TECHNIQUE OF AN ESTIMATION OF RISK FOR HEALTH OF THE POPULATION OF THE PLANNED AND REALIZED INDUSTRIAL ACTIVITY, ADVANTAGE AND PROSPECT

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By the example of the large enterprise of Republic Kazakhstan comparison of use in practical ecological activity of a method of sanitary- hygienic standartization and a technique of an estimation of risk is carried out. The technique of an estimation of risk offers the complex difficult system of the calculations demanding for its carrying out highly specialized and well prepared personnel. The received data have an exact mathematical basis and more rigid hygienic estimation of interaction of the person with the chemical substances polluting atmospheric air. Absence of normative legal base at a republican level limits of use of the technique for practical application. At the international level creation of uniform legal base, global standards and the popular advisory coordination center with wide access to databases are actual.
Key words: techniques, an estimation of risk, health of the population, sulfur dioxide, nitrogen dioxide, hydrogen sulphide, atmospheric air.

Now in Kazakhstan there is no united conventional technique of an estimation of influence of industrial activity on health of the population.

We earlier carried out a comparative estimation of application in practical activities on preservation of the environment of domestic and foreign techniques according to the influence of harmful factors on health of the person (1, 2, 3, 4). The methodology of an estimation of risk to health of the population under influence of harmful factors of an environment is developed by EPA the USA (EPA US). Unification of requirements, principles, methods and criteria of an estimation of risk for the health connected to influence of chemical substances, polluting an environment, in view of documents of the domestic, foreign and international organizations carried out in Russia (5). Till now in Kazakhstan it has not received wide application though there are departmental documents and the separate literary data (6, 7, 8). The purpose of our work was the comparative characteristic of use of a method of sanitary- hygienic standartization and a technique of an estimation of the risk, executed in the large enterprise of Republic Kazakhstan.

Material and methods of research

The technique of an estimation of risk for health of the population (5) chemical substances polluting an atmosphere formed as a result of activity of a large developing industrial complex in comparison with control territory (the data of the Republic of Kazakhstan) is used. Calculations of size CPZ (sanitary protection zone) for the industrial complex including working, builded and planned factories, are executed by a department of protection of atmospheric air of Agency according to the legislation of republic and with use of the software allowed to application in territory of the country. The calculations are carried out for 3 substances, 2 groups of summation in 9 settlement points with an estimation of influence on health of the population of five settlements (A, B, C, D and E), located on the border of a sanitary - protective zone. The list of considered substances with the indication maximum concentration limit and a class of danger is resulted in table 1.

Results of research

Size CPZ for an industrial complex has made 7 kms that allows to provide a level of substances polluting an atmosphere on border of the nearest settlements below maximum permissible. The amount of emissions of considered polluting substances in an atmosphere is submitted in table 2.

The total amount of emissions of polluting substances in an atmosphere from the taken into account sources of working, builded and planned objects of an industrial complex makes 18435 tons one year. The structure of analyzed polluting substances is submitted by 60,23 % sulfur dioxide, 39,04 % nitrogen dioxide, 0,74 % by hydrogen sulphide.

Table 1. The characteristic of polluting substances

The name of substance	Maximum concentration limit	A class of danger of substances
Nitrogen (IV) oxide (Nitrogen dioxide)	0.085	2
Sulfur dioxide	0.5	3
Hydrogen sulphide	0.008	2

Table 2. Amount of emissions of polluting substances in an atmosphere

The name of the enterprise	Nitrogen dioxide		Sulfur dioxide		Hydrogen sulphide	
	gramme/ second	tonne/year	gramme/ second	tonne /year	gramme/ second	tonne /year
Factory 1	63.8	1887.1	177.8	5589.7	2.4	69.3
Factory 2	105.4	3321.9	156.0	4919.0	2.0	63.9
Factory 3	1039.5	1987.6	41.9	594.2	0.02	0.3
In total		7196.6		11102.9		133.5

Comparison with background concentration and referential dozes shows, that the amount of analyzed substances in an atmosphere at full designed capacity of the enterprise exceeds referential level that allows to use a technique for the quantitative characteristic of risks for health.

The first stage of risk assessment has allowed to define, that analyzed substances do not possess cancerogenic activity.

The index of danger is designed, as the relation of an influencing concentration chemical substance to it referential to a level.

$$HQ \equiv \frac{C}{RFC}, \text{ where}$$

HQ - index of danger,
C - concentration, mg / cube m,
RfC - referential concentration.

Indexes of comparative uncancerogenic danger are resulted in table 3.

Table 3. Indexes of comparative uncancerogenic danger

The name of substance	Indexes
Hydrogen sulphide	165.00
Nitrogen dioxide	15.75
Sulfur dioxide	2.80

As the designed factors of danger of substances exceed «one», the probability of development in the population of harmful effects at daily receipt of these substances during a life grows proportionally to increase in an index. The maximal uncancerogenic danger is represented with hydrogen sulphide - 165.00. According with degree of danger nitrogen dioxide is on the second place. Sulfur dioxide at ranging takes the third place.

The total index of danger (HI) is designed under the formula:

$$HI \equiv \sum HQi, \text{ where:}$$

HQi - indexes of danger to separate components of a mix of substances polluting an atmosphere.

The total index of danger (THI), characterizes allowable receipt and also exceeds «one».

The received settlement concentration of polluting substances testify that all considered substances are dangerous to health. The greatest contribution, both to total size, and to risk of influence on bodies of breath brings hydrogen sulphide. Then - dioxide nitrogen. Sulfur dioxide plays less significant role in formation of risk. The total risk is significant and makes 183,55. Biological action of substances potentiate influence on the same critical body, mainly respiratory system.

On the basis of the epidemiological data we carry out the calculation of risk of infringements development of a children health state. It is established, 38,05 of additional cases of diseases of pneumonia on 100 thousand person of the corresponding population, that is 9 % higher, than in control territory.

The maximal valid for one occation concentration of substances polluting an atmosphere from all three structures of an industrial complex are established for nitrogen dioxide - 0,63 maximum concentration limits on border of settlement A, for hydrogen sulphide - 0,41 maximum concentration limits on border of settlement D and for sulfur dioxide - 0,22 maximum concentration limits on border of settlement D (Table 4).

Table 4. The maximal ground concentration of polluting substances in settlement points

The name of settlement points	The maximal concentration in settlement points, in shares of maximum concentration limit				
	NO_2	SO_2	H_2S	Group of summation NO_2+SO_2	Group of summation H_2S+SO_2
Settlement A	0.63	0.14	0.33	0.65	0.44
Settlement B	0.29	0.14	0.30	0.35	0.36
Settlement C	0.20	0.07	0.16	0.20	0.20
Settlement D	0.48	0.22	0.41	0.65	0.61
Settlement E	0.43	0.09	0.25	0.50	0.31

The estimation of an exposition of analyzed polluting substances is carried out by calculation of daily dozes at their inhalation receipt with atmospheric air. For calculation all settlements located near the border of a sanitary - protective zone are taken. The established risks for health of the population (without taking into account the age) are submitted in table 5.

Table 5. The integrated estimation of an exposition

Polluting substances	The risk caused by inhalation influence of chemical substances in atmospheric air as a result of activity of an industrial complex				
	Settlement A	Settlement B	Settlement C	Settlement D	Settlement E
Sulfur dioxide	2,0E-02	2,0E-02	1,0E-02	3,1E-02	1,0 E -02
Nitrogen dioxide	1,5 E -02	7,0E-03	4,9E-03	1,2E-02	1,3 E -02
Hydrogen sulphide	7,5 E -04	6,9 E -04	3,7 E -04	9,4 E -04	5,7 E -04
Total receipt	3,6 E 02	2,8 E -02	1,5 E -02	4,4 E -02	2,4 E -02

Individual risk during all life, equal or smaller 1 x 10^{-6} corresponds to one additional case of serious disease or death per 1 million exposed persons and characterizes the small risk levels which are not distinguished from usual, daily risks. The risk from activity of the large industrial complex, designed for all analyzed substances influencing health of the population, living on border of a sanitary - protective zone exceeds this level.

For the hydrogen sulphide, the designed risk level is stacked in an interval more than 1 x 10^{-4}, but less than 1 x 10^{-3}, and is not allowable for the population. For sulfur dioxide and nitrogen dioxide the range of individual risk during all life more than 1 x 10^{-3} is not comprehensible for the population and demands carrying out of emergency actions on its decrease.

The established risk for health as a result of activity of a large developing industrial complex on border of a sanitary - protective zone is not allowable for the population.

Thus, the technique of an estimation of risk for health of the population offers the complex difficult system of the calculations demanding for its carrying out highly specialized and well prepared personnel. At the same time, the received data have an exact mathematical basis and, undoubtedly, more rigid hygienic estimation of parameters of interaction, than earlier known techniques that makes it attractive to use in system of complex difficult relations «the person - industrial activity». The absence of legislative normative legal base at a republican level limits opportunities of technique use for practical application.

At the international level creation of uniform normative-legal base and the global standards regulating interaction of the person and surrounding, including, the industrial environment is actual. Creation of the uniform, popular advisory coordination center with wide access to databases for carrying out of calculations of an estimation of risk to health of the population.

References:

1. The All-Russia scientific - methodical seminar «Modernization of modern education: to ecological competence - through ecological activity», Sankt-Peterburg.-2006, 255-258.

2. Skolsky V.A., Namyatov A.A.., Uvarov V.N., Rudenko I.M., Eidinov Yu. I. Modern theory and practice for assessing the impact of projected activities on the environment, Almaty, 2007.

3. Wallace L.A. The total Exposure Assessment Methodology (TEAM) Study: Summary and Analyses: Volume I. US Environmental Protection Agency, Report. Office of Research and Development.-Washington, D.C.-1987.-NEPA/600/6-87/002a

4. National integrated programmers on environmental and health in/Countries in Central and eastern Europe (CCEE)/Seminars on environmental epidemiology a text book-1993.-197s.

5. The management according to risk for health of the population at influence of the chemical substances polluting an environment, P 2.1.10.1920-04, Is authorized by the Main state health officer of the Russian Federation, the First deputy minister of public health services of Russian Federation Г.Г.ОНИЩЕНКО on March, 5, 2004.

6. The order of Minister of preservation of the environment of Republic Kazakhstan from June, 6, 2008 №139-p « About the statement « Techniques of an estimation of risk for a state of health of the population from environmental contamination ».

7. The order of Chairman of Committee of the state sanitary-and-epidemiologic supervision of Ministry of Health of Republic Kazakhstan from December, 28, 2007 № 117 « About the statement of Methodical instructions according to risk for health of the population of chemical factors of an environment ».

8. Belonog A.A., Slazhneva T.I., Jakovleva N.A., Korchevskij A.A., Abdrahmanova S.Z., Mashenko S.N. Estimation of risk of influence on health of the population of chemical factors of an environment. Methodical recommendations, Almaty, 2004.