

Determining the Removal of Harmful Substances During the Construction Period

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Abstract. The construction industry is a fairly capacious consumer of various fuel and energy resources, the period of construction of buildings deserves special attention, which is comparable to the stage of operation in terms of average annual costs. A document containing maximum allowable emissions is mandatory for categories of enterprises, including construction industries, which, in the course of their work, pollute the atmosphere with emissions of various substances: combustion products, exhaust gases, dust, etc. The article assesses atmospheric air pollution with harmful substances from the operation of machines and mechanisms at the construction site during the construction of an apartment building. The values of harmful emissions by types of mechanization of construction works are considered. The maximum allowable total emissions into the atmosphere for the considered construction object were calculated in order to control the quality and composition of pollutants into the atmosphere from mechanized sources located at the construction site. The results of calculations of maximum allowable emissions make it possible to assess the level of impact on the atmospheric air. If the emission values are exceeded, monitoring of compliance with environmental pollution is introduced in order to take corrective measures to improve the environmental situation.

Key words: maximum allowable emissions, harmful substances, construction site, machines and mechanisms, environment, monitoring, construction technology.

1 Introduction

Modern construction of both large cities and small settlements involves the construction of various residential, social and commercial facilities. In general, the construction industry affects the formation of a number of environmental problems:

- excessive consumption of energy resources, which leads to the depletion of natural resources;
- changes in the environment, landscapes;
- destruction of representatives of flora and fauna due to their displacement from their usual places of residence;

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- overload of the transport system, which leads to air pollution;
- negative impact of wastewater;
- increase in the amount of household and industrial waste;
- water pollution;
- work on construction sites, detrimental to human health.

The energy sector of any state is one of the decisive factors in the development of its economy, in connection with which the energy-saving policy is aimed at the efficient and rationally responsible use of energy resources in various sectors of the national economy. At the same time, the consumption of fuel and energy resources is continuously associated with the problem of environmental safety resulting from the negative impact of harmful emissions into the environment.

The fundamental goal in the field of ensuring the environmental safety of the energy sector is to reduce the burden of the fuel and energy complex on the environment by reducing emissions of pollutants into the environment and reducing the generation of waste in various industries. Construction production is one of the main anthropogenic factors that have a negative impact on the environment. The impact occurs at all stages of the life cycle of a building: construction, operation, dismantling [1]. According to studies [2-4], it has been established that in the general life cycle the stage of building construction, despite the use of various construction technologies, including energy-saving ones, is the most energy-consuming. During this period, the construction of buildings and structures should be considered as a source of significant pollution.

In recent years, studies have been carried out to stabilize biospheric compatibility [5–6] while observing the safety requirements for buildings and structures based on the balance of the biotechnosphere of the region and human development. An important factor is environmental pollution for each construction site. In particular, most of the machinery and equipment, as well as the construction site itself, are powered by electricity. As is known, electricity generation is carried out using various types of fuel power plants, hydroelectric power plants, nuclear analyzes, etc. Thermal power facilities have a negative impact on the environment, known harmful substances exacerbate thermal pollution of the atmosphere [7–9].

The construction of any object should begin with a study of the building area - conducting engineering and environmental surveys in order to justify the construction and, as China does, to prevent, reduce or eliminate favorable environmental consequences [10].

In order to control and regulate the amount of pollutants in the environment, generally accepted calculations of maximum permissible pollution (MAP) have been adopted.

At the maximum allowable emission, it is customary to consider the rate of emission of a pollutant into the atmosphere. Recently, it has been customary to consider its volume or mass as characteristics of a harmful substance. This indicator is set for stationary sources of pollution.

During the construction period, machines and mechanisms should be switched on to the main stationary sources of pollution at construction sites, which can be used depending on the construction technology used and the type of work (earth, installation, concrete, finishing, etc.). At the same time, according to the first Russian [11-13] and foreign [14-15] studies in various industries, the largest emission of harmful substances, as a rule, is produced in the atmospheric air.

2 Materials and Methods

Methodological approaches for solving the established problem are based on the calculation, analysis and comparison of emissions of harmful substances from the work of various energy consumers at the construction site during the construction of a representative object.

To assess the pollution of atmospheric air with harmful substances, an apartment building was chosen as the object of study.

The main technical and economic indicators for this facility are presented in Table 1.

Table 1. Technical and economic indicators of the construction object.

No. p/p	Name of indicator	Units	Block sections A and B	Block section B	Building Total
1	Built-up area	m ²	976,17	406,65	1382,82
2	Residential building area	m ²	8 093,86	2 855,64	10 949,50
3	Non-residential area	m ²	-	352,50	352,50
4	Structural volume of the building, including:	m ³	26 037,70	11 109,71	37 147,41
	– above el. 0.000	m ³	24 116,97	10 228,46	34 345,43
	– below el. 0.000	m ³	1 920,73	881,25	2 801,98
5	Building height				
	– architectural	m	33,35	30,65	
	– fire technical	m	27,00	24,84	
6	Number of storeys	floor	10	9	
7	Number of floors	piece	11	10	
	– basement	piece	1	1	
	– residential	piece	10	8	
	– non-residential (built-in premises of the 1st floor)	piece	-	1	
8	Estimated population	number	240	89	329

According to the data presented in the construction organization project, the estimated duration of the construction of the designed residential building is 10.5 months.

During the construction of the selected facility, the main sources of pollution will be the engines of machines, mechanisms and trucks involved in construction work. Emission of pollutants will also occur during welding, metal cutting and finishing works.

The following sources of pollution and the corresponding harmful substances released during the work, presented in Table 2, will operate on the territory of the construction site.

Table 2. Sources of pollution at the construction site.

No. p/p	Sources of pollution in the workplace	Released harmful substances
1	Operation of vehicles and construction equipment	Nitrogen dioxide, nitrogen oxide, carbon, sulfur dioxide, carbon monoxide, kerosene
2	Welding post (welding works)	Iron oxide, manganese and its compounds, nitrogen dioxide, carbon monoxide, gaseous fluorides, poorly soluble fluorides, inorganic dust
3	Waterproofing works with hot bitumen	Limiting hydrocarbons C12-C19
4	Excavation	Dust inorganic
5	Metal cutting works	Iron oxide
6	Mobile compressor operation	Nitrogen dioxide, nitrogen oxide, sulfur dioxide, carbon, carbon oxide, benz (a) pyrene, formaldehyde, kerosene

The release of harmful substances during the construction of any object causes environmental and economic damage, which is the loss of natural resources and the cost of their compensation or restoration.

Calculation of payment for emissions of pollutants into the atmosphere from the gross volume of their emissions is made according to the formula:

$$P_i = \sum (c_i \times g_i) \quad (1)$$

where: g_i - the mass of the i -th component emitted into the atmospheric air, t;
 c_i - the rate of payment for the emission of 1 ton of the i -th harmful substance, rub./t.

3 Results and Discussion

Based on the calculation results, the values for each type of pollutants generated during the construction of the selected facility were determined in Table 3 should be used.

Table 3. List of atmospheric pollutants during the construction period.

Pollutant		Used criterion	Criterion value, mg/m ³	Hazard Class	Total substance release	
Code	Name				g/s	t/period
0123	Iron oxide	MPC* s/s	0,04	3	0,0102257	0,002215
0143	Manganese and its compounds	MPC m/r	0,01	2	0,0000065	0,000002
0301	Nitrogen dioxide	MPC m/r	0,2	3	0,1911249	0,236828
0304	Nitrogen (II) oxide	MPC m/r	0,4	3	0,0310635	0,038436
0328	Carbon	MPC m/r	0,15	3	0,052075	0,0415
0330	Sulfur dioxide	MPC m/r	0,5	3	0,0297578	0,032599
0337	Carbon oxide	MPC m/r	5	4	0,6120288	0,46025
0342	Fluorine gaseous compounds	MPC m/r	0,02	2	0,0000133	0,000004
0344	Fluorides, inorganic	MPC m/r	0,2	2	0,0000234	0,000007
0703	Benzopyrene	MPC* s/s	1,00e-0,6	1	0,0000002	2,00e-07
1325	Formaldehyde	MPC m/r	0,05	2	0,0022	0,0024
2732	Kerosene	ISEL	1,2		0,1350297	0,120526
2754	Alkanes C12-19	MPC m/r	1	4	0,000106	0,007784
2908	Dust inorganic	MPC m/r	0,3	3	0,0168099	0,118803
Total Substance: 14					1,0804622	1,061354
including solid: 6					0,0791382	0,162527
liquid/gaseous: 8					1,001324	0,898827
Groups of substances of combined harmful action:						
6046	(2) 337 2908					

Pollutant		Used criterion	Criterion value, mg/m ³	Hazard Class	Total substance release	
Code	Name				g/s	t/period
6053			(2) 342 344			
6204			(2) 301 330			
6205			(2) 330 342			
* MPC - maximum permissible concentration						
**ISEL are indicative safe exposure levels						

As a result of the construction activities for the construction of the object in question, 14 types of pollutants and 4 groups of summation of harmful substances will be emitted into the atmosphere. The gross emission of harmful substances during the mechanization of work at the construction site will be 1,061354 t/period, and the total maximum one-time emission rate will be 1,0804622 g/s.

The calculation results showed that the expected maximum surface concentrations during the construction period do not exceed the maximum allowable concentrations for all pollutants. However, the calculation showed that in the total total mass, despite compliance with the maximum established standards, the emission values are significant. In this regard, during the construction period, it is necessary to monitor the emission of harmful substances in order to identify deviations from established environmental standards and prevent negative environmental impacts.

Based on the obtained values, the total emission of a substance is calculated for the emission of harmful substances during the construction period, presented in Table 4.

Table 4. Payment for emissions of harmful substances during the construction period.

Substance		Emissions, t/period	Emissions fee
code	Name		
0123	Iron oxide	0,002215	0,10214694
0143	Manganese and its compounds	0, 000002	0,01379322
0301	Nitrogen dioxide	0,236828	41,41837526
0304	Nitrogen (II) oxide	0,38436	45,2814516
0328	Carbon	0,0415	1,913814

0330	Sulfur dioxide	0,032599	1,864793196
0337	Carbon oxide	0,46025	0,927864
0342	Fluorine gaseous compounds	0, 000004	0,0043788
0344	Fluorides, inorganic	0,000007	0,001601712
1325	Formaldehyde	0,0024	5,5145664
2732	Kerosene	0,120526	1,017480492
2754	Alkanes C12-19	0,007784	0,105924672
2908	Dust inorganic	0,118803	8,397708858
Total 98,166 rubles			

4 Conclusions

The energy sector of any state is one of the decisive factors in the development of its economy, in connection with which the energy-saving policy is aimed at the efficient and rationally responsible use of energy resources in various sectors of the national economy. At the same time, the consumption of fuel and energy resources is continuously associated with the problem of environmental safety resulting from the negative impact of harmful emissions into the environment.

The release of harmful substances during the construction of any object causes environmental and economic damage, which is the loss of natural resources and the cost of their compensation or restoration. In case of emission of harmful and dangerous substances exceeding the established norms, the implementation of environmental protection measures should be envisaged and the necessary programs for industrial environmental control over the nature of changes in ecosystem components during the construction of the facility should be developed. The cost of planned environmental protection measures is determined on the basis of tender procedures. As a result, the emissions project allows the regulatory authorities to track the total amount of pollution in a particular area and propose measures to improve the environmental situation.

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