ENSURING ENVIRONMENTAL SAFETY OF SPECIAL ECONOMIC ZONES, TAKING INTO ACCOUNT THE INFLUENCE OF INDUSTRIAL ENTERPRISES AND MOTOR VEHICLES

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Abstract: The economists have developed a fundamentally new concept of the so-called "territory of advanced social and economic development" for the economic growth and stable development of the country's regions, especially those, which are located far from the capital. The reason for the creation of these objects is the desire to form powerful economic centers in remote parts of the country, which will become an attractive object in the region. At the same time, the concentration of a greater number of industrial facilities leads to the deterioration of environmental situation in the region. In this regard, the issue of ensuring the environmental safety of these territories has become urgent. There are the following tasks within the framework of present scientific research: to form the database of physical parameters, qualitative and quantitative composition of pollutants, existing sources of atmospheric pollution of the special economic zone “Alabuga”; to assess air pollution, caused by the emissions from industrial enterprises, using calculation and instrumental methods.

Key words: special economic zone, environmental monitoring, emissions of hazardous substances, industrial enterprises.

1 Introduction

Currently, the problem of studying the environment is becoming increasingly important. The pursuance of the research is dictated by the need of protection and rational use of the environment, and preservation of a favorable environmental situation. Having concentrated enormous reserves of various types of energy, harmful substances and materials, industrial production has become a constant source of technological danger. In addition to stationary sources, environmental damage is caused by the emissions from motor transport (Korchagin et al, 2013; Suleymanov et al, 2013).

In the cities with developed industry, the share of pollutants from motor vehicles emissions is more than 50% of the total volume of harmful emissions into the air basin, in addition to the sufficiently high background of pollution from stationary sources (industrial enterprises, thermal power plants, parking areas and garages, petrol filling stations, etc.) (Korchagin et al, 2013; Suleymanov et al, 2013; Lozhkin et al, 2009; Suleimanov et al, 2018).

The presented calculation and instrumental methodology for environmental monitoring of air pollution in the city from emissions of industrial enterprises and vehicles involves the use of special experimental research methods, that is due to high requirements for the reliability and accuracy of the results. The inventory procedure of stationary sources of emission, the methods and number of air sampling, the methods of laboratory instrumental analysis, metrological characteristics of instruments and equipment, the conditions for the tests and processing of experimental data are defined **(**Suleimanov et al, 2018; Suleimanov et al, 2018; Khabibullin et al, 2013; Kajino, 2003)**.**

2 Methods

Based on the calculations of diffusion of pollutant emissions, 4 control points were selected for instrumental measurements of air pollution and noise impact. The list of control points is presented in table 1.

Table 1. List of control points

Control Point	Controlled substance	MPC (one-time, d/a), SRLI mg/m^3
T1 – is located on the border with the v. Gari, northwards from the industrial zone border (at a distance of 416 m)	Nitrogen dioxide	0.2
	Sulphur dioxide	0.5
	Hydrogen sulfide	0.008
	Suspended matters	0.5
	Phenol	0.01
T2 – is located on the border of the unified sanitary protection zone (USPZ), eastwards from the border of the industrial zone, towards the v. Bekhterevo (at a distance of 1000m)	Nitrogen dioxide	0.2
	Sulphur dioxide	0.5
	Hydrogen sulfide	0.008
	Suspended matters	0.5
	Phenol	0.01
T3 - is located on the border of the USPZ, southwards from the border of the industrial zone, towards the v. Bolshaya Tarlovka (at a distance of 1000 m)	Nitrogen dioxide	0.2
	Sulphur dioxide	0.5
	Hydrogen sulfide	0.008
	Suspended matters	0.5
	Phenol	0.01
T4 - is located on the border of the v. Bolshaya Kachka, southwestwards from the border of the industrial zone (at a distance of 755 m)	Nitrogen dioxide	0.2
	Sulphur dioxide	0.5
	Hydrogen sulfide	0.008
	Suspended matters	0.5
	Phenol	0.01

Air sampling was carried out in accordance with GOST 17 2.3.01-86, RD 52.04.186-89, as well as in accordance with the requirements, described in the measurement procedures for the selected indicators (table 2). Data on the conditions of sampling were recorded during the measurements.

Table 2. Measurement procedures

Substance	Measurement procedure	Method
Nitrogen dioxide	Operation manual for the gas analyzer "Elan" (EKIT 5.940.000 RE)	Electrochemical
Hydrogen sulfide	RD 52.04.795-2014	Photometric
Suspended matters	RD 52.04.186-89, p.5.2.6	Gravimetric

Sulphur dioxide	RD 52.04.794-2014	Photometric
Phenol	RD 52.04.799-2014	Photometric

The instruments and equipment for sampling and measuring the content of pollutants are the following: aspirator PU-4E; automatic air sampler OP-422 TTs; meteorological meter MES-2, mechanical stopwatch SOPpr-2a, high-accuracy electronic balance RV-512, special accuracy electronic balance RV-214, spectrophotometer "LEKI SS109UV", gas analyzer "Elan".

Suspended matters were taken using the filters AFA-VP, and the sampling device PU-3E. Phenol, sulfur dioxide, hydrogen sulfide were taken using the absorption devices, aspirators PU-4E, OP-422 TTs, with subsequent study of the samples at the laboratory, by the photometric method. The temperature, pressure, and wind speed were measured using the meteorological meter MES-2.

3 Results and Discussion

108 ingredients and 19 groups of substances with the effect of summation are discharged into the atmosphere from the sources of emissions of the enterprises, located in the special economic zone "Alabuga". Emitted substances belong to 1, 2, 3, 4 hazard classes.

Gross emissions of substances from the total mass of emissions are the following:

- hazard class 1 - 0.03 t/year (0.001%);
- hazard class 2 - 85 t/year (2%);
- hazard class 3 - 2687 t/year (55%);
- hazard class 4 - 1465 t/year (30%);
- with established SRLI (Safe Reference Level of Impact) - 650 t/year (13%).

The main contribution to gross emissions from the enterprises sources is made by:

- carbon oxide - 1432 t/year (29%);
- nitrogen dioxide - 1155 t/year (24%);
- sulfur dioxide - 928 t/year (19%);

The results of instrumental verification of the polluting substance content are presented in Table 3.

Table 3. The results of instrumental verification of the polluting substance content.

Point No.1

Values	Indicator	Nitrogen dioxide	Phenol	Suspended matters	Sulphur dioxide	Hydrogen sulfide
	1	2	3	4	5	6
Average	d/a	0.05	0.003	0.13	0.03	0.004
	MPC OT	0.23	0.3	0.26	0.06	0.54
Maximum	d/a	0.06	0.004	0.17	0.03	0.005
	MPC OT	0.30	0.4	0.34	0.06	0.63
Minimum	d/a	0.03	0.002	0.09	0.03	0.004
	MPC OT	0.15	0.2	0.18	0.06	0.50

Point No.2

Values	Indicator	Nitrogen dioxide	Phenol	Suspended matters	Sulphur dioxide	Hydrogen sulfide
	1	2	3	4	5	6
Average	d/a	0.04	0.002	0.10	0.03	0.004
	MPC OT	0.18	0.24	0.20	0.06	0.50
Maximum	d/a	0.05	0.003	0.15	0.03	0.005
	MPC OT	0.25	0.3	0.30	0.06	0.63
Minimum	d/a	0.02	0.002	0.04	0.03	0.004
	MPC OT	0.10	0.2	0.08	0.06	0.50

Point No.3

Values	Indicator	Nitrogen dioxide	Phenol	Suspended matters	Sulphur dioxide	Hydrogen sulfide
	1	2	3	4	5	6
Average	d/a	0.04	0.002	0.11	0.03	0.004
	MPC OT	0.19	0.18	0.22	0.06	0.50
Maximum	d/a	0.06	0.003	0.15	0.03	0.005
	MPC OT	0.30	0.3	0.30	0.06	0.63
Minimum	d/a	0.02	0.001	0.06	0.03	0.004
	MPC OT	0.10	0.1	0.12	0.06	0.50

Point No.4

Values	Indicator	Nitrogen dioxide	Phenol	Suspended matters	Sulphur dioxide	Hydrogen sulfide
	1	2	3	4	5	6
Average	d/a	0.04	0.002	0.11	0.03	0.004
	MPC OT	0.18	0.2	0.21	0.06	0.50
Maximum	d/a	0.05	0.003	0.15	0.03	0.005
	MPC OT	0.25	0.3	0.30	0.06	0.63
Minimum	d/a	0.02	0.001	0.06	0.03	0.004
	MPC OT	0.10	0.1	0.12	0.06	0.50

The cases of exceedence the maximum permissible concentration of studied compounds in atmospheric air were not detected.

For nitrogen dioxide, the average value of the concentration coefficient MPC OT for point No.1 is 0.23, the maximum value is 0.30, the minimum value is 0.15; for point No. 2: the average value is 0.18; the maximum value is 0.25, the minimum value is 0.10; for point No. 3: the average value is 0.19; the maximum value is 0.30, the minimum value is 0.10; for point No. 4: the average value is 0.18; the maximum value is 0.25, the minimum value is 0.10;

- for phenol, for point No. 1: the average is 0.30, the maximum is 0.40, the minimum is 0.20; for point No. 2: the average is 0.24; the maximum is 0.30, the minimum is 0.20; for point No. 3: the average is 0.18; the maximum is 0.30, the minimum is 0.10; for point No. 4: the average is 0.20; the maximum is 0.30, the minimum is 0.10;
- for suspended matters, for point No. 1: the average is 0.26, the maximum is 0.34, the minimum is 0.18; for point No. 2: the average is 0.20; the maximum is 0.30, the minimum is 0.08; for point No. 3: the average is 0.22; the maximum is 0.30, the minimum is 0.12; for point No. 4: the average is 0.21; the maximum is 0.30, the minimum is 0.12;
- for sulfur dioxide, for point No. 1: the average is 0.06, the maximum is 0.06, the minimum is 0.06; for point No. 2: the average is 0.06, the maximum is 0.06, the minimum is 0.06; for point No. 3: the average is 0.06, the maximum is 0.06, the minimum is 0.06; for point No. 4: the average is 0.06, the maximum is 0.06, the minimum is 0.06;
- for hydrogen sulfide, for point No. 1: the average is 0.54, the maximum is 0.63, the minimum is 0.50; for point No. 2: the average is 0.50, the maximum is 0.63, the minimum is 0.50; for point No. 3: the average is 0.50, the maximum is 0.63, the minimum is 0.50; for point No. 4: the average is 0.50, the maximum is 0.63, and the minimum is 0.50.

To assess the quality of atmospheric air pollution, it is proposed to use the calculated complex air pollution index (CCAPI) and the complex air pollution index (CAPI), which are the indicators of air quality. When calculating CCAPI, the data on the content of pollutants are used, based on the calculation of dispersion of pollutants emissions, obtained using the Unified program of air pollution estimation "Ecolog 4.6". The classification of CCAPI and CAPI allows to determine the acceptable level of environmental hazard. The following levels of danger of air pollution are used: low (0 ... 4), elevated (5 ... 6), high (7 ... 13), very high (≥14). Figure 2 presents the assessment of air pollution at control points, using CCAPI and CAPI.

CCAPI values are higher than CAPI. This is due to the fact that the simultaneous operation of all equipment, and the most unfavorable parameters for dispersion of pollutants, are taken into account in the calculations. The highest values of CCAPI and CAPI were detected at control point No. 1.

4 Summary

According to the results, for the special economic zone of an industrial and production type "Alabuga", it is proposed to establish the calculated unified sanitary protection zone, based on the combination of factors nowadays, and for the future, equal to 1000 meters, with a reduction from the north side along the border with the village Gari up to 416 meters, from the west side along the border of the village Bolshaya Kachka up to 755 meters, from the south side along the border of food industry enterprises up to 44 m.

Due to the critical values of the background concentrations of hydrogen sulfide and formaldehyde, which form the summation group No. 6038, the issue of location of resident enterprises within the boundaries of SEZ IPT "Alabuga", the technology of which assumes the emission of these substances, should be solved only after calculation of dispersion, taking into account all enterprises of the special economic zone "Alabuga".

To monitor the state of pollution of SEZ territory, it is proposed to conduct annual studies: the number of points of air control is 8. The program assumes 50 days of field studies of atmospheric air pollution per year.

5 Conclusions

The calculations of dispersion of pollutant emissions were carried out from all sources of the enterprises, taking into account the simultaneous operation of sources, under the most adverse conditions, with the criterion of calculation expediency $\sum Amax/MPC < 0.1$.

Based on the calculations of dispersion of pollutant emissions, 4 control points were selected for instrumental measurements of air pollution.

At 4 control points, the investigations were carried out on the content of nitrogen dioxide, hydrogen sulfide, suspended matters, sulfur dioxide, and phenol in atmospheric air. The cases of exceedence the maximum permissible concentration of studied compounds in atmospheric air were not detected.

It is proposed to use the calculated complex air pollution index and the complex air pollution index, which are the indicators of air quality. It was defined, that the values of the calculated complex air pollution index were higher than the values of the complex air pollution index. This is explained by the fact that the simultaneous operation of all equipment, and the most unfavorable parameters for dispersion of pollutants are taken into account in the calculations. The highest values of the calculated complex air pollution index and the complex air pollution index were detected at the control point No. 1.

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