6% opted for the Management Body, 27.3% the Forest Service, 28.1% the local residents, 22.6% the Government, 9.6% the volunteers, 6% visitors and 2.9% someone else (Figure 7).

Furthermore, the residents express their dissatisfaction with the level of information provided on issues related to the National Park in their local region, since 56.6% consider the level of information to be very low (s_p=0.0253), 35.3% consider it to be low (s_p=0.0244), 5.2% high (s_p=0.0113) and 1.8% very high (s_p=0.0068). The lack of information given to residents is directly related to their non-participation in the decision-making processes that concern the National Park in their area. The level of participation of Evros Delta locals in the decisions regarding the National Park is considered to be very low by 69.6% (s_p=0.0235), 21% consider it low (s_p=0.0208), 5.7% high (s_p=0.0118) and 1.6% very high (s_p=0.0063).
Regarding the promotion of the National Park by the Municipality, only 3.6% (sp=0.0096) state that they are fully satisfied, 6.5% (sp=0.0126) are very satisfied, while 38.2% (sp=0.0248) are simply satisfied; about three out of ten (sp=0.0242) are less satisfied by the promotion undertaken through an initiative of the Municipality and 13.8% (sp=0.0176) state they are not at all satisfied. The 3.9% (sp=0.0099) of the locals did not answer the question.

Furthermore, about for out of ten (sp=0.0251) say they are less satisfied by the promotion undertaken by the Prefecture (present-day Deputy Regional Authorities), about two in ten (sp=0.0203) are satisfied, a small percentage of 6% (sp=0.0168) seem to be fully to very satisfied, while 27.3% (sp=0.0227) are not at all satisfied. The 6.2% (sp=0.0123) of the locals did not answer the question.

There is also a low level of satisfaction with the promotion carried out by the Ministry of Tourism Development, with almost three in ten (sp=0.0238) stating they are less satisfied, 9.4% (sp=0.0149) are satisfied, a relatively small number amounting to 3.9% (sp=0.0140) seem to be fully to very satisfied, while about half of them (sp=0.0255) are not at all satisfied. The 6.2 % (sp=0.0123) of the locals did not answer the question.

The situation is similar regarding their satisfaction with the promotion of the National Park by the media, with the 34.8% (sp=0.0243) being less satisfied, 16.9 % (sp=0.0191) are satisfied, 6% (sp=0.0121) very satisfied, 1.8% (sp=0.0068) fully satisfied, and about four in ten (sp=0.0247) not at all satisfied. The 3.4 % (sp=0.0092) of the locals did not answer the question.

Finally, regarding the Internet, the residents’ satisfaction is equally low, since 2.3% (sp=0.0077) state they are fully satisfied, 5.2% (sp=0.0113) are very satisfied, 25.7% (sp=0.0223) are satisfied, while about half (sp=0.0431) are less to not at all satisfied with the promotion of Evros Delta National Park. The 19 % (sp=0.0200) of the locals did not answer the question (Figure 8).
The residents are also dissatisfied with the promotion of their area’s historical and cultural assets, since only 2.6% state they are fully satisfied, 8.3% are very satisfied, and 21.6% are satisfied; similarly to the above cases, over half are less to not at all satisfied by the promotion of the local historical and cultural assets (Figure 9).

The residents’ views regarding the ineffective promotion of their region, both in relation to the existence of the protected area, and to the historical and cultural assets of the broader border region they live in, are also confirmed by their views concerning the area’s current economic growth, and their expectations for the future. More specifically, only 25.5% (s_p=0.0222) are aware that subsidies to establish new enterprises do exist, while 71.2% (s_p=0.0231) do not know whether subsidies are provided by the State for tourism development in their region. The question was not answered by 3.4% (s_p=0.0092) of the residents. Furthermore, as regards the exploitation of the area’s assets, almost six in ten (63.7%, s_p=0.0467) consider there is less to no exploitation, 14.8% (s_p=0.0181) say it is of quite a high level, 2.6% (s_p=0.0081) say it is high, and only 2.1% say it is very high (s_p=0.0073). Great part of the residents, 16.9% (s_p=0.0191) did not answer the question.
Furthermore, the attitude of most residents towards investments in the region is more positive when the latter involve the local villagers, rather than other residents of Evros region, or people from other parts of Greece or foreigners (Table 3). This goes to show the imperative need for a change in focus by the Administration, first on a local level and then nationally, regarding the inflow of investments. It is important for opportunities to arise for the development and strengthening of local businesses, as well as employment opportunities for the local population. With the help of subsidies, the necessary preconditions will be created to achieve this goal.

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th></th>
<th>Quite positive</th>
<th></th>
<th>Quite negative</th>
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<td>sp</td>
<td>p, %</td>
<td>sp</td>
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<td>sp</td>
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<td>sp</td>
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<tr>
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<td>0.0249</td>
<td>20.8</td>
<td>0.0207</td>
<td>7.0</td>
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<td>5.7</td>
<td>0.0118</td>
<td>5.5</td>
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<td>0.0253</td>
<td>23.1</td>
<td>0.0215</td>
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<td>People from other</td>
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<td>22.6</td>
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<td>9.1</td>
<td>0.0147</td>
<td>8.3</td>
<td>0.0141</td>
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<td>parts of Greece</td>
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<tr>
<td>Foreigners</td>
<td>41.3</td>
<td>0.0251</td>
<td>18.4</td>
<td>0.0198</td>
<td>11.9</td>
<td>0.0166</td>
<td>18.7</td>
<td>0.0199</td>
<td>9.6</td>
<td>0.0147</td>
</tr>
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</table>

Table 3. Locals’ views on the investors’ origin

Finally, in an effort to examine the relationship of cooperation or competition between the two National Parks in Evros Prefecture, and any other interaction that may exist, or may potentially arise in future, the residents of Evros Delta were asked their opinion regarding the effect of Dadia National Park on the National Park of Evros Delta. Of the residents, 70.1% (sp=0.0234) believe it helps with the development of their region, 9.1% (sp=0.0147) that it draws away visitors, 15.1% (sp=0.0183) that there is no interaction, and 0.8% (sp=0.0045) did not answer the question.

4.3 Views of the Management Body of Evros Delta National Park

The views of the Management Body (MB) of Evros Delta were then examined, regarding the problems faced by the Administration in the management of the National Park, its promotion and the development of the area. According to the views of the MB, there are problems affecting its operation, such as a lack of regular funding, a shortage in the required guarding staff and problems concerning its action due to the ineffective duty distribution among agencies. The latter is closely related to the involvement of the Forest Service, the Police and the Port Authority to command interventions in arising law-breaking situations. Moreover, the existent infrastructure, such as the information centre, the reception building and the administration offices, which were cracked during an earthquake, is difficult to be restored. There are also deficiencies in the existent vehicles.

Regarding the collaboration between the MB and the local residents of Evros Delta, the former mentioned that although the residents are represented in the decision-making processes regarding the National Park, via members of the Agriculture, Fishery Cooperation of Evros and the Municipality of Alexandroupolis, they seem reluctant to accept the MB’s operations. According to the MB, it can be attributed to the conflicts with the locals associated with the protection status restrictions that influence their agricultural, stock-breeding and fishery operations.

Concerning its cooperation with the other administrative bodies, the staff at the MB report that they are working for better cooperation with the Deputy Regional Head, the Forest Service, the Police and the Port Authority. Nevertheless, cooperation is hindered due to staff and vehicles deficiencies.
Moreover, the collaboration with the Municipality of Alexandroupolis presents difficulties due to the latter’s actions to serve personal political interests. Finally, there is no organized collaboration with the Dadia MB.

Regarding the National Park’s promotion through the MB of Evros Delta, this is achieved through an informative video, and by using electronic and printed promotional leaflets and brochures, wherever is possible and especially in the hotels of the area. Within the framework of their collaboration, efforts should be made with the assistance of the Municipality and the Regional Authorities, to better promote the National Park by the distribution of informative brochures and posters in the centre of Alexandroupolis city. Thus, the staff at the MB reports that the effective promotion of the National Park should be based on the better organization of the Local and Central Administration. They also argue that no efforts have been made by the Ministry of Tourism Development. Not to mention that due to the MB, a significant effort is being made by the local media and the internet to promote the National Park, covering manifestations and events held by the MB. Concerning the area’s historical and cultural assets promotion, the MB argues that is organized in more effective way, specifically regarding the churches of the area and the archeological sites of Alaxandroupolis city.

The MB believes that the future of the National Park after 2015, when it will no longer be funded by EU resources, will depend on its inclusion in national funding programs.

The views of the MB concerning the area’s development, mainly focus on the fact that the local residents are not satisfied with their quality of life due to the reduction of their primary production (mainly agriculture and fisheries), caused by the protection regulations of the National Park and there are few investments in tourism sector to support regional development.

Finally, in an effort to examine the relationship of cooperation or competition between the two National Parks of Evros Prefecture, in Dadia and Evros Delta, and any other form of interaction that may exist, or may arise in future, the MB of Evros Delta was asked to express its opinion about the intention of tourists visiting Evros Delta to also visit the neighboring National Park of Dadia. The MB believes that the most visitors of Evros Delta also visit Dadia. The fact that some Delta visitors do not include a trip to the neighboring National Park of Dadia in their itinerary, according to the MB, is mainly related to time availability.

4.4 Views of Axendroupolis Municipality

The views of Alexandroupolis Municipality, where the area of Evros Delta belongs to, were then examined, regarding the problems facing the MB, its promotion and also relating to the development of the area.

According to the Municipality, the operation of the MB is facing problems related to financial issues. According to the vice mayor, the funding resources provided for the functioning of the MB are used in an ineffective way, mainly for staff salaries and some temporal improvement requirements for the existent infrastructure.

Furthermore, the Municipality claims, that the scientific personnel is not specialized in order to serve the development perspectives of the area. The vice mayor himself suggests that an effective management of the National Park could be achieved only if undertaken by the personnel certain Municipal Departments. Moreover, according to Alexandroupolis Municipality, the incoordination within the MB and other administrative bodies and confusion of duties makes the guarding staff operations more difficult.

Regarding the infrastructure, the Municipality believes that the MB facilities are in bad condition, mainly abandoned within the boundaries of the National Park. Albeit, the Municipality in collaboration with the Regional Authorities are planning a new project comprising the construction of
a new building with contemporary technological means for fauna observation and a new Information Centre. The project also includes extra recreation services available for the National Park visitors.

As regards its collaboration with the local residents of Evros Delta and the MB, the Municipality mentions that the former do not take part in the relevant decision-making processes, due to the lack of communication between them and the MB and thus serious conflicts arise. As the Municipality claims, the MB is responsible for the situation mentioned, since their operations aim only at the protection status implementation.

Regarding the cooperation between the administrative authorities and the MB, the Municipality feels that it is in a quite good level with Regional Authorities, although it is not efficient. In relation to the visitors’ behavior, the vice mayor states that visitors are totally unaware of the MB establishment as well as its operations.

As for the promotion of the National Park by the MB, it is almost non-existent according to the Municipality, because of the lack of effort and political planning. Moreover, the Municipality argues that the ineffective promotion is also associated with the lack of government planning, in collaboration with the Regional Authorities and the Municipality in order to achieve an integrated operation. The same opinion holds regarding the areas’ historical and cultural assets promotion.

For the future of the National Park (NP) after 2015, when the funding by EU sources will stop, the vice mayor of Alexandroupolis, believes that the MB should be abolished and the management of the National Park should be assigned to the Municipality. In this way, he claims that its bureaucratic character will be eliminated and the NP management would succeed in a more sensible way.

Concerning the region’s development, the Municipality agrees that there are quite many investments and they mainly come from local people or residents of Evros Prefecture, targeting at hotels and other tourist infrastructure.

Finally, in an effort to examine the relationship of cooperation or competition between the two National Parks of Evros Prefecture, and any other interaction that may exist or develop in future, the Municipality of Alexandroupolis was asked to explain whether the interaction between the two Parks has a positive or negative effect. According to the vice mayor’s opinion, the existence of two National Parks, Dadia and the Evros Delta, functions as a driving force for the tourism development of the broader region, since both National Parks can only affect each other positively, at least as regards development. The Municipality also believes that through effective management there can be a transition from a network of protected areas to a network of development, since the diversity of the two types of habitat, the terrestrial one in Dadia and the wetlands at the Delta, offers visitors an enriched experience and an overall picture of the region’s identity.

4.5 Views of the Regional Authorities of Eastern Macedonia and Thrace

We then examined the views of the Regional Authorities of Eastern Macedonia and Thrace (RAMTH), which is the administrative region that the Evros Delta area belongs to, concerning the problems facing the MB, the promotion of the National Park and local development.

According to RAMTH, the operation of the MB is facing problems related to its funding, which depends to a large extent on EU Operational Programs (OPs), thus resulting in delayed payment of the relevant credits and huge time gaps between OPs launch and realization. There is also a shortage in the qualified scientific personnel needed for field research and in guarding and supervisory staff. The RAMTH, in order to face these problems, is operating some seasonal projects that will provide the MB with extra staff.
Regarding infrastructure, RAMTH mentions that the regional council has approved programming agreements between RAMTH and the MB Evros Delta, in order to finance the construction of a new building for the MB offices and Information Centre.

The views of RAMTH concerning the cooperation between the locals of Evros Delta and the MB are based on the fact that local people are only indirectly involved in the decision-making processes, through representatives of the major economic agents active in the area (farmers, stock-breeder, fishermen, etc.). Consequently, an effective management program must include efforts to approach the local population and inform and aware them about the issues of Evros Delta. Regarding its collaboration with other administrative bodies, such as relevant departments of the Region or Municipality, RAMTH believes that it is substantial and fruitful, and aims at the effective protection and management of the area.

Furthermore, regarding the visitors’ behavior, RAMTH states that no problems have been reported. As regards the promotion of the National Park, RAMTH states that the promotion and enhancement of the National Parks in the broader region must involve an integrated effort, adding that this role can be assumed by RAMTH. Within this framework, the latter has already arranged the participation of the four MBs representing the National Parks of Eastern Macedonia and Thrace in NEXUS – the 1st Exhibition on Alternative Forms of Tourism; it also states that its joint promotion of the 4 National Parks must continue. Furthermore, the promotion of the area’s historical and cultural assets was pursued in the past through various publications and materials prepared by the Regional Authorities, but such steps need to be better organized in the future. The construction of the museums of Alexandroupoli, Doxipara and Didymoteicho is also expected to make a major contribution to the promotion of the local culture. In addition, the promotion of the archaeological sites of Samothrace will be a major step towards promoting the historical and cultural assets of the area. This can be effectively achieved through international fairs and the Internet.

As regards the future of the National Park after 2015, when the EU financial means will come to an end, RAMTH states that discussions have already begun with the political leaders of the competent Ministry of the Environment and Climate Change and the coordinating agency of the MBs concerning their future and financing. It also adds that due to the current financial situation in Greece, the MBs must also find their own means of financing their activities.

Regarding the development of the region, according to RAMTH, those living around the National Parks have a comparative advantage, since their area has greater potential for economic growth. Nevertheless, there are only few investments for the development of the region, and they mainly come from local sources. Framework programs such as Leader, the Integrated Rural Development Programs and the Developmental law have financed some local investments. Up to now, these investments are viewed as a dynamic first step, which must continue and be supported. In general, to successfully deal with the problems regarding the effective administration and management of the National Park, it is necessary to have the cooperation of all stakeholders.

Finally, RAMTH was asked to state its opinion regarding the interaction between the National Parks of Dadia and the Evros Delta. According to RAMTH, the existence of two National Parks is a driving force for development, since it provides the broader region with a comparative advantage by offering a variety of experiences to visitors. RAMTH believes that tourism activities can be developed, and the primary sector can be re-activated in the processing and promotion of local traditional products. It also states that, all the National Parks of the whole Region of Eastern Macedonia and Thrace should function autonomously but also in cooperation with one another, so that the network of protected areas can evolve into a broader network of development.
5. DISCUSSION – CONCLUSIONS

The most visitors are satisfied from their experience in the National Park of Evros Delta, while the Regional Authorities of Eastern Macedonia share the same opinion. On the other hand the MB of the National Park argues that their visitors’ satisfaction should be improved, especially on matters concerning the areas cleanliness and accessibility. The Municipality of Alexandroupolis, albeit reckons that environmental communication between visitors and the MB should be enhanced, as the former are totally unaware of the MB’s actions and operations. As Andrea et al. (2012 b) and Coghlan (2012) note, visitors’ perceptions on the management of a protected area which has been chosen as their destination, is important information and constitutes useful data for effective management of protected areas as tourist destinations.

The enactment of a large number of Laws, Provisions, Presidential Decrees and Joint Ministerial Decisions concerning the protected areas of Greece, that will ensure the implementation of a protection status, reveals the interest of the Central Administration in the protection of the environment and recognises the developmental potential of these areas, but also creates problems in the application of the law provisions (due to overlapping responsibilities) (Tampakis 2009). This mainly occurs because their implementation involves a large number of administrative bodies with specific responsibilities, such as the Forest Service, the MB, the Hellenic Police the Port Authorities and others. In the case of Evros Delta, almost half of the visitors consider the Local Authorities, as well as the MB, as responsible for applying the protection status. Most of the locals regard the Local Authorities as responsible for the protection of the area, although they are dissatisfied with the protection status implementation. This fact reveals that locals are not sufficiently informed about the responsible bodies for the application of the protection status. The MB of the National Park needs to improve its organization and approach the local population, so that they are aware of the role of each administrative mechanism regarding the Park’s protection; it should also ensure their participation not only in the relevant decision-making processes, but in their implementation as well.

The promotion of the National Park is another asset that needs to be improved, since visitors are informed about the National Park, mainly by friends or acquaintances. The views of the rest stakeholders, such as the MB, the locals, the Municipality and the Regional Authorities, also confirm this point of view. The promotion of cultural and historical assets is being held in more sufficient way, although all stakeholders argue that more intensive endeavors should be organized in the future.

Approximately half of the visitors intent to visit the neighbouring National Park of Dadia, situated in same Prefecture with the Evros Delta, in the same trip. The significant number of tourists, who intend to combine the trips at both National Parks of Evros, illustrates that a model network of protected areas can be applied. Additionally, as Andrea et al. (2012b) notes, visitors’ satisfaction with the two National Parks of Evros Prefecture is also apparent from their willingness to encourage others to visit both of them. This fact is also recognised by the Regional Authorities, the Municipality of Alexandroupolis, the MB and the locals, regarding their interaction as driving force for rural development. Therefore, the positive interaction between the two Parks should be encouraged in the frame of sustainable development for the broader area. The coordination, improved organization and cooperation between the administrative bodies of both Parks can serve as an operation for the effective promotion of both Parks as a combined touristic package. Moreover the cooperation between the administrative bodies and the travel agencies, in order to inform visitors in advance about the existence of a network of protected areas and the various facilities and activities available at both Parks, can also be used as a tool for an enriched tourist experience.

Many questions are raised by the notion of locals concerning their dissatisfaction with their quality of life, the unawareness on matters related with the National Park of Evros Delta and the lack of participation in its decision – making processes. Intrinsically, the administrative authorities verify the latter. However, as Tampakis et al. (2011) notes, managers should take into account the views of the
local population and enhance locals’ participation in order to ensure the implementation of the protection status as well (Wallner and Wiesmann 2009). Administration in order to be successful should provide the means so that citizens will be able to take part in environmental decision-making processes and assume relevant responsibilities (Graham et al 2003; Lebel et al 2006).

As regards the development of the region, few locals acknowledged the existence of subsidies aimed at precisely that objective; they do realize, though, that their impact so far has not led to the desired developmental results. The same opinion is also shared by the various administrative bodies, except from the Municipality, which argues that quite many investments were made in tourism infrastructure development, mainly regarding hotels. Whereas, the existence of the National Park is a major factor for sustainable development and offers a comparative advantage to the region of Evros to develop its tourism potential, a fact also confirmed by the visitors to the Park, approximately half of whom state that the reason for their visit was recreation, entertainment and wildlife observation.

The effectiveness of the administrative bodies and management of the National Park of Evros Delta is determined by the adoption of “best practices”. This entails participation of the local community through the application of environmental communication programs that will aim to inform and raise awareness among these stakeholders (Skanavis 2004; Andrea 2008; Andrea et al 2012c). Not to mention that strong cooperation affiliations among the administrative bodies is still a prerequisite for effective management. Whereas, bureaucratic nature that hiders planning from implementing, lack of coordination, undefined responsibilities and, in the case of the Central Administration, lack of political will and indifference, are the main challenges that environmental managers are called to encounter. As, Fox et al. (2012), highlights, unfavourable conditions may restrain the management effectiveness. Objectives confusion, political indifference, lack of capacity within the administrative authorities and lack of funding, can serve as strong impediments towards management processes (LaChapelle et al 2003; McCool and Guthrie 2001). The administration of protected areas must be based, apart from the Central Administration, on cooperation with the local community, local cooperatives-associations, and a community-focused approach (Borrini-Feyerabend 2003; Lockwood 2010).

Finally, regarding the future of the National Park after 2015, when the funding provided by the EU will cease, various solutions are proposed by the administrative bodies. The MB of Evros Delta regard it as insecure, anticipating for a new strategic planning based anew on their incorporation in pilot programs for funding. Nevertheless the Municipality embraces a different point of view, suggesting its incorporation in the respective Municipality Services. Whilst, the Regional Authorities state that in relation with the current economical crisis in Greece, MBs should adopt a more autonomic character and find their own means of financing their activities, which was covered by the national budget in the past (Tampakis 2009). Accordingly, although protected areas are eligible for a large number of national or community programs, they can also seek support from foreign capital investments at the same time (Tampakis 2009).

Nowadays, according to the MB, the Municipality and Regional Authorities, the MB of Evros Delta faces various problems allying with irregular funding and its ineffective use, not to mention the insufficient infrastructure. Moreover overlapping responsibilities within the various administrative bodies and undefined responsibilities in the principal government planning for protected areas are considered as serious constraints towards effective management. To make ends meet, a new strategic plan with clear objectives and defined responsibilities for every administrative body is required. In Greece, the initial classification regarding the administrative care of protected areas led to the creation of independent agencies in each region (Kassioumis 1994), whereas in practice, no responsibilities were ever assigned by law to these agencies (Papageorgiou and Kassioumis 2005). In the case of Evros Prefecture, the two MBs of Dadia and Delta could be incorporated in one management body for both Parks. In this way it would be able to manage both Parks at a lower cost and also promote them as a combined destination. Thus, boarding the MBs with professional staff and providing them funds
on a regular basis with the support of both governments and society (Lange and Müller 2009), would function as a starting point for the management effectiveness improvement and the promotion of the area.

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REFERENCES


Andrea, V. 2008. Locals’ attitudes, perceptions and opinions regarding environmental protection and development of the area of Amvrakikos Gulf, Orestiada: Master Thesis, Department of Forestry and Management of the Environment and Natural Resources, Democritus University of Thrace.


Matis, K. 2001. Forest Sampling, Democritus University of Thrace, Xanthi.


**Websites**

EXPERIENCES OF THE CZECH REPUBLIC DURING REMOVAL
OF CONSEQUENCES OF NATURAL DISASTERS

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Abstract

The paper informs about using of temporary bridges after floods in the Czech Republic in 2010. Czech Army Engineers participated on bridge reconstruction The Corps of Engineers were deployed in the centre of the floods with a specific task – to diagnose and rebuild the damaged or destroyed bridges on request of the Department of Transportation. They had to build immediately the temporary bridges, experts from Department of Engineer Structures were given the important task – to diagnose and design all temporary bridges that army engineers had to build. Our bridges help both individual and general public in their everyday life. On some important roads they can drive as they are used to and do not need to look for a detour in the length of up to dozens of kilometres. Paper deals with impact of modern Information Technology to effectiveness of Corps of Engineer. There were discussed advantages of using of modern IT equipment to fulfil non-standard missions. The article described the basic types of bridge faults after floods and further there is made an appraisal of their impact on the determination of loading capacity. Extending of the lifetime of bridges can reduce the energy inputs required for their building and therefore the ecological environmental protection. The most environmentally friendly construction is the construction that is never design to build.

Key words: Ecological, environmentally friendly construction, engineer troops, loading capacity, lifetime, monitoring of the bridges, temporary bridges, Reach Back Laboratory.

INTRODUCTION

In the Czech Republic there are various kinds of natural disasters and industrial accidents. One of the most common disaster is recurring floods. In the past 15 years floods hit eight times various parts of the country, when some areas were hit repeatedly in like e.g. Moravia region.

To help ensure a quick recovery is the most important transport infrastructure. Extension of damages to roads and bridges is different for each flood and does not depend only on the type of flood. What is important is to coordinate the activities of all the components of the Integrated Rescue System of the Czech Republic. Due to the delimited number of members of this system it is necessary to plan their territorial deployment.

In 2009, there was hit the area of north-eastern Moravia, and in 2010 the flood wave spilled over the regions of Liberec and Usti nad Labem.

After the floods, there came approximately 50 requests for replacement of bridges in the affected areas. Experts from the University of Defence participated in designing of totally 33 MS bridges and one bridge TMS (see table 1). [1], [2]. The table shows that the average length of the bridge is about 18 m. However length combinations in which the bridge MS were stored in the warehouses of the State Material Reserves (ASMR) and how it was originally proposed is 21m. [3].
Localities of MS bridge constructions with their length which had to build in 2009 and 2010 [2].

In our paper we describe the experience of liquidation of consequences during floods in 2010.

**FLOODS IN NORTHERN BOHEMIA IN 2010**

At the weekend of 7. to 8. August 2010 fell in the North region extreme rainfall, terrain retention capacity was significantly reduced after the previous rainy season. The result of all effects was the creation of flash floods on the upper reaches of the tributaries of the Labe river. There were damages including all types of infrastructures and people were unhappy because the Integrated Rescue System of the Czech Republic did not have enough power to help rescue all people.

![Destroyed Bridge in the village Dolní Vitkov in September 2010](image)

Engineer troops, for the restoration of the infrastructure, were deployed on the 10th August, with the mandate to 30 September 2010.
The initial conditions for the provision of assistance to affected areas and the use of the military option is emergency legislation 110/1998 Coll. B CR and zz. 219/1999 Coll. OS CR 239/2000 Coll. IRS, 240/2000 Coll. And LR 241/2000 Coll. HOPKS. On the basis of these laws the government could declare in the respective regions EMERGENCY state and adopt statutory orders and resolutions for the immediate solution of the crisis. Another law, which governs the use of the military is the Law on the Armed Forces of the Czech Republic number 219/1999 Sb. Among other tasks of the Army of the Czech Republic, which are calculated by § 14 of the Act, include the use of the military for rescue operations during disasters or other serious situations threatening the lives, health, or property of significant value or environment.

To the typical defects of bridge constructions belong (Among them):
- Washed part of the retaining wall of communication,
- Destroyed Bridge, rotated and shifted support structure of the bridge
- Bridge carried away by the flood
- Flood washed away the bridge abutments, bridge pier foundations and left only supports of the bridge.
- Washed bridge structure, because the water flow under and over the bridge caused a vortex created like in the funnel and after the water absorption the bridge itself created kind of funnel.
Inverted bridge

1.1 Deployment of military units and placement of Experts from Military Academy, Department of Engineer Structures during the reconstruction of transport infrastructure.

Army of the Czech Republic is not a permanent component of the Integrated Rescue System of the Czech Republic. Its powers and resources are deployed for rescue operations only after exhaustion of the forces and resources of the competent departments of the state administration, or in the event that the scope and intensity of the threat exceeds from the beginning their options.

The possibility of using part of the Army to carry out tasks within the Integrated Rescue System is enshrined in the aforementioned Law on the Armed Forces. According to § 14, paragraph 1, letter c) of Act No. 219/1999 Coll. may be active soldiers used during disasters that threaten human life or important economic assets.

Only after fulfilment of condition of § 14, paragraph 1, letter c) can be deployed the army. In the first order by strength and resources of the 15th Engineer and rescue brigade. Rescue battalions are able to work in complex and difficult conditions, with the deployment of heavy equipment. They have specially trained to autonomous rescue companies that operate as a unit designed for civil protection with a nationwide presence.

The main task of the department engineering technology is addressing the issue of compensation for destroyed bridges by building makeshift bridges from sets of heavy bridge kits (TMS) and bridge kits (MS).

Cooperation between the Department of Defence - the University of Engineering technologies and the Ministry of Transport during crisis consists mainly in mutual coordination of the steps to eliminate the consequences of flooding.

Start of cooperation reached in 1994, when teachers and students of the department were involved in the training of specialists from the state administration in building bridges at the training centre of the Ministry of Transport in Kojetín.

The logical continuation of cooperation in the reconstruction of the destroyed infrastructure was teacher involvement in the restoration of transport infrastructure after floods. ŽV ACR members, teachers and students of the department K203 UO Brno have been involved in this work since 1997. They are engaged in the construction of temporary bridges from kits MS, TMS and MMS in the affected areas. Experience from removing of the aftermath of these floods were implemented into the methodology of training of specialists from government in building makeshift bridges from kits MS and TMS in Kojetín.

Desired speed of restoration sought automation of design work and delivery of specialized works to other professionals from the Army and the civilian sector. Into the engineering survey were involved specialists from Geodetic and Cartographic Institute in Dobruška, into picking up the material for the construction of bridges and sets MS, TMS were significantly involved Crisis Management Department of Ministry of Transport.

Eligibility of requirements for temporary construction was secured by individual municipalities presented their requirements through Regional Flood Defence. After the approval of the Ministry of ACR was surveyed the site, project handling and it was delivered material held by the Administration of State Material Reserves (ASMR below) on the construction site and the construction of their own stress tests including bridge structures.

Diagnostic group used special methods for diagnostics of bridges. Planning group dealt in 2010 with projecting of two types of bridge temporaries and construction MS (19 bridges) and TMS (one bridge). Both groups used to Reach Back Laboratory for better communication.
The appropriate software for creating of drawings was selected. For MS it was SmartSketch, and for TMS it was Autodesk Inventor. All dates was save on Reach Back Laboratory.

TMS in the village Víska designed in Autodesk Inventor

The use of Reach Back concept is easy in this case. It subsists in technical support and sharing technical knowledge between the university engineer’s departments and in-the-theatre engineer’s [5]. The informations and data are shared in visual form and are available immediately for several teams not only on particular territory but all over the world. The indispensability of the Reach Back concept was proven several times during floods in 2010 [4].

The first designed TMS bridge in the village Víska

Engineers for the reconstruction of the affected areas built 20 bridges type of MS a total length of 357 m and one bridge type TMS with a total length of 66 m in the village Viska.
Deflection in mm on the bridge in the village Víska calculated in special program SCIA

Theoretical deflection (maximum in this case was 23.9 mm) is comparable with results of the load test from the next figure and it must be nearly the same. The example presents only the use of load test to determine the resistance capacity of the bridge construction for the needs of the Army of Czech during floods.

The load test in the village Víska TMS 66 m
The first designed MS bridge in the village Svor - local part Rousínov

The first renewed bridge in the village Svor - local part Rousínov
Experience from the previous floods have highlighted the importance of sharing information between all components involved in the construction of temporary bridges. It was therefore made a close cooperation with surveyors from VGHMÚř in Dobruška and then at the Department of Engineering Technologies started an extensive project on computer-aided design of temporary bridges and sets MS and TMS and methodology how to handle these projects.

CONCLUSION

Czech Army Engineers participated on bridge reconstruction after floods 2010 and they diagnosed, designed and built 21 temporary bridges, with total length of 357 m, mainly in north Bohemia. Authors of this article diagnosed and controlled reconstruction with loads tests of the bridges and were on all places which had to face the consequences of natural disasters during floods in 2010 and earlier.

The critical factor of the mission was time. We had to build the bridges on large territory and this meant frequent long distance machinery moving. The staff of diagnostics and project groups worked under heavy press, but every mistake could have been very expensive and time consuming. Engineers of the bridges helped both individual and general public in their everyday life.

The article described the approach to application of methodology by assessment of criticality of transport infrastructure during floods as a tool for evaluating of network traffic, focusing on critical infrastructure of the transport sector.

Due to lack of funds for investments and reconstructions of transport infrastructure the examination of existing structures gain importance. To ensure the reliability of bridge structures it is necessary to identify the defect in time and suggest the way of removal. Early removal of defects on the bridge structures can maintain their capacity and extend their lifetime during floods. It can reduce the energy inputs required for their building and therefore reduce the negative impact on environment.

Reconstruction of the bridges after good diagnostics of bridge prepare much better bridge for natural disaster then reconstruction with only common inspection without better diagnostic and then it has better loading capacity applicability, durability, suitability of the bridge.

We know from history that the floods in the Czech Republic were in the past. From 12century period between the two great floods was less than 100 years. If we further deepen the cooperation between Department of Engineering Technologies UO Brno, ŽV ACR MD Department of Emergency Management we will be properly prepared for the next flood, and it certainly won’t snaps us as much as the previous ones.

Reconstruction of the bridges before floods give bridges much more higher probability to survive longer during floods and have longer lifetime then the bridges without reconstruction of the construction. Much better for the nature is reconstruction of the bridge or to build temporary bridge than to build new one.

REFERENCES


SAFETY AND ENVIRONMENTAL MANAGEMENT:
NEW LEGISLATIVE DECREE 81/08

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Abstract

The prevention of accidents at work is ruled, in all European Union member states, by specific rules and measures that must be adopted to safeguard the health and safety of workers. In Italy, the main provision in this field is Legislative Decree No. 81/08 and later modifications, which defines the rules to be observed for the management of prevention of risks in the workplace. The aim of this article is to analyse the various aspects of Legislative Decree 81/08.

Key words: Safety, Safety Management, Environmental Safety, Management.

1. INTRODUCTION

On 30th April 2008 the Consolidated Legislation on Health and Safety of Workers and Employees (Legislative Decree no. 81/2008) was published in the Gazzetta Ufficiale, signed by the Head of State Giorgio Napolitano on 9th April 2008, and came into force on 15th May 2008. The Act, which consists of 306 articles, 13 titles and 51 attachments, includes all the rules which are already present in the Legislative Decree no. 626/94, as well as, of course, a number of other measures that already existed regarding construction sites, vibration, signage, noise, asbestos and lead. Anticipated for thirty years (as required by Law 23 December 1978, n. 833 Establishment of the National Health Service, art. 24), the main purpose of this legislation is to simplify the regulatory framework on the safety of workers. To better understand the real significance of this document, it is appropriate to investigate the historical evolution of legislation in Italy, correlating the development of legislation with the changes of the social and working world which have taken place in our country over the past two centuries.

2. MATERIALS AND METHODS

2.1 The evolution of the law on health and safety at work

Between 1770 and 1830, while the French Revolution and the Napoleonic wars were turning Europe upside down, a quieter, but no less insignificant, phenomenon was occurring in Britain (which then radiated out throughout Europe and even overseas to the United States). This phenomenon also merited the name of revolution: the Industrial Revolution. The issue of safety was therefore born with the explosion of the Industrial Revolution in the nineteenth century, which led to the mass exodus of workers from the countryside to the cities to work in the new factories, providing the workforce that was needed for the production of goods and services on a large scale. The worrying increase in injuries, grueling working hours (12-18 h day), and poor hygiene and environmental conditions in the workplace led the workers to organise themselves into trade unions and make demands for the improvement of their working conditions in terms of exploitation, health, and safety in the workplace.
These numerous new forms of protest were beginning to cause problems to public order, so a regulation in the field of security and work-related injuries needed to be formed. At the end of the 19th century the first provisions of the law began to be introduced; provisions which, over time, have been replaced by new and more complete ones that have had to adapt to the evolution of technological progress and to the establishment of new production methods that involved the emergence of new risks with the possibility of impairment of the health of workers.

Italy was one of the first countries in the world to adopt specific legislation on the protection of worker safety. The determinants of health and social work, in fact, have always been studied and analysed carefully by the Italian medical-scientific world. It is no coincidence that, historically, an Italian, Modena Bernardino Ramazzini, is recognised as the ‘founder’ of occupational medicine. At the turn of the eighteenth century, he introduced a new question to hippocratic medical history: *quam et artem exerceas?*. Ramazzini, author of *De morbis Artificum diatribe* (Diseases of Workers - Padua, 1700), identified through the analysis of sixty categories of workers, the damaging effects of work and ‘the harmful nature of the substances used.’ The first law in Italy for the protection of the working class was the one on the insurance of accidents at work, law n. 80 of 1898. The legislature of the time considered work-related accidents an unavoidable factor linked to industrial production. The problem of worker protection and prevention of occupational accidents and diseases was not, therefore, taken into account. The introduction of compulsory insurance against accidents at work developed the concept of strict liability of the employer, but it limited the ‘reparation of damage,’ which involved the ‘economic refreshment’ for the worker who suffered the injury.

Since the late 1800s there has been a real evolutionary process of legislation in this matter, a process that will remain so in the future because it must adapt and stay abreast of the unstoppable progress. The regulatory framework for health and safety in the workplace can be divided into three historical periods:

- the first is represented by provisions adopted from the 50s to the 80s, created in order to balance the demands of social and political change as a result of the post-industrial war with the needs of an increasingly demanding protection of security in the world of work;
- the second is the standards issued in the 90s as a result of the transposition of EU directives and awareness of the dynamic involvement of employees in the enterprise security management;
- the third is the enactment of a Consolidated Security (Legislative Decree no. 81/2008 along with the corrective decrees and decrees issued to date).

Thus the story of accident prevention regulations in Italy passes through a crescendo of standards ranging from the 50s to the present day. Its foresight approach provided first a ‘technological’ model of prevention (DPR 547/55, Presidential Decree 164/56 and DPR 303/56), which followed what he saw as ‘participated’ prevention (Legislative Decree no. 277/91 and Legislative Decree no. 626/94 and subsequent amendments and supplements). It then provided an ‘organised’ model of prevention as envisioned by the legislature of Legislative Decree no. 81/2008.

2.2 From the ‘30s to ‘50s: the principles of the current hinge order regarding health and safety at work

Over time, safety in the workplace has been the subject of several legislative initiatives with a single objective: to guarantee and improve health and safety conditions of workers. The key principles of the legal system in terms of health and safety at work are well set in a history within the Penal Code, the Civil Code and the Constitution of the Italian Republic.

A first innovation in the field of safety at work came with the inclusion of certain provisions in the Penal Code (Royal Decree of 19 October 1930, n. 1398), which still retain a role of primary importance in the national legal safety on the job. The regulations to which it refers are the articles
437, 451, 589 and 590 of the Penal Code, which govern the offences related to accident prevention. In this regard, the preliminary point is that, while Art. 437 and 451 c.p. have a ‘preventionist’ purpose, as conducted by criminal sanctions which may cause situations of danger, regardless of the occurrence of the accident itself, Art. 589 and 590 c.p. have, on the other hand, a ‘repressive / punitive’ character of serious events (homicide and unintentional injuries), which have already occurred and which were the direct result.

The Civil Code (Royal Decree of 16th March 1942 n. 262) addresses, in a direct manner, the issue of security of workers in two articles, which are extremely important for the prevention of accidents and illnesses in the workplace: Articles 2050 and 2087 of the Civil Code. Art. 2050 cc, entitled as Responsibility for the Operation of Dangerous Activities, states that ‘anyone who causes harm to others in performing a dangerous activity, by its nature or the nature of the means used, is liable to pay, if not prove that they have taken all appropriate measures to avoid the damage.’ Article 2087 cc, entitled as The Protection of Working Conditions, states that ‘the employer is required to evaluate the performance of the measures which, according to the particularity of the work, experience and technology, are necessary to protect physical integrity and moral personality of work.’ With the inclusion of this last article in the provisions of the 1942 Civil Code, the foundations of a different way of thinking about prevention were laid, and the principle of common ‘duty of job security’ law was established to load the entrepreneur and, therefore, to consider the ‘workers’ right to mental and physical protection.’

The protection of health and safety of workers finds its greatest recognition in the Constitution of the Italian Republic, which came into force on 1st January 1948, and is the first and most important ‘source of knowledge’ of our legal system, or the acts that contain the rules (norms) governed by the community organization (State) to which we belong. It is called also the ‘law of laws’ to indicate its position of pre-eminence over all other sources of law, understood as above, such ‘laws, regulations, customs’ (Article 1 of the provisions of the law in general). And the ‘Constitution’ sets out, among the ‘fundamental principles’ of the state, the protection of health (Article 32), that the work ‘in all its forms and applications’ (art. 35) and that of safety, liberty and human dignity, which cannot cause particular harm, are also recognised as part of the freedom of private initiative (Art. 41).

2.3 From the 50s to the law 626/94

An organic and autonomous body of legislation aimed at preventive health protection of workers was not issued until the second half of the ’50s. In fact, the Enabling Act of 12th February 1955, no. 51 authorised the Government to issue general and specific rules for the prevention of accidents and occupational hygiene, to be applied in almost all sectors. Decrees that were enacted by the legislature of 1955 and 1956 should be mentioned, because of the importance they held until the adoption of Legislative Decree 9th April 2008, no. 81, the DPR 27th April, 1955 no. 547 which laid down the rules for the prevention of accidents at work, the DPR 7th January, 1956 no. 164 which laid down the rules for the prevention of occupational accidents in construction and in the field of occupational hygiene, and the DPR 19th March, 1956, no. 303.

This body of law has had the advantage, on the one hand, of having extended the scope of the accident prevention regulations to all activities in which workers are employed, and on the other hand, of having identified specific obligations on the employer, manager, supervisor, builders and workers. A different concept starts to develop, assigning a new role to prevention in health and safety at work, which leads to a focus on preventive protection of the psychophysical state of workers, independent and distinct from the traditional restorative protection and / or insurance.

The main features of the decrees of the 50s were predicting an ‘objective’ responsibility in the hands of the employer and the acceptance of the concept of ‘technological prevention.’ The term ‘technological prevention’ aims to emphasise the fact that the decrees of the 50s were based, in most
cases, on mandatory adoption of appropriate technical objectives (devices, environmental conditions, personal protective equipment, etc.), and only in limited cases, on information treated with prudence and caution.

The legislation of the 50s still presented numerous limitations on the inside, such as:

- the lack of any information / training of workers, qualifying as an intervention in terms of prevention;
- the lack of identification of specific limit values of exposure;
- the remediation of those identified were too general;
- workers and their representatives were still poorly involved in prevention.

Another highlight of the evolution of the regulatory system in the field of health and safety at work is represented by the law of 20th May 1970 n. 300, better known as The Workers' Statute, which still remains the cornerstone of the system of safeguards and guarantees that the Constitution had outlined, both briefly and in general terms. The Workers' Statute has strengthened the protection of workers in every aspect of the employment relationship. Compared with the problem of security, it is stated that the workers, ‘through their representatives, have the right to control the application of the rules for the prevention of accidents and occupational diseases and to promote research, development and implementation of all appropriate measures to protect their health and their physical integrity.’ (Article 9 Association).

Also in the '70s, with the National Health Care Reform of 1978 (Law 833/78), regional socio-Local Health Units (the current Local Health Services - ASL) were created for the protection of the health of all citizens of the territory and in particular of employees; through this Act certain powers which were previously assigned to the government agencies such as the ENPI (National Agency for the Security of Accidents) and the ANCC (National Association for the Control of Combustion), and the Department of Labour (now the Regional Offices of Labour), are transferred to the regions and hence the ASL. Within the Health Care Reform, an Act concerning safety and hygiene at work was anticipated by 31/12/1979, the drafting of which, however, was not completed until April of 2008.

From the '80s onwards, the European Union began autonomous legislative activity, issuing directives and guidelines, in order to standardise health and safety regulations in the workplace across all Member States.

The Legislative Decree of 19th September 1994 no.626 is the implementation of eight European directives, namely 89/391/EEC, 89/654/EEC, 89/655/EEC, 89/656/EEC, 90/269/EEC, 90/270/EEC, 90 / 394/CEE and 90/679/EEC, improving the health and safety of workers at work. In our legal system, this Decree has introduced a European concept of security based on the planning of prevention, risk assessment, training, participation and collaboration of workers and their representatives. The Legislative Decree no. 626/1994, or more commonly ‘the 626,’ was a real turning point in the regulation of safety at work, going from a ‘technological model of prevention’ (DPR 547/55, Presidential Decree 164/56 and Presidential Decree 303/56 ) to a ‘participated model of prevention.’ The 626 has tried to create a safer working environment, focusing on minimising the risks at the source, through prevention activities and programming. To achieve this goal, the ‘participatory model of security’ was introduced. According to this model, the obligation to ensure compliance with safety in the workplace does not only rest on the employer, the leaders and the control bodies already present in the prior regulations, but also on new subjects:

- the service of prevention and protection and its manager;
- the doctor;
workers;

the representative of the workers' safety.

It is, therefore, an entirely new model, based on the cooperation of subjects previously ignored, that within the scope of their responsibilities, they become obliged to give effect to the principle of prevention.

2.4 Legislative decree no. 81/2008

Despite the reception of European legislation in the field of health protection in the workplace, the lack of enforcement and compliance with some of its principles has led in recent years to the persistence of a high number of accidents in the workplace, including fatalities (1207 white deaths in 2007, according to estimates by INAIL), although there is gradual reduction compared to previous years. In particular, the clamour that followed the fatal accidents towards the end of 2007 (including the incident at the Thyssen-Krupp factory, on the night of 6th December) resulted in the government accelerating the early stages of drafting and approval of a new Act relating to health and safety of workers, namely Legislative Decree no. 81/2008.

The Legislative Decree no. 81/2008, hereinafter the ‘Testo Unico sicurezza-TU’ (the Safety Act) correct and updated by Legislative Decree no. 106/2009, is the measure by which Art. 1 of the Enabling Act Aug. 3, 2007, no. 123 (Measures for the protection of health and safety at work and delegates to the Government for the reorganisation of the legislation) was implemented, and the principles and criteria contained in it. This decree was issued to streamline, simplify, and innovate, where necessary, the existing legislation. With the publication of the Legislative Decree 9th April 2008 no. 81 in the Gazzetta Ufficiale (Supplement no. 108 / L to the Official Gazette no. 101 of 30 April 2008) and the subsequent enforcement of the new provisions, the main hitherto existing regulations, with few exceptions, were repealed, including Legislative Decree no. 626/1994 and the decrees of the ’50s, therefore the whole matter of health and safety protection was regulated again.

The legislature of the Legislative Decree no. 81/2008 (and that of the Legislative Decree no.106/2009) has sought to turn the page from the previous era by offering new legislation rules that paint an entirely new approach to security. An approach characterised by the obligation and necessity of preparing a business management system, marked by flexibility, ease of implementation, and active involvement of all those involved in the work itself. As stated earlier, it outlines a transition to an ‘organised model of prevention,’ a new business management system to fit into any working environment, public and private sector with the necessary procedures and specific organisational policies, whatever the size of the company.

The Act, as well as strengthening and clarifying some aspects of the legislation previously in force, introduces important innovations in the field of health and safety in the workplace.

The most significant are as follows:

- The scope of the legislation is extended to all employees (and the self-employed) in all areas of public and private activities. In fact, art. 2 of the T.U. Safety Act defines the ‘worker’ as someone who, ‘irrespective of the type of contract, holds a job in the organisation of a public or private employer.’

- The principle of prevention is the focal point of the T. U. Safety Act. The law aims to ensure an organisational model in the enterprise, designed to prevent any possible risk connected with working activities. The same principle tends to encourage the adoption of organisational models and, in particular, of those referred to by UNI INAIL July 2001 and OHSAS 18001:2007. Article. 30 of Legislative Decree 81/08 attributes an effective exemption from administrative liability provided for by Legislative Decree no. 231/01 to the effective implementation of such models. The Legislative
Decree n. 231, entitled *Administrative Liability of Legal Persons, Companies and Associations without Legal Personality*, constitutes the implementation of the commitments undertaken by Italy, even at European and international level in the fight against corruption. It introduced criminal liability for institutions into the Italian legal system, for certain offences committed for the benefit or on behalf of the Authority, by representatives, administration or management of the company in question or an organisational unit having financial and functional autonomy (senior positions), as well as persons under the direction or supervision of one of those aforementioned (subjects). This responsibility is in addition to that of the person who has physically committed the crime.

- Reviewing and tightening of the sanctions.
- Introduction of the concept of health, understood not only as the absence of disease or infirmity, but also as a complete physical, mental and social state. In fact, it is now mandatory in the risk assessment to take into account the special hazards including those related to work-related stress.
- Conversion into law of some of the legal interpretations consolidated as the delegation of functions (Article 16 Legislative Decree no. 81/2008) and the exercise of the powers of this fact (Art. 299 Legislative Decree no. 81/2008).

- Definition and enhancement of the figure of the ‘charge’, by providing specific training.
- Strengthening the role of workers’ representative for safety not only at the corporate level, but especially at the local level, with the creation of the representative of the territorial security that will ensure the application of the new rules in enterprises without trade union representatives.
- Reviewing and strengthening the functions of the joint bodies, to which a promotional role, technical assistance or organisational enterprises with public support are attributed.
- Confirmation of the discipline (Law 123/2007) of the management of procurement contracts.
- Streamlining of institutional functions with involvement of the social partners and circulation of information, implemented through:
  a) The establishment of the Committee for the address and the evaluation of active policies and for the national coordination of supervisory activities in the field of health and safety at work (Article 5), through which it was finally realised that coordination between national institutions and local authorities whose absence since the end of the 70s has been the first point of the breakdown of the national prevention system (the second point was connected to the lack of involvement of trade unions and employers’ associations in the definition of policies).
  b) The allocation to the ‘National Consultative Commission of a full tripartite character’ (Article 6 of Legislative Decree no. 81/2008), with ten representatives from each component: Ministries, Regions, employers’ associations, trade unions and the ‘redefinition of its powers’ in the interests of systemic planning.
  c) Establishment of the Regional Committees of coordination (art. 7 of Legislative Decree no. 81/2008).
  d) Establishment of the National Information System for the prevention (SINP, Art. 8 Legislative Decree no. 81/2008) in order to provide useful data to guide, plan, and evaluate the effectiveness of prevention activities of occupational accidents and occupational illnesses, which is relative to workers enrolled and not enrolled in public insurance companies. It was also established to direct the activities of supervision, through the integrated use of the information available in existing information systems, including through both the integration of specific files and the creation of databases.
e) Reorganisation of the duties and functions of INAIL and ISPESL of IPSEMA (from 31st July 2010, of 30th July 2010, no. 122 Conv. Decree Law of 31st May 2010, no. 78, the functions of IPSEMA INAIL and ISPESL were merged, with the suppression of the same bodies), in the matter of health and safety in the workplace (Article 9 of Legislative Decree no. 81/2008).

3. RESULTS AND DISCUSSIONS
3.1 The system of sanctions provided for by legislative decree no. 81/2008

One of the main innovations introduced by Legislative Decree no. 81/2008 was the total re-think of sanctions, implementing powers conferred on the Government by Law no. 123/2007 to reorder the prevention system. The rules on sanctions were further modified by Legislative Decree no. 106/2009, corrective of the Act. The analysis of the changes introduced by Legislative Decree no. 106/2009 shows that the main changes concerned the sanctions system through a rationalisation of the penal and administrative sanctions resulting from violations of the obligations of the various parties (employers, managers and staff charge, etc.) on the basis of the effectiveness of the tasks carried out and the proportioning penalties to the realities of work characterised by particular risks. The penalty system has been modulated in such a way as to provide tougher sanctions for behaviours that endanger worker health (‘modular sanctions according to the risk,’ Law no. 123/2007).

The proposed sanctioning of the Consolidated reformed presents 28 articles devoted to the prediction of criminal and administrative offences charged, respectively, of:

- employer (articles 14, 55, 68, 87, 159, 165, 170, 178, 219, 262, 282, 286, 297)
- charge (Articles 56, 263, 283)
- competent doctor (artt. 58, 220, 264, 284)
- worker (Articles 59, 285)
- designer, manufacturer, supplier, installer (Art. 57)
- charterers and the grantor in question (Article 87)
- principals and managers (Art. 157)
- coordinators for the design and execution (Art. 158)
- part of the family business, small business owner and partner of the partnerships in agriculture (art. 60)
- the self-employed (artt. 60, 160)
- anyone (Articles 264 bis, 286)

The penalties for violations concerning the protection of health and safety in the workplace can be summarised as follows:

- ARREST for more serious conduct
- ARREST OR FINE for other violations
- FINE for less serious crimes
• ADMINISTRATIVE SANCTIONS for administrative offences, provided that non-compliance of the legislature is considered minor.

• PRECAUTIONARY MEASURES, such as the suspension of activities.

In the field of criminal penalties the following are included:

• The penalty of arrest only, the most severe sanction, is given in two cases of contravention: failure to comply with the order of suspension of business given by the supervisory board for serious and repeated violations of protection health and safety at work, and the omission of the risk assessment for companies subject to special risks (e.g. companies manufacturing and storing explosives, extractive industries with more than 50 workers, public and private inpatient facilities with more than 50 employees, thermal power plants, companies that expose workers to biological hazards etc.).

• The alternative penalty of arrest and the fine is applied to the majority of the fines provided for in the TU Safety Act.

• The penalty of fine only is given for violating Art. 55, paragraphs 3, 4 and 5 letter e) and Art. 159, paragraph 1 (including the case of violations relating to risk assessment, medical examinations of workers, checks on the implementation of security measures and the protection of health, the consultation of the representative of worker safety, the Operational Safety Plan prepared in the absence of one or more of the elements listed in Annex XV, etc.).

Regarding ADMINISTRATIVE SANCTIONS, which naturally carry minor penalties, are given for violations, usually, of a documentary or bureaucratic nature of the legislature, which are not particularly serious and which have a pecuniary nature. For example, you can cover several illegal conducts in the field of communications relating to health monitoring to the competent doctor, information on occupational accidents to insurers and the names of the representatives of worker safety, consultation of workers’ representative for safety in situations listed in the TU, the exposure of the identification card by workers of companies that engage in contracting and subcontracting, periodic assessment of work equipment, etc.

PRECAUTIONARY MEASURES involves the suspension of business activities (Article 14 of Legislative Decree no. 81/2008). The suspension of the business referred to in Article 14 of Legislative Decree no. N. 81/2008, already provided for in Article 5 of Law 123/07, is one of the most important institutional sanctions, the application of which is delegated to the supervisory bodies. The Ministry of Labour and Social Policy, with circular no. 33/2009, pointed out that the measure is precautionary, aimed at ending the danger to the health and safety of workers, but at the same time also characterised by the profiles of sanctions. The measure may be adopted by the supervisory authorities of the Ministry of Labour and Social Policy for the portion of the business affected by the violation, in the presence of two conditions:

• when it is found the use of personnel not resulting from the mandatory documentation is equal to or greater than 20% of the total number of workers in the workplace;

• when there are serious and repeated violations of health and safety at work.
The first event, the exclusive competence of the supervisory bodies of the Ministry of Labour and Social Policy, includes all cases in which there is employment of workers without prior notification of the employment agencies, according to the specific type of contract. The second case, also the responsibility of the supervisory bodies of local health and, with regard to fire prevention, the National Body of Fire, regards the presence of serious and repeated violations of health and safety, awaiting the enactment of a special ministerial decree, are those listed in Annex I to the Legislative Decree no. n. 81/2008.

According to article 14 of Legislative Decree 81/08, when there is recurrence in the five years following the order of a violation subject to prescription of the supervisory board (which is complied with by the offender) or a violation found by final judgement, or when the same party commits multiple violations of the same nature. In this sense it will be the inspection personnel who will verify whether a violation 'of the same nature' has been committed by the same employer. It follows that the presence of 'multiple violations' - therefore at least two, also contextual - within five years from the first violation found - with compulsory requirement obeyed or by final judgement - will lead to the adoption of the suspension.

Violations of the same nature are considered and the same provision to provisions other than those identified, pending the adoption of the decree referred to in the previous period, Annex I above.

The suspension may be revoked by the supervisory body of the Ministry of Labour and Social Policy provided that there is:

a) the regularisation of workers resulting from the scriptures or other documentation required;
b) verification of the restoration of regular working conditions in the event of serious and repeated breaches of discipline relating to the protection of health and safety at work;
c) the payment of an additional sum to those provided following the application of civil penalties, criminal and administrative provisions, amounting to € 1,500 in the case of suspension for irregular work and € 2,500 in the case of suspension for serious and repeated violations the protection of health and safety at work.

The suspension may be submitted within 30 days, respectively, to the Regional Directorate of the work of local courts and the President of the Regional Council, which are pronounced within 15 days of notification of the appeal. After expiry of that last term the suspension ceases to be effective.

Non-compliance of the suspension is sanctioned by the employer:

a) with a term of imprisonment up to six months in the case of suspension for serious and repeated violations of health and safety at work;
b) by imprisonment for three to six months or a fine ranging from €2,500 to €6,400 in the case of suspension for unauthorised work.

The suspension is also followed by a preemptive measure to bargain with the Public Administration under the Ministry of Infrastructure and Transport.
Table 1 Standardised injury rates (per 100,000 workers) in EU countries 2003-2008

<table>
<thead>
<tr>
<th>Member States</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>Var. 2008/2003 %</th>
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<td>3.125</td>
<td>3.024</td>
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<td>2.864</td>
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<td>3.008</td>
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<td>3.5</td>
<td>2.3</td>
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<td>2.5</td>
<td>2.6</td>
<td>2.9</td>
<td>2.5</td>
<td>2.4</td>
<td>-14.3</td>
</tr>
<tr>
<td>Germany</td>
<td>2.3</td>
<td>2.2</td>
<td>1.8</td>
<td>2.1</td>
<td>1.8</td>
<td>1.9</td>
<td>-17.4</td>
</tr>
</tbody>
</table>
Table 32 Accidents at work in the European Union* 2003-2008

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>EU 15</th>
<th>N.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>1.2</td>
<td>1.1</td>
<td>1.7</td>
<td>1.5</td>
<td>1.4</td>
<td>1.8</td>
<td>50.0</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>2.8</td>
<td>2.7</td>
<td>2.0</td>
<td>3.4</td>
<td>2.2</td>
<td>1.7</td>
<td>-39.3</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>1.8</td>
<td>1.1</td>
<td>2.2</td>
<td>2.7</td>
<td>2.6</td>
<td>1.5</td>
<td>-16.7</td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>1.9</td>
<td>2.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.3</td>
<td>1.3</td>
<td>-31.6</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1.1</td>
<td>1.4</td>
<td>1.4</td>
<td>1.3</td>
<td>1.3</td>
<td>1.0</td>
<td>-9.1</td>
<td></td>
</tr>
<tr>
<td><strong>EU 15</strong></td>
<td><strong>2.5</strong></td>
<td><strong>2.4</strong></td>
<td><strong>2.3</strong></td>
<td><strong>2.4</strong></td>
<td><strong>2.1</strong></td>
<td>N.D.</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

(2) Excluding commuting accidents and those due to traffic accidents and whilst on board any form of transportation during work, as data cannot be collected from all countries.

Source: Eurostat

4. CONCLUSIONS

This brief analysis on the state of bargaining on workplace safety highlights some points that need to be highlighted since it could be a track of work and reflection on key future. Why is it so important to raise awareness and educate the workers and the public about the safety on the job? There are at least two reasons:

1) Ethical

INAIL: Injury statistics on 27th April 2012 show a decline of accidents at work in Italy in 2011, with a decrease of 6.4% to 726,000.

The number of workers who have lost their lives remains below 1,000: there are 930 victims (40 less in comparison to 2010). There has been an increase of 9.6% in occupational diseases.

2) Economic

Analysis of the costs and expenses of accidents operated by research bodies (such as EURISPES in the Report on Italy 2010) showed a cost of €40 billion for the community. If the number of injuries in the workplace decreases by 1%, savings would amount to €438 million, or a decrease of only 5% would amount to savings of €2.2 billion.

Training in occupational safety is the key to reach the target of zero injuries.
Learning about safety means conveying the value of human life, to acquire knowledge and awareness of their role, the ability to take responsibility, give social value to work and learn to understand and manage risk both individually and collectively. Learning about safety means to increase the wealth of corporate knowledge, corporations being the only ones who can afford to deal with the risks of the future.

REFERENCES
"OSHA’s Fall Prevention Campaign", (2012). Occupational Safety and Health Administration.


INAIL, Statistiche per la prevenzione, Istituto nazionale per l'assicurazione contro gli infortuni sul lavoro, Centro di informazione e di documentazione infortunistica, Roma, 1977 e sgg

Inail: Workers Compensation Authority.


Testo unico sicurezza sul lavoro 81/2008.

THE EFFECT OF ORGANIC AMENDMENTS ON AVAILABILITY OF HEAVY METALS IN CONTAMINATED SOILS

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Abstract

Enrichment of soils with organic matter could reduce the content of bioavailable metal species as a result of complexation of free ions of heavy metals. In this experiment, the influences of different rate of organic amendments on the soil organic content and humus fractions and their ability to reduce metal availability in heavy metal contaminated soils were investigated. The field experiment was conducted on soils contaminated by the Non-Ferrous-Metal Works near Plovdiv, Bulgaria. Different amounts of vermicompost and compost (5 and 10%) were incorporated into the top 20 cm of soil. To determine the effect of the organic amendments, the soil samples were collected 1 month after addition of organic amendments from depth of 20 cm. The soil organic content and humus fractions were determined. The total content of heavy metals and concentration of their available species in the soil were determined using aqua regia and DTPA extraction, respectively. The results showed that addition of vermicompost and compost increased contents of soil total organic carbon and total N. Organic amendments influenced considerably the humus fractions by changing the ratio C_HA/C_FA in favour of the humic acids, in which changes of the type of humus from fulvic type in control to humic-fulvic type in addition of 5% and 10% vermicompost and humic type in addition of 10% compost. Application of the compost and vermicompost reduces the amount of aggressive fulvic acids, organic matter components which pose a potential environmental risk. The results of the present study indicated that soil application of compost and vermicompost decreased DTPA-extractable levels of heavy metals in the soil. This is indicative of heavy metals immobilisation by humic substances from compost and vermicompost application. Results appear that verify the function of humic acid in improving phytoremediation efficiency of soils contaminated with heavy metals; and potential environmental availability of metals may be controlled by soil organic amendments.

Key words: organic amendments, organic carbon, heavy metals, availability, contaminated soils

1. INTRODUCTION

Contamination of soil by heavy metals is of major concern because of their toxicity. Elevated levels of heavy metals in soils may lead to their uptake by plants, which depends not only on heavy metal contents in soils but is also determined by soil pH value, organic matter and clay contents, and influenced by the fertilization (Fytianos et al., 2001). The fluctuation of mentioned parameters cannot change the total amount of heavy metals in soil but can significantly affect their bioavailability (Ge et al., 2000). Soil amendment is a major requirement for the successful establishment of vegetation in metal-contaminated soils. The addition of amendments into soils precipitates or increases metal sorption, therefore decreasing the proportion of the total element in soil solution (Brown et al., 2005; de Varennes and Queda, 2005; de Varennes et al., 2006). The addition of amendments such as fly ash, pig manure, sewage sludge, is effective in lowering the metal toxicity of soil and provides a slow release of nutrient sources such as N, P, K to support plant growth (Wong, 2003; Chiu et al., 2006).
Addition of organic matter amendments, such as compost, fertilizers and wastes, is a common practice for immobilization of heavy metals and soil amelioration of contaminated soils. Some researches showed that amendment of contaminated soils with organic matter reduced bioavailability of heavy metals (Khan et al., 2000). Soil organic matter has been of particular interest in studies of heavy metal sorption by soils, because of tendency of transition metal cations to form stable complexes with organic ligands (Elliott et al., 1986). Organic matter is known to form strong complexes with heavy metals (Krogstad, 1983). The content of organic matter affects speciation of heavy metals in soil (Lo et al., 1992). High organic matter content was reported to decrease concentrations of Cd and Ni in soil solution (Arnesen and Singh, 1999). This is very important because a high content of organic matter in contaminated soil is one of the ways to exclude heavy metals from the trophic chain. Cow manure, poultry manure and pig manure were found to be effective in reducing lead availability to plants, leading to lower uptake of lead (Scialdone et al., 1980; Wong and Lau, 1985; Ye et al., 1999). They are commonly used as tailings amendments because the addition of organic matter can significantly improve the physical characteristics and the nutrient status of mine soil (Ye et al., 1999). In addition, fertilizers are an essential ingredient for successful restoration of mine wastes (Bradshaw and Chadwick, 1980)

The use of composts has been recognized generally as an effective means for improving soil aggregation, structure and fertility, increasing microbial diversity and populations, improving the moisture-holding capacity of soils, increasing the soil cation exchange capacity (CEC) and increasing crop yields (Zink and Allen, 1998).

Vermicompost contains most nutrients in plant-available forms such as nitrates, phosphates, and exchangeable calcium and soluble potassium (Orozco et al., 1996). There is accumulating scientific evidence that vermicomposts can influence the growth and productivity of plants significantly (Edwards, 1998). Various greenhouse and field studies have examined the effects of a variety of vermicomposts on a wide range of crops including cereals and legumes (Chan and Griffiths, 1988), vegetable, ornamental and flowering plants (Atiyeh et al., 2000), and field crops (Arancon et al., 2004).

The main aim of this study was to evaluate the effects of different rate of organic amendments (i) on the soil organic content and humus fractions and (ii) ability to reduce metal availability in heavy metal contaminated soils.

2. MATERIALS AND METHODS

The experiment was performed on an agricultural field contaminated by the Non-Ferrous-Metal Works near Plovdiv, Bulgaria. The field experimental was a randomized complete block design containing five treatments and four replications (20 plots). The treatments consisted of a control (no organic amendments), compost amendments (added at 5 and 10%), and vermicompost amendments (added at 5 and 10%). Plot size was 24 m$^2$ (3 m x 8 m). The soil from each plot were combined and mixed with amendments. Characteristics of soils and organic amendments are shown in Table 1. The soils used in this experiment were slightly acidic, moderate content of organic matter (OM) and essential nutrients (N, P and K) (Table 1). Pb, Zn, Cd and Cu total concentrations were high and exceeded the limit value in agriculture soils. The pseudo-total content of Zn, Pb and Cd is high (1430.7 mg/kg Zn, 876.5 mg/kg Pb and 31.4 mg/kg Cd, respectively) and exceeds the maximum permissible concentrations (200 mg/kg Zn, 70 mg/kg Pb, 1.5 mg/kg Cd).

To determine the effect of the organic amendments, the soil samples were collected 1 month after addition of organic amendments. A soil subsample was air-dried, passed through a 2-mm sieve and characterized for soil pH (H$_2$O) in deionised water suspension of 1:5 (w/v); total nitrogen by the Kjeldahl method (N Kjeldahl); total oxidizable organic carbon according to Tjurin’s method in
modification of Nickitin and Fishman (with titration) (1969); organic fractions – accelerated method of Kononova – Belchikova (Kononova, 1966), following one time extraction with sodium pyrophosphate (0.1 M Na₄P₂O₇·10H₂O mixed with 0.1 N NaOH). The humic acids (HA) and the fulvic acids (FA) were separated by precipitation of the HA, bringing the alkaline extract to pH ≈ 1 with concentrated H₂SO₄. The fraction of the combined with R₂O₃ and movable humic acids was obtained by additional treatment of the soil sample with a solution of 0.1 N NaOH, and the so-called ‘brown’ humic acids were separated by precipitation with concentrated H₂SO₄ to pH ≈ 1. Optical characteristics of humic acid were measured on spectrophotometer BOECO S-22 (absorption at λ 465 nm and 665 nm). The same procedures were applied to organic amendments.

The pseudo-total and DTPA-extractable concentration of heavy metals, micro and macroelements in the soils, after four weeks’ equilibration were determined. Pseudo-total content of metals in soils was determined in accordance with ISO 11466. The available nutrients and mobile heavy metals contents were extracted by a solution of DTPA (1 M NH₄HCO₃ and 0.005 M DTPA, pH 7.8) (Soltanpour and Schwab, 1977).

Table 1. Characterization of the soil and the organic amendments used in the experiment

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Soil</th>
<th>Compost</th>
<th>Vermocompost</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.5</td>
<td>6.9</td>
<td>7.5</td>
</tr>
<tr>
<td>EC, dS/m</td>
<td>0.2</td>
<td>0.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Organic matter,%</td>
<td>2.22</td>
<td>72.1</td>
<td>38.58</td>
</tr>
<tr>
<td>N Kjeldal,%</td>
<td>0.236</td>
<td>2.223</td>
<td>1.569</td>
</tr>
<tr>
<td>C/N</td>
<td>9.41</td>
<td>32.43</td>
<td>24.59</td>
</tr>
<tr>
<td>Pseudo-total P, mg/kg</td>
<td>642</td>
<td>12653.9</td>
<td>10210.8</td>
</tr>
<tr>
<td>Pseudo-total K, mg/kg</td>
<td>5517.5</td>
<td>6081.7</td>
<td>10495.1</td>
</tr>
<tr>
<td>Pseudo-total Ca, mg/kg</td>
<td>10607.5</td>
<td>32158.7</td>
<td>31848</td>
</tr>
<tr>
<td>Pseudo-total Mg, mg/kg</td>
<td>9577.5</td>
<td>2086.5</td>
<td>7754.9</td>
</tr>
<tr>
<td>Pseudo-total Pb, mg/kg</td>
<td>876.5</td>
<td>12.02</td>
<td>32.25</td>
</tr>
<tr>
<td>Pseudo-total Cu, mg/kg</td>
<td>124.8</td>
<td>43.23</td>
<td>53.33</td>
</tr>
<tr>
<td>Pseudo-total Zn, mg/kg</td>
<td>1430.7</td>
<td>170.77</td>
<td>270.3</td>
</tr>
<tr>
<td>Pseudo-total Cd, mg/kg</td>
<td>31.4</td>
<td>0.192</td>
<td>0.686</td>
</tr>
<tr>
<td>Pseudo-total Fe, mg/kg</td>
<td>41650.9</td>
<td>3177.31</td>
<td>11813.7</td>
</tr>
<tr>
<td>Pseudo-total Mn, mg/kg</td>
<td>1244.5</td>
<td>360.48</td>
<td>423.3</td>
</tr>
</tbody>
</table>

The same procedures were applied to organic amendments.

To determine the heavy metal content in the plant and soil samples, inductively coupled emission spectrometer (Jobin Yvon Horiba "ULTIMA 2", France) was used. Three independent replicates were performed for each sample and blanks were measured in parallel.
Statistical analysis

Statistical analyses were conducted with Statistica v. 7.0. Pearson’s linear correlations were used to assess the relationships among pH, the soil organic content, various organic carbon fractions and available Pb, Cu, Zn and Cd in soil.

3. RESULTS AND DISCUSSION

The effects of compost and vermicompost on pH, soil organic content and organic fractions, and total N are summarized in Figure 1. The results obtained by us showed that the soil organic properties depended on the type and rate of the soil amendments and treatment.

3.1. pH

Soil pH varied with amendment treatment (Fig.1). Application of compost reduced the soil pH significantly as compared to control, whereas application of vermicompost in increased soil pH. The
direction of the change in soil pH as a result of treatment application reflected the initial pH of the amendment material. The increase in pH could be due to the higher pH value of the vermicompost (pH of 7.5) in relation to soil (pH of 6.5). However, this increase is not considered dangerous to soil quality because the values remained close to neutrality. The sensitivity of soil pH to the organic amendments was likely due in part to the low buffering capacity (Neilsen et al., 1995, 1998). The addition of vermicompost increased soil pH and pH increased with the higher dose of vermicompost. Contrary, Atiyeh et al. (2001) reported that the increase of vermicompost rate in the soil resulted in the decrease in soil pH. The production of NH$_4^+$, CO$_2$ and organic acids during microbial metabolism in vermicompost may be contributed to the decrease in soil pH (Albanell et al., 1988).

The addition of compost decreased soil pH. The obtained results confirm finding from Walker et al. (2003) that addition of compost to soil let to decrease soil pH. Smiciklas et al. (2002), Pattanayak et al. (2001) and Yaduvanshi (2001) also observed a decrease in soil pH after the use of organic materials. The production of organic acids (amino acid, glycine, cystein and humic acid) during mineralization (amminization and ammonification) of organic materials by heterotrophs and nitrification by autotrophs would have caused this decrease in soil pH.

3.2. Organic matter

Organic matter plays an important role in soil, because of its higher CEC and water holding capacities as well as its chelation ability and influence on soil stability. So, it is considered as a good resource of available elements. It improves soil structure, aeration and aggregation (Sparks, 1995).

3.2.1. Total organic carbon (TOC)

The increase of soil organic carbon with addition of organic amendments to soil is caused by high organic matter content of compost and vermicompost (Table 1). The application of organic amendments led to a significant increase in organic matter content, compared to its initial level (Fig. 1). The soils treated with compost and vermicompost exhibited a higher organic content than the control. Therefore, the addition of compost was able to affect the soil organic matter content, however,
in contrast to previous data (Bohn et al., 1985; Giusquiani at al., 1995), our data demonstrates that the organic content increase was proportional to the compost dose used.

### Table 2. Organic matter fractions according to Konova-Belichikova for organic amendments and treated soils

<table>
<thead>
<tr>
<th></th>
<th>TOC</th>
<th>Extracted with 0.1N H$_2$SO$_4$</th>
<th>Extracted with a mixture of 0.1N NaOH and 0.1M Na$_2$P$_2$O$_7$</th>
<th>C$<em>{HA}$/C$</em>{FA}$</th>
<th>Extracted with 0.1N NaOH</th>
<th>D4/D6</th>
<th>N</th>
<th>C/N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Aggressive fulvic acids)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compost</td>
<td>72.9</td>
<td>1.017</td>
<td>4.91</td>
<td>3.85</td>
<td>1.05</td>
<td>1.61</td>
<td>3.67</td>
<td>2.69</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.08</td>
<td>21.9</td>
<td>5.29</td>
<td>1.44</td>
<td>72.34</td>
<td>61.99</td>
</tr>
<tr>
<td>Vermicompost</td>
<td>38.58</td>
<td>0.829</td>
<td>3.77</td>
<td>2.28</td>
<td>1.49</td>
<td>34.81</td>
<td>1.53</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.15</td>
<td>9.77</td>
<td>5.91</td>
<td>3.86</td>
<td>90.23</td>
<td>4.54</td>
</tr>
<tr>
<td>Control Soil</td>
<td>2.22</td>
<td>0.416</td>
<td>0.61</td>
<td>0.15</td>
<td>0.45</td>
<td>1.606</td>
<td>0.34</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>18.75</td>
<td>27.6</td>
<td>6.91</td>
<td>20.3</td>
<td>72.34</td>
<td>51.8</td>
</tr>
<tr>
<td>5% V</td>
<td>3.99</td>
<td>0.168</td>
<td>0.94</td>
<td>0.39</td>
<td>0.55</td>
<td>3.04</td>
<td>0.71</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4.22</td>
<td>23.73</td>
<td>9.89</td>
<td>13.85</td>
<td>76.26</td>
<td>65.7</td>
</tr>
<tr>
<td>10% V</td>
<td>9.36</td>
<td>0.269</td>
<td>1.80</td>
<td>1.02</td>
<td>0.785</td>
<td>9.36</td>
<td>1.30</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.88</td>
<td>19.28</td>
<td>10.89</td>
<td>8.39</td>
<td>80.72</td>
<td>64.9</td>
</tr>
<tr>
<td>5% C</td>
<td>4.95</td>
<td>0.185</td>
<td>1.47</td>
<td>0.83</td>
<td>0.64</td>
<td>3.48</td>
<td>1.30</td>
<td>0.54</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.74</td>
<td>29.76</td>
<td>16.83</td>
<td>12.9</td>
<td>70.23</td>
<td>65.2</td>
</tr>
<tr>
<td>10% C</td>
<td>8.64</td>
<td>0.271</td>
<td>1.64</td>
<td>1.09</td>
<td>0.55</td>
<td>6.99</td>
<td>1.98</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.13</td>
<td>19.08</td>
<td>12.6</td>
<td>6.39</td>
<td>80.92</td>
<td>75.2</td>
</tr>
</tbody>
</table>

TOC – total organic carbon (% from soil mass); TEC – total extractible carbon (% from soil mass / % from TOC); HA – carbon from huminic acids (% from soil mass / % from TOC / % from TEC); FA – carbon from fulvic acids (% from soil mass / % from TOC / % from TEC); Humines (% from soil mass / % from TOC); Aggressive FA (% from soil mass / % from FA)

The organic content reached 3.99 and 9.36 % in result of adding of vermicompost at rate 5% and 10% respectively. Compost application led to increase organic content to 4.95 and 8.64% (Table 2). Both tested organic amendments had capacity to raise soil organic matter (Fig. 1), and there is no significant difference between these amendments, in spite of higher large organic matter content in compost (72.9%). The use of organic amendments increases the soil organic carbon and improves soil structure. Fortuna et al. (2003) argued that the vermicompost amendment could increase the carbon contents up to 45% of the original levels, and thus contribute to increase the soil structural stability, particularly that of the macroaggregates.

### 3.2.2. Organic matter characteristics

#### 3.2.2.1. Total extractable C, Humic and Fulvic acids, extracted with 0.1M Na$_2$P$_2$O$_7$+0.1N NaOH
Humus components were measured using the method proposed by Kononova and Belcikova (Kononova, 1966), by dividing the soil sample into several subsamples and by performing extractions with sodium pyrophosphate solution (0.1 M Na₄P₂O₇ x 10H₂O, 0.1 N NaOH, pH ≈ 13). The solution based on sodium pyrophosphate is considered to be the best extractant for humic fractions. The resulting extract is used for measuring the total extractable carbon (TEC) and the carbon from humic acids (HA), after removing the fulvic acids (FA). The total content of fulvic acids results from calculations.

The values for total extractable carbon extractable by 0.1M Na₄P₂O₇+0.1N NaOH (TEC) in control soil reached to 27.65%. Application of organic amendments led to decrease TEC content to 19.28 and 19.08% (Table 2). There is a correlation between the TEC in the samples and TOC (r=0.78) (Table 3).

Changes occurred in the content of humic acids and fulvic acids. Application of compost and vermicompost increases the content of humic acids and reducing fulvic acid compared to control.

| Table 3. Linear correlation coefficients among pH, the soil organic content, humus fractions and available Pb, Cu, Zn and Cd |
|-----------------|-------|----------|--------|--------|--------|---------|--------|--------|--------|--------|--------|
| pH TOC FA TEC | HA | FA | Humin | C_HA/C_FA | HA | D4/D6 | N | C/N | Pb | Cu | Zn | Cd |
| n | 1 | 0.78 | 0.65 | 1 |
| ns | 0.98 | 1 |
| TEC (pyr) | 0.54 | 0.70 | 0.80 | ns | 1 |
| HA (pyr) | 0.87 | 0.94 | 0.90 | 0.80 | 0.71 | 0.80 | 1 |
| FA(pyr) | 0.94 | 0.90 | 0.80 | ns | 1 |
| Humin | 0.54 | 0.70 | 0.65 | 1 | 0.71 | 0.80 | 1 |
| C_HA/C_FA | 0.52 | 0.70 | 0.72 | 0.40 | 0.35 | 0.85 | 0.40 | 1 |
| HA R₃O₃ | 0.42 | 0.42 | 0.34 | 0.50 | 0.70 | 0.50 | 0.81 | 1 |
| HA Ca | 0.85 | 0.94 | 0.90 | 0.80 | 0.51 | 0.36 | 0.74 | 0.83 | 1 |
| D4/D6 | 0.46 | 0.76 | 0.83 | 0.27 | 0.48 | 0.79 | ns | 0.92 | 0.52 | 0.52 | 1 |
| N | 0.31 | 0.97 | 0.98 | 0.69 | 0.83 | 0.69 | 0.55 | ns | 0.69 | 1 |
| C/N | ns | 0.92 | 0.88 | 0.78 | 0.99 | 0.78 | 0.87 | 0.73 | 0.41 | 0.80 | 0.80 | 1 |
| Pb | 0.74 | 0.47 | 0.50 | 0.33 | 0.36 | ns | 0.58 | 0.83 | 0.67 | 1 |
| Cu | ns | 0.52 | 0.67 | 0.42 | ns | 0.34 | 0.26 | 0.62 | 0.67 | 0.67 | 1 |
| Zn | 0.96 | ns | 0.37 | 0.71 | ns | 0.37 | 0.58 | 0.62 | 0.95 | 0.41 | ns | 0.87 | 0.21 | 1 |
| Cd | 0.91 | 0.47 | 0.44 | 0.54 | 0.65 | ns | 0.54 | 0.30 | 0.46 | 0.84 | ns | 0.40 | 0.94 | 0.40 | 0.95 | 1 |

TOC – total organic carbon, FA aggr.- aggressive FA, extracted with 0.1N H₂SO₄, HA (pyr) - extracted with a mixture of 0.1 N NaOH and 0.1M Na₄P₂O₇, FA (pyr) - extracted with a mixture of 0.1 N NaOH and 0.1M Na₄P₂O₇.
N NaOH and 0.1M Na₄P₂O₇, TEC- extracted with a mixture of 0.1 N NaOH and 0.1M Na₄P₂O₇, HA R₂O₃ - combined with R₂O₃, HA Ca – combined with Ca ns-not significant

3.2.2.2. Ratio of carbon of humic acids to carbon of fulvic acids. One of the major quality indicators of soil organic matter and its humified part is the ratio of carbon of humic acids to carbon of fulvic acids ($C_{\text{HA}}$:$C_{\text{FA}}$). The $C_{\text{HA}}$:$C_{\text{FA}}$ ratio was calculated to determine the types of humus: humic ($C_{\text{HA}}$:$C_{\text{FA}}$ >1.5), fulvic-humic ($C_{\text{HA}}$:$C_{\text{FA}}$ 1.0-1.5), and humic-fulvic ($C_{\text{HA}}$:$C_{\text{FA}}$ 0.5-1.0) (Grishina, 1986). The lowest values of the ratio $C_{\text{HA}}$:$C_{\text{FA}}$ were registered in control soils ($C_{\text{HA}}$:$C_{\text{FA}}$=0.3). The $C_{\text{HA}}$:$C_{\text{FA}}$ < 1 ratio showed that the bigger part of carbon was present in fulvic acids’ composition compared with humic acids. In organic soils, this ratio is indicative of the maturity and stability of soil organic matter. A $C_{\text{HA}}$:$C_{\text{FA}}$ ratio about or below 1.0 indicates a significant supply of plant debris, as fulvic acids are the first product of the humification process. Generally, a $C_{\text{HA}}$:$C_{\text{FA}}$ ratio in excess of 1.0 is beneficial, indicating that organic matter is stable and mature, and that permanent bonds with the mineral soil phase dominate over mobile formations, which are easily transported inside the soil profile (Kononova, 1966).

Organic supplements influenced considerably the humus fractions by changing the ratio $C_{\text{HA}}$:$C_{\text{FA}}$ in favour of the humic acids, in which changes of the type of humus from fulvic type in control to humic-fulvic type in addition of 5% and 10% vermicompost and humic type in addition of 10% compost. The changes in $C_{\text{HA}}$:$C_{\text{FA}}$ ratio as a consequence of compost and vermicompost addition to soils are presented in Fig.2. As expected, addition of compost to soils significantly increased the $C_{\text{HA}}$:$C_{\text{FA}}$ ratio. This is indicative of an increase in the carbon associated with the HA fraction. However, the increase was small in comparison with the large amount of organic matter applied. The small increase was in keeping with the quality of the compost used (Table1). The compost had a high content of total carbon (72.9%), but only (< 10%) of which was associated with humus like substances ($C_{\text{HA}}$ and $C_{\text{FA}}$) extractable using NaOH (Wu, 2001).

Knowing the quantity of humic substances in the soil is important because humic materials have a relatively high content of free radicals which play important roles in polymerisation and redox reactions. This affects the mobility of metals (both those with nutrient value and those that are of concern because they are pollutants), because cations with estimated reduction potentials of 0.5–0.7 eV are easily reduced by these radicals (Skogerboe and Wilson, 1981).

![Fig.2. Percentage of humic fractions in soil](image-url)
of the carbon was accumulated in insoluble humus compounds (humin and particulate organic matter). Addition of organic amendments led to an increase of the quantity of the humin, from 72.3% in control to 80.7% - 80.9% in soils with 10% vermicompost and 10% compost addition. Humin content was positively correlated with total nitrogen (r=0.69) and TOC content (r=0.78) (Table 3).

In addition to specific humus compounds (humic acids, fulvic acids, and humins), organic matter also comprises non-specific compounds (carbohydrates, amino acids, lignin, tannins, and others) that may not be extractable and are contained in humins (Simpson et al. 2007). In contrast to specific humus compounds, some non-specific humus compounds are susceptible to rapid microbial decomposition (Stevenson 1994).

The content of humic compounds in TOC is also defined by the degree of humification, expressed as the sum of humic and fulvic acids in TOC (Kononova, 1966). With the progression of humification in organic soils, nitrogen is accumulated in the complex humic compounds in the humin fraction (Okruszko, 1993).

### 3.2.2.4. HA extracted with 0.1 N NaOH

Application of the compost and vermicompost to soils led to an increase of the free humic acids and those bound to mobile R₂O₃. Application of compost and vermicompost led to an increase of the humic acid bound to R₂O₃ from 51.8% in control soil to 64.9% in soils amended with 10% vermicompost and 75.2% in soils amended with 10% compost (Table 2). Application of compost and vermicompost led to a decrease of the organic component mobility and most of the organic matter components bound very hard to minerals.

Changes in the content of humic acids bound to Ca²⁺ were found. Application of compost and vermicompost led to a decrease of the humic acids bound to Ca²⁺ from 48.2% (control soil) to 35.1% and 24.8% after compost and vermicompost application (Table 2).

### 3.2.2.5. FA extracted with 0.1 N H₂SO₄

Organic carbon extracted by 0.1 N H₂SO₄ (the most mobile and low molecular fraction of the organic matter) is presented in moderate values (18.75%) in control soil and could be able to influence the organic components mobility. Application of the compost and vermicompost reduces the amount of aggressive fulvic acids to 2.88 and 3.13% (Table 2).

It is well known that free and/or HA bonded to three valence cations (fraction 0.1 N NaON) and acid fraction (aggressive fulvic acids, 0.1 N H₂SO₄ extract) are organic matter components which pose a potential environmental risk. So, their lower content is a precondition for the low potential environmental risk of the soil with organic amendment studied.

### 3.2.2.6. D4/D6 ratio

The coefficient of colour Q, introduced by W. Shrpringer, was widely used for evaluating the character of the humus substances’ colour. It was equal to the ratio of the optical densities of two wave lengths with sufficiently intensive maximum of absorption - 465 and 665 nm: Q = λ₄₆₅ / λ₆₆₅ (Tomov and Artinova, 2005). The D4/D6 ratio of the HA fraction increased significantly as a consequence of the compost and vermicompost application (Table 2). Larger values of D4/D6 ratio have been associated with the presence of smaller size organic molecules or more aliphatic structures and usually with higher content of functional groups (Stevenson, 1994). It signifies the increase of carbon linked to HA, which was confirmed through the C₄₆₅/C₆₆₅ analysis. There was a positive correlation coefficient of 0.92 between C₄₆₅/C₆₆₅ and D4/D6 ratios. The presence of smaller sized, highly aliphatic molecules suggested that the organic matter fraction was more reactive and soluble through a wider pH range, characteristics often associated with the FA fraction of soil organic matter. Numerous researchers have shown the FA fraction of organic matter to be associated more with metal leaching than the HA
fraction (Gaffney et al., 1996; Chirenje et al., 2002a,b). Humic acids tend to be more aromatic and more prone to precipitation under the acidic conditions common in many soils, making them less mobile. Therefore, it could be argued that, while the FA fraction makes organic matter more reactive, it may also lead to greater leaching of both cationic nutrients and pollutants.

The increase of the optical density was correlated with the level of hydrolisability of the humic acids and more precisely with the participation of inhydrolisable residium in the molecule. A dependence between the correlation of the most important fractions in the humic acids’ molecule and their colour was revealed. The “more mature” humic acids had the highest values of optical density. The aromatic nuclei, carriers of carboxylic groups, prevailed in their structure (Tomov and Artinova, 2005).

3.3. Total N

The changes in the organic content in soils brought about changes in the total nitrogen content (Fig.1). Our calculations showed that there was a strong positive correlation between the total organic content (TOC) and the total nitrogen content with value of the correlation coefficient \( r=0.97 \) (Table 3).

The results showed that the total N concentration in soil was significantly affected by compost and vermicompost treatments. The soils treated with vermicompost at the rate of 10% had more total N compared to soils without vermicompost application. Vermicompost might have produced more residual N in soil than those in control plots. There have been other reports of increase of N in soil after application of vermicompost (Nethra et al., 1999).

3.3.1. Soil C/N ratio

The soil C/N ratio is often used to explain different turnover rates for early residue decomposition. The C/N ratios of the soils are narrow. N can be easily mineralised when the C/N ratio is less than 20:1. According to Mikkelsen and Hartz (2008) the C/N ratio of added organic materials is a good, but not an absolute, predictor of whether N immobilization is likely (C/N ratio > 25:1) or if mineralization is likely (C/N ratio < 20:1). In our study, the mean of C/N of soil was narrow (9.41 -12.67), below 20 in all soils (Table 2).

3.4. Mobile content of heavy metals (Pb, Cd, Zn, Cu)

In Fig. 3 are presents the results for quantities of mobile forms of DTPA extracted Pb, Cd, Cu and Zn from naturally contaminated soil from the region of Plovdiv and their change after adding organic soil amendments. An important factor influencing the mobility of Pb, Cu, Cd and Zn is the quantity of organic matter in the soil (Ross, 1994; McGrath et al., 1998, 2000). Many authors have found that soils with high organic carbon content, as well as adding organic fertilizer cadmium content in soil decreases. This effect is explained by the high cation exchange capacity of organic matter and its ability to form chelate complexes with Cd. Haghiri (1974) found that reducing the cadmium content of plants by increasing the amount of imported organic meliorants due to higher cation exchange capacity of the soil.

Organic amendments affect DTPA-extractable heavy metals. The results show that organic supplements affect differently on the amount of mobile zinc. Quantities extracted with DTPA mobile forms of zinc increases with the amount rate of the compost to soils. Application of vermicompost reduces the amount of available Zn to 193.1 mg/kg, while the addition of compost led to its increase to 328. 8 mg/kg.

The total Zn content, pH, organic matter, adsorption sites and microbial activity of the soil affect the Zn availability (Alloway, 1995). The soil pH is the most important factor controlling Zn availability, which decreases with the increase of the pH (Shuman, 1999). In this experiment increase Zn availability after compost application was attributed to the pH reduction and the greater organic matter degradation. Shuman (1999) found that retention of Zn in the soil increased in the presence of organic
fertilizers. Zn can form insoluble compounds - precipitates during the mineralization of organic meliorants (Walker et al., 2003) and insoluble compounds in the form of ZnCO$_3$ in calcareous soils (Usman et al., 2004). Shuman (1999) found that pH, clay content and organic matter and cation-exchange capacity influence the adsorption of Zn in soils. Mandal and Hazra (1997) found that the addition of organic amendments and lower soil pH leads to an increase in the amount of available Zn.

A correlation between the content of mobile zinc and soil pH and between mobile zinc and organic matter in the soil was found (Table 3).

Similar are the results obtained with respect to cadmium. Application of vermicompost reduced the amount of DTPA-extractable mobile forms of Cd from the soil, while compost can even increase Cd to 18.8 -19.2 mg/kg. Similar results were obtained from Karaca (2004) on the application of mushroom compost and grape marc. Reducing extracted with DTPA mobile forms of Cd may be due to the high cation exchange capacity of organic matter and the ability to connect Cd from the soil. Korcak and Fanning (1985) found a positive correlation between DTPA-extractable mobile forms of Cd and quantity organic matter content in the soil.

[Figure 3. Effect of different organic amendments (compost (C) and vermicompost (V)) applications to soils on availability of heavy metals]

Downward trend in mobile forms by the action of soil amendments is expressed more clearly in terms of Pb and Cu. In most cases, mobile forms of Pb and Cu diminished. Organic supplements lead to lower content of DTPA extractable Cu. The reduction of Cu content may be due to the transformation of organic matter in a stable form that could link more Cu.

Humic acids from organic amendments tend to form complexes that are different for each metal and also depend on soil conditions such as pH, cation exchange capacity and clay mineral fraction (Barancikova and Macovnikova, 2003). Organic matter not only forms complexes with these metals but it also retains them in exchangeable forms, affecting each metal differently. Some metals are bound and rendered unavailable while others are bound and readily available (Kononova, 1966;
Stevenson, 1994). The results of the present study indicated that enrichment of soil with organic matter could reduce the content of bioavailable metal species as a result of complexation of free ions of heavy metals. This is indicative of heavy metals immobilisation by humic substances from compost and vermicompost application. Results appear that verify the function of humic acid in improving phytoremediation efficiency of soils contaminated with heavy metals; and potential environmental availability of metals may be controlled by soil organic amendments.

4. CONCLUSIONS

Based on the results obtained we can make the following important conclusions:

1. Application of organic amendments leads to improved physical and chemical properties of soil. Applications of organic amendments to soils leads to increased content of N, the magnitude of this increase depends on the composition of organic amendment.

2. Compost and vermicompost application increases the soil organic content. Organic amendments influenced considerably the humus fractions by changing the ratio CHA/CHA in favour of the humic acids, in which changes of the type of humus from fulvic type in control to humic-fulvic type in addition of 5% and 10% vermicompost and humic type in addition of 10% compost.

3. Application of the compost and vermicompost reduces the amount of aggressive fulvic acids, organic matter components which pose a potential environmental risk. So, their lower content is a precondition for the low potential environmental risk of the soil treated with organic amendment.

4. Organic amendments reduce the amount of DTPA-extractable mobile forms of Pb and Cu, depended on the dose and decreased with an increase in application rate of amendments. The vermicompost treatments caused a decrease in the available content of Zn and Cd, while compost increased DTPA-extractable Zn and Cd.

5. The results of the present study indicated that soil application of compost and vermicompost in most cases decreased DTPA-extractable levels of heavy metals in the soil. This is indicative of heavy metals immobilisation by humic substances from compost and vermicompost application. Results appear that verify the function of humic acid in improving phytoremediation efficiency of soils contaminated with heavy metals; and potential environmental availability of metals may be controlled by soil organic amendments.

REFERENCES


47. Smiciklas, K.D., Walker, P.M. & Kelley, P.M. (2002) Utilization of Compost (Food, Paper, Landscape and Manure) in Row Crop Production. Department of Agriculture and Health Sciences, Illinois State University, USA.


THEORETICAL PREREQUISITES FOR COMPLEX AUTOMATED INFORMATION SYSTEM FOR REMOTE MANAGEMENT OF CRISIS SITUATIONS IN RAIL TRANSPORT

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Abstract

The article is aimed at presenting the current state of development of the KISDIS project, the overall objective of which is to create a comprehensive model of information system allowing its users to activate remotely the procedures for dealing with emergencies in rail transport. The basic methodology for selecting the type of hazard on railway has been developed and validated in the current phase of the project. This methodology, which is unique even from a broader European perspective, has not been published yet.

Key words: rail transport, information system, crisis situation

1. INTRODUCTION

The issue of critical infrastructure is high on the agenda worldwide. The current European security science prefers bringing solutions for the areas of power industry, transport and information technologies. The authors and their workplaces participate in a number of projects focused on three above-mentioned sectors of critical infrastructure. Solving the issues in transport sector is significant, because rail transport as a subsector of critical infrastructure plays a significant role in Central Europe.

The project VG20122015070/Ministry of Interior of the Czech Republic on the “Complex Automated Information System for Remote Management of Crisis Situations in Rail Transport with Focus on Critical Infrastructure”, called KISDIS, started in 2012. The first stage included the information analysis of available materials abroad with the aim to find similar projects carried out in particular European countries. The outcomes of the analysis confirmed that the electronic support for the management of crisis situations in rail transport has not been solved in any of the countries included in the survey.

The project started as part of security research of the Czech Republic in response to the call for the projects of applied research. The goal of the KISDIS project is to develop an expert information system, which would effectively combine crisis management of rail transport with regional crisis management. The currently used systems have been developed in different departments as autonomous systems and at present they do not enable users to share information on an emergency situation effectively and quickly. Therefore experts on rail transport and regional crisis management co-operate in the project.

There have been 23 types of hazards defined and accepted by all departments in the Czech Republic (Crisis Plan 2005), (Narušení funkčnosti 2010). The first stages of the project in 2012-2013 are aimed at developing the methodology which will exploit earlier defined types of hazards in the area of rail transport of the Czech Republic. With regard to the overall goal of the project it was necessary to
define a functioning data set, which will be the basis for the future expert information system. The outcomes of initial stages are very original. The proposed methodology has been tested in the conditions of rail transport and it is assumed that it will be certified on a national level. The outcomes of initial stages have become a real basis for the functioning of future complex information system for remote management of crisis situations in rail transport. (Vidrikova, Dvorak, Kaplan 2011)

2. ANALYSIS FOR THE METHODOLOGY OF HAZARD TYPES IN RAIL TRANSPORT

The initial analytical phase has been focused on updating a large information base. Information has been updated on the protection of critical infrastructure in the transport sector in Germany, Poland, Austria and the Slovak Republic. Information was also collected on the critical infrastructure hazard assessment in the above mentioned countries. Attention has been paid to the changes of support for restoration and reconstruction of damaged railway lines and facilities in the neighbouring countries. Special attention has been paid to the current outcomes of the projects within the 7th EU Framework Programme aimed at improving the long-distance control of rail transport and the information support of crisis management. Extensive analyses have been the basis for setting the further procedure within the KISDIS project. The principle precondition for work with the methodology selecting the hazard types is the fact that rail transport is considered to be a compact system. For the needs of the research the rail transport infrastructure is divided into individual railway lines and stations. When appropriate parameters are acquired the railway lines (or their parts) may be considered as being of certain type. Standardized documentation, which is elaborated for such a type, can be distinguished in a particular situation only by a number and name of station. Similarly, if the railway stations are classified into five categories, it is sufficient to elaborate documentation for one type of station and distinguish different stations by different names in operational documentation.

The procedure of activities according to the methodology represents the first step in the process of planning the measures for managing the crisis situations on rail and requires a good knowledge of the assessed railway line, terminology of transport, logistic and construction guidelines of the Railway Infrastructure Administration (hereinafter RIA). The methodical instructions enable not only the selection of hazard types from the list provided by the railway controller crisis information system. The methodology is logically ordered in compliance with the definition of hazard as one source of risk. Prior the final determination of particular type of hazard it integrates the completed analyses into one table in the order which is introduced in the KISDIS programme software environment.

2.1. Determining the basic multi-purpose criteria

Impacts on rail infrastructure (a subsector of critical infrastructure) are assessed by comparing a selected location with assumed consequences. The assessment includes both a particular location of critical infrastructure and the possibilities that a particular event may have an impact on the functionality of the element of critical infrastructure (Dvorak, Leitner, Sventekova, Sousek 2011), (Dvorak, Sousek, Englich 2007).

In case the location is hazardous, or the consequences have impact on the functionality of the element of critical infrastructure, its identification is changed (e.g. highlighted) and considered to be of higher priority during further processing. The multicriterial assessment is carried out in the following order of importance:

1. The determination of hazardous location;
2. The determination of risk source;
3. The activation of risk source;
4. Reason why the risk source may be activated;
Risk sources are always connected with a particular location. The crossings of railway lines with other line infrastructures are very frequent activation mechanisms of risks. Other frequent causes include unintentional mistakes of traffic participants, extreme weather conditions and technical breakdowns. A real emergency, a collapsed bridge on a railway corridor, is shown in Figure 1.

![Collapse of a road bridge on a railway line – Studénka 2008 (photo www.zelpage.cz)](image)

Figure 1. Collapse of a road bridge on a railway line – Studénka 2008 (photo www.zelpage.cz)

2.2. General Classification of Hazards

The authors firstly defined the general classification of hazards for rail transport on the basis of extensive analyses of real emergencies in rail transport and with the effort to employ the existing classification of hazards. The risk sources were transferred into particular hazard type names due to the preparation of a model and possible programming. It is registered in one sentence consisting of four parts, i.e. EVENT — RISK SOURCE ACTIVATION — LOCATION — CAUSE, in the following format:

1. “name of EVENT” caused by;
2. “name of RISK SOURCE ACTIVATION”;
3. in “name of LOCATION”;
4. caused by “name of CAUSE”.

Note: information written in quotation marks is inserted automatically from the database.

The range of own analytical research activities is evident from the decreasing number of generated types of hazards, see Table 1. They are significant part of the proposed methodology. [5]
Table 1. Changes in the number of identified names of hazards

<table>
<thead>
<tr>
<th></th>
<th>No of elements</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>original</td>
<td>current</td>
<td>original</td>
<td>current</td>
</tr>
<tr>
<td>Event</td>
<td>4</td>
<td>1</td>
<td>12.032</td>
<td>2.800</td>
</tr>
<tr>
<td>Risk Source Activation</td>
<td>47</td>
<td>50</td>
<td>12.032</td>
<td>2.800</td>
</tr>
<tr>
<td>Location</td>
<td>4</td>
<td>4</td>
<td>2.620</td>
<td>627</td>
</tr>
<tr>
<td>Cause</td>
<td>16</td>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The term change of operational conditions is used in the methodology for naming all the EVENTS on the railway. It may be characterized as a course of action which disturbed the traffic on railway and in order to identify the type of event better it may be subdivided in the following way:

- the stoppage of traffic – hazard may result in inability to operate the rail transport;
- the change of schedule – hazard may result in the reduced range of transport;
- the change of technology – hazard may have an impact on the work scheme;
- the change of service – although the infrastructure is not disturbed, the identified hazards may result in the change of services being offered.

The second important step is naming the RISK SOURCE ACTIVATION, which stems from the identification of risk sources. The risk sources identified in railway transport are facilities in railway infrastructure, railway buildings, constructions, operational personnel, customers and buildings and facilities near the railway line. Expert analyses, which took several months, defined 35 activation mechanisms altogether (e.g. fire, flood, explosion, collision, etc.)

The third step includes analyzing the location of the type of hazard by connecting the activation mechanisms with the risk sources. There were 50 possible combinations defined during an extensive expert discussion. These combinations in railway transport are significant and of quite high probability.

The CAUSES were divided into two basic groups (natural and man-made). The further procedure was based on putting them in relation to risk source activation. The risk source activation was related to location in the previous step (e.g. railway line, station, building, train). Probability of such combinations has to be always assessed. Unreal combinations have been excluded from further analysis. More causes have been considered (i.e. synergic effect) when calculating the type of threat. Their assessment and ordering resulted in 14 groups of causes according to their common characteristics, part of which is shown in Table 2 (the first 5 causes are mentioned as an example). They are written into the type of threat under the term “name of Cause”.
Table 2. Table of particular causes in relation to the name of cause (sample)

<table>
<thead>
<tr>
<th>No</th>
<th>Name of cause</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Atmospheric and cosmic anomalies</td>
<td>Storm, other electric phenomena in the atmosphere, cosmic radiation, magnetic anomalies, meteor impact.</td>
</tr>
<tr>
<td>2</td>
<td>Biological emergency</td>
<td>Extremely increased reproduction of insects transmitting the infection, increased numbers of weeds, viruses, bacteria, animal vermin, wild infected animals.</td>
</tr>
<tr>
<td>3</td>
<td>Mass dissatisfaction of population</td>
<td>national conflicts, racial conflicts, religious conflicts, violation of social reconciliation</td>
</tr>
<tr>
<td>4</td>
<td>Mass unrests</td>
<td>prisoners’ mass rebellions and escapes, disorderly conduct, unauthorized demonstrations</td>
</tr>
<tr>
<td>5</td>
<td>Human factor fault</td>
<td>tiredness, mistake, lack of attention, communication error, organizational shortcomings, inappropriate repair or maintenance, deviation from the determined operational conditions, operator’s fault, violation of operating procedures and occupational health and safety principles, safety system switched off, exchange of hazardous substances</td>
</tr>
</tbody>
</table>

3. SIMILAR SOLUTIONS ABROAD

The KISDIS project is focused on critical infrastructure, sector transport, subsector rail transport. Within the above-mentioned context it is necessary to respect international institutions and their recommendations and guidelines which significantly affect our area of interest. Firstly it is the International Union of Railways, information is available at www.uic.org. Secondly it is the European Railway Agency, information is available at http://www.era.europa.eu. The issue of critical infrastructure is tackled mainly by the EU joint research centre which aims its projects mainly at the protection of critical infrastructure (i.e. European Reference Network for Critical Infrastructure Protection), more information is available at http://sta.jrc.ec.europa.eu/index.php/cip-action-menu/38-erncip-task-force/172-european-reference-network-for-critical-infrastructure-protectionq-task-force.


A significant joint project of the USA and Canada has been aimed at assessing the elements of critical infrastructure. The project is available at http://www.ni2cie.org/CARVER2.asp and can be utilized also in the subsector of rail transport. As the outcome of the programme product is practical and fully functional its introductory screenshot with input data has been included into the text below.

Figure 2 – The introductory screenshot of the CARVER program product (Project CARVER2)

4. OUTCOMES AND DISCUSSION

The outcomes of the first year of the project may be divided into three groups. The first set of outcomes was based on a partial goal, which was aimed at identification and selection of suitable data. This goal has been met by creating the real data sets within the KISDIS project. The second set of outcomes has been aimed at real and practical benefits of the methodology for selecting and processing the types of hazards. The third set of outcomes resulted in the domain analysis and model cases to be employed in practice.

4.1. Identification and Selection of Suitable Data

The most significant data basis for the types of hazards in transport is The Type Plan of the Ministry of Transport called “Large-Scale Disturbance of Transport System Functionality”. At present the Plan has five annexes dealing with individual types of transport. The annexes are focused on rail transport, road transport, road economy, civil aviation, and domestic water transport.

The Type Plan provides users with data for crisis planning in rail transport. It also lists the risks related to the railway traffic, scenarios of development of crisis situations, primary and secondary impacts of crisis situations, conditions and prerequisites for managing the crisis situations, recommended type procedures, and requirements for resources.

Crisis plan is another significant data basis. It includes the summary of planning, methodical and information documents and data required for decision-making, control and co-ordination activities in a crisis situation. It standardizes the procedures of crisis management authorities in the area of transport, provides basic data and characteristics of possible crisis situations (it includes type plans) and determines possible solutions including their impacts on transport.
4.2. Methodology for Selecting and Processing the Types of Hazards

It has been decided to insert the name of hazard type into a pre-prepared matrix (see Table 3). Determining the types of hazards was the synthesis of general criteria, which includes all possible combinations generated from the EVENT, RISK SOURCE ACTIVATION, LOCATION AND CAUSE. The names have been compiled into a sentence in the following form and order:

- Name of EVENT with the help of word “due to”.
- Name of RISK SOURCE ACTIVATION.
- “in” name of LOCATION.
- “caused by” name of CAUSE.

<table>
<thead>
<tr>
<th>EVENT</th>
<th>RISK ACTIVATION</th>
<th>LOCATION</th>
<th>CAUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change of operational conditions due to</td>
<td>Bombardment of railway vehicle</td>
<td>On the railway line</td>
<td>Atmospheric and cosmic anomalies</td>
</tr>
<tr>
<td>Change of operational conditions due to</td>
<td>Immobility of traction vehicle</td>
<td>In train</td>
<td>Mistake caused by human factor.</td>
</tr>
</tbody>
</table>

Defining the types of hazards, their testing and verification in co-operation with experts on rail transport and regional crisis management resulted in the summary Table containing 627 types of relevant and quite probable types of hazards. The type names of hazards have become the basic database for prepared expert information system.

4.3. The Model of System Employment

The KISDIS information system consists of control and monitoring nodes. It includes at least one control node with the **KISDIS Windows system** (see Figure 3) and at least one monitoring node with the **KISDIS Internet system** (see Figure 4). In case of need a monitoring node of another information system may be added to the KISDIS system.

The main part of the **KISDIS Windows** system consists of three main components:

- KISDIS Windows Client,
- KISDIS Windows Mobile,
- KISDIS Windows Server.

The **KISDIS Windows Client** component will serve for inserting and editing the information on the management of crisis situations in the database. The KISDIS Windows Client component will be installed into the crisis manager´s work station.

The **KISDIS Windows Mobile** component will serve for receiving, displaying and reverse sending of information on the duties of task forces. This component will be installed into the task forces´ mobile phones.

The **KISDIS Windows Server** component will provide the exchange of information between the KISDIS Windows Client and the KISDIS Windows Mobile components. The information will be stored into the KISDIS database. Each control node will have one KISDIS database.
The mutual independence of all three components has been chosen as the main criterion of functionality of the whole KISDIS Windows system. Thus each component has been operational even in case the other components are not. The following Figure shows the basic employment of individual components of the KISDIS Windows information system and their inter-relations (see Figure 3).

Figure 3. Basic KISDIS Windows model of employment (author Kasal, R.)

Figure 4. - KISDIS Internet – basic model of employment (author Kasal, R.)
The surrounding co-operating information systems are standard e-mail servers enabling communication through IMAP and SMTP protocols and database servers or database files. Smart phones and Internet infrastructure are also parts of surrounding co-operating systems.

The KISDIS Internet system consists of the network of servers – nodes of the “KISDIS Internet Server” type and remote users – nodes of the “Remote user” type. The servers use HTTP server for providing information in the form of web pages. The servers may mutually update their data through the port types of web services. Server also implements the port types for the third parties’ information systems – node “Another remote server” (see Figure 4).

The remote users cannot communicate directly with each other within the KISDIS network; they are in the role of a client.

5. CONCLUSION

The first outcomes of the KISDIS project have been published in the paper. The universal employment of the proposed expert information system in relation to the administrator of critical infrastructure and public administration is a prerequisite for its future employment in the Czech Republic and possibly in other EU countries. The authors of the project believe that other activities of the project will result in the certification of the developer methodology on a national level. The primary goal of the project is to improve the information support of crisis management in two different areas – in rail transport and municipal crisis management.

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REFERENCES


Narušení funkčnosti dopravní soustavy velkého rozsahu, Ministry of Transport of the Czech Republic No: 116/2010-030-CRS, 1st November 2010

Vidrikova, D., Dvorak, Z., Kaplan, V.: The current state of protection of critical infrastructure elements of road transport in conditions of the Slovak Republic. Kaunas, Lithuania, Kaunas University of Technology, 2011

Web sources:
http://www.dhs.gov/topics
http://www.era.europa.eu
http://www.nato.int/cps/en/natolive/official_texts_75565.htm
http://www.ni2cie.org/CARVER2.asp
http://www.uic.org
INTELLECTUALIZATION OF TRANSPORT SYSTEMS FOR THE BENEFIT OF SAFETY AND THE SUSTAINABLE DEVELOPMENT OF TERRITORIES

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Abstract

The opportunity of intellectual transport systems application for maintenance of safe functioning city transport system in automobilization growth is considered in the article. For making of scientifically-proved managerial decisions it is offered to use a developing intellectual system of decision-making support. It is shown, that the complex problem solution promotes improving safety and decreasing ecological load on environment.

Key words: city transport system, traffic safety, management rational methods, simulation model

The major criterion of a sustainable development in the world is achievement of strategic balance between activity of the person and maintenance of reproducing possibilities of biosphere [5]. It is especially important for regional development since the region is the open difficult dynamic social ecological and economic system functioning under the influence of internal factors, realized through local governments, and external, caused by state economic and social policy [6].

Development of machinery and technologies, means of communications, and also globalization of economy are provided with dynamical development of transport and road branch, uniting transport systems of regions and the countries. In the report on a traffic security status in the world, prepared by World Health Organization (WHO), is underlined that «... promoting movement of the goods and people, road transportations benefit both to the countries, and separate persons. They facilitate access to workplaces, the economic markets, education, recreation centers and entertainments and to health services that, in turn, directly and indirectly has positive influence on population health. Nevertheless, growth of road transportations creates also considerable burden for health of people – in the form of a road and transport traumatism, diseases of respiratory tracts and consequences for the health, caused by reduction of physical activity. Air pollution, emissions of hotbed gases, consumption of nonrestorable resources, the household inconveniences caused by the neighborhood with a busy highway, and noise have number of additional negative economic, social and ecological consequences of movement of people and the goods on roads.

Development of scientific and technical progress and growth of well-being of the population promote increase both qualitative, and quantitative level of automobilization.

Automobilization in Russia goes by fast rates, lagging behind, however, economically developed countries of Europe, Asia and the North America. There are big regional distinctions in level of automobilization of the population: from high in capitals and the richest border and fuel regions (130 - 220 cars on one thousand inhabitants) to the lowest (from 100 to 10 cars on one thousand inhabitants). Regional differentiation, in a way, correlates with a variation of this indicator outside Russia: from countries of Eastern Europe (220 - 200) to developing countries of Asia, Latin America and Africa. Such distinctions are caused by a population standard of living [3]. According to S.A. Tarhov, increase of automobilization level of the population will lead to considerable change of spatial mentality and
improvement of an economic situation of people, and, hence, to a change of their attitude to environment and national economy and regions, to private responsibility increase for participation in development of domestic and regional economy, that is, finally, to increase of all population living standard of region and the country. At the same time, negative consequences of automobilization refer to air and soil pollution along highways and motorways, the noise pollution of the city and suburban environment increasing number of failures and victims of road accident, amplifying hypodynamia among drivers and all passengers of motor transport, and also strengthening of life dependence from negative consequences of automobilization, though freedom of driving a private car is considerably higher, than in public passenger transport.

Automobilization process goes along with an essential backlog of ecological indicators of vehicles operating in the Russian Federation and fuels and lubricants being used from the world level. Dynamics of automobile branch development is that growth of number of vehicles on city roads and considerable growth of city street traffic intensity, leads to sharp deterioration of traffic conditions and level of transport service. Backlog in development of a transport infrastructure leads to capacity reduction of highways, an aggravation of power problems and deterioration of an ecological situation as a whole that, in particular, leads to growth of diseases among the urban population [7].

The director of analytical agency Avtostat Sergey Tselikov specifies in paradox of automobilization in Russian regions. As he said, even in such large Russian cities, as Moscow, St.-Petersburg, Ekaterinburg and Samara where daily traffic jams practically paralyze a traffic, automobilization level is so far lower than in Europe – 330 - 350 cars on 1000 inhabitants (by October, 2011) [10]. According to agency Avtostat, population supply of cars by 1000 inhabitants began increasing sharply since 2005. Then only 176 cars fits 1000 inhabitants, by 2010 this indicator has grown to 231 cars, on the beginning of 2012 the park of cars in Russia has exceeded 35,5 million units that makes 250 cars on each one thousand inhabitants. At maintaining rates of automobilization by 2020 its level across Russia will grow to 350–360 cars on 1000 inhabitants, and in large megacities this indicator can come close to 500 cars, Sergey Tselikov considers.

Considerable growth of intensity of movement in city streets involves deterioration of traffic conditions, leads to growth of number of road and transport incidents (road accident) and victims in them people, and also to sharp deterioration of level of transport service of a city as a whole. As show researches, ecological and social costs (the expenses connected with local air pollution, road and transport incidents and stoppers) can reach 10 and more percent of gross national product of region or the country and considerably to exceed the sums necessary for initiation of transition to "green" economy [10].

Transport is that area in which effective both ecologically safe projects and the decisions should be used, capable to provide a sustainable development of a city infrastructure, keeping balance between comfortable living conditions and solicitous attitude to the nature. However, measures on optimisation and management of transport system of a city for today are based on intuitive and expert estimations which do not bear in itself any demonstrative base. The given measures lag behind development of transport system of a city and lead to that:

- Transport decisions which have not complete character and which efficiency is too small are made;
- The choice of economically inefficient priorities is carried out at drawing up of ground plans of new high systems, reconstruction of crossroads, introductions of new routes of passenger transport, designing of parkings etc.

Sergey Tkachenko, former director of Research and Planning Institute of Moscow General Plan, warned in 2010 that Moscow automobilization level by 2020-2025 can grow to 450-550 and more cars on 1000 inhabitants that is outside possibilities of a city infrastructure, town-planning and
territorial resources of Moscow. The head of Ministry of Transport Igor Levitin at the end of the last year said that more often town-planning errors and backlog of rates of road construction from automobilization level leads to traffic jams.

Thriving automobilization and limited street network capacity, especially in old cities with dense housing, have forced the authorities of megacities different continents to search for new possibilities of traffic jams and gas pollution control, to realize fresh ideas on creation of comfortable city environment, declaring an unconditional priority to high mobility of the population. In these conditions the only true and obvious decision is public transport development [6].

The analysis of condition and functioning of transport system of Russian cities testifies that its stability and safety decrease every year in view of discrepancy of automobilization increase rates to a street network infrastructure development level. Such tendencies remain despite measures taken on safety at transport, and also that automobilization level in Russia is still far from similar indexes in the countries of Europe (fig. 1 - 2).

![Fig. 1. Rating of federal districts of Russia on car security index on 1000 inhabitants [8]](image)

Every year the requirement for traffic optimization increases, in particular it concerns developing countries with dynamical automobilization growth. As experiment of the developed countries shows, many problems can be solved at the cost of transport networks perfection and a road infrastructure. However, possibilities of problem solving in such a way are frequently limited by many factors, the main of which is absence of road system expansion possibility. Management and redistribution of transport streams with use of the modern technologies united by the general term «intellectual transport systems» (ITS) can be the other solution where decision-making is based on the information received in
real time for the purpose of influence on transport behavior of participants of movement [1].

As experts «A+C Consult» specify, ITS help with the solving of the following problems:

- Optimization of transport streams distribution in a network in time and space;
- Increase in capacity of an existing transport network;
- Granting priorities for driveway to certain type of transport;
- Transport control in case of accidents, catastrophes or carrying out actions influencing traffic;
- Safety growth on roads that leads to capacity increase;
- Decrease in negative ecological influence of transport;
- Granting information on road condition to all persons concerned.

The basic ITS components and participants are:

- Transport infrastructure;
- Vehicles;
- The telematic equipment of transport infrastructure and vehicles elements;
- Intellectual information displays, traffic signs and traffic lights with possibility of their remote control;
- The centers of gathering and information processing;
- The centers of decision-making and traffic control.

The decision is found by world transport community in creation not control systems of transport, but transport systems in which communication facilities, management and control are initially built in vehicles and objects of an infrastructure. And possibilities of management (decision-making) on the basis of the information received in real time are accessible not only to transport operators, but also to all transport users.
Such problem is solved by construction of integrated system: person — transport infrastructure — vehicles, with the maximum use of the newest information and operating technologies. Such "advanced" systems are called intellectual.

At certain interpretation distinctions in different countries such definition can be generalizing.

ITS is a system integration of modern information and communication technologies and means of automation with a transport infrastructure, vehicles and the users, focused on increase of safety and efficiency of transport process, comfort for drivers and transport users.

For improvement of situations on roads development of an infrastructure and, in particular a network of streets should advance, or, at least, correspond to changes of automobilization level. It is extremely difficult to predict change of motor transport movement intensity on a city street network owing to reconstruction of roads sections, construction of the new centers of gravity, residential areas because it is necessary to consider a great number of likelihood parameters. In most cases network of streets reconstruction is carried out without growth of traffic volume and traffic density owing to what such measures as road section widening, building of new turns, additional lanes do not give a positive effect, and in some cases result in situation deterioration on roads.

Growth of vehicles number is not considered as well at construction of centers of population gravity. At constructing of driveways on shopping centers territory street network occupancy degree of adjoining sections that creates problems for drivers and pedestrians frequently is not considered, conducts to growth of road accidents and traffic jams.

At designing of new residential areas the problem with arrangement of parking lots is solved. However situations in courtyards remain difficult, frequently inhabitants prefer to park cars more close to the places of residence and if there are no parking lots nearby, cars "spend the night" on lawns, children's playgrounds and sidewalks, jamming passages on a courtyard which leads to emergency situations.

All it forms a complex of the problems complicating functioning of a city transport system. The complex solving of the specified problems can provide a use of the intellectual transport system considering various street network characteristics. Research with use of offered system can be spent in several directions:

1. The analysis of real situations arising on a street network (for example, accident, street cleaning) on simulation model taking into account average speed of movement and density of a transport stream, a waiting time in turns (en route delays) of vehicles and passengers.

2. Search of the optimum traffic control problem solving with a choice of changeable parameters (such as, time of traffic lights switching, quantity of lanes, etc.). Average speed on analyzed street network section, a waiting time at crossroads etc. can be a criterion function in this case.

3. Street network topology change influence forecasting (building of bypass roads, introduction of vehicles availability gauges at a crossroads, change of crossroads types etc.) on important characteristics of a transport stream.

Traffic jams control. The problem is solved by regulation of traffic intensity in the given direction, for example, a redirection of a passenger transport route on alternative roads [4].

Basis of system offered forms the multidimensional data model (OLAP-cube) (fig. 3 - 4).
The multidimensional intellectual data model is installed in traffic control center and serves for gathering, storage and formalization of road network parameters.

Measurements of analytical cube are:

1. Model, make and type of a car engine.
2. Season.
3. Time a day.
4. Average useful life of passing cars.
5. Traffic intensity.
7. Average speed of a stream.
8. Length of traffic jams and quantity of stops.
9. Total of cars passing in an hour.
10. Value of emissions in atmosphere (CO, NOx etc.).
11. Quantity of road accidents for the tested period.
The operative information which comes to Control centre in a mode of real time from various sources is necessary for correct reproduction in a model of real situations: from servers of the municipal enterprises, from the equipment for operative monitoring of a road situation (GPS/Glonass systems).

Storage of the information in the form of an OLAP-cube and its subsequent processing will allow to estimate street network parameter dynamics with high accuracy on different measurements (quantity of vehicles, a road section, a season, average speed, traffic light availability etc.). Packages of the formalized data are continuously transferred in a simulation system for changing of model parameters (fig. 5). Thus, the simulation model allows to consider every minute change of a situation on roads that is necessary for an estimation of the taken measures.

For working out of simulation models we use software product of the Russian company «XJ Technologies» - Anylogic [2]. The major goals of the constructed models are:

- Modeling of existing and predicted transport streams;
- Modeling of all road network and public transport network;
- The analysis and estimation of traffic rules and traffic intensity;
- Working off of scenarios «what will happen, if...»;
- Platform for transport and information systems.
- Traffic jams and congestion forecasting;
• Choice of the optimum traffic arrangement at crossroads and throughput estimation for each traffic variant;
• The analysis of throughput and traffic in a zone of stops taking into account a public transport priority;
• Optimisation of traffic lights operation;
• The analysis of "narrow" places.

Fig. 5. Scheme of information streams processing

The most productive system decisions are processed and register in the knowledge base from which subsequently, at incoming inquiry, one of the most suitable results stored in it is deduced.

ITS development project for Naberezhnye Chelny, which is the second largest industrial city and one of the most important traffic centres in the Republic of Tatarstan, can be an example of such decision. As the city actively develops, actual problems of passenger and automobile traffic analysis and forecast on a city street network are:

- estimation of accepted planning decisions on transport parameters: according to level of road sectors and junctions loading, speed, accessibility, road accident number;
- determination of street network sectors and junctions, which demands re-planning (change of geometrical parameters, updating of traffic light operating modes);
- determination of required flow capacity of reconstructed and street network sectors and junctions that are under construction.

Optimum method for the decision of the above-stated problems is simulation modeling. For the model adequately describing an existing situation, the preliminary stage includes:

- City data gathering as a whole;
- Mapping of an existing city street network;
- Studying the plans on street network reconstruction;
- Monitoring passenger and transport traffic;
- Data gathering on atmospheric air pollution level by motor transport on city roads.

Statistical analysis data of the information received at natural supervision can form the basis for construction of simulation model. Accuracy of the forecast at carrying out experiments on simulation model in case of its adequacy is up to 95-97% that allows solving formulated tasks. Use of simulation model allows to compare some possible variants and to choose the best for the given conditions, and also gives a chance for recommendation making on development of a city street network and planning of activities for its development.

One of problem sectors of Naberezhnye Chelny city is crossing of Chulman and Druzhby Narodov avenues (fig. 6). The City administration had been given the data about transport traffic of this sector. On the basis of the data presented by traffic police, it has been revealed that the given sector is a place with high concentration of road accidents that creates problems both for normal functioning of transport system and for environment where transport increases its negative influence by jamming.

For more detailed analysis of a sector its simulation model has been constructed.

The following factors have been considered:
- Geometry of a street network sector;
- Density of transport traffic;
- Intensity of a pedestrian stream in the sector with distribution on lanes;
- Traffic light operating modes in the previous and subsequent sectors.

As criterion function cars average speed was considered, because high speed becomes the reason of frequent road accidents in the given sector.

Results of experiment on a model have shown that on a considered sector street traffic is characterized by presence of the following adverse factors:
- High density of traffic.

Fig. 6. A view of simulation model of a considered street network sector before optimization
- High average speed of car traffic in a sector.
- Presence of unsupervised pedestrian crossing.

The scheme of a crossroads with a traffic light regulation has been offered for decrease of the adverse factors influence on traffic parameters. Making a few proposed changes into simulation model of a considered sector (fig. 7) with carrying out of the subsequent experiment on it, has shown that such variant will lead to decrease road accident, and also stabilizes parameters of transport and pedestrian streams. Objects "traffic lights" have been used in the model for the purpose of stream speed decrease and ensuring safe movement of pedestrians.

![Fig. 7. A view of simulation model of a considered street network sector after optimization](image)

The proposed plan on crossroads reconstruction, can lower emergency danger of a sector at minimum expenses, and also lower negative ecological load on environment. Besides, the optimum operating mode of the traffic light has been revealed, allowing providing pedestrians a possibility of crossing the avenue safely. The proposed decision has been approved by traffic police of Naberezhnye Chelny city and works on preparation for sector reconstruction are conducted at present.

REFERENCES


Tarkhov, SA 2004, *Regional distinctions of automobilization in Russia* (Russian), first number, Russian Federation, Moscow.


*The report on a traffic security status in the world. Time to work* (Russian) / World Health

*Intellectual transport systems - a necessary element of innovative development* (Russian), viewed 22 August 2012,

*The reason of the Chelyabinsk jams is found* (Russian), viewed 22 July 2012,


INNOVATIVE CONCEPT FOR MINIMISATION AND INTEGRATED MONITORING OF POLLUTANTS IN THE LEATHER INDUSTRY TOWARD SUSTAINABLE PRODUCTION

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Abstract

Sustainable development means that the needs of the present generation should be met without compromising the ability of future generations to meet their own needs.

Leather production recovers the hides/skins that result from the production of meat and transform them into a noble material that finds applications in a myriad of consumer goods.

Leather industry is, however, an environmentally intensive activity that can carry adverse effects to water, air and soil if the plant does not apply pollution prevention techniques.

The general objective is the development of innovative minimization techniques and of an integrated, computer aided-monitoring system for pollutants for the leather industry.

The new innovative technological & monitoring system presented in the paper will catalytically act for: improving the quality of the working environment, reducing/eliminating the pollutants, facilitating the implementation of the EMS and eco-labelling in the Romanian leather sector, contributing directly to its competitiveness and sustainable development

Key words: leather industry, integrated monitoring, VOCs monitoring, sustainable production

1. INTRODUCTION

The tanning industry provides a high added value material to a number of value chains, notably in the fashion, furniture and automotive sectors.

The raw materials of the European tanning industry are hides and skins of which over 99% are derived from animals that have been raised primarily for wool, milk and/or meat production. This fact clearly illustrates the ecological role of tanneries; recovering a by-product, which in the absence of the leather industry would have to be disposed of, thus demonstrating similarities with the recycling industry.

European tanneries base their leadership on a mix of tradition and innovation. They keep alive a number of traditional artisan processing skills that ensure the product’s high quality reputation, but invest in technological and non-technological research and development in order to remain at the forefront of product and process innovation.

Education and training, modern tanning machinery and efficient chemical auxiliaries, process automation and rationalisation, state of the art environmental protection and pioneering social responsibility all represent an integral part of the strategies of Europe’s tanneries towards sustainable development. Tanneries are capable of introducing continuously to the market new products and styles, and new applications for different end uses, but at the same time Europe’s comparative advantage lies in that its tanners include in the value offer of their leathers the intangibles reflecting their response to the global challenge of sustainable development (Economical, Environmental, Social) as set out by Brundtland in 1987 (Our Common Future, WCED).
1.1. Overview on the European Tanning Sector

The roots of European tanning industry can be found in very ancient times. Prehistoric tanning activities have left little archeological remains apart from certain flaying tools, some products and certain references and illustrative drawings. Quite a big well preserved tannery was discovered in the ruins of Pompei city (Italy), destroyed by the Vesuvio volcano more than two thousand years ago (August 24th 79 b.c.). Moreover, the importance of the industry has always been prominent for the European economy as, even at the beginning of the XXth century, the tanning sector still was one of the biggest industries of the whole area. Even if its incidence at global level has been declining in recent decades due to the growth of the sector in some emerging economies, the European tanning sector is still the global leader both in terms of:

(a) **turnover**, covering 26.7% on world total (after China, accounting for 29.5%);

(b) **overall quality** level reached by the industry through product and process innovation, as referred to **technology** (through a constant research on the processing cycle and product performance modernization), **environmental performance** (chemicals, water, solid waste and air emissions consequent to the tanning process are all treated and recycled), **social commitment** (relationships with workers and social dialogue with related trade unions have led to improved education and training and a constant reduction of injuries), **design and style innovation** (a very big importance is given to the research, the creation and the development of new fashion trends).

### THE EUROPEAN LEATHER INDUSTRY IN 2011

<table>
<thead>
<tr>
<th>Sector</th>
<th>Companies</th>
<th>Employees</th>
<th>Turnover (000 000 €)</th>
<th>Extra-EU Export (000 000 €)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tanning</td>
<td>1.783</td>
<td>34,504</td>
<td>7.750</td>
<td>2.307</td>
</tr>
<tr>
<td>Footwear</td>
<td>11.692</td>
<td>274,296</td>
<td>13.905</td>
<td>4.700</td>
</tr>
<tr>
<td>Leather goods</td>
<td>10.710</td>
<td>83,464</td>
<td>9.541</td>
<td>4.066</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>24.185</strong></td>
<td><strong>392.264</strong></td>
<td><strong>31.196</strong></td>
<td><strong>11.073</strong></td>
</tr>
</tbody>
</table>

Source: Eurostat, Entrepreneurial Association

According to last annual data available (2011), at present the sector is composed by nearly 1.800 companies and 34,500 workers. As outlined in the following graph, the trend in the last decade, following the production volume results, has been on the decrease for both elements: -25% for the number of companies, -36% for employees.

The tanning sector has traditionally been mainly composed by small and medium sized enterprises, but big companies have not been missing. At present, the average size of an EU tanning company is 18 person per enterprise and it is important to notice that in 2000 it was 24 with a continuous decline in the following years. In other words, it appears that small and medium sized companies have been giving a better response to the big changes characterizing the world leather market in the first ten years of the new century. From this point of view, the European national industries present different characteristics, mostly depending on their productive specialization. The most important tanning sectors of Southern Europe (Italy, Spain, Portugal, France) are mainly composed by smaller undertakings. These countries are mostly specialized in the production of leather for fashion sectors, that often need a craftsmanship approach that big companies are not able to provide. Conversely, the most important tanning sectors of Central and Northern Europe, focused on the upholstery
destinations, present higher average dimensions of companies as economies of scale play a key role in these particular marketplaces.

Figure 1. The European Tanning Industry - Number of companies and employees

Source: Eurostat, Entrepreneurial Associations

In 2011, the total turnover of the EU tanning industry was 7.8 billion Euro, corresponding to a production of 224 millions sq.m. of finished leathers and about 44 thousands tons of sole leather.

Italy traditionally represents also the main tanning country in the European Union. Its share on total production is around 62% in terms of total EU tanning turnover and 60% in terms of volume. There has been just a little increase as compared to 2002, as in that year the country accounted for 60% in turnover and 57% in volume.

Spain ranks 2nd, covering 10/11% (in volume and value) but registering a fall during the last decade (when its incidence was 12/13%).

Austria, France, Germany and United Kingdom are actually around 3% to 6% on the EU total. There were no very big changes for them if compared to ten years ago although their product mix in terms of market destination may have changed. With the exceptions of Denmark, Luxembourg and Malta, all the others EU members still record the presence of tanners in their own territories.

The European leather production has always been very flexible, processing hides and skins from all the main animal origins and serving all the main client manufacturing utilizations.

The analysis of the production in terms of animal typology reveals that the main origin processed by the industry has always been hides of large bovines (71% on total), followed by sheepskins (14%), then goat skins (8%) and calf skins (6%). The remaining animal raw materials processed (principally hides and skins from reptiles, pigs etc.) cover a very small part of the industry (less than 1%) and can be considered as niches. This segmentation, that is strictly linked to the meat industry, has never shown very big modifications.

The principal destination use of leather, not only in Europe, has traditionally been the production of leather for uppers for the footwear sector. That is still the first manufacturing client of the EU leather industry (41% on total). In spite of the big fall suffered by the market destination in the furniture sector during the recent years, the second most important utilization of EU leather is for upholstery; divided into furniture (17%) and car interiors (13%). Leather goods covers 19%, while garments presently absorbs 8% (2% for the remaining niche segments).
1.2. Environmental Indicators of European Leather Industry

Environmental sustainability of leather production is essentially based on three pillars: raw materials processed, process efficiency, pollution prevention and control.

With regard to **raw materials**, 99% of the hides and skins processed by European tanneries derive from animals that have been raised primarily for other economic purposes (wool, milk and/or meat production). Raw hides and skins are “renewable by-products” that are recovered and transformed, through a complex sequence of chemical and mechanical operations, into a high value added intermediate material for a number of strategic industries. In this context, finished leather represents a natural and renewable alternative to oil based products that are used for the same purposes.

The present section of the paper focuses on the description of a set of reference indicators summarising the environmental performance of European tanneries. Achievements in this area by the sector are the result of investments in both process technologies (improvement through process efficiency and process innovation) and in End-of-Pipe technologies (improvement through treatment of outflows, such as wastewater).

The definition of environmental expenditure adopted in the present report corresponds to the one proposed by Eurostat: “any expense incurred to implement an action whose main (direct or indirect) objective is to manage and protect the environment, that is an action deliberately and principally aimed at preventing, reducing or removing the environmental degradation caused by any production and consumption activities”.

Chemical auxiliaries are used in numerous processes of leather manufacturing. The interaction between chemicals and the dermis (hide or skin substrate) is needed to eliminate non-required substances and to modify the structure and mobility of the collagen fibres, in order to provide the final leather with the required physical characteristics, including its final appearance. Chemicals in tanneries are normally used either in an aqueous medium or sprayed onto the leather surface. Chemical product research and process development have been constantly evolving towards substitution of dangerous chemicals, reducing exposure at the workplace and improved occupational health and safety, process efficiency, higher exhaustion of processing baths and reduction of releases of spent chemicals into the natural environment.

Data collected by national tanners associations show an average value of 2.02 kg of chemicals per m² of finished leather over the 2010 – 2011 period. Reductions of the intensity of process chemicals, as well as an increase of eco-compatibility of auxiliaries are achieved through continuous experimentation and through the co-operation of tannery technicians with chemicals and machinery suppliers. Chemical consumption per product unit decreased by 6.2% between 2010 and 2011.

**Water consumption and discharge**: water serves as a medium for fundamental process phases, for example tanning and dyeing, which all occur in drums and other vessels through dissolved chemicals. Water is also used to wash leather, machinery and the workplace. The most important water sources are represented by authorised and regulated artesian wells located within the tannery site and industrial and civil aqueducts. Water supply and wastewater treatment represent the most important environmental aspects of the tanning industry.

Water consumption reported by European tanneries, per product unit averages 0.13 m³/m². The reduction of water consumption per product unit has been an environmental priority for European tanners over the years. This has been possible mainly through the setting of continuous improvement objectives aiming at developing water efficient processes and water recycling technologies. Almost 95% of the water used in tanneries is subsequently discharged; the remaining share is represented mostly by water that evaporates during manufacturing or the moisture content of waste sent to recycling and/or disposal.
The water discharged is then sent for purification. Unlike some non-European competitor countries, where environmental legislation is either lacking or poorly enforced, 100% of European tanneries treat their wastewaters through complete and complex purification systems.

The majority of leather production in south European countries is concentrated in tanning districts. Here, centralised effluent treatment plants have been built and improved over time. Centralised water purification plants managed by district consortia are an excellent international example of intercorporate collaboration for environmental sustainability. In this context, tanneries normally carry out only primary treatment within their facilities, delegating to the centralised effluent treatment plants the other necessary physical, chemical and biological treatments.

In territories where tanning districts are located, the same effluent treatment plants, originally created to serve the industry, have evolved over the years and nowadays also contribute significantly to the purification of civil wastewater.

Tanneries located outside industrial districts carry out wastewater purification independently, and discharge their treated effluent mostly to public sewage systems.

Tanning wastewater quality is mainly monitored by analysing the following 8 parameters: (UNESCO-IHE, 2011)

**TSS (Total Suspended Solids)**

This indicates the quantity of undissolved solids, which can be separated by filtration. In tanning operations, TSS mainly derive from residues of hides and skins, produced during the wet end operations, and from undissolved chemical products.

**COD (Chemical Oxygen Demand)**

The parameter indicates the quantity of oxygen required for the complete oxidation of the organic and inorganic compounds dissolved in the effluents. In tanning operations, COD values are affected by organic residues of hides and skins and by process chemicals that have not been fully exhausted (i.e. organic acids, tannins, resins, fatliquors etc).

**Sulphates (SO4=)**

Sulphates are contained in a vast range of tanning chemical compounds. Cooperation among tanneries and chemical suppliers is leading to the identification of alternative Sulphate free products.

**Nitrogen**

Nitrogen content in wastewater is generally expressed as TKN: Total Kjeldhal Nitrogen, namely, the concentration of total organic Nitrogen deriving from the breakdown of proteins and urea. In tanning wastewater, also ammonia (NH₃) and ammonium salts (NH₄⁺) are other significant parameters.

**Chlorides (Cl⁻)**

Chloride content in tanning effluents is derived mainly from the salt used in raw hide or skin preservation, dissolved in the first process phases, and from some chemicals (such as ammonium chloride, sodium chloride and hydrochloric acid) used in wet end operations. A high salt load can have negative effects on the water's osmotic potential and on its organoleptic characteristics.

**Chrome (III)**

Basic chrome sulphate (CrOHSO₄) is the most common tanning agent worldwide. The Chrome used for tanning is in its trivalent state of oxidation, in which it does not have the toxic characteristics associated to the hexavalent state.

**Sulphides (S=)**

These are compounds containing sulphur, which can be toxic to aquatic life. They are monitored to ensure that they do not exceed acceptable limits.
Sodium sulphide (Na₂S) is used in the initial processing phases, in particular, to remove hair from hides and skins. The environmental impact is due mainly to its potential toxicity in certain environmental conditions, to its contribution to the COD value and to the characteristic bad odour transferred to the water, which has less environmental impact but is more evident.

Minimisation of water pollution has been achieved in European tanneries through the development and implementation of process-integrated techniques, aimed at reducing the chemical content in wastewater, either by modifying chemical dosage, or by favouring high exhaustion of baths.

To produce one square metre of leather European tanneries consume 0,13 m³ of water. Effluent treatment systems implemented by tanneries are extremely efficient for almost all parameters monitored with the exception of dissolved salts, representing an unsolved technological problem at international level.

**Waste management:** European tanneries produce, on average, 2,14 kilograms of waste for every square metre produced. This figure might apparently represent an environmentally significant value, but the overall management and final destination of tanning wastes have to be taken into due consideration.

The weight of fully processed bovine grain side leather represents only approximately 20 – 25% of the weight of the raw hides entering the tannery. Some tanneries produce and market co-products (such as splits) as lower specification leathers. In other cases, by-products or wastes deriving from the tanning process are used as raw material for other production processes. Only a very small portion of the residues directly deriving from raw hides and skins do not find a second use. Other typical wastes of tanneries (such as sludge generated during wastewater purification treatments) have been mainly dumped in the past, although alternative technologies are emerging nowadays.

**Air emissions:** the main parameters affecting air quality in tanneries are Volatile Organic Compounds (VOC), dust and Hydrogen Sulphide. Moreover, the thermal systems used to generate heat release a number of pollutants during combustion, namely Nitrogen Oxides (NOₓ), Sulphur Oxides (SOₓ), and, of course, Carbon Dioxide (CO₂). On this latter parameter, innovative and very interesting sectoral approaches on Carbon footprint have been described in a technical report produced by UNIDO.

For emissions to the air, data provided by national associations on the consumption of organic solvents per product unit have been elaborated at European level; it is shown how average data (43,36 g/m²) does not differ very much from 2010 and 2011 annual values. Moreover, the evolution of solvent consumption compared to production in Arzignano - Italy, the biggest tanning district in Europe, shows that the trend for solvent consumption has been decreasing (-72%) from 1996 to 2011.

**Environmental costs:** environmental expenditures are defined in accordance with Eurostat as: “expenses incurred to implement an action whose main objective is to manage and protect the environment…” In European tanneries, the proportion of environmental expenditures of turnover amounts to 4,3%. The indicator increased by over 4% in one year. Considering the fact that common values of industrial margins (EBDTA) for tanning businesses seldom exceed 5%, the importance and magnitude of the effort towards environmental protection expended by European tanners, and the impact on their international competitiveness versus non-European tanneries become evident. This unbalanced playing field provides unfair and unethical comparative advantages to certain international competitors who follow much less sustainable industrial practices. If this issue is not adequately addressed, it will continue producing negative effects on the planet and on the European Leather sector that is engaged in producing wealth, jobs and progress, demonstrating virtuous conduct from an environmental point of view. Environmental protection should be rewarded rather than discouraged.

European tanneries review continuously the efficiency of their production processes, perform audits and undertake research into new, more efficient technologies. One important aspect for tanneries
(possibly leading to further environmental costs) is activity aimed at improving energy efficiency through, for example, adoption of less energy intensive techniques and greater use of renewable energy sources.

Competition in the globalised leather market will be increasingly affected by the way stakeholders reward tanneries’ environmental performances. All the efforts sustained in Europe over the years deserve to be valued more by public authorities and better incentivised through measures encouraging environmental investments and implementing tax credits in relation to the environmental expenses incurred.

These environmental indicators of the European Tanning Industry evidence an industrial sector that strives for excellence and that holds collectively a leading position at global level. (COTANCE, 2012)

2. EXPERIMENTAL

Having in view all these considerations, the general objective of the study was the development of an innovative minimization concept and of an integrated, computer aided-monitoring system for pollutants to aid a sustainable production in the leather industry. The three major scientific and technical objectives were: (i) identification of the significant environmental aspects for each activity by monitoring emitted pollutants; (ii) implementation of new ecological techniques for minimizing pollutants in leather manufacturing process; (iii) optimization of pollutant control/analysis methods by designing and implementation of an innovative monitoring system.

The new innovative complex (technological & monitoring) system resulted will catalytically act for: improving the quality of the working environment, reducing/eliminating the pollutants, facilitating the implementation of the environmental management systems and eco-labelling in the Romanian leather sector, contributing directly to its competitiveness and sustainable development.

2.1. Environmental Aspects of Leather Processing

"In order to prevent, reduce and as far as possible eliminate pollution arising from industrial activities in compliance with the ‘polluter pays’ principle and the principle of pollution prevention, it is necessary to establish a general framework for the control of the main industrial activities, giving priority to intervention at source, ensuring prudent management of natural resources and taking into account, when necessary, the economic situation and specific local characteristics of the place in which the industrial activity is taking place". (2010/75/EU Directive IPPC, 2010)

Hide processing results in environmental pollutants which are toxic to both human health and the environment and need to be carefully and closely monitored.

The tannery operation consists of converting the raw hide or skin, a highly putrescible material, into leather, a stable material, which can be used in the manufacture of a wide range of products.

A significant amount and variety of chemicals and specific products are used in the processes. The whole process involves a sequence of complex chemical reactions and mechanical processes. Amongst these, tanning is the fundamental stage, which gives leather its stability and essential character.

The tanning industry is a potentially pollution-intensive industry. The environmental effects that have to be taken into account comprise not merely the load and concentration of the classic pollutants, but also the use of certain chemicals: e.g., biocides, surfactants and organic solvents. Environmental issues associated with tanning sector include the following:

- Waste-water
- Air emissions
Solid waste
Hazardous materials

The quantities and qualities of emissions and wastes produced by tanneries strongly depend on the type of leather processed, the source of hides and skins, and the techniques applied. Due to the wide versatility of tanneries, both in terms of the types of hides and skins used and the range of products manufactured, the reported emission and consumption levels are generally indicative. The environmental impacts of tanneries originate from liquid, solid and gaseous waste streams and from the consumption of raw materials such as raw hides, energy, chemicals and water.

The main releases to waste water originate from wet processing in the beamhouse, the tanyard, and the post-tanning operations. The main releases to air are due to the dry-finishing processes (Albu, 2005).

The figure 2 provides the input /output overview from a modern bovine tannery (UNIDO, 2005; PPacheco, 2006).

2.2. Air Emissions in Tanneries and VOCs Monitoring

Air emissions from tanning facilities include organic solvents from tanning and leather finishing operations; sulphides from the beamhouse and wastewater treatment; ammonia from the beamhouse, tanning, and post-tanning operations; dust / total particulate from various process operations; and odours.

Emissions of sulphur dioxide may occur during bleaching, post tanning operations, or CO₂ deliming, but they are not typically a significant source of emissions.

Organic Solvents

Organic solvents are used in degreasing and finishing processes. Untreated organic solvent emissions from the finishing process may vary between 800 and 3500 mg/m³ in conventional processes. Approximately 50% of VOC emissions arise from spray-finishing machines, and the remaining 50% from dryers. Chlorinated organic compounds may be used and emissions released from soaking, degreasing, dyeing, fatliquoring, and finishing processes.

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Figure 2. Input/output overview from a modern tannery which has its own waste-waters treatment plant (WWTP) (Acronyms: COD - Chemical Oxygen Demand; BOD - Biochemical Oxygen Demand; Tot-N - Total Nitrogen; Cr - Chromium)
Pollution prevention and control measures include the following:

- Consider water-based formulations (containing low quantities of solvent) for spray dyeing;
- Implement organic solvent-saving finishing techniques such as roller coating or curtain coating machines where applicable (e.g., application of heavy finish layers), and otherwise use spraying units with economizers and high volume / low-pressure spray guns;
- Prohibit the use of internationally banned solvents under the Montreal Protocol on Ozone Depleting Substances;
- Control VOC emissions through the application of secondary control techniques. Examples of industry-specific controls include wet scrubbers (including the use of an oxidizing agent to oxidize formaldehyde), activated carbon adsorption, bio-filters (to remove odours), cryogenic treatment, and catalytic or thermal oxidation.

An innovative element is the use of sensors for the continuous monitoring of hydrogen sulphide, ammonia, dust, and volatile organic compounds, which will allow technological interventions and technical measures for reducing these emissions to standard levels.

This paper presents a versatile VOCs emission monitoring system for leather finishing process surveying.

It is known that Volatile Organic Compounds (VOCs) are one of the most pollutant substances emitted during industrial processes and especially in painting and leather industry. VOCs in the tanning industry vary in terms of composition and concentration versus time (Poncet T., 2006).

About 90% of the solvents contained in the leather finishing system evaporate during its application, which affects the air quality in the workplaces. VOCs are one of the sources for the stratospheric ozone depletion and ground level photochemical ozone formation. Mainly other organic compounds, as aldehydes, ketones, and ethers are toxic or carcinogenic human health sources. Thus, benzene and 1,3-butadiene are leukemia agents, formaldehyde is a nasal carcinogen, polynuclear aromatic hydrocarbons are lung cancer agents.

The following directions should be pursued in order to avoid VOCs:

- the application and use of water-based finishes;
- successful management of water-based topcoats;
- water collection and treatment of over-spray;
- biological treatment or absorption and catalytic oxidation of the emissions from the finishing operation.

VOCs are considered hazardous chemicals due to their explosion potential at specific concentrations. Theoretically, a system for gaseous control could be projected for contaminants concentrations under Low Explosion Limit (LEL) or over Upper Explosion Limit (UEL).

Due to uncertainly in LEL calculation, the monitoring system in real-time, are usually designed for concentration under 25% from LEL which offer a secure protection interval.
In the table below, there are presented the LEL and UEL for the most important VOCs:

<table>
<thead>
<tr>
<th>Chemical product</th>
<th>Low Explosion Limit (LEL) (%)</th>
<th>Upper Explosion Limit (UEL) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>2.5</td>
<td>12.8</td>
</tr>
<tr>
<td>Acrilonytrile</td>
<td>3.0</td>
<td>17.0</td>
</tr>
<tr>
<td>Ammonia</td>
<td>15.0</td>
<td>28.0</td>
</tr>
<tr>
<td>Benzene</td>
<td>1.2</td>
<td>7.8</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>1.3</td>
<td>50.0</td>
</tr>
<tr>
<td>Ethyl Alcohol</td>
<td>3.3</td>
<td>19.0</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>7.0</td>
<td>73.0</td>
</tr>
<tr>
<td>Gasoline</td>
<td>1.4</td>
<td>7.6</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>2.0</td>
<td>80.0</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>13.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Octane</td>
<td>1.0</td>
<td>6.5</td>
</tr>
<tr>
<td>Propane</td>
<td>2.1</td>
<td>9.5</td>
</tr>
<tr>
<td>Styrene</td>
<td>0.9</td>
<td>6.8</td>
</tr>
<tr>
<td>Toluene</td>
<td>1.1</td>
<td>7.1</td>
</tr>
<tr>
<td>Xylenes</td>
<td>0.9</td>
<td>7.0</td>
</tr>
</tbody>
</table>

The target expectations from a monitoring system of VOCs should be:
- evaluation of finishing products and formulation regarding such emissions;
- evaluating the efficiency of air purifying devices;
- objective, continuous and transparent value records;
- costs decreasing through abandon of outsourcing VOCs evaluation;
- integration of the monitoring system in a network computer inside of plant or connected to public authorities.

For research purposes have been tested three innovative systems for VOCs monitoring:
- Nondispersive Infrared absorption (NDIR) system;
- Gas Alert Micro 5 PID system;
- HC Detector with tin oxide semiconductor system.

First system was eliminated having no sensitivity for VOCs in tanning industry. For the second and the third systems have been obtained the results presented in figure 3.
Figure 3 – Measurements with GAM 5 PID and HC Detector systems

- For the first stage of the measurements (applying the surface coat with 250 s duration) PID system has no detection because the values of measured concentrations are in the limit of the fond in the cabin;
- In the second stage (applying the top finishing 250-500 s) the PID system has a delayed response (the collecting time of the sample is slower as the evacuation speed);
- The HC Detector has given the most accurate measurement for the both stages and the values are about 4 times higher as those detected by PID system;
- Having in view these results the HC system with the tin oxide semiconductor has been selected for tests in tanning finishing stages.

3. RESULTS AND DISCUSSION

The quantity of VOCs emissions depend on the substance used in the leather finishing process and the physical and chemistry process of deposition (EPA, 1993). The purpose of the developed process is to minimize the quantity of VOCs driven into the atmosphere. Water curtains are an efficient technique to control particulate emission. The exhaust passes through a water curtain that absorbs the particulates existing in the gas stream. The process monitorys by the authors are included in a suction hood with water curtains. The monitoring system has the role of evaluation the VOCs emission by testing the processes of leather finishing and establishing the best one from the point of view of VOCs emissions and also to verify that in the emitted VOCs in the atmosphere are in the range stated by international standards.

3.1. Hardware System Design

The monitoring system is intended to be a real-time one, in order to signal out any exceeding of the imposed limits. The monitoring system must fulfil the following requirements:

- to have a high sensitivity at low pollutant concentrations;
- to have low response time, in order to be a real time monitoring system;
- to be sensitive on a large range of substances & concentrations, especially to those existing in tanneries;
- the output signal must not depend on the temperature and humidity;
to be in accordance with all processes in the leathers finishing phase and with the given standards;

- a general net must be accomplished to guide the signals from the local microcontrollers to a central computer;

- to have low power consumption and a low price.

To obtain these requirements the monitoring system must contain: sensors for VOCs and temperature, the conditioning circuitry for these sensors, suction system of the gas in the hood (pump and the connecting hose pipes), data acquisition and computing system, graphic interface and a special housing, which gives ruggedness to the system, but enables the gas intake and has a graphic interface.

**Sensors**

The chosen sensor is rugged, small, high sensitive to many VOCs and low price one; it is a tin oxide sensor and its detection principle is conductivimetric. (TGS, 2006) Thus, the output parameter measured for such a sensor is its conductance $G_S$ which has a non-linear dependence to the output concentration (Caldararu M, 2006).

The sensor is temperature sensitive, thus a temperature compensation circuit was necessary. It was designed a compensation circuit with a thermistor, as given in figure 4, which is sensitive for leather finishing VOCs specific concentrations.

The voltages VRL and VTh can be measured separately and introduced in the controller, PLC type, which is used for data computing.

![Figure 4. Temperature compensation circuit](image)

**3.2. Data Acquisition and Computing System**

We used a Mitsubishi ALPHA 2 controller, as it can be programmed by using logic circuits. The used software is “Mitsubishi Alpha programming” version 2.40. The main characteristics of this controller are: fast and reliable, easy programmable, low dimensions, backlight display the entrances might be used as analogue or digital ones, has 200 block functions. The input signals are the voltages on the sensors (TGS, thermistor). The output signals are connected through a serial interface SR 232 to a graphical terminal GOT 1000 Mitsubishi. The graphic interface GOT 1000 is included on the front of the housing and has the following advantages: is a high resolution screen, with 65 536 colours; it is a „touch screen”, includes a RISC processor on 64 bits, it is in concordance with IP67 environmental...
conditions, it has a performant software GT Designer2, the connexions can be done with a serial port RS232C or Ethernet interfaces. The resulting system is presented in figure 5.

Figure 5. The VOCs monitoring system of the finishing processes of the tanneries

1- TGS 2602 sensor; 2- Suction system of the gas in the hood (pump and the connecting hose pipes); 3- Thermistor for temperature compensation; 4- PLC ALPHA 2 controller; 5- Graphic terminal (HMI – Human Machine Interface) with internal controller GOT 1000; 6- Anticondensation vessel & dust filter, 7- power supply for the pump

Operating steps

1) Start-up: The preconditioning of the measuring block including the sensor TGS 2602 for 10 minutes.

2) VOCs Monitoring: On the graphic screen is plotted the time evolution of the VOCs concentration and its instantaneous value is given. The pump can be stopped or set in motion through a touch screen button. The pump status is showed on the screen.

3) Emission value display: By using the touch screen the actual value of the VOCs concentration is given.

4) Settings: A special window for monitoring settings is designed. In this window the alarm threshold for VOCs alarm concentration can be adjusted. The temperature compensation can also be set in this window.

Software system design

The software is included in the two controllers of the PLC and HMI. The data are transferred through a serial interface RS 232 (Figure 6 and Figure 7).
The acquisition data and conditioning of the VOCs sensor TGS, the analogue/digital conversion are done by the PLC, using the software SW0D5-ALVLS-EUL. The logical diagram, using the blocks Flicker, Pulse and Counter, for the measuring block of our application is done in accordance with figure 6 (the dedicated communication window of the software).

The software for the HMI (Human Machine Interface) was designed using the special software media GT Designer 2 version 2.73B. All the graphical elements were done using this software. In addition the temperature correction was calculated also in this controller. In figure 7 a design window of the GOT 1000 software is given.

The VOCs monitoring system was used in the leather finishing cabinet developed by institute. It works well in the range of small VOCs concentrations (1 – 100 ppm) as well as in the range of the large concentration values (> 1000 ppm).

4. CONCLUSIONS

A versatile VOCs monitoring system was performed. Its large detection range (1 - 1000 ppm) makes it suitable for the VOCs emission monitoring applications in the leather finishing stage.

The research activity is continuing in order to develop other innovative systems using specific sensors for the computer-aided monitoring of hydrogen sulphide, ammonia and dust emissions in leather processing. All of these will allow technological interventions and technical measures implementing for reducing these emissions to standard levels.

Environment management is an important instrument for the improvement of the environmental performance of industrial activities. The implementation of such systems supports the global approach to environment problems, the economic relief of the impact upon the environment and the effectiveness of the human and material effort in the process of complying with the regulations in the environment protection field and sustainable development principles.

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REFERENCES


UNIDO-Mass Balance in Leather Processing, 2005

J. W. F. Pacheco et al, Water Management in the Tanning Industry – A Diagnosis under the Cleaner Production Principles in Sao Paulo State, Brazil - “Cleaner Production Initiatives and Challenges for a Sustainable World” São Paulo – Brazil, May 18th-20th 2011

2010/75/EU Directive IPPC; 24.11.2010


UNESCO-IHE Institute for water education of The Netherlands, Sustainable industrial emission limits for tanning industry, 2011

Poncet T., VOCs in the tanning sector: characteristics, reduction and treatment, World Leather, May 2006, p.16

EPA “Air emissions and control technology for leather tanning and finishing operations” EPA-453/R-93-025, 1993


REDUCING HEAVY METAL DISCHARGES IN TANNERY EFFLUENT
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Abstract
The main sources of heavy metals in tannery effluent are chrome-tanning agents that have not been completely consumed. In conventional tanning processes, it is already standard practice in large wet blue tanneries to precipitate the chrome and to recycle the reclaimed tanning agent, because the concentration of chrome is relatively high. If the chrome cannot be recycled, the amount of chrome tanning agent applied needs to be kept as low as possible in order to minimize discharges of chrome in the waste water.

This paper presents an organic tannage system (wet-white pretannage), alternative to chrome tannage, which considerably reduces environmental problems.

Key words: tanning, chromium, leather, wet white leather, free of chrome leather

1. INTRODUCTION
Chrome tanning is the most common type of tanning in the world. Chrome tanned leathers are characterised by top handling quality, high hydro-thermal stability and excellent user properties. Chrome waste from leather processing poses a significant disposal problem. It occurs in three forms: liquid waste, solid tanned waste and sludge. In most countries, regulations governing chrome discharge from tanneries are stringent. Today, all tanneries must thoroughly check their waste streams. Chrome discharge into those streams is one of the components that has to be strictly controlled.

The environmental impact of chrome waste from tanneries has been a subject of extensive scientific and technical dispute. Statutory limits have since been set for chrome discharge and disposal, and relevant guidelines have been drawn up throughout the world.

Given the close correlation between chrome tanning and the environmental impact of leather processing, auditing the efficiency of processing operations takes on prime importance.

Conventional chroming process generally involves in pickling, chroming and basifying, and there are several defects existing in the process (Sykes 1981, Germann 1995): i) 8-10% salt and 1.0-1.2% sulfuric acid were used in pickling, which results in higher contents of chlorides, sulfates and chemical oxygen demand (COD) in the effluent. ii) The uptake of chromium in conventional chroming is lower (70-80%), a considerable amount of chromium left in the effluent may result in environmental problems(Ludvik 1997). iii) A great deal of chrome containing solid wastes such as splittings and shavings are produced, which is certainly difficult to be degraded and harmful on the environment if discharged directly (Tao Zhang et al, 2009).
Figure 1. Collagen-chromium (III) compounds – crosslinked

Much criticism has been directed towards the use of chromium salts in leather tanning, but it has to be borne in mind that chromium can occur in different oxidation states and its compounds behave differently. Most chromium(VI) compounds are highly toxic and classified as MAK III A 2 carcinogens, but chromium(III) is an important trace element in man and animals.

Chromium compounds are, or at least used to be, one of the most common causes of occupational skin disorders. Chromium(III) is not regarded as being sensitizing, because it does not readily penetrate the skin, but water-soluble chromium(VI) compounds penetrate the skin very easily. Chromium(VI) is then reduced intracutaneously to trivalent chromium, which enables it to react with the proteins in the skin and trigger an allergic reaction.

The issue of chrome is perhaps one of the most debated issues between authorities and the tanning industry because of the difference in opinion about the toxicity of chromium (III) salts used in the tanning industry. The tanning industry has the view that the chromium (III) tanning agent is not toxic and can be compared with table salt. Authorities opinion is that chromium (III) should be considered toxic, especially for aquatic life. What is agreed is that chromium (VI) is much more toxic than chromium (III). The toxic mechanism of action differs for hexavalent versus trivalent chromium. Hexavalent chromium causes cellular damage via its role as a strong oxidising agent, whereas trivalent chromium can inhibit various enzyme systems or react with organic molecules. Chromium (III), the naturally occurring form, has low toxicity because it is non-corrosive and passes poorly through membranes, but chromium (VI) is highly toxic because it has strong oxidation characteristics and passes readily through membranes.


Despite the fact that chromium has been under pressure from some regulatory authorities, the extent of substitution of chromium tanning agents has been limited. The main reason for this is that chromium is the most efficient and versatile tanning agent available, and it is relatively cheap.

These practical and operational constraints have resulted in attempts to find an alternative to chromium (III) tanning (German H.P., 2010) for the production of free-of-chrome (FOC) leather, whilst retaining the mineral character in leather. Accordingly, Al (III) (Hernandez J.H., 1983; Hancock
R. A. et al., 1980), Zr (III), Ti (III & IV) (Bi Yu Peng et al, 2007), Kleban, M., US Pat, Appl. No. 200601151738, their mixed salts (Covington A.D., US Patents 4563156, 4731089) and most recently nano-silicates (Liu, Y, et al 2010) and sodium waterglass were tested as effective partial or total replacement tanning agents or for the production of a reversibly tanned new intermediate semi-processed product and commodity: “wet-white” or “wet-stabilised” leather. Overall metal ion complexes have some affinity for protein, but when applying the criteria of adequate reactivity colour, availability, cost and toxicity eliminates nearly all of the commercially available agents as viable options.

Syntans, Resins, and Polyacrylates are agents used alternatively or in addition to chrome and vegetable tannins.

Previous research studies demonstrated that using oxazolidine (Roig M. et al. 2011) (Figure 2) or resorcinol tanning agents (Hiu C. et. al. 2009) (Figure 3) combined with other (vegetable or synthetic agents) allows for the obtaining of quality leathers that can be used by footwear and upholstery industries.

Figure 2. Oxazolidine E

![Oxazolidine E](image)

Figure 3. Resorcinol

![Resorcinol](image)

1.1. Oxazolidines (Angus Chem. GmbH) are saturated heterocyclic compounds prepared by reacting primary amino alcohols with formaldehyde. Monocyclic or bicyclic oxazolidine ring structures are formed depending on the choice of starting chemicals, it is therefore possible to synthesize a variety of oxazolidines from different amino alcohols. Oxazolidines are highly useful chemicals for a wide variety of applications: corrosion inhibitors, emulsifiers, diluents or tanning agents. The oxazolidine marketed for use as tanning agents are water soluble compounds, compatible with most chemicals normally used in tanning operations and can be introduced at several points in the tanning process.

The capacity of the Oxazolidine E for tanning leather is based on the formation of a reaction intermediate due to:

- the protonation of oxygen of each ring in acid medium, which weakens the C-O bond or,
- the oxazolidine rings opening caused by hydrolysis in an acid medium to provide an intermediate with two N-(hydroxymethyl) groups, and the subsequent nucleophilic attack of the collagen amino groups to this intermediate specie (Figure 4).

Leathers tanned with chromium salts have a high stability, determined by a shrinkage emperature (Tg) over 100°C, while the leathers tanned with oxazolidine alone reach shrinkage temperatures of below 75°C. It is therefore necessary to carry out the oxazolidine tanning in combination with synthetic or vegetable tanning agents to achieve higher shrinkage temperatures and obtain leather of comparable quality to the chrome tanned leather.
1.2. Resorcinol is a diphenol which can be transformed into a prepolymer by Manich reaction with formaldehyde.

![Collagen-oxazolidine crosslinked](image1)

**Figure 4. Collagen-oxazolidine crosslinked (Roig M. et al. 2011)**

![Tanning agent based on resorcinol pre-polimer](image2)

**Figure 4. Tanning agent based on resorcinol pre-polimer**

1.3. **Resorcinol – Oxazolidine E**

Recent studies demonstrated that resorcinol-oxazolidine treated collagen is more stable system than that with sequential combination tannages with the same materials. The study has demonstrated that oxazolidine E underwent ring opening to form the N-methylol intermediate and reacted with the hydrogen bonds of resorcinol to form Tanning Matrix. The Tanning Matrix then penetrated into the collagen fibres and by aggregation prevented the denaturation of collagen fibres of heating. The next reaction is the involvement of hydrogen bonds and hydrophobic interactions, and the aldehyde groups of oxazolidine E in reaction with basic amino acid side chains of collagen as the major force involved in stabilization of collagen. In this way, a multiple point combination tanning occurs with the Tanning Matrix creating a high level stabilization of collagen and high hydrothermal stability (Hui C. et al, 2009).

This model of reticulation of resorcinol-oxazolidine E with collagen is shown in the Figure 6.

This paper presents the results obtained from different tanning tests on cowhides, at a pilot scale, using oxazolidine, resorcinol prepolymer or oxazolidine-resorcinol combination as an alternative to
traditional chrome tanning. It is presented the procedures followed, physical characterization of obtained leathers, as well as the impact of this technology on waste water and solid waste generated.

Figure 6. Reticulation model of resorcinol -oxazolidine E with collagen

2. MATERIALS AND METHODS

Salted cowhides were chosen as raw material for the chromium-free leather production for determining the effects of the newly synthesized leather tanning products. These newly synthesized organic tanning agents based on pre-polymers shown in Figures 2 and 3 were used as pre-tanning agents for this study. (F. Platon et al., 2010).

The Figure 7 presents the Flow Chart for conventional and experimental processes and the Figure 8 presents the equipment for experiments at pilot scale.

Figure 7. Flow Chart for conventional and experimental processes.
3. EXPERIMENTAL

Wet salted cawhides were treated from soaking to bating as usual. The bated pelts were cut along the backbone line, left parts for conventional process, and right parts for the experimental ones. The chemicals employed in the experiments are of commercial grade, the chemicals used for analytical technique are of reagent grade.

![Figure 8. Tanning drum used in pre-tanning tests on pilot scale](image)

Experimental and conventional processes are provided as Table 1. As Table 1 showing, bated pelts were directly pre-tanned with oxazolidine E (Experiment E3). The bated pelts were of high pH value (6.8-7.0) and most active groups of collagen were exposed. Control sample was made using Chromium salts (Experiment C) on pickled pelts. The other experiments were conducted also on pickled pelts at 2.8-3.0 pH. Then the pre-tanned pelts were split and shaved.

<table>
<thead>
<tr>
<th>Exp code</th>
<th>Process</th>
<th>Chemical</th>
<th>Time</th>
<th>pH&lt;sub&gt;initial&lt;/sub&gt; – pH&lt;sub&gt;final&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Conventional chrome tanning on pickled pelts</td>
<td>8% Chromium salts (25% Cr_2O_3) + 10% sodium bicarbonate</td>
<td>8 hours</td>
<td>3.0-4.0</td>
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<tr>
<td>E 1</td>
<td>Pre-tanning with Oxazolidine E on pickled pelts</td>
<td>2 % Oxazolidine E</td>
<td>5 hours</td>
<td>3.0-4.8</td>
</tr>
<tr>
<td>E 2</td>
<td>Pre-tanning with Resorcinol and Oxazolidine E on pickled pelts</td>
<td>4% Resorcinol pre-polymer + 2% Oxazolidine E + 1% sodium bicarbonate</td>
<td>10 hours</td>
<td>2.8-4.8</td>
</tr>
<tr>
<td>E 3</td>
<td>Pre-tanning with Oxazolidine E on bated pelts</td>
<td>2 % Oxazolidine E</td>
<td>5 hours</td>
<td>6.8-8.5</td>
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</table>
The pre-tanned leathers were analysed for shrinkage temperature presented in the Table 2.

Table 2. Shrinkage temperature (Ts) of the pre-tanned leathers

<table>
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<th>Experiment code</th>
<th>Shrinkage temperature, Ts, °C</th>
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In the Table 3 the characteristics of tanning effluents are presented.

Table 3. Characteristics of Tanning Effluents

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<th>Organic tannings experiments</th>
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<td>2.</td>
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<tr>
<td>3.</td>
<td>Chrome oxid, g/dm³</td>
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</table>

4. RESULTS AND DISCUSSION

Results indicated that the highest Ts of combination tanning leathers is resorcinol pre-polymer-oxazolidine E in sequence. In course of resorcinol pre-polymer tanning first the tanning parameters were pH 3.0 and 4% dosage (based on weight of cow pelts), and the tanning parameters were pH 3.5 and 2% dosage when oxazolidine E as tanning agent. The Ts of pre-tanned leather with resorcinol-oxazolidine combination was 72°C (Experiments E2).

Pickling is a preliminary process for preparing hides for tanning, largely by adjusting the pH with acid and controlling the swelling with salt. Higher salt concentrations in the tannery effluent resulting from the conventional pickling process have been an environmental concern, leading to a trend in developing a salt-free pickling process. Additionally, failure to control the swelling of hides during this step would lead to damage or defects in the fibre. This not only impacts the subsequent tanning process, but also the final quality of the tanned leather. In this study of salt-free pickling process oxazolidine E was used and compared to a conventional acid/salt pickling process (Experiments E1 and E3).

The penetration of the new tanning agents reflected by Shrinkage temperature (Ts) was not only complete, but also uniform, assuring stabilization of the wet-white leathers for further mechanical or other chemical processing.
All characteristics of Chrome Tanning Effluent (experiment C) are higher than those of experimental organic tanning.

The benefits of the novel tanning system using oxazolidine or/and resorcinol as the pre-tanning agents are:
* no chromium in organic tanning effluents which make it easier and cheaper to treat;
* residual salt could be significantly reduced;
* because the system eliminates a pickle step, there is a reduction in strong mineral and organic acids use;
* the tanning process could be reduced by up to five hours;
* the shrinkage temperatures ranged from 68-72°C, depending on the substrate.

5. CONCLUSIONS

Oxazolidines and resorcinol can be used as tanning agents in several different ways as illustrated in this paper.

Combinations of oxazolidines with resorcinol can replace chrome tanning without sacrificing the physical and thermal properties of the tanned leather. Finally, with the use of oxazolidine, a more effective salt-free pickling process can be achieved and the environmental impact within leather manufacturing can be further reduced.

Since there was no chromium existed in the splittings and shavings, the wastes could be treated and reused more easily.

ACKNOWLEDGEMENTS

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REFERENCES

Bi Yu Peng et al, Novel titanium (IV) tanning for leathers with superior hydrothermal stability II. The influence of organic ligands on stability and tanning power of titanium sulfate solutions, JALCA, 102(9), 261, 2007
COTANCE, The European Tanning Industry Sustainability Review, 2002, World Summit on Sustainable Development
Covington A.D., US Patent 4563156
Covington A.D., US Patent 4731089, Synektan TAL, ICI
German H.P. - *Sustainable Leather Manufacture: A realistic target or Wishful thinking? –* LERIG Congress India, 2010


Hernandez J.H., JALCA, 78(8), 217, 1983

Kleban, M., *Chrome-free Waterproof Leather*, US Pat, Appl. No. 200601151738


DETERMINATION OF ATTERBERG LIMITS USING SEISMIC REFRACTION METHOD

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Abstract

P-wave velocities were determined from seismic refraction studies at 42 different locations where the bore-holes were drilled in the Kocaeli region, NW Turkey. Two layers were identified from seismic refraction studies. 42 P-wave velocity values were calculated both for the first layer (residual soil) and the second layer (saturated soil). 42 undisturbed soil samples were collected at a depth of 1-2m in the first layer and 8-9m in the second layer in order to figure out their Atterberg limits (liquid limit, plastic limit and plasticity index). The P-wave velocity values were correlated with corresponding values of Atterberg limits. Results indicated that liquid limit, plastic limit, and plasticity index exhibit reasonable good correlations with P-wave velocity ($R^2 = 0.63$ - $0.797$). Relationships are logarithmic functions. Liquid limit, plastic limit, and plasticity index decrease logarithmically with an increase in P-wave velocity. It can be concluded that the Atterberg limits of saturated soils can be predicted from P-wave velocity measurements for preliminary investigations.

Key words: Atterberg limits, saturated soils, P-wave velocity, regression analysis

1. INTRODUCTION

Determination of seismic wave velocities in saturated soils is very significant in order to figure out their physical and mechanical properties as well as to make correlation with other soil index and geotechnical properties. Seismic wave propagation in saturated soils has investigated by many authors (Garg et al., 1974; Gajo 1996, Miura et al., 2001; Kurtulus, 2000; Bozkurt and Kurtulus, 2009; Kurtulus et al., 2009; 2010). Fener et al., 2005 conducted P-wave velocity measurements on the undisturbed soil samples and correlated P-wave velocity values with the corresponding values of Atterberg limits. They found good logarithmic functions between P-wave velocities and Atterberg limits. The Atterberg limit values are very important in civil engineering for seismic mitigation of structure placed on soil foundation consist of saturated soil. The composition of soils is an important factor which influences some soil properties, such as shear strength, liquid (LL), plastic limit (PL) etc. Determination of Atterberg limits requires soil sampling and laboratory studies. It takes time and effort. In this study, the Atterberg limits (LL, PL and PI) were correlated with P-wave velocity determined from seismic refraction method.

2. GEOLOGY AND LOCATION OF INVESTIGATION AREA

Paleozoic, Paleocene-Eocene, Pleistocene and Quaternary-alluvium aged formations are located in the investigation area (Fig.1). The saturated soil was considered in this study. The saturated soil layers in the investigation area differ both laterally and horizontally. The soft soils consists of yellowish sand and mil, rare greenish marl and shale, silty sandy clay, sandy silty clay, gravelly sandy silty clay, sandy, silt, gravel and clay. The soils composed of average 12.29% gravel, 27.23% sand and 60.48% clay and silt, and 20.62% water content.
3. DEFINITION OF P-WAVE VELOCITY IN SOILS

The P-wave velocity ($V_p$) is defined as (Dobrin, 1976; Telford et al., 1977; Kurtulus, 2010)

$$V_p = \sqrt{\frac{\lambda + 2\mu}{\rho}} = \sqrt{\frac{K + 4/3\mu}{\rho}}$$

Where, $\lambda$ is the Lame constant, $K$ is the bulk modulus, $\mu$ is the shear modulus, and $\rho$ is the bulk mass density. The elastic constants of soils are dependent of some parameters, including the state of effective stresses, void ratio, water content, and cementation.

4. PHYSICAL DEFINITION OF ATTERBERG LIMITS

Atterberg limits are a basic measure of a fine-grained soil. They can be used for identification, description, and classification of fine-grained soils. Atterberg limits define four states for a soil depending on the value of the water content. The liquid limit is the minimum moisture content at which the soil can flow under its own weight; the plastic limit is the minimum moisture content at which the soil can be rolled into a 3 mm diameter thread without breaking; the shrinkage limit is the moisture content where further loss of moisture will not result in any more volume reduction.

5. LABORATORY STUDIES

42 undisturbed soil samples were collected within the boreholes at about 1-2 m of depth remained in the first layer (residual soil) of the stratum and another 42 samples were taken in the same boreholes at about 8-9 m of depth remained in the second layer determined by seismic refraction method (Fig. 1). These, samples were tested in the laboratory to determine their liquid limit (LL), plastic limit (PL) and
plasticity index (PI). The tests were performed in accordance with ASTM D4318-standart Test Methods for liquid limit, plastic limit and plasticity index of soils. The test results are given in Tables 1 and 2.

Table 1. P-wave velocity values of the first layer and Atterberg limits determined from the soil specimens collected 1-2m of depth in the first layer

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<th>No</th>
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Table 2. P-wave velocity values of the second layer and Atterberg limits determined from the soil specimens collected 8-9m of depth in the second layer

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7. SEISMIC REFRACTION SURVEY

The seismic refraction surveys were conducted at 42 different locations in the Kocaeli area (Fig 1). The seismic data were recorded using a 12 channel Geometrics Seismic Enhancement (Smart Seis) seismograph. The first arrival phases assumed to be refracted from the same interface, the P-wave velocities were calculated from the slope of the line connecting these phases and then extended the line connecting these phases back to zero offset point using GeoSeis computer program (Fig 2). We determined that the slopes of the lines were best fitted to the points of the first breaks. The calculated P-velocities for the first and the second layers are illustrated in Tables 1 and 2. The P-velocities of the first layer range from 260m/s to 587m/s whereas those of the second layer 623m/s to 1428m/s. The depth of the first layer (residual soil) varies between 1.5m and 3.5m.

8. CORRELATION ANALYSIS

Correlations between P-velocities and Atterberg limits of the specimens determined from the first and second layers were performed. The liquid limit, plastic limit, and plasticity index exhibit good correlations with P-wave velocity. The relations follow a logarithmic function. Liquid limit, plastic limit, and plasticity index decrease logarithmically with an increase in P-wave velocity. The P-wave velocity and Atterberg limits of second layer showed slightly better correlation than that of the first layer’s (Figs. 3-8). The empirical relationships between Vp and PL, LL, PI for the first and second layers are illustrated in Table 3. The relation between (Vp₁) and (PL₁) has the maximum correlation coefficient (R²=0.7971) and relation between (Vp₂) and (PL₂) has the minimum correlation coefficient (R²=0.633).
Fig. 3. Scatter data of $(Vp_1)$ and $(LL_1)$ for the first layer

$y = -18.34 \ln(x) + 151.8$

$R^2 = 0.7576$

Fig. 4. Scatter data of $(Vp_1)$ and $(PL_1)$ for the first layer

$y = -4.185 \ln(x) + 44.273$

$R^2 = 0.7587$

Fig. 5. Scatter data of $(Vp_1)$ and $(PI_1)$ for the first layer

$y = -14.16 \ln(x) + 107.53$

$R^2 = 0.6548$

Fig. 6. Scatter data of $(Vp_2)$ and $(LL_2)$ for the second layer

$y = -23.78 \ln(x) + 210.14$

$R^2 = 0.7755$

Fig. 7. Scatter data of $(Vp_2)$ and $(PL_2)$ for the second layer

$y = -6.08 \ln(x) + 61.673$

$R^2 = 0.7971$
Fig. 8. Scatter data of \((V_p)^2\) and \((PI)^2\) for the second layer

### Table 3. Correlation between P-wave velocities and Aterberg limits determined from the first and the second layers

<table>
<thead>
<tr>
<th>Empirical equation</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(V_p_1=-18.34\ln(LL_1)+151.8)</td>
<td>0.7576</td>
</tr>
<tr>
<td>(V_p_1=-4.185\ln(PL_1)+44.273)</td>
<td>0.7578</td>
</tr>
<tr>
<td>(V_p_1=-14.16\ln(PI_1)+107.53)</td>
<td>0.6548</td>
</tr>
<tr>
<td>(V_p_2=-23.78\ln(LL_2)+210.14)</td>
<td>0.7755</td>
</tr>
<tr>
<td>(V_p_2=-6.08\ln(PL_2)+61.673)</td>
<td>0.7971</td>
</tr>
<tr>
<td>(V_p_2=-17.7\ln(PI_2)+148.47)</td>
<td>0.633</td>
</tr>
</tbody>
</table>

### 9. CONCLUSION

P-wave velocity is affected by the liquid limit and plastic limit of the soils. Therefore, many authors have been tried to find out same relations between these parameters since the determination of liquid and plastic limits of the soils is a time-consuming job. Many attempts for this purpose were done using ultrasonic pulse velocities. We attempted to figure out correlations between the P-wave values obtained from seismic refraction studies and corresponding values of Atterberg limits. Two seismic layers were identified in the seismic refraction studies. The first layer consists of residual soil and the second one consists of saturated soil. For that reason, the soil samples were collected from the first and the second layers to check which correlations would give better results. The relations follow a logarithmic function. Liquid limit, plastic limit, and plasticity index decrease logarithmically with an increase in P-wave velocity. Reasonable good correlations with the correlation coefficients ranges between \(R^2 = 0.633\) and \(0.7971\) were obtained. The relation between \((V_p_2)\) and \((PL_2)\) has the maximum correlation coefficient \((R^2=0.7971)\) and relation between \((V_p_2)\) and \((PI_2)\) has the minimum correlation coefficient \((R^2=0.633)\). The correlation coefficients of \((V_p_2)\) and \((PL_2)\) and \((V_p_2)\) and \((LL_2)\) are slightly higher than the correlation coefficients of \((V_p_1)\) and \((PL_1)\) and \((V_p_1)\) and \((LL_1)\). It can be concluded that it is easy to predict Atterberg limits from P-wave velocity calculated from seismic refraction studies for preliminary investigations since it is easy, economic and fast.
REFERENCES


FATTY ACID CONTENT IN LIPIDS FROM WILD MICROALGAE STRAINS FROM AMATITLÁN LAKE

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Abstract

Microalgae are known to produce oils, and some, in considerable amounts. In this work, oils were extracted from microalgae biomass, and their fatty acid profiles evaluated. Biomass was obtained from the culture of 8 microalgae strains from Amatitlán Lake, as well as that produced at the shore of the lake. Microalgae strains were isolated through micromanipulation, establishing a strain bank in the laboratory at Instituto de Recursos Energéticos, Universidad Galileo. The strains were cultured in COMBO culture medium and biomass was obtained. The oil was extracted using hexane in a Soxhlet apparatus. Extracts were analyzed by gas chromatography, obtaining fatty acid profiles for each. Nine strains were evaluated; Chlorella vulgaris showed the highest oil percentage (36%). 7 strains showed very similar profiles, with balanced proportions of SFAs, MUFAs and PUFAs. The main fatty acids were: palmitic, palmitoleic, oleic, linoleic and linolenic. Optimizing culture conditions may raise oil percentages and improve fatty acid profiles for selected strains. Lake phytoplankton biomass contained a high percentage of SFAs (80%), mostly palmitic. Currently, the commercial production of microalgae for biodiesel is not feasible by itself. Nevertheless, if the technical limitations of the processes are overcome, the methodological intricacies unraveled, and the bioproduct diversity exploited, the production of biodiesel from microalgae should be in the future.

Key words: biodiesel, microalgae, biomass, fatty acids.

1. INTRODUCTION

The potential for the exploitation of microalgal biomass has been proposed by many authors in the last decade (Campbell, 2008; Chisti, 2007, 2008; Cohen, 1986; Gouviera & Oliveira, 2009; Loera-Quezada & Olguin, 2010; Sheehan et al, 1998). In Guatemala, studies to determine the energetic potential of microalgal biomass have not yet been performed. At the time, most part of the biofuels are produced from sub-products of the sugarcane industry, which are transformed to ethanol. Biodiesel has been produced from the seeds of Jatropha curcas, a native plant used as live fence in rural areas of the country. Unfortunately, harvesting costs are too high to be economically feasible (Openshaw, 2000). Recently, the advantages of producing microalgae biomass from sewage water treatment plants, has been pointed out, within which we can mention the following: their ability to purify the water and fixing carbon, as well as the generation of feedstock for biofuel production (Shilton, Mara, Craggs, & Powell, 2008).

A number of bioproducts can be obtained from the biomass of various species of microalgae. Several have been exploited massively, and more are being bioprospected and studied for productivity and profitability. Through the expansion of the diversity of bioproducts that are obtained from a particular
massively cultivated strain, it is possible to support the financial viability of producing biofuels from microalgae.

Amatitlán Lake is a polluted water body located at 20 km from Guatemala City. It has a surface extension of 152 km², an average depth that oscillates between 20 and 33 m, and a water level that fluctuates between 1.5 and 2.3 m. Visibility is quite low; measured with Secchi disk, it varies between 0.1 and 0.8 m. It is located at an altitude of 1200 m.a.s.l., and it is subjected to a local average annual rainfall of about 2,847 mm (Pérez, et al., 2011). Along its calm shores phytoplankton biomass accumulates due to the constant input of sewage waters discharged along the lake’s watershed. The main objective of this research was to evaluate the oil content and fatty acid profiles of wild microalgae strains from this lake.

2. MATERIALS AND METHODS:

2.1 Isolation of Microalgae Strains

Isolation of strains was done using the traditional micromanipulation technique (Andersen, 2005), applying sterile technique (Kawachi et al, 2005) from the samples previously cultured in flasks. The procedure was performed in sterile conditions in a laminar flow hood, assisted with an inverted microscope. The clean individual cells were inoculated in culture tubes with sterile culture medium. All isolated cultures were exposed to cool white fluorescent light during 12 hour photoperiods to promote cell growth and the establishment of unialgal cultures. Strains were maintained in non-axenic conditions and propagated into further culture tubes in liquid culture media. The following strains were isolated:

- Chlorella sp. 1
- Chlorella sp. 2
- Chlorella vulgaris
- Chlorophyceae “G”
- Monoraphidium griffithii
- Scenedesmus acutus
- Schroederia spiralis
- Selenastrum capricornutum

Taxonomic identity of microalgae strains was determined with the aid of literature by Bellinger (2010) and Lee (2008), and internet taxonomy sites (Guiry, 2011; Guiry & Guiry, 2011; PhytoAtlas, 2011).

2.2 Biomass Production

Biomass was produced, for every strain that would be analyzed, through the following steps: a) propagation of inocula, b) massification of inocula and, c) inoculation in tanks. The first step was to propagate the original strain into further culture tubes, in order to have the sufficient inocula for the further steps. These were given a maximum of three weeks to grow and be used. COMBO culture medium recipe was obtained from Andersen (2005). Each tube inoculum was used to inoculate sterile culture media in 500ml glass flasks. These cultures were given two weeks to develop and used as inocula for larger volumes of culture medium. For the last step, 10 gallon glass tanks were filled with culture medium, and inoculated with the previous cultures in flasks. The conditions given for the
cultures were: 16 hr/day light provided by 40W cool white fluorescent lamps and constant aeration by aquarium pumps connected to aerating stones. Growth was allowed for three weeks to ensure maximum yield prior to harvesting the algal biomass.

2.3 Harvesting and Dehydration of the Biomass

The generated biomass was harvested by sedimentation and further centrifugation, to obtain an algae paste. The paste was washed by suspending in deionized water and reconcentrating by centrifugation to remove dissolved salts, bacteria and cellular debris. This procedure was repeated several times until the water came out clear after centrifugation.

Biomass was dehydrated in a solar dryer at a maximum temperature of 55 °C. Thin algae flakes were obtained and grinded mechanically. The powdered biomass was stored in refrigeration until the extractions were performed.

2.4 Oil Extraction and Fatty Acid Profile Determination

Lipids were extracted from dry biomass for all of the strains evaluated. The Soxhlet method was applied, using hexane as solvent. Each extraction was performed with a maximum of 30 gr of dry, powdered biomass, through a period of 5 to 6 hours. The hexanic extract was stored for further fatty acid profiling.

The fatty acid profile was performed for 9 lipidic extracts: 8 from isolated strains and 1 from wild biomass; following AOAC 969.33 and AOAC 963.22 standards (AOAC, AOAC Method 969.33. Fatty Acids in Oils and Fats, 2000). The oils were concentrated at 40°C at reduced pressure and dried under a nitrogen atmosphere, derived to their methyl esters, and chromatographed through an HP-88 (100m x 0.25 mm x 0.20 µm) stationary phase chromatography column, using an ionized flame detector. The identification of profiles was performed by comparing against the patterns of 35 fatty acids. The extracts contained oils and photosynthetic pigments (mainly chlorophyll and carotenoids), although, the last were not analyzed.

3. RESULTS

3.1 Fatty Acid Profiles from Microalgae

Results from the fatty acid methyl ester (FAME) analysis are presented in Table No.1. The left column shows the list of fatty acids detected in the analyzed extracts, including that of the wild biomass. Values are presented in percentages of total sample analyzed. Fatty acids detected range from 6 (caproic acid) to 24 carbon atoms (lignoceric and nervonic acids). The most abundant fatty acids range from 16 to 18 carbon atom chains. Fatty acids out of this range were found in the most cases as traces.

Table No. 2 shows dry weight oil percentages obtained from 4 strains of microalgae and the wild biomass collected at the shore of Lake Amatitlán. The highest percentage (36%) was obtained from *Chlorella vulgaris*. Wild phytoplankton biomass attained 17%, and *Scenedesmus acutus*, 12.70%. All other strains had oil percentages lower than 10%.
**Table No.1 [Part 1]. Fatty Acid Profile Analysis.** Fatty acid percentages present in biomass lipid extracts from 8 microalgal strains and wild lake biomass are shown. The three last rows account for the total of fatty acids according to the degree of saturation.

<table>
<thead>
<tr>
<th>Fatty Acid / Microalga Species</th>
<th>Wild Lake Biomass</th>
<th>Chlorella sp. (1)</th>
<th>Chlorella vulgaris</th>
<th>Chlorophyceae “G”</th>
<th>Monoraphidium griffithii</th>
<th>Scene desmus acutus</th>
<th>Schroederia spiralis</th>
<th>Selenastrum capricornutum</th>
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<tbody>
<tr>
<td>Caproic Acid (Hexanoic) (C6:0)</td>
<td>0.77</td>
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<td>0.79</td>
<td>0.87</td>
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<td>0.34</td>
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<td>0</td>
<td>0.45</td>
<td>0.56</td>
<td>0.78</td>
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</table>
Table No.1 [Part 2]. Fatty Acid Profile Analysis. Fatty acid percentages present in biomass lipid extracts from 8 microalgae strains and wild lake biomass are shown. The three last rows account for the total of fatty acids according to the degree of saturation.

<table>
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<th>Fatty Acid / Microalga Species</th>
<th>Wild Lake Biomass</th>
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<th>Chlorella sp. (2)</th>
<th>Chlorophyceae “G”</th>
<th>Monoraphidiun griffithii</th>
<th>Scenea desmids</th>
<th>Schroederi spiralis</th>
<th>Selenastrum capricornutum</th>
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<td>17.95</td>
<td>17.91</td>
<td>20.61</td>
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<td>0.78</td>
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<td>18.67</td>
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<td>13.58</td>
<td>25.99</td>
<td>32.77</td>
<td>31.84</td>
<td>34.65</td>
<td>27.11</td>
<td>35.91</td>
<td>27.65</td>
</tr>
</tbody>
</table>
Table No. 2. Oil Percentage in microalgae biomass. Oil percentage in dry weight was evaluated for 4 isolated strains and wild lake biomass.

<table>
<thead>
<tr>
<th>Strain</th>
<th>Oil Percentage (w/w)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wild Lake Biomass</td>
<td>17</td>
</tr>
<tr>
<td>Chlorella &quot;diminuta&quot; 1</td>
<td>2.48</td>
</tr>
<tr>
<td>Chlorella &quot;diminuta&quot; 2</td>
<td>3.07</td>
</tr>
<tr>
<td>Chlorella vulgaris</td>
<td>36</td>
</tr>
<tr>
<td>Chlorophyceae &quot;G&quot;</td>
<td>1.38</td>
</tr>
<tr>
<td>Monoraphidium griffithii</td>
<td>4.15</td>
</tr>
<tr>
<td>Scenedesmus acutus</td>
<td>12.70</td>
</tr>
<tr>
<td>Schroederia spiralis</td>
<td>4.93</td>
</tr>
<tr>
<td>Selenastrum capricornutum</td>
<td>8.75</td>
</tr>
</tbody>
</table>

From the 24 fatty acids detected in the samples, 5 (palmitic, palmitoleic, oleic, linoleic and linolenic acids) were the most abundant in the 9 extracts. Graph No. 1 shows in a comparative manner the percentages of these fatty acids. In general terms, oleic and palmitic acids were the most abundant. In proportion, the wild biomass reached the highest percentage of palmitic acid (75.26%), vastly higher than the percentage in the pure strains. *Selenastrum capricornutum* is the closest, with 46.04%, and Chlorophyceae “G” the lowest, with 15.29%. This should reflect in the physical properties of the corresponding oils. Palmitic acid melts at 63°C, palmitoleic acid at -0.1°C, oleic acid at 16°C, linoleic acid at -5°C, and linolenic acid at -11°C. The higher content of palmitic acid will reflect in the tendency to solidify at room temperature. Ascending proportions of the other fatty acids will confer the oil a higher fluidity at low temperatures, with palmitoleic and oleic acids being the best, due to the combination of fluidity and oxidation stability. High proportions of poly-unsaturated fatty acids have proven not to be a desirable characteristic of oils for biodiesel, due to their low oxidation stability. The highest proportions should ideally be met by palmitoleic and oleic acids, conferring the oils with fluidity and oxidation stability.
Graph No.1. Abundance of the main fatty acids in microalgae strain biomass extracts. 
Percentages of the five more abundant fatty acids (palmitic, palmitoleic, oleic, linoleic and linolenic) in the lipidic extracts are shown in a comparative manner.
Graph No.2. Fatty acid percentages according to their degree of saturation. Percentages of fatty acids in the lipidic extracts, according to their degree of saturation (saturated, mono-unsaturated and poly-unsaturated), are shown in a comparative manner.

**Fatty acid percentages according to their degree of saturation**

- **Saturated Fatty Acids**
- **Monounsaturated Fatty Acids**
- **Polyunsaturated Fatty Acids**

**Strain**

- Lake Ermia
- Chlorella 1
- Chlorella 2
- Chlorella vulgaris
- Synechococcus sp.
- Synechococcus sp.
- Synechococcus sp.
- Synechococcus sp.

**Percentage**

- 0.00
- 20.00
- 40.00
- 60.00
- 80.00

**Percentages**

- 0.00
- 2.00
- 4.00
- 6.00
- 8.00
- 10.00
- 12.00
- 14.00
- 16.00
- 18.00
- 20.00
- 22.00
- 24.00
- 26.00
- 28.00
- 30.00
- 32.00
- 34.00
- 36.00
- 38.00
- 40.00
- 42.00
- 44.00
- 46.00
- 48.00
- 50.00
- 52.00
- 54.00
- 56.00
- 58.00
- 60.00
- 62.00
- 64.00
- 66.00
- 68.00
- 70.00
- 72.00
- 74.00
- 76.00
- 78.00
- 80.00
- 82.00
- 84.00
- 86.00
- 88.00
- 90.00

**Species**

- S. capricornutum
- S. strain
- S. strain
- S. strain
- S. strain
Graph No. 2 shows the percentages of fatty acids according to their degree of saturation, namely, saturated, monounsaturated and polyunsaturated. There are higher proportions of the monounsaturated fatty acids within the evaluated strains, with the exception of Selenastrum capricornutum, in which saturated fatty acids abound, than that of poly-saturated and saturated fatty acids. Wild biomass displayed the highest percentage of saturated fatty acids. Scenedesmus acutus showed a polyunsaturated fatty acid percentage slightly higher than the other strains. These proportions may vary with culture conditions. Lower culture temperatures may induce a rise in the synthesis of particular low melting point fatty acids, against higher melting point fatty acids (poly-unsaturated against saturated). High percentages of monounsaturated fatty acids are desirable, as in the case of Monoraphidium griffithii.

The cluster analysis in Diagram No. 1 shows the degree of similarity between the extracts according to fatty acid classes. Two main clusters form: one conformed by Selenastrum capricornutum and wild biomass, and the one constituted by that of the 7 remaining strains. The first cluster relates to the dominance of saturated fatty acids, and the second, with the more balanced percentages of the three classes, and dominance of the monounsaturated. Diagram No. 2 shows these relationships in more detail, using the data corresponding to all fatty acids, without discriminating by degree of saturation. Diagram No. 3 groups the strains in terms of monounsaturated fatty acids uniquely. A sharper distinction is established for the wild biomass, evidencing a higher similarity of Selenastrum capricornutum with the 7 strains comprising the larger cluster, without considering saturated and polyunsaturated fatty acids.

4. DISCUSSION

4.1 Oil percentages and fatty acid profiles

Oleaginous microalgae can store within their structures a fraction of lipids of an average of 25%. This value is generally associated with green algae and diatoms. Cyanobacteria show, in average, a lower percentage of 9.8%. Lipids in microalgae are mainly glycerol esters formed by fatty acid chains ranging mostly from 14 to 20 carbon atoms. The evaluated microalgae strains Chlorella vulgaris and Scenedesmus acutus, and the wild lake biomass, show an important percentage of oil, for which they should be considered an important source for its extraction.

The wild lake biomass shows a considerable percentage of oil (17%), taking in account that it is mainly composed by Cyanobacteria (Microcystis spp.) and zooplankton. It was established that some of the isolated strains (Scenedesmus acutus, 12.7%; Chlorella vulgaris, 36%) show a fatty acid profile similar to that found in oleaginous seeds like Oil Palm (Elaeis guineensis) and Piñón (Jatropha curcas). Both microalgae strains can be considered oleaginous.

A high variety of fatty acids was found on the evaluated strains. Palmitic acid (CH₃(CH₂)₁₄COOH), a saturated fatty acid formed of 16 carbon atoms, was the most abundant. This fatty acid is used in the manufacturing of food products and pharmaceuticals, for the elaboration of lubricant oils, waterproof materials, and soap. It is present in vegetable oils, like coconut and palm oils. It was found mainly in the wild lake biomass (75.26% of palmitic acid in 17% w/w dry weight biomass), and close to 50% in Selenastrum capricornutum. The other strains showed percentages between 15 and 30% of this fatty acid. The abundance of this saturated fatty acid confers oxidation stability and higher melting point to the oil, causing to be buttery at room temperature.

Oleic acid (cis C18:1 or CH₃(CH₂)₇CH=CH(CH₂)₇COOH), a mono-unsaturated fatty acid, is also abundant. It is highly stable to oxidation, insoluble in water, but soluble in benzene, alcohol, ether and other organic solvents. It is mainly used to make soaps, cosmetics, in the textile industry and in the cleansing of metals. It was found in percentages between 41 and 47.14%, not abundant in wild lake biomass, and above 22% in all the isolated strains, being an important fatty acid in the cellular composition of these strains.
Diagram No. 1. Hierarchical Cluster Analysis of fatty acids according to degree of saturation contained in microalgae strain biomasses. The composition of lipidic extracts is compared within all the biomasses in terms of the three categories of fatty acids.

Dendrogram using Average Linkage (Between Groups)
Diagram No. 2. Hierarchical Cluster Analysis of fatty acids contained in microalgae strain biomasses. The composition of lipidic extracts is compared within all the biomasses in terms of the fatty acids present regardless of their degree of saturation.
Diagram No. 3. Hierarchical Cluster Analysis of mono-unsaturated fatty acids in microalgal strain biomass. The composition of lipidic extracts is compared within all the biomasses in terms of the mono-unsaturated fatty acids present (palmitoleic, elaidic, oleic, cis11-eicosenoic, erucic and nervonic).

Linoleic acid (CH$_3$(CH$_2$)$_4$CH=CHCH$_2$CH=CH(CH$_2$)-COOH) was found in lower percentages, with its highest value (16.10%) in Chlorophyceae “G”, and the lowest in wild lake biomass. It is found in vegetable oils like linseed, soy, sunflower and cottonseed oils. It is widely used in the food industry and the production of hydrogenated fats.

Linolenic acid (CH$_3$-CH$_2$-CH=CH-CH$_2$-CH=CH-CH$_2$-CH=CH-(CH$_2$)-COOH) is poly-unsaturated. It is used in the food and pharmaceutical industries. It was found in the highest percentage in *Chlorella vulgaris*, and in the lowest in wild lake biomass.

4.2. Potential of microalgae oil for biodiesel

In order to choose the appropriate oils for the synthesis of biodiesel, it is necessary to center upon an idealized optimal fatty acid profile. According to Pinzi et al (2009) the preferable scenario from oil derived from vegetable sources, for an ideal transterification and optimal performance in diesel engines, would show a high percentage of mono-unsaturated fatty acids, and a minimum of the poly-
unsaturated, and regulated amounts of the saturated. Mono-unsaturated fatty acids maintain appropriate fluidity at low temperatures (cold flow), in contrast to the saturated, which crystalize at higher temperatures than the former, causing the obstruction of the fuel delivery system. The mono-unsaturated possess higher oxidation stability than the poly-unsaturated, for which they can withstand longer periods in stock without degrading considerably. Although the poly-unsaturated characterize for their low melting points, their oxidation stability is poor, rendering them undesirable for quality biodiesel. Chisti (2007) suggests there be a low percentage of the poly-unsaturated due to their propensity to oxidation during prolonged storage. Knokte (2008) concludes that an optimal oil for biodiesel must have high percentages of palmitoleic, oleic, and even, decanoic acids. Having in account these factors and parameters, it is possible to evaluate the oil quality of the nine biomasses analyzed, in accordance with their fatty acid profiles.

Although Schroederia spiralis yields a high percentage of palmitoleic acid, in an acceptable profile, the oil yield produced by the strain was very low to be considered for biodiesel. The wild lake biomass contains high palmitic acid proportions, rendering it inappropriate for the purpose. Biogas (methane) generation could be a better option if this naturally occurring biomass is going to be exploited. For biodiesel production, the strains of Chlorella vulgaris and Scenedesmus acutus described in this work, offer the best options, due to their higher oil yield. It should then be considered of importance to evaluate the possibility to raise the oil yields of these strains, and even induce the biosynthesis of higher proportions of mono-unsaturated fatty acids, through the manipulation of culture conditions, including nitrogen starvation and temperature control and other stress factors.

The lipidic extract from Monoraphidium griffithii displays 50.84% of the mono-unsaturated, 22.05% of the saturated and 27.11% of the poly-unsaturated fatty acids. This profile nears in proportions to the idealization closer than that of the other strains, although still to high for the less desirable poly-unsaturated fatty acids. Nevertheless, the oil yield is not significant.

The profile for Chlorella vulgaris shows a lower quality than the aforementioned strain, due to lower mono-un-saturated and higher saturated levels. However, for biodiesels destined for warm climates, cold flow should not be an issue, alone or blended appropriately with petrodiesel.

The potential of Scenedesmus acutus should be considered, considering the possibility of raising the yields and optimizing its fatty acid profile according the the requirements of the application (biodiesel production). The oil extracted from the wild lake biomass, composed mainly by the cyanobacteria Microcystis aeruginosa, contains about 80% of saturated fatty acids and 7.48% of poly-unsaturated fatty acids, which reduces substantially its potential for use as a stock for biodiesel production.

It is possible to generalize that oleaginous microalgae, from diverse groups, show, under normal culture conditions, an average lipidic fraction of 25.1%; magnitude that can rise up to 45% in stressing culture conditions. This is in respect to green algae and diatoms (Hu et al, 2008). The ubiquity of microscopic green algae inhabiting diverse habitats, added to the easiness of reproduction in laboratory conditions, has facilitated the identification of numerous oily species. In the case of Microcystis aeruginosa (in wild lake biomass), species that has been spotted in all sampled sites in the lake, 75% of palmitic acid is found. In reference to the 9.8% average of oil in cyanobacteria, the wild lake biomass ranged high. In artificial culture conditions the outcome may be more favorable. A higher disposition to genetic manipulation in this group may further enhance the capacity to yield oil in this group (cyanobacteria), in contrast to green algae and diatoms. Therefore, their aptitude to be exploited for the production of biofuels is not yet discarded (Rittmann, 2008).
5. CONCLUSIONS

Gas chromatography analysis of lipidic extracts from microalgae biomass, demonstrate the presence of oil in the structures of the strains evaluated. The most abundant fatty acids found were: palmitic, palmitoleic, oleic, linoleic and linolenic. The oils extracted from these strains show fatty acid profiles similar to those of oily seeds. Hierarchical cluster analysis show there is similarity within the profiles of seven strains, excepting Selenastrum capricornutum and the wild lake biomass. The oil yield, in terms of dry biomass, is a determining factor in the applicability of any strain in the production of oil.

Oil is found in wild lake biomass, although in a low percentage. With a high content of saturated fatty acids, palmitic acid predominates. Two strains to be considered of importance for biomass to oil production are Chlorella vulgaris (36% oil) and Scenedesmus acutus (13% oil). Controlled culture systems may enhance these percentages, as well as the fatty acid profiles could be improved.

The study provides a base for future research regarding energy from microalgal biomass. Among the described species, the two strains of Chlorella show the best fatty acid profiles to be used as a feedstock for biodiesel production. Nevertheless, the biology of these species should be further studied to optimize their cultures and obtain higher oil yields. The biomass from Amatitlán Lake is not sufficiently appropriate to be used as a feedstock for the conversion to biodiesel, mainly because of its relatively low oil yield and high percentage of saturated fatty acids (therefore, scarce in the mono-unsaturated). This biomass could be useful more appropriately for the generation of methane gas through anaerobic biodigestion and, therefore, be of benefit for the generation of heat and electricity.

6. REFERENCES


OHSAS 18001 OCCUPATIONAL HEALTH AND SAFETY
MANAGEMENT SYSTEMS APPLICATIONS
Aida Sahmurova
Okan University, Department of Health Management, Istanbul, Turkey

Abstract
The objective of occupational health and safety studies are to protect the employees from work accidents and occupational diseases; and provide a healthier environment for them at work. However, there are two things which should not be ignored. One is to increase the efficiency by ensuring the security of the production; other one is to provide security of the operation.

The studies of identifying and implementing safety measures based on scientific research with the aim of minimizing the losses caused by work accidents and occupational diseases simply collected in terms ‘Job Security’.

The overall objective of Occupational Health and Safety is to reduce the liabilities to both workers and family, work place and other authorities and depending on this to avoid any damage to the country economy.

In this study the administration system 18001 which is recently accepted and spreading, and which can be a solution to the business health and security problem is considered. The main concepts of this is explained and the applications of this on the electronic sector is expressed. The applications are given on “Profilo Telra Electronic Industry Trade Inc.” selected as a sample.

In the study also the new legislation of Occupational Health and Safety issues have been discussed within the framework of EU harmonization efforts and the changes have been highlighted.

When No. 4857 of the new Labor Code and the law supporting the statutes/regulations were examined instead of Law No. 1475 on the “Occupational Health and Safety” concept, in fact all enterprises has to be required to install an Occupational Health and Safety Management System even though they are not certificated.

Key words: Work Safety, Management Systems, OHSAS 18001, Profilo Telra Electronic

INTRODUCTION
Strengthening arguments with regard to the fact that human creative capacity should be benefited more in favour of business productivity, minimization of losses gains importance, enrichment of quality nature of employees and increase of their expectations, escape from social and ethical liabilities forces people to resist other bottlenecks, and similar developments have made human factor in business organizations more central and important than in the past. (1)

Until a short time ago, management perception which regards the idea assuming the attitude which is necessary to look like a person who complies with law as burden specifies objectives beyond giving response to the requirements theoretically resulting from law and regulations. (2)

Establishments which act fearlessly in the process of finding ways of getting rid of cost factors such as health, safety and environment and test every kind of method with the ambition of expanding rapidly, with the purpose of restricting competition advantage they have acquired in this way, the scope of
“consensus norms” (ISO 9000, QS9000 etc.) which function as a barrier in favour of the establishments holding the confidence of passing the critical point in terms of growth and gaining strength, have also widened and come to the point of including health and environment dimensions (ISO 14000, OHSAS 18001).

On the other hand, such new concepts require information and equipment, technology and infrastructure, and therefore, create a new sector (3).

Finally, with various dynamics and reasons, a management perception relatively emphasizing more on preventive, protective health services in establishments than in the past is developing. (4)

It is increasingly becoming a requirement to determine, evaluate health effects resulting from the business, operations, raw material, semi-finished and finished products, machinery and equipment of establishments, and cleaning, maintenance and repair activities of such establishments, and minimize and trace damaging effects through a preventive approach and reconstruc such activities within a perception of management system. (5)

A doctor type recovering lost working hours for sending a patient by closing himself/herself to his/her “infirmary” and just writes out prescription is turning into a stage which is not desirable for the managements as well as employees.

Preventive medicine type institutions which share the responsibility of protecting and improving health with the employees/personnel, and participate in production-management functions through the view of their professional sensitivity seem to replace raditional therapeutic medicine. (6)

Apart from the new tendencies in industrial field, as the requirement of professional mission and sensitivity, professional responsibility, doctors should be able to assess potential factors, reasons before becoming sick and injured, and be able to develop a systematic, constant prevention, protection and tracing programme. (7)

**PURPOSE**

Purpose of this study is to explain the requirements in order to assume administrative approach to job safety and health issues in establishments and to exemplify the system through an original application.

Application part of the study, job safety system requirements in electronic sector have been modelled by application study carried out in Profilo Telra Electronic Industry Trade Inc. in Çerkezköy Factory. Installation stage of the system continued, and following such stage, applications carried out were traced for 4-6 months. The system has been developed through feedbacks obtained from applications.

**MATERIAL AND METHOD**

The establishment in which Job Safety Management System has been applied is Profilo Telra Electronic Industry Trade Inc., in Çerkezköy Organized Industrial Zone. First establishment of the group “Profilo” was established in Istanbul in 1953 with 18 employees as Ironworks. Since then, the company has developed, grown and become Profilo Holding.

Profilo Telra Electronic Industry Trade Inc. began production in Çerkezköy establishments in 1991. It covers 85,000 m² enclosed area on approximately 250,000 m² area.

The plant, in general, has been arranged within modern and European standards which comply with full automation. Main production units have been equipped with melf and standard component string computers, fully automatic computer-controlled chassis control and final mounting bands. In addition
to this, dyehouse, plastichouse, PCB production and styropor production units take place in integrated units.

Fig. 1. Profilo Telra Elektronic Industry Trade Inc. Cerkezköy Organization Chart

FINDINGS

Establishment of Job Safety Management System

As a result of the researches carried out, in order to form efficient Job Safety Management System in any establishment, it has been decided to carry out studies in respect of the following points:

- Formation of Occupational Health and Safety Policies
- Risk Assessment
- Accident Investigation and Analysis
- Emergency Preparedness
- Job Safety Rules and Work Permits
Establishment of the System; system has begun to be formed by determination of responsibilities. At this stage, firstly, a booklet stating what is required for establishing the system on the basis of the subject under the name of “Job Safety Management System Requirements” has been distributed to the Department Managers and such requirements have been explained with an 8-hour training.

Estimated period for system establishment is 1 year. During this period, overall situation assessment has been made by the participation of Department Managers, Job Safety Management Representative and Job Safety Expert and joint decisions regarding interconnected subjects have been formed.

Following publication and application of required procedures, instructions and forms, ISIG Field Teams have been informed and requested to start applications as soon as possible.

1. Formation of Occupational Health and Safety (OHAS) Policies

OHAS Policy which explicitly indicates all health and safety objectives and commitment to develop this performance and is approved by top management of the establishment should be formed. OHAS Policy should be consistent with all branches of the organization and other Management Systems (Quality/Environment). For that purpose; OHAS Policy prepared in Profilo Telra can be seen in Annex-a.

2. Formation of Risk Assessment System

The documents defining the system have been issued in accordance with ISO 9000/14001 Quality and Environment Management System and within this context, firstly, the procedure describing the process general risk assessment system has been written. Certain principles have been taken into consideration during the preparation of this procedure with the purpose of improving the efficiency of the system:

- All personnel/employees from top to bottom are responsible for providing safe, healthy and comfortable working condition. Therefore, risk assessment studies should be carried out in the form of “Team Work” and synergy should be created among personnel/employees.
- Acting based on the logic “Those who do the job best know it best”, the views of all related personnel/employees during studies should be addressed as the input of risk assessments.
- A period should be determined with the purpose of revising risk assessments made (such period is one year in general)
- In the event that following situations occur, risk assessments made in related units must be repeated:
  - Changes of settlement plan,
2.1. Application of Risk Assessment System:

In order that application becomes effective after the stage of system formation, Risk Assessment Forms on the basis of processes have been prepared. During preparation of such forms; previous experiences, data of occupational accidents and health service records have been used and the processes holding more risks have been given priority.

As a result of general informing, those carrying out such studies and making risk assessment have gone to work area, and risks have been specified, classified. Views of department manager and operators have been considered, and the findings on which consensus are formed are regarded as threat, and have been entered into records.

3. Accident Investigation and Analysis

3.1. Occupational Accidents

Main principles of required actions to be taken in the event of any occupational accident within the boundaries of the factory have been described below:

1- Those who see the accident first shall report it to the First Aid Official of work area, First Line Supervisor and Occupational Safety Expert. As even seconds are very important at this point, with the purpose of preventing loss of time, all personnel/employees must know first aid officials in their areas very well

2- First medical intervention is made to the accident victim by the First Aid Official and the victim is sent to Medical Department. It is known that first medical interventions mostly ease medical interventions and in some cases, have rescued life. Therefore, First Aid Officials must be carefully chosen, receive detailed first aid training and the principles of such training must be reminded once a year.

3- Necessary medical intervention and treatment are made in Medical Department, If the situation of the accident victim is worse, he/she is sent to hospital. Hospital results are always followed and all findings are attached to the personal health file of the victim.

4- A form under the name of “Occupational Health Survey Form” is made. Such form is filled in by First Line Supervisor, Workplace Doctor and Occupational Safety Expert and thus, accident is kept under file.

3.2. Near Miss

The incidents which may result in accidents but escape from accidents by a hair's-breadth are called “Near Miss”. Repeated occurrence of same kind accidents should be considered preview of occupational accident. For that purpose, in Occupational Health Survey Form of the factory, within the section of accident types, this situation has been evaluated. Near miss accident investigation system containing important points regarding the subject has been formed.
4. Preparation of Emergency Plans

Emergency plans are the plans which explain how it is required to be acted in case of any potential emergency situation and also how such emergency situation should be handled. In order to be able to prepare emergency plans, first, detailed risk assessment study must be carried out.

Emergency plan prepared as a result of risk assessment made in the factory consists of the following:

1. Evacuation Plan
2. Fire Extinguishing Instruction
3. Fire Department Instruction Book
4. First Aid Instruction
5. Rescue Instruction
6. Response Plan Against Spillage and Leaks
7. Safety Instruction
8. Earthquake Protection Instruction.

5. Occupational Safety Rules and Work Permits

Establishments must apply legal requirements regarding occupational safety. Such requirements have been provided according to the sectors in “Worker’s Health and Job Safety Regulation”. Said regulation must also be taken into consideration when determining internal worker’s safety rules. Jobs which are subject to permission in Profilo Telra Industry Trade Inc. are classified as follows:

- Determining the rules for risky jobs
- Application of permit system by determining the jobs subject to permission
- Application of license system by determining the jobs which require license

5.1. Application of permit system by determining the jobs subject to permission

Required control and inspection have been conducted in the factory and discovered that the following jobs require permission:

- Non-Production Welding Jobs Working in high areas

5.2. Non-Production Welding Jobs

Many welding jobs for maintenance are done in the factory. Welder and the other employees/personnel around are exposed to light and smoke where such welding job is done. Also, there is high degree of fire risk depending on the location where welding job is done. Fire brigade official shall be present during the job of welding. Following the completion of welding job, related location shall not be left for 2 hours and kept under control.
6. Tracing Personal Protective Equipment

Personnel/Employees do not want to use personal protective equipment due to the fact that they either do not know the risks they are exposed to or they feel uncomfortable when they use such equipment. Tracing system is necessary for raising use rate of such equipment to the highest level.

“Personal Protective Equipment Delivery Record” specified in Annex-c has been formed with the purpose of keeping record of such equipment given to the personnel/employees.

7. Ergonomy and Industrial Hygiene

The system formed in respect of Ergonomy and Industrial Hygiene is based on determining and solving the problems systematically. A committee must be formed in order that such study can be carried out better. Such committee in the factory is Council of Occupational Health and Safety.

7.1. Solving the Problems of Ergonomy and Industry

Common problem solving techniques must definitely be used at the stage of solving the problem. Therefore, problem solving techniques are taught to the personnel/employees working in the factory.

8. Controlling Chemical Substances

With the purpose of controlling chemical substances, first, current problems have been specified and the following problems have been found:

- Entering the chemical substances into the factory unlabelled or with non-Turkish labels and using such chemical substances in this way,
- Material Safety Data Sheets (MSDS) in respect of chemical substances are inadequate or missing,
- Since MSDSs are not placed in usage areas, personnel/employees are not satisfactorily informed about the effects of such chemical substances.

With the purpose of raising the awareness of the personnel/employees in respect of chemicals, MSDSs have been put up on the boards in work areas. Additionally, introductory cards under the name of “Material Safety Data Sheet” have been put up on the boards in the areas where such chemicals are used.

9. Medical Processes

Factories are equipped with health service centers, medical personnel and the area specified within “Occupational Health and Safety Regulation”, where such medical personnel may carry out their activities.

Medical center has 2 different functions, one of which is preventive medicine and the other one is first aid. Purpose of preventive medicine studies is to prevent occupational accidents and professional illnesses through periodical treatments and participation in rehabilitation efforts.
10. Encouraging Personnel/Employee In Respect of Occupational Safety

In terms of sustainability of the system, it shall be useful to inform personnel/employee about general evaluation. For that purpose, occupational safety boards have been prepared in various areas of the factory, and thus, following information has been introduced:

- Occupational Accident Statistics
- Important Procedures
- Posters
- Paper News
- Letters Written By Management
- Audit Results
- General Rules of Occupational Safety

Another important point is to reward those who make contribution to improvements and good applications in respect of occupational safety. Motivation of such personnel/employees regarding the subject shall be raised to the highest level.

11. Preventive Approaches to Occupational Safety

Many purchases can be made through new projects. In particular, occupational safety criteria in respect of machinery and equipment purchase must be specified best before purchase process, and must be put in specifications. For instance, ladder which can reach to the upper part in current workbenches similar to the new one to be purchased is not available. Such inadequacy specified in risk assessment is placed in the specification of new workbench and the workbench with ladder is purchased.

If new machinery and equipment are entered to the factory holding desired property, all buildings are constructed in accordance with standards, processes in respect of discovering fault and of improvement shall not be necessary during next periods, which is the ideal one.

12. Contractor Safety

Establishments may transfer their temporary and permanent jobs to contractors by making agreements with such firms. In this case, employees of contractor carry out their activities in different areas of the factory. First step in respect of contractor control is choice of the right firm. In respect of choice of such firms, criteria such as previous performance of the firms, the fact that whether personnel/employees of said firm are well-trained, proficiency certificates (ISO 9000 series, ISO 14001 etc.) issued by certification bodies must be taken into consideration. Said firm shall be easily controlled if a responsible firm regarding occupational safety issues is chosen.
13. Conformity with Legal Requirements

All establishments must meet legal requirements in terms of occupational safety. “Occupational Health and Safety Regulation” sets forth the requirements regarding occupational safety which must be met by the establishments carrying out activities in Turkey.

With the purpose of tracing legal requirements, “Liability Plan” has been prepared. Legal requirements regarding main points in this table has been set forth within system procedure which explains how said legal requirements are met in the factory.

14. Tracing and Measuring

Within the scope of Occupational Health and Safety, periodical measurement is carried out at the points specified in the Factory.

Table 2. Table of periodical inspection

<table>
<thead>
<tr>
<th>MEASUREMENT</th>
<th>PERIOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic evaporating gas in indoor atmosphere</td>
<td>2 years</td>
</tr>
<tr>
<td>Measurement of noise</td>
<td>2 years</td>
</tr>
<tr>
<td>Thermal Comfort measurements (humidity, temperature)</td>
<td>2 years</td>
</tr>
<tr>
<td>Measurement of Enlightenment in Working Environment</td>
<td>2 years</td>
</tr>
<tr>
<td>Lead measurement in indoor atmosphere</td>
<td>1 year</td>
</tr>
<tr>
<td>Audio test</td>
<td>1 year</td>
</tr>
<tr>
<td>Radiation and earthing measurement in lightning rod</td>
<td>1 year</td>
</tr>
<tr>
<td>Pressure vessel controls</td>
<td>1 year</td>
</tr>
<tr>
<td>Lifting tool controls</td>
<td>3 months</td>
</tr>
<tr>
<td>Building earthing measurements</td>
<td>1 year</td>
</tr>
<tr>
<td>General medical examination of personnel/employee</td>
<td>6 months</td>
</tr>
<tr>
<td>Chemical analysis of drinking water</td>
<td>4 months</td>
</tr>
<tr>
<td>Bacteriological tests of drinking water</td>
<td>4 months</td>
</tr>
<tr>
<td>Germ carrier examination</td>
<td>3 months</td>
</tr>
<tr>
<td>Pulmonary function test</td>
<td>1 year</td>
</tr>
</tbody>
</table>

RESULT AND SUGGESTIONS

Findings obtained as a result of system formation efforts made in the Factory of Profilo Telra Electronic Industry Trade Inc. can be summarized as follows,

1. Confidence of all personnel/employees in the system and changing of frame of mind in respect of ensuring safe and healthy work environment in establishments shall shorten improvement process. However, it is, in particular, not an easy task to change traditional view of people
regarding occupational safety. Obtaining the support of top management in terms of breaking the resist of people against change is very important.

2. Fundamentals of Occupational Health Management System consist of proactive thinking and the activities planned according to such thinking. Therefore, establishments which wish to adopt systematic approach towards occupational safety must definitely form risk assessment system.

3. Personnel/Employees to do duties within the system should be the right people and adequate training must definitely be provided with such responsible employees/personnel.

4. Top or medium level managers should set good example with their appropriate and right approach and attitude towards occupational safety. The most important point to be considered here is to use personal protective equipment without exception.

5. As in the case of Quality and Environment Management System, philosophy of continuous improvement is prevailing in this system as well. Objectives to be achieved in the process of improvement should be specified and all personnel/employees should be informed about such objectives.

6. The role of training is considerable in terms of efficiency of system. Training should not only be perceived in such a way that people gather in a room and some subjects are taught as “Desk Training”. In particular, short explanations and warnings regarding the subject or the activity by mid level managers to personnel/employees in work areas shall be useful.

7. Operation of the system should be periodically revised. For that purpose, controls should be planned as in Quality and Environment Management System.

8. If personnel/employees are wished to be completely integrated to the system, this should be encouraged. Celebration of the day free from any occupational accident and rewarding the suggestions which may increase occupational safety are the most commonly used two techniques.

9. Occupational safety and the requirements of environment issues have intertwined in many points. Therefore, environmental factors should not be ignored in the process of system formation.

As a result of 8-month activities with applications, permanent system which has also satisfied the top management has been formed in the factory. What the establishment is required to do following such process is to control the system continuously in accordance with legal requirements, and in case of any failure or inadequacy, to make necessary amendments and ensure continuity.
# PROFİLO TELRA A.Ş. POLICY OF OCCUPATIONAL HEALTH AND SAFETY

1-ENSURING HEALTH, SAFETY AND SOCIAL RIGHTS OF EMPLOYEES WITHIN THE FRAMEWORK OF LEGAL RESPONSIBILITIES

- No employment of child labourer,
- Compliance with daily work periods,
- No employment by force,
- Payment of wages in full and due time,
- No discrimination regarding religion, race, sex, political idea, philosophical belief, etc.,

2-COMPLIANCE WITH RELATED LAW AND REGULATIONS,

3-MAKING CONTINUOUS IMPROVEMENT IN THE DIRECTION OF HEALTH, SAFETY OBJECTIVES,

4-TAKING ALL NECESSARY PRECAUTIONS WITH THE PURPOSE OF MINIMIZING ACCIDENTS AND ILLNESSES AND CARRYING OUT NECESSARY ACTIVITIES IN THE DIRECTION OF IMPROVING WORKING CONDITIONS,

---

**EMERGENCY**

<table>
<thead>
<tr>
<th>SITUATION</th>
<th>TEL NO</th>
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</thead>
<tbody>
<tr>
<td>Fire</td>
<td>428-429</td>
</tr>
<tr>
<td>Natural Disasters (earthquake, flood, etc)</td>
<td>428-408</td>
</tr>
<tr>
<td>Environment Accidents</td>
<td>428-430</td>
</tr>
<tr>
<td>War</td>
<td>428-408</td>
</tr>
<tr>
<td>Sabotage</td>
<td>428-408</td>
</tr>
<tr>
<td>Accident and Injury</td>
<td>408-487</td>
</tr>
<tr>
<td>Spillage/Leak of Chemical Substances</td>
<td>First Supervisor</td>
</tr>
<tr>
<td>Excess dust, smoke, steam, odour, noise</td>
<td>First Supervisor</td>
</tr>
<tr>
<td>Product/Equipment transport, store</td>
<td>462-463</td>
</tr>
</tbody>
</table>
Annex - b

RISK MANAGEMENT PROCESS FLOW CHART

1st Stage
Specify the Process

Identify Failure Scenario

2nd Stage
Specify Potential Risks
(Qualitative and Quantitative Risk Assessment)

(Potential of Process
(Data of Engineering Department)

Failure Data of Parts

Reaction of Material
(Data of Engineering Department)

Human Factor

3rd Stage
Cost of Acceptance or Removal Risk

Safety

Cost of Acceptance or Removal Risk

Losses

Remove Risk

Transfer Risk
PROTECTIVE SAFETY EQUIPMENT
PERSONAL DELIVERY RECORD

1 - ) : I HAVE TAKEN DELIVERY OF PERSONAL PROTECTIVE EQUIPMENT NAME/PROPERTIES OF WHICH ARE STATED BELOW AND WHICH MUST BE USED IN MY WORK PLACE IN ACCORDANCE WITH OCCUPATIONAL HEALTH AND SAFETY REGULATION

2 - ) : WHERE AND WHEN PROTECTIVE EQUIPMENT DELIVERED TO ME IN RESPECT OF MY JOB SHALL BE USED, ABNORMAL SITUATIONS WHEN USING SUCH EQUIPMENT, RISKS WHICH I SHALL CONFRONT IN CASE OF NOT USING SUCH EQUIPMENT HAVE BEEN EXPLAINED TO ME.

3 - ) : I SHALL HANDLE MAINTENANCE OF AND PROTECT THE FOLLOWING EQUIPMENT.

<table>
<thead>
<tr>
<th>CODE</th>
<th>DESCRIPTION OF EQUIPMENT</th>
<th>SPECIFICATION</th>
<th>QUANTITY</th>
<th>DELIVERY DATE</th>
<th>USER’S SIGNATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEAD PROTECTIVE</td>
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<tr>
<td>EAR PROTECTIVE</td>
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<tr>
<td>EYE PROTECTIVE</td>
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<td>RESPIRATORY PASSAGE</td>
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<tr>
<td>FACE PROTECTIVE</td>
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<tr>
<td>HAND PROTECTIVE</td>
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<td>LEG PROTECTIVE</td>
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<td>SKIN PROTECTIVE</td>
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<tr>
<td>BODY PROTECTIVE</td>
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<tr>
<td>PARANTERAL</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>WHOLE BODY</td>
<td></td>
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</tr>
</tbody>
</table>

NOTE : THIS FORM SHALL BE SENT TO THE NEW WORK PLACE OF THE EMPLOYEE IF HE/SHE IS TRANSFERRED. IF HE/SHE LEAVES JOB, THEN SUCH FORM SHALL BE SENT TO THE HUMAN RESOURCES

<table>
<thead>
<tr>
<th>UNIT</th>
<th>JOB</th>
<th>NAME SURNAME</th>
<th>SIGNATURE</th>
<th>DATE</th>
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</thead>
</table>

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REFERENCES

INFRARED SPECTROSCOPY FOR THE INVESTIGATION OF LIVER AT INTOXICATION OF CADMIUM

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Abstract

Determination of the changes in liver tissues of rats intoxicated by cadmium in the Amide I region with the help of Fourier Transform–Infrared/Attenuated Total Reflectance (FT-IR/ATR) spectroscopy. Spectroscopic analysis of rats liver intoxicated by administration of cadmium tissues has been performed in the interval 4000 – 400 cm⁻¹. Investigation of spectral data allows us to mark the significant changes in the samples of rat’s liver. The comparison between the control and the treated samples has revealed clear changes in the typical lipids stretching vibrations region 1800 – 1000 cm⁻¹. Furthermore, in the 3000 – 2500 cm⁻¹ stretching CH vibrations region, we see a clear change in the band shape.

Key words: cadmium, intoxication, infrared spectroscopy, liver, rats

1. INTRODUCTION

Intoxication of rats by cadmium has a great influence on the secondary structure of liver proteins. Study of (FT-IR/ATR) spectra of liver tissues in the Amide I region shows significant differences between the secondary structure of liver proteins in control and intoxicated with cadmium groups. Characteristic changes in alpha, beta and other components of proteins secondary structure distribution can be determined with a help of infrared spectroscopy. Different mathematical programs help to perform nonlinear least squares multipeaks curve fitting, and as a fitting model was used Lorentzian model of distribution. Infrared spectroscopy is tremendously useful in determining the presence of certain characteristic groups in large molecules, such as proteins (Dumas P. et al., 2003, Stuart B., 1997).

Infrared spectroscopy can detect and monitor characteristic changes in molecular composition and structure. Spectroscopic techniques have been extensively studied as a potential diagnostic method that can provide information about both the chemical and morphological structure of tissue.

Infrared light energy lies in the range of about 0.5 kcal (2 kJ)-9.5 kcal (40 kJ). The energy of most molecular vibrations also lies in this range.

Molecular spectroscopy is very complicated because molecules contain more than two or atoms. In fact, the more atoms there are in the molecule, the more complicated the interpretation of the spectrum can be. However, it is possible to simplify the interpretation of a molecular spectrum based on the types of movement of molecules and the energies required for these movements.
Infrared spectroscopy is one of the standard work-methods of the manufacturing world, whether in semiconductor production, process control in chemical engineering, or environmental monitoring. It is relatively inexpensive, rapid, very sensitive, and can provide quick and efficient information on chemical reaction conditions through its ability to detect characteristic vibrations of molecules of interest in the process under investigation.

The main goal of this work is to characterize the changes that can develop in the liver because of poisoning with cadmium.

2. MATERIALS AND METHODS

The study was performed on white male rats of the same age, weighing 180-200 g, kept under standard conditions of vivarium, with free access to food and water. There were formed two groups of animals: one - intact (control), and second - animals to whom the solution of cadmium sulfate at a dose of 1.5 mg/kg was orally administered. Intoxication was performed within 14 days, and then rats were decapitated under anesthesia and selected the livers and kidneys were harvested for further research. This work was carried out in accordance with European Convention for the Protection of Vertebrate Animals Used for Experimental and other Scientific Purposes.

Because of the small light penetration depth in samples Spectroscopic studies were performed on (FTIR/ATR) spectrophotometer "Nicolet 380" of the Thermo Electron Corporation. All spectra were obtained using ZnSe ATR cell light reflection from the sample, in the working wavelength range 650 - 4000 cm\(^{-1}\) with a spectral resolution of 4 cm\(^{-1}\).

Absorption spectra were processed with specially developed programs. Each absorption band characteristic position in the spectrum was defined exactly. Quantitative content of different types of secondary structures were calculated from total area of the absorption spectrum fitted from the individual components and after that were determined the percentage (%) ratio off each area component input relative to total area under the curve. For mathematical - statistical data was used Lorentzian algorithm of curves fitting. The Amide I mode is primary a C=O stretching band. It may have some contributions from CN stretching and CCN deformation vibrations.

3. RESULTS AND DISCUSSION

Figure 1 (FTIR/ATR) absorbance spectra of the control (red line) and treated with cadmium samples in the wave number range 650 - 4000 cm\(^{-1}\).

When analyzing IR spectra measured from intact rat liver samples it turned out that they differ from the IR spectra measured from the experimental group (poisoned with cadmium) of animals and have specific absorption bands in the Amide I spectral region 1700 – 1600 cm\(^{-1}\) where peaks were detected at 1616 cm\(^{-1}\), 1632 cm\(^{-1}\), 1650 cm\(^{-1}\), 1659 cm\(^{-1}\), 1667 cm\(^{-1}\), 1677 cm\(^{-1}\), 1688 cm\(^{-1}\), 1696 cm\(^{-1}\). In spectral area between 3000 and 2887 cm\(^{-1}\) of methyl and methylene vibrations of protein side-chains were detected peaks at 2823 cm\(^{-1}\) and 2911 cm\(^{-1}\).

These analyses show the presence of three different contributions: the first one related to OH vibrations of tightly bonded H\(_2\)O molecules, the second one strictly connected to the OH groups due to metabolic processes and the last one, at the highest frequency, due to OH vibrations belonging to H\(_2\)O molecules strongly distorted by asymmetric bonds.
Fig. 1. (FTIR/ATR) absorbance spectra were measured from the control group rats’ liver (A) and intoxicated with cadmium sulfate (B).

It is well known that the hepatic alteration by chemical agents (in particular cadmium) can irreversibly damage the activity of enzymes which are devoted to biotransformation processes (Plaa G.L. et al., 1994).

In the frequency wave range from 1680 cm\(^{-1}\) to 1670 cm\(^{-1}\) absorption band is the result of fluctuations in which change bond length of the carbonyl group. Areas of proteins secondary structure relate accordingly to these irregular fluctuations. In this range the spectrum recorded absorption bands with maxima at 1690 cm\(^{-1}\) and 1696 cm\(^{-1}\). In the range 1670 cm\(^{-1}\) - 1688 cm\(^{-1}\) absorption components were caused by the presence of reverse bends in certain segments of the polypeptide chains of the liver (Backmann, J. et al., 1996, Byler D.M. et al., 1986, Carpenter J.F. et al., 1989, Kong J. et al., 2007).

In the spatial structure of liver protein’s of intact animals present all forms of the secondary structure, such as - \(\alpha\)-helix, \(\beta\)-fold parallel and antiparallel type, reverse turns and irregular or amorphous areas. Absorption bands of certain types of structures partially overlap. It should be noted that liver proteins have largely spatial configuration of \(\beta\)-type structures with a certain number of \(\alpha\)-helical and disordered segments (Sasic S. et al., 2005, Surewicz W.K. et al., 1988, Susi H. et al., 1987, Wolpert M. et al., 2006).
Fig. 2. IR spectra of control group (A) and investigation group (B) under the Lorentzian non linear curve fitting algorithm.
For qualitative analyses of Amide I region were compared two types of algorithms: Gaussian distribution and Lorentzian distribution. Lorentzian distribution show better results in distinguishing the difference between poisoned with cadmium and control group of animals.

The difference between the spectral characteristics of the liver of intact animals and animals intoxicated with cadmium can be demonstrated by statistical indicators.

4. CONCLUSIONS

Infrared spectroscopy can be successfully used as a tool for investigation of the changes in liver of rats at intoxication with cadmium.

Infrared analyses in a wide range of wavenumber 650 - 4000 cm\(^{-1}\) were performed on rat liver samples.

The aim of this work was to characterize, by a spectroscopic technique, the damage caused by cadmium intoxication in rat liver. With the support of recent results, the (FTIR/ATR) absorption technique provides reliable, reproducible spectra that can be used to unambiguously distinguish normal specimens from experimental ones. It is worth emphasizing that IR spectroscopy furnishes a quantitative analysis with the advantages of fast characterization, good reproducibility, and gives possibility to examine small samples.

Studies of IR spectra show differences in spectral characteristics of intact and at intoxicated samples, shift of the maxima of the absorption bands, increase or decrease of the integrated intensity, which can be used for studies of heavy metals in tissues.

REFERENCES


QUALITY OF PEPPER FRUITS (CAPSICUM ANNUUM L.) UPON THE APPLICATION OF THE BIOFERTILISERS CULTIVATED UNDER THE CONDITIONS OF ORGANIC AGRICULTURE
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²Yuzuncu Yil University Faculty of Agriculture Department of Horticulture, Van/Turkey
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DETERMINATION OF ATTERBERG LIMITS USING SEISMIC REFRACTION METHOD
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OHSAS 18001 OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEMS APPLICATIONS
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