

**THE USE OF BUILDING WASTE OBTAINED DURING RECYCLING TOGETHER WITH
ORGANIC MATERIAL FOR REVITALISATION OF PANEL HOUSING ESTATES**

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Abstract

During recycling of building waste there arises fine material which is not being used and nowadays it ends up at waste dumps. The authors of this paper are dealing with recycling of building waste and its re-use during revitalisation of panel housing estates. Recycled building waste itself would not be suitable for green spaces which would affect the appearance of housing estates. The authors focus on mixing of fine parts of recyclate with organic material which is gained by composting. The new mixture should have characteristics as similar as possible to natural conditions for a successful growth of vegetation even though there is used the waste which would normally end up in dumps. This solution is interesting not only from the economic point of view but also from the point of view of environment protection.

Key words: Recycling, building waste, organic material, revitalisation, estate, environment

INTRODUCTION

The issue of the environment protection in the building industry and in construction material production has still been underestimated even nowadays. Primary raw materials gained by means of mining and energy-consuming processing are most commonly used in the production. However, re-use of materials from reconstructions, renovations and demolitions not only saves the environment but it is also convenient from the economic point of view. In the building industry as well as in reclamation of mining sites, revitalisations and other landscaping and planting works, topsoil and subsoil layers and peat are primarily used instead of secondary materials which originate from biological waste. The importance and immediacy of this topic can be best illustrated by actual numbers – in the Czech Republic itself, the amount of reclamation and revitalisation works that have been carried out since 1993 was 20 billion CZK. A significant part of these costs was invested unnecessarily. In the global scale, the annual costs connected with reclamation are about 50 trillion dollars. In the Czech Republic, technologies based on large volumes of earthworks are used. These are mostly connected with topsoil, its transfers, storing, distribution and finishing procedures at the space designated for reclamation. These procedures are very costly. The necessary organic matter arises from the dead leaves and other dead parts of planted trees. This process is easy to disrupt by, for instance, denudation or mineralization and therefore it is very slow and it lacks efficiency. The following chapters provide information about recycling, describe the principles of the researched technology and introduce the initial results of the research.

Demolition, redevelopment, demolition works, renovation of buildings and the current way of dealing with construction waste

Currently, most of these activities are carried out without previous considering “what to do with the waste”. Selection procedures are won by those who offer the lowest price without thinking about the future.

In most cases the debris is not re-used and all the waste is transported to waste dumps. This leads to an increase in costs and to excessive burdening of the environment not only during the process of demolition (transport, loading) but also by destroying natural resources.

The current trend in both construction and revitalisation is the following:

- Demolition of existing buildings
- All the building (waste) material is transported to waste dumps
- New building material is brought in
- Beginning of new construction

For a responsible manager, the main aim should lie in a complex evaluation of the demolition and evaluation for the future

The whole idea is based on the assumption that before something new starts to be built, it should be clear how to deal with the old one. This means:

- To reduce taking away as much as possible
- To reduce the use of waste dumps as much as possible
- To reduce the use of new materials for building
- To reduce the bringing of new material to the site
- To reduce storage
- **To maximise re-appreciation** (Henková 1992, own translation)

The way of secondary use of building waste

The basis of building waste recycling

In the process of recycling as a whole it should be a clear rule that the quality and efficiency of the whole process of recycling depends on the quality of the demolition work and especially on the demolition waste sorting directly on the spot” (www.arism.cz). Building waste as such is in many cases not dangerous. Much bigger threat to the environment is represented by its amount and by the fact that in most cases the waste is not re-used. An ideal solution is the use of mobile recycling lines which consist of both grinding and separating parts (Čech 2011).

The recycling process consists of several parts:

- Demolition
- Pre-sorting (elimination of visible foreign substances, especially of contaminated or organic etc.)

- Graining
- Elimination of foreign substances (e.g. iron)
- Sorting (output grading of recyclate)



Fig. 2. An example of a mobile recycling line.

The following diagram shows the recycling process scheme which is used in the Czech Republic.

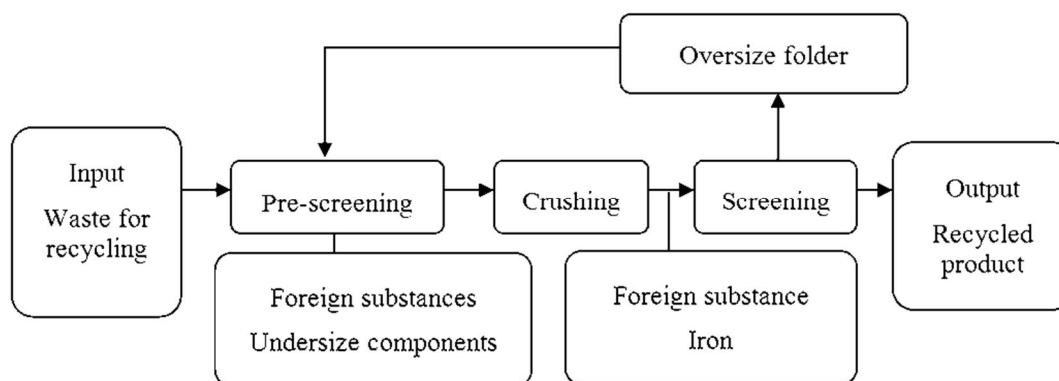


Fig. 3. Scheme of the recycling process used in the Czech Republic (Source: www.panelovedomy.ekowatt.cz, accessed February 15 2012).

Principles of the research and the materials used

This section of the paper describes materials which were used during the research.

These are both materials which are products of recycling and organic material which arises from biological waste. This research will deal primarily with fine-grained material which is created during the recycling process and which is mostly unutilized and is only transported to waste dumps.

Materials created during the recycling process

According to the type of the building, its state and its material composition it is possible to gain re-usable materials during the process of recycling.

By planning of the recycling in advance and pre-sorting before beginning of demolition works, it is possible to maximise the amount of material which can be subsequently re-used. This kind of material arises during the recycling of concrete, glass, ceramic components, wood and tar.

Debris

Debris is waste from recycling of materials from demolition. Recyclates of building materials may be used in various activities connected with construction. However, their full utilisation is not ensured so far.

Machines and devices which are used in building materials recycling can modify the original debris. The way the demolition works are carried out is also very important. In spite of the efforts to maximise the use of this material in construction, more than 20 per cent of materials remain unutilized. In renovations and reconstructions of building, this percentage is higher than 50 per cent.

This residual material is called minus material. It arises during graining of materials from demolition, mainly of masonry construction and coats. This fine fraction which contains mixture of bricks, lime, concrete and also soil is not suitable for any further use in building. It is difficult to densify it, it is highly moisture-absorbent and it contains non-homogeneous materials. Its main disadvantage is its dustiness. Therefore most companies only transport the grained material to waste dumps (Henek 2011).

Organic material

According to the size and the way of composting it is possible to distinguish three main types of composting:

- In-home composting
- Community composting

During in-home and community composting, aeration is ensured mostly by the natural physical processes – diffusion and convection. However, manual digging up (with pitchfork or shovel) is advisable at least twice a year.

- Industrial composting

During industrial composting, organic waste is processed in central composting plants. Aeration is mostly realized by mechanical digging up done by compost shovellers. Aeration can be also done by means of forced aeration when the air renewal in composted material is realized by pumping air in and out.

The aim of composting is to return organic remnants into the cycle of substances in nature. Humus and its acids are important for formation of optimal structure and looseness of soil and they help to retain sufficient amount of nutrients and water. Compost makes processing of soil easier, increases

absorption and retention capacities, restores soil, supports life in soil, reduces plant diseases and pests, reduces soil acidity and stabilizes pH value, reduces erosion, lowers water consumption, prevents desiccation and in the long term it provides plants with vital nutrients.

Soil micro-organisms use humus as a permanent source of nutrients. The reproduction efficiency of humus is in composts incomparably higher than in other organic fertilizers. Compost creates extraordinarily stable and highly valuable organic structure of soil. It contains all the important main and trace nutrients. Compost is non-harmful from the point of view of hygiene. Compost of high quality is completely free from germinative seeds and rootstocks of weeds. Releasing of nutrients from compost is gradual. Nutritive value of compost of high quality may also substitute great amount of industrial fertilizers which brings not only direct economic effect but also significant ecological benefits.

The main objective of this research is to link two completely unrelated areas of human activities: building industry and agriculture.

The first stage of the research

Materials and aids used

- Inorganic

For the sake of the possibility of comparison of various materials, the following materials were used in this research.

Debris

This material arose during graining and sorting of a building made of burnt brick, lime mortar and lime plasters both internal and external.

The building is from the 1930s and therefore the lime is weathered and only moderately alkaline.

The mixture contains 52 per cent of brick grit fraction 0-4 mm, 4 per cent of concrete 0-4mm, 23 per cent of sand 0-4mm and 21 per cent of lime dust.

Silica sand – medium grain 0.75mm

Silica sand ST 56

Silica sand RTK 3

Burnt clay 1-3 mm

- Organic

For the first stage of the research, compact organic constituent was used as the organic material.

Peat

Vegetable – lucerne seed (used for finding out of growth qualities)

- Aids

Plastic pipeline – cut into equally long parts and modified by plastic wrap and bottom

Geotextile

Measure container – for substrate and lucerne seed

Trowel for stirring

Technological procedure

- Pipeline preparation

Insertion of textile and placing on horizontal surface with identical properties such as, for instance, the same sun exposure for all the samples

- Substrate preparation

Three portions of peat and one portion of inorganic material were mixed in the container.

- Filling of the prepared containers from the plastic pipeline

The containers were filled and the substrate was shaken off and refilled up to 5 cm from the upper edge. After the filling and placing at the checking stand, the substrate was dampened evenly. This resulted in settlement of the substrate and it was therefore refilled up to 5 cm below the upper edge. A small amount from each substrate was laid aside for refill and covering of seeds. Seeds of lucerne were measured and evenly sprinkled on the substrate surface. Four samples from each and the fifth sample as the checking sample. The seeds were then covered by centimetre-thick layer of substrate.

- Treatment of the samples

The samples were dampened regularly and they were regularly checked not to become dry. Because the samples were stored in an open space, they were not protected against rain. However, rain affected all the samples in the same way.

Results of the first stage of the research

After first three days the plants appeared. In all the samples there was the same amount of them. However, after some time (3 days) some of the plants in samples with silica sand perished. In the sample with debris the plants have been growing.

Currently, measuring of infiltration has been in progress. So far it is clear that debris because of its alkaline character decreased pH level of the mixture and thus contributed to better growth. Another factor is that debris lightens the mixture.

Conclusion of the first stage of the research

For the next stage of the research, it is necessary to choose another organic part, for example garden substrate or topsoil or subsoil layer. It remains undecided whether used garden substrate of one or more types. Furthermore, it is necessary to replace textile by draining layer or another retaining natural material such as jute or sisal. For further experiments it is also necessary to know the source of debris.

Planned continuation of the research

The objective of the research is to develop a complex technology for production of special reclamation substrates. This new technology should bring about a decrease of demands on currently used expensive technical steps during reclamation, such as manipulation, storage and distribution of topsoil. It should also enable and increase in biodiversity of reclaimed areas. By developing a new complex technology for efficient reclamation and revitalization, there arises an exceptional space for entrepreneurial opportunities in the Czech Republic.

Another aim of the research is to suggest a complex use of utmost amount of recycled material from demolitions and reconstructions of various types of buildings. This will lead to an analysis of the types of the building and the materials which they contain, and a suggestion for sorting technology and subsequent effective re-use of the materials.

CONCLUSION

This research should contribute to complex use of materials gained during recycling of building material. The use of the fine-grain fraction of the recycle is very limited and the rest of the fraction is transported to waste dumps. A future aim is to suggest the possibilities of recycling of all the materials gained during partial renovations of various types of buildings which would lead to considerable financial savings and to protection of the environment.

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