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AIR POLLUTION AS A FACTOR OF LUNG CANCER IN KAZAKHSTAN

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Abstract

The article is an analysis of air pollution for the period 2011-2013 by priority air pollution cities of Kazakhstan: Almaty, Ust-Kamenogorsk, and Pavlodar. In these cities revealed values of maximum permissible concentration (MPC) of pollutants in the air of populated areas , the magnitude of the integrated pollution index (API5) , which was calculated using the five substances with the highest normalized values MPC considering their risk class , as well as estimated by the excess of MPC . The article also provides an analysis of lung cancer incidence in the last 3 years due to the identification of development with air pollution.

Key words*: air pollution, API5, lung cancer, mortality.*

INTRODUCTION

In all developed and developing countries, one of the major causes of death and disability population are malignant neoplasms [1]. According to research by the World Health Organization (WHO) growth of cancer incidence in the world will be mainly due to lung cancer, colorectal cancer in men and breast cancer and cervical cancer in women [2]. Each year about 17,000 people die because of cancer, 42% of them - working age [3]. In 35 countries, lung cancer is considered the main cause of death [4,5]. Mortality from cancer in Kazakhstan ranks second in the structure of mortality. Among the most common malignancies in the country, lung cancer ranks 2nd (11.4%) . Men suffer lung cancer much more often, and in the structure of morbidity among men is lung cancer (20.4%) [3,10]. Lung cancer has a greater extent than other forms of cancer associated with air pollution by carcinogenic substances . These substances are found not only in the industry, that throw them overboard, in the industrial centers, along highways, but also far beyond. The main contribution to air pollution brings heat and power sector, mining and ore-processing industries, metallurgical complexes of the republic and the exhaust gases of motor transport. Due to the growth of gross output in the industry, with the wear process mode equipment tendency of increase of natural resources claimed emissions of pollutants into the environment. Thus, in the country there is an annual increase of pollution sources. [6] The level of air pollution is prevalent in cities such as Almaty,

Ust –Kamenogorsk , Pavlodar , Temirtau , etc. The main problem of air pollution in Almaty is the high amount of pollutant emissions of road transport, which contain about 200 chemical compounds. About 70% of lead added to gasoline with ethyl liquid into the atmosphere. Exhaust gases - the main reason for exceeding the allowable concentrations of toxic substances and carcinogens in the atmosphere of large cities, the formation of smog. Among them, the most dangerous are the nitrogen oxide , carbon monoxide , aldehydes, derivatives of anthracene (1,2- benzanthracene , 1,2,6,7 - dibenzanthracene , 5,10- dimethyl -1 ,2 - benzanthracene) . Everyone knows the most dangerous carcinogen - benzpyrene having property incorporated into the DNA molecule, causing further congenital anomalies, blood diseases, particularly leukemia, is also a major emissions from road transport. Aromatic hydrocarbons through metabolic transformation form derivatives having carcinogenic activity [12]. Due to the hydroxylation of one of the rings it is converted to a reactive epoxide which alkylates guanine amino nitrogen and other bases, which leads to incorrect translation of the entire DNA.

For cities such as Pavlodar, Ust -Kamenogorsk major sources of air pollution are power plants and industrial plants. For example the total share in Ust-Kamenogorsk is 97.5 % for sulfur dioxide emissions , 76 % of nitrogen dioxide , 48.3% for phenol and 9% formaldehyde [13] , causing the occurrence of cancer of the respiratory tract and lungs in humans , which once again proves the connection of air pollution in the development of tumors. Mechanism of toxic action of phenol derivatives is based on the separation of oxidation and phosphorylation , protein coagulation , whereas formaldehyde inhibits the activity of SH- enzymes , inhibits the synthesis of nucleic acids , vitamins violates exchange , thereby causing hematological malignancies, leukemia, lymphatic tumors and brain.

AIM.

Determine the level dependence of pollutants of air on the development the malignant tumors of the lung.

MATERIALS AND METHODS

As a material is used a data of state of air pollution in 2011, 2012, 2013. Affiliated points were selected priority cities of Kazakhstan in the level of air pollution: Almaty, Ust-Kamenogorsk, Pavlodar. The main criteria are the quality values of maximum permissible concentration (MPC) of pollutants in the air of residential areas (Appendix 1). Pollution levels measured by the integrated pollution index (API5), which was calculated using the five substances with the highest normalized values MPC considering their risk class, as well as estimated and exposure limits are exceeded. In Almaty, the observation of air quality conducted by 16 positions: 5 stationary, 5 ground automatic, 6 automatic altitude. Were measured concentration of suspended solids, sulfur dioxide, carbon monoxide, nitrogen dioxide, phenol, formaldehyde .In the city of Ust-Kamenogorsk were conducted on 5_ fixed stations. Were measured concentration of suspended solids, sulfur dioxide, carbon monoxide, nitrogen dioxide, phenol, chlorine, formaldehyde and arsenic. Observations of air quality in the Pavlodar city took place on 4 monitoring stations by 2 fixed, 2 automatic. Measured concentrations of suspended solids, sulfur dioxide, carbon monoxide, nitrogen dioxide, hydrogen sulfide, ozone, phenol, hydrogen chloride and chlorine.

Incidence rates are taken from the report and records of medical institutions of Almaty, Ust-Kamenogorsk and Pavlodar.

RESULTS AND DISCUSSION

According to the results made by observations of the state of air pollution in the cities of the Republic of Kazakhstan [7,8,9], the highest level of air pollution in 2011-2013 years observed in Almaty (API5 - 11.5) (Table 1).

Table 1. Priority list of cities of the Republic of Kazakhstan by the level of air pollution

city		Air pollution index - API5		
		2011 year	2012 year	2013 year
1	Almaty	13,3	10,5	11,5
2	Ust-Kamenogorsk	8,4	7,9	7,6
3	Pavlodar	2,6	2,7	2,4

In Almaty, air pollution index (API5) in 2011 was 9.1 Annual average concentrations of formaldehyde was 3.2 MAC, nitrogen dioxide - 2.1 MAC. Suspended solids, carbon monoxide, sulfur dioxide and phenol were within normal limits. Maximum concentrations of single carbon monoxide was 3.8 MAC, nitrogen dioxide - 2.7 MACs, suspended solids - 1.6 MAC, formaldehyde-1, 4 MAC In 2011 in comparison with 2010 level of air pollution in the city of Almaty fell slightly.

In 2012, the air pollution index (API5) was 10.5 The average concentration of formaldehyde was 3.4 MAC, nitrogen dioxide - 2.5 MPC MPC -1.1 suspended solids

The carbon monoxide, sulfur dioxide, and the phenol was in the normal range. Maximum concentrations of single suspended solids was 11.7 MAC, nitrogen dioxide - 4.5 MACs, carbon monoxide - 4.0 MPC, formaldehyde-1, 5 MPC, phenol - 1.1 MAC. In 2012, in comparison to the year 2011, the level of air pollution in the city of Almaty increased

Observations of the heavy metal content in the air held in Almaty on 2 hand positions, all the analyte concentration were within normal limits Pollution index (API5) in 2013 was 11.5 The average concentration of nitrogen dioxide was 3.4 MPC, formaldehyde - 3.2 MAC. Suspended solids, sulfur dioxide, carbon monoxide and phenol were within normal limits.

Maximum concentrations of single nitrogen dioxide was 9.4 MAC, carbon monoxide - 5.4 MACs, suspended solids - 2.0 MAC, phenol - 1.2 MAC In 2013 in comparison with 2012 level of air pollution in the city of Almaty has not changed, and in comparison with 2011 has increased (Figure 1.2)

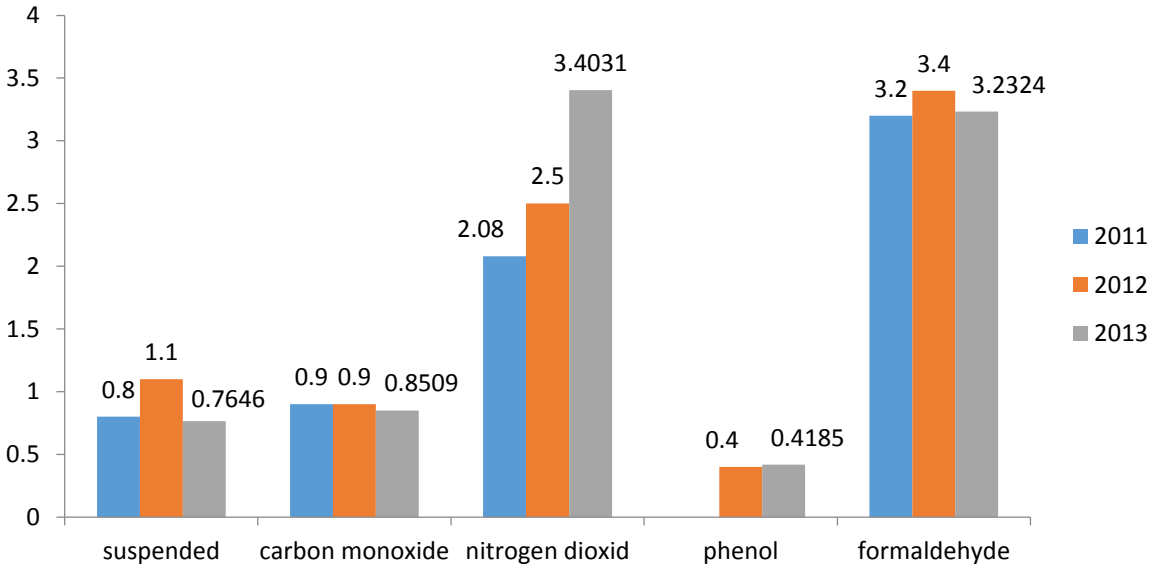


Figure 1. Multiplicity average concentration exceeding MAC main air pollutants in the city of Almaty for 2011-2013

Over the last 10 years in Almaty incidence of malignant neoplasms is held high and exceeds the republican level by 20% (incidence in 2012. In Almaty 242.2 per 100 thousand population, RK 183.1 per 100 thousand population) Annual growth in the number of patients with cancer is at Almaty to 5%. The most common nosological forms of Almaty are - breast cancer (12.3%), lung cancer (10.1%), colorectal cancer (9.6%), gastric cancer (9.5%), skin cancer (11.4%).

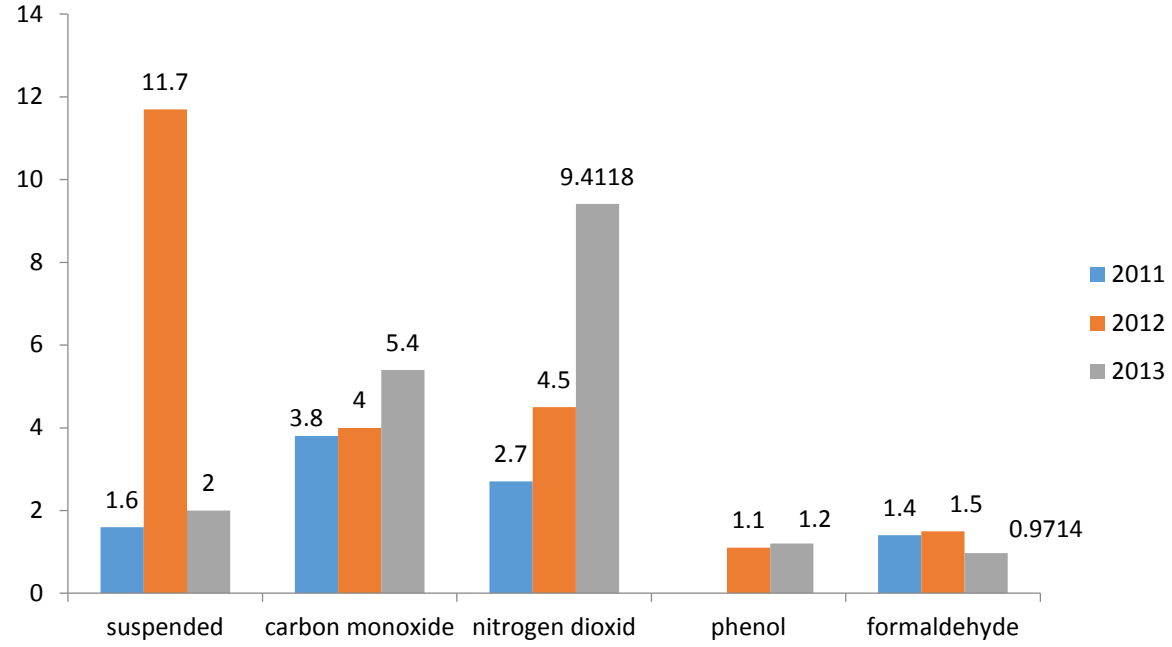


Figure 2. Multiplicity exceeding MAC maximum concentration of major pollutants of Almaty for 2011- 2013

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Every year in Almaty dies from cancer about 2,000 people, and 25% were patients with newly diagnosed (mortality in Almaty in 2012, 124.1 per 100 thousand population in the Republic of Kazakhstan 101.0 per 100 thousand population)

In the East - Kazakhstan emissions of air pollutants from stationary sources (per capita) , kilogramm/100 5. High rate due to the fact that EKR is an industrial region . Economic complex structure region is represented by 62 % of the industry . [8] According to the Department of State Sanitary and Epidemiological Surveillance in the field of pollution of the environment with heavy metals , especially lead, zinc and cadmium and other toxicants in the region has reached levels that are unsafe for human health.

Observations of the atmospheric air in the city of Ust-Kamenogorsk were conducted on 5_ fixed stations Pollution index (API5) in 2011 in the city was 8.4 and in comparison with 2010 (API5 - 7.2) the level of air pollution in the city of Ust-Kamenogorsk – increased

Annual average concentration of nitrogen dioxide was 2.2 MAC, sulfur dioxide - 1.8 MPC, formaldehyde -1 , 4 MAC , MAC phenol exceeded 1.2 times. The content of suspended substances , carbon monoxide , arsenic, chlorine were within normal limits . Maximum concentrations of single phenol was 7.6 MAC, nitrogen dioxide - 7.4 MACs , sulfur dioxide , 3, 7, MAC, suspended solids - 2.8 MACs , carbon monoxide , 2.4 MAC , hydrogen chloride -1 , 9 MAC chlorine - 1.6 MAC . In 2011 . In 2012. pollution index (API5) was 7.9 . The average concentration of nitrogen dioxide was 2.1 MAC, sulfur dioxide - 1.6 MAC , formaldehyde - 1.4 MACs , suspended solids - 1.1 . The content of carbon monoxide , arsenic, phenol , chlorine were within normal limits .

In 2012, a maximum of one-time concentrations of nitrogen dioxide was 7.2 MAC, carbon monoxide - 4.4 MAC, phenol - 3.7 MACs , sulfur dioxide and suspended solids - 2.6 MAC . Pollution index (API5) in 2013 in the city was 7.6 . Mean monthly concentration of nitrogen dioxide was 2.2 MAC, suspended matter and sulfur dioxide - 1.3 MAC , phenol and formaldehyde - 1.1 MAC. Carbon monoxide , chlorine , arsenic, within the normal range . Maximum concentrations of single nitrogen dioxide was 8.6 MPC , suspended solids - 5.0 MAC, phenol - 4.0 MAC, sulfur dioxide - 2.5 MAC, carbon monoxide - 2.4 MAC

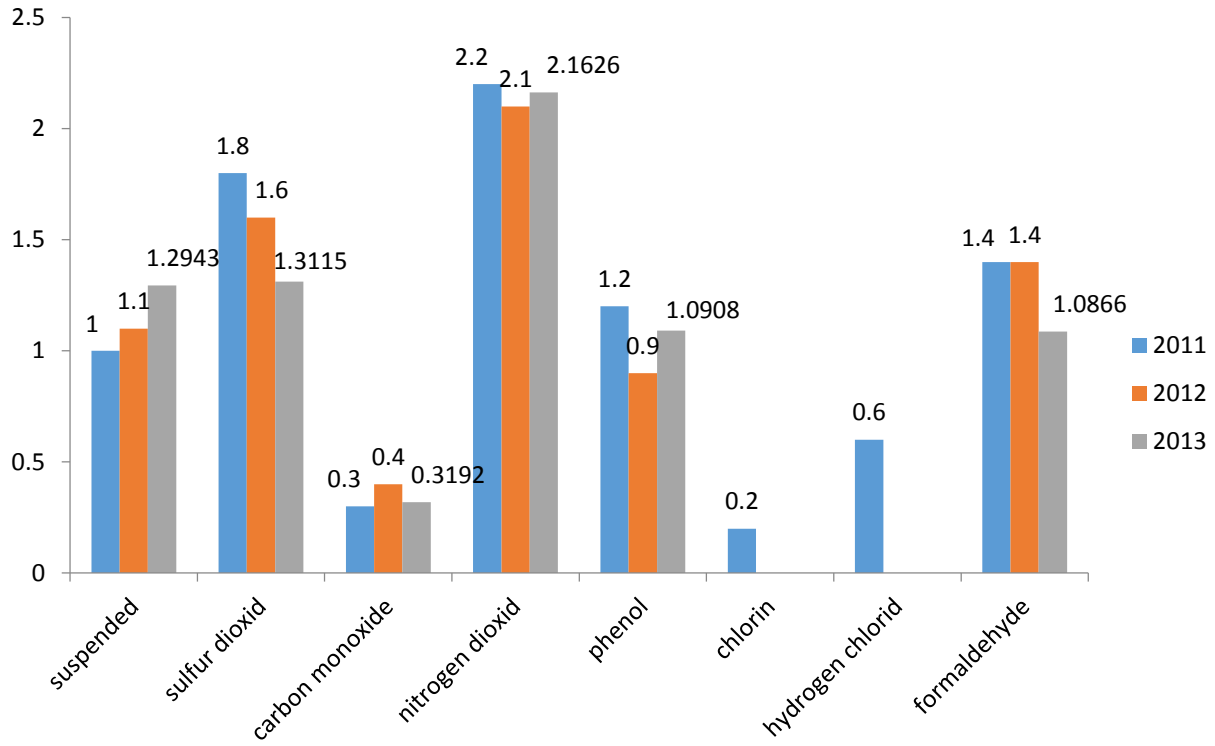


Figure 3. Multiplicity average concentration exceeding MAC main air pollutants in the city of Ust-Kamenogorsk in 2011-2013

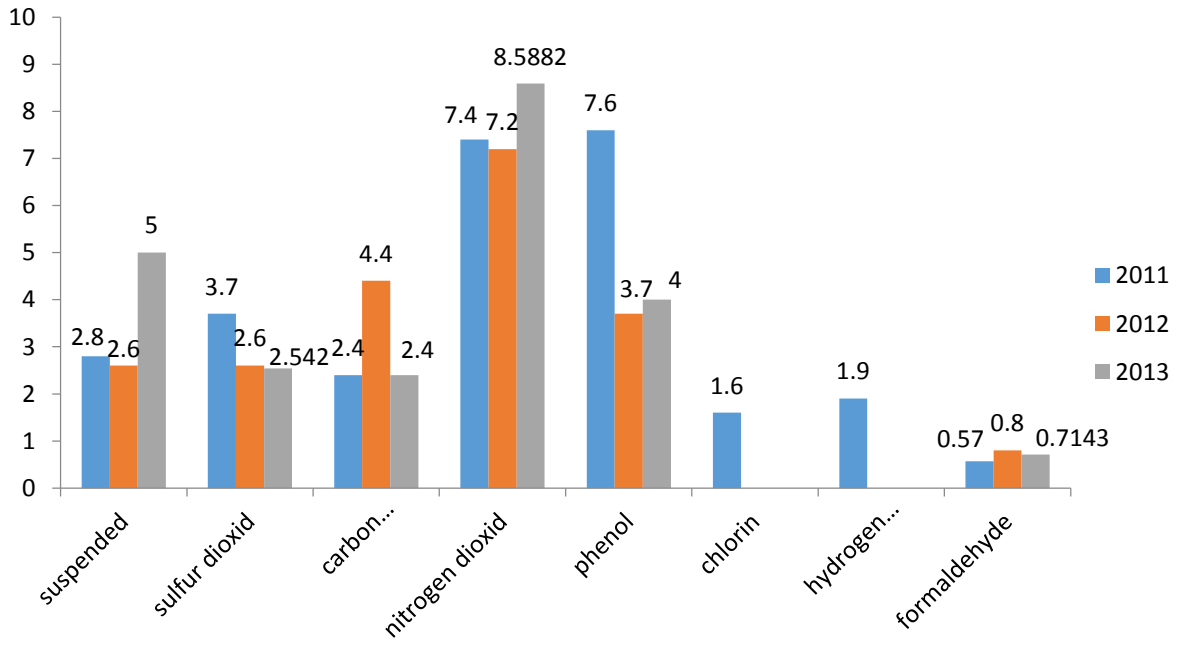


Figure 4. Multiplicity MPC excess of maximum concentration of major pollutants of Ust-Kamenogorsk in 2011-2013.

In 2013 compared with 2012 levels of air pollution in the city of Ust -Kamenogorsk has not changed (Figure 3.4) [7,8,9] .

The incidence of malignant tumors in the lungs of the East Kazakhstan region per 100 thousand population in 2010 was 37.4 , in the city of Ust- Kamenogorsk - 42.1 . The absolute number of cases of lung cancer in that year in the region - 522 , -134 people in the city . For 2011. morbidity area per 100 thousand population was 33 , 8, and is second only to skin cancer . Around the city this figure - 38.5 . The absolute number of cases of lung cancer in the city of Ust -Kamenogorsk in 2011 - 123 people in the region - 472. In 2012, the incidence of the area by 100 thousand people was 8.9 , the city figure - 38.7 . The absolute number of cases in a given year in the city was 124 , in the region - 124 people .

In Pavlodar region emissions of pollutants into the air from industrial enterprises generated located in three cities in the region, so 47% of the emissions generated in Ekibastuz, 26% - Aksu and 25% in Pavlodar The remaining areas of the region accounts for about 2% of emissions

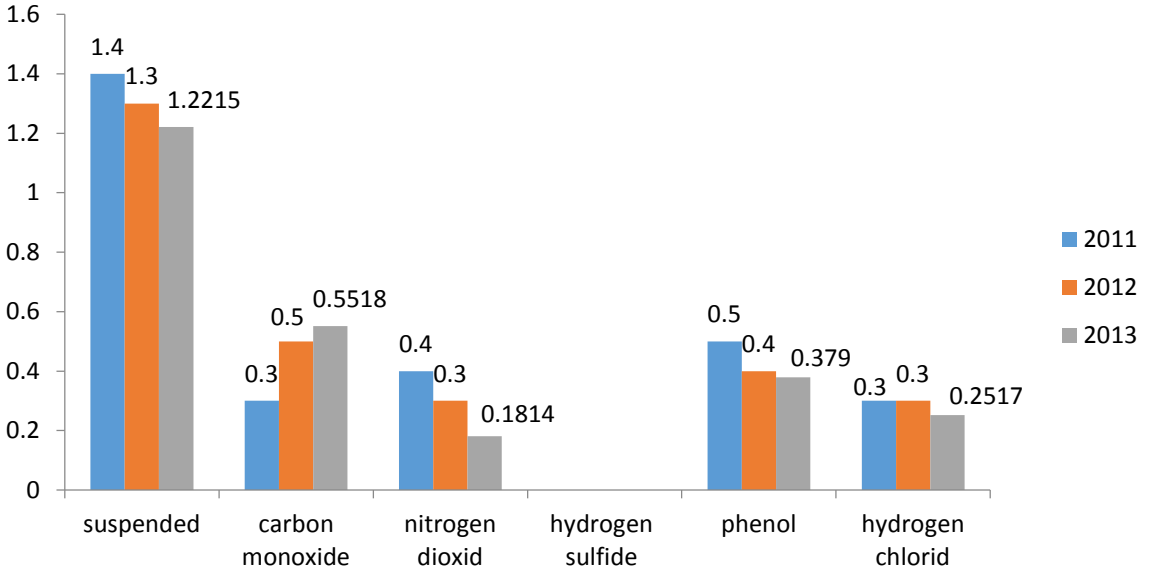


Figure 5. Multiplicity average concentration exceeding MAC main air pollutants in the city of Pavlodar in 2011-2013

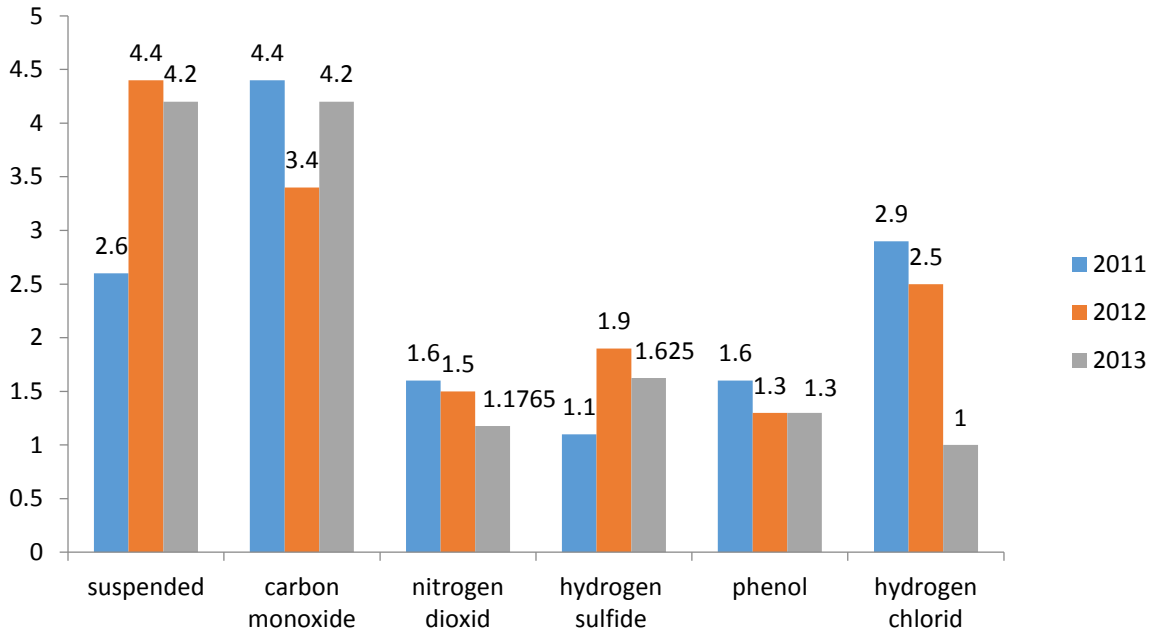


Figure 6. Multiplicity MPC excess of maximum concentration of major pollutants in Pavlodar for 2011-2013

Sources of air pollution , with the bulk of the emissions into the environment in the form of emissions of Pavlodar region are companies [10].

Observations of the atmospheric air in Pavlodar were conducted on two hand positions. We measured the concentrations of suspended solids , sulfur dioxide , sulfates , carbon monoxide , nitrogen dioxide , hydrogen sulfide , phenol, hydrogen chloride and chlorine (Figure 5.6) .

In 2011 year the low level of air pollution. Pollution index (API5) was 2.7 . Annual average concentration of suspended solids was 1.4 MAC.

The content of nitrogen dioxide, phenol, sulfur dioxide, carbon monoxide, hydrogen sulfide,

hydrogen chloride and chlorine were within the permissible norm Maximum concentrations of single carbon monoxide was 4.4 MAC, hydrogen chloride-2, 9 MAC, weighted substance - 2.6 MAC, nitrogen dioxide and 1.6 MAC phenol, hydrogen sulphide-1.1 MAC. In 2011 in comparison with 2010 level of air pollution in the city of Pavlodar, did not change significantly In 2012, the air pollution index (API5) was 2.7

The average for the first half of suspended solids concentration was 1.3 MAC. Content of nitrogen dioxide , phenol, sulfur dioxide , carbon monoxide , hydrogen sulfide, hydrogen chloride and chlorine were within the permissible norm . Maximum concentrations of single substances was 4.4 weighted MPC, carbon monoxide - 3.4 MAC, hydrogen chloride - 2.5 MAC, hydrogen sulfide - 1.9 MAC, nitrogen dioxide - 1.5 MAC , phenol - 1.3 MAC . In 2012 compared to 2011 , the level of air pollution in the city of Pavlodar has not changed significantly . In 2013, shows a low level of air pollution . Pollution index (API5) was 2.4 . Mean monthly concentration of suspended solids was 1.2 MAC. Sulfur dioxide , carbon monoxide , nitrogen dioxide , phenol, chlorine and hydrogen chloride were within the permissible norm . The maximum single concentration of suspended solids and carbon monoxide was 4.2 MAC, hydrogen sulphide - 1.6 MAC, phenol - 1.3 MAC, nitrogen dioxide - 1.2 MAC In 2013 in comparison with 2012 level of air pollution in the city of Pavlodar has not changed [5,6,7]

In Pavlodar region until 2011 when the annual growth of malignant novobrazovaniyami averaged 5-6%, in 2012 the number of cancer patients in the area increased by 20%. The main increase in the number of cancer was due to increasing the number of lung cancer sufferers So, if in the last few years in the first place had breast cancer and stomach, and lung cancer was 3-4 place, by the end 2012 to first place was the incidence of lung cancer [11].

RESULTS

Thus, the highest figures for the 2011-2013 API registered in Almaty, Ust-Kamenogorsk, while in Pavlodar it was only 2.6 Lung cancer rates in all the cities were high for the observed period.

In Almaty there are no large enterprises polluting enviroment, air pollution occurs mainly due to vehicles. Average concentrations of nitrogen dioxide and formaldehyde, which are known carcinogens, and for all three years exceeded the MPC several times.

East Kazakhstan region is characterized by high emission of pollutants into the atmosphere, as in the region are large mining and processing plants, steel mills In the city of Ust-Kamenogorsk for 2011-2013 is noticed maximum from a single concentration of phenol - 7.6 MAC, nitrogen dioxide - 7.4 MACs, sulfur dioxide-3, 7 MAC.

In Pavlodar region major contribution to the incidence of lung tumors contributes mass emissions into the environment as a waste of plants. Due to the limited number of fixed positions (of 2) in Pavlodar, indicators of pollutants not fully reflect the nature of urban atmospheric pollution

In general, these pollution index can be used to calculate the carcinogenic risk in the area.

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