British Journal of Global Ecology and Sustainable Development
Volume- 44, September 2025
ISSN (E): 2754-9291

ASSESSMENT OF AIR POLLUTANT EMISSIONS FROM A CONSTRUCTION ENTERPRISE (CASE STUDY OF SAMARKAND UZBEKGAZSUV CONSTRUCTION LLC)

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Abstract

This article analyzes the air pollutants emitted as a result of the activities of *Samarkand Uzbekgazsuv Qurilish* LLC, located in Jomboy district of Samarkand region. The enterprise emits approximately 19.01 tons of harmful substances into the atmosphere each year. The major share consists of inorganic dust (42.5%) and carbon monoxide (32.6%). In addition, sulfur oxide accounts for 12.8%, nitrogen oxide – 9.4%, and hydrocarbons – 2.6%. The asphalt production unit is the largest contributor, releasing 10.39 tons of pollutants annually.

It was shown that under unfavorable weather conditions, the use of gas and dust cleaning equipment can reduce emissions by 20–40%, while the use of low-polluting fuels can reduce them by 30–60%.

The research findings serve as an important scientific basis for ensuring environmental safety in industrial enterprises and improving air quality.

Keywords: Air pollution, emissions, environmental monitoring, MAC, EIA, Jomboy district, industrial enterprise.

Introduction

Protecting the environment, particularly atmospheric air, from the impact of industrial emissions is one of the most pressing global issues today. As a result of industrial development and the increasing scale of production, various chemical substances are being released into the atmosphere. Such processes lead to the disruption of ecological balance, deterioration of air quality indicators, and negative effects on human health. Therefore, monitoring atmospheric emissions, conducting their inventory, and determining the maximum permissible concentrations based on sanitary and hygienic standards are of great importance.

In the Republic of Uzbekistan, a system has been established to regulate and monitor industrial enterprises' atmospheric emissions of pollutants. In particular, enterprises are required to develop projects for the Maximum Allowable Emissions (MAE), which serve as a key instrument in ensuring environmental safety during production processes.

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Although scientific and technological progress has advanced the development of society's productive forces, it has also accelerated the exploitation of natural resources, leading to the pollution of air, water, and soil. In particular, dust and gaseous emissions from road construction and construction material manufacturing enterprises pose significant environmental risks.

Therefore, the present study aims to analyze the atmospheric pollutant emissions of Samarkand Uzbekgazsuv Qurilish LLC, assess their sources, and evaluate the associated environmental risks.

The purpose of this study is to evaluate the volume, composition, and environmental impact of air pollutants emitted by Samarkand Uzbekgazsuv Qurilish LLC and to propose effective emission reduction measures.

This study is significant as it provides empirical evidence on industrial emissions in a developing regional context, offering practical insights for environmental management strategies and policy implementation.

General Information about the Enterprise

Samarkand Uzbekgazsuv Qurilish LLC is located in Jomboy city, Jomboy district, on Tashkent Street, with a total land area of 3.2732 hectares. The main activity of the enterprise is road repair and construction works.

The enterprise is bordered by the following facilities: to the north — *Jomboydonmahsulot* JSC, located 70 meters away; to the south — the residential area of *Khashdala* neighborhood; to the west — a compressed natural gas filling station belonging to *Sambest in Qest* LLC; and to the east — the Tashkent–Samarkand railway and a residential area. The nearest residential settlement is located to the south of the enterprise, at an approximate distance of 300 meters.

The production regime consists of 8 hours per day, covering 290 working days per year. A total of 60 employees work at the enterprise. The area's relief is flat, with a relief impact coefficient equal to 1. The geographical coordinates of the enterprise's location are as follows:

39°42′1.16″C, 67°05′2.96″B;
39°41′54.21″C, 67°05′9.82″B;
39°41′52.77″C, 67°05′5.07″B;
39°41′58.94″C, 67°04′58.08″B.

These data are crucial for evaluating the environmental condition of the enterprise and developing appropriate mitigation strategies.

Jomboy district, where the enterprise is located, lies within the plain zone of the region and is characterized by the following climatic conditions:

The highest sunshine duration occurs during the hottest summer months; in Jomboy district it ranges from 354 to 386 hours per month, which accounts for 82–90% of the expected amount.

In autumn and winter, winds predominantly blow from the southwest, while in summer they mainly come from the northwest (see Table 1).

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ISSN (E): 2754-9291

Table 1. Meteorological Indicators of Jomboy District

№	Name of Indicator	Value
1	Regional Coefficient (A)	200
2	Relief Impact Coefficient	1
3	Average Maximum Summer Temperature, °C	+34,2
4	Average Minimum Winter Temperature, °C	−3,8
5	Wind Speed, m/s	3,6
6	Annual Precipitation, mm	321,4
7	Wind Direction Distribution (%)	N – 17; NE – 11; E – 9; SE – 5; S – 7; SW – 13; W – 16; NW – 22

According to climatic conditions, Jomboy district of Samarkand region belongs to Climate Zone Category III.

Materials and Methods

The object of the study was *Samarkand Uzbekgazsuv Qurilish* LLC, located in Jomboy district. The quantity and composition of atmospheric emissions generated in the production and auxiliary units of the enterprise were examined.

For the study, data were collected based on the enterprise's production indicators related to technological processes, reports from the Regional Department of Ecology, as well as on-site observations. The volume of atmospheric emissions was calculated in accordance with the methodological guidelines approved by the Ministry of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan (UZB M-001-2004). The emission mass was calculated using a standardized formula approved by regulatory guidelines.

$$\boldsymbol{A = G \times q \times k}$$

where:

M — mass of emitted pollutant (t/year), G — raw material or fuel consumption (t/year), q — emission coefficient (g/s or t/year), k — correction coefficient accounting for the technological process.

The emission coefficients were taken from GOST 17.2.3.02–78 and the applicable regulatory documents.

The determined quantities were compared with the maximum permissible concentrations (MPC) and the allowable emission limits (MAE). The assessment was based on the document approved by the Ministry of Health of the Republic of Uzbekistan, titled *"Hygienic Standards for Air in Production Zones."* To evaluate the dispersion of pollutants in the air, the methodology *"Method for Calculating the Dispersion of Pollutants in the Atmosphere in the Republic of Uzbekistan"* (Tashkent, 2010) was used. The dispersion of dust was illustrated using a schematic diagram.

When accounting for meteorological conditions, additional calculations were carried out to develop an emission reduction plan under unfavorable weather conditions, considering wind speed, atmospheric stability, and inversion conditions, as well as scenarios for reducing production volumes by 20%, 40%, and 60%.

Results and Discussion

Eight types of pollutants were identified as being emitted into the atmospheric air from the emission sources at the enterprise, with a total annual amount of 19.011172 t/year (see Table 2).

Table 2. Pollutants Emitted into the Atmospheric Air at the Enterprise

Name of Pollutant	Percentage Share of Emission	Total Emitted into the Atmosphere, t/year
Inorganic Dust	42,50	8,08
Carbon Monoxide	32,61	6,20
Nitrogen Oxide	9,42	1,79
Hydrocarbons	2,60	0,4952
Sulfur Oxide	12,84	2,442
Benz(a)pyrene	0,0004	0,000072
Welding Dust	0,02	0,0034
Manganese Oxide	0,003	0,0005
	100,0	**19,011172**

It was determined that different units of the production enterprise emit pollutants of varying composition and quantity into the atmosphere (see Table 3).

Table 3. Volume of Pollutants Emitted into the Atmosphere at the Enterprise

Production Unit / Workshop Name	Source Number on the Map Scheme	Name of Substance	Pollutant Emissions	
			Actual	
			g/s	t/y
Inert Material Storage – Gravel	1	Inorganic Dust	0,128	1,07
Inert Material Storage – Sand and Gravel	2	Inorganic Dust	0,213	1,23
Mineral Mixtures Storage Facility	3	Inorganic Dust	0,107	0,62
Mixing Unit	4	Inorganic Dust	0,053	0,44
Transfer Unit	5	Inorganic Dust	0,158	0,95
Receiving Unit	6	Inorganic Dust	0,106	0,89
Asphalt Production Unit	7	Carbon Monoxide Nitrogen Oxide Sulfur Oxide Benzo(a)pyrene Inorganic Dust	0,646 0,13 0,253 0,000004 0,36	5,39 1,09 2,12 0,000048 2,88

Bitumen Melting Unit	8	Carbon Monoxide Nitrogen Oxide Sulfur Oxide Benzo(a)pyrene Hydrocarbons	0,067 0,014 0,025 0,000002 0,0021	0,81 0,17 0,302 0,000024 0,0252
Bitumen Storage Unit	9	Hydrocarbons	0,02	0,47
Welding Unit	10	Welding Dust Manganese Oxide	0,0011 0,00016	0,0034 0,0005

Analysis of pollutants emitted from the 10 units of the enterprise showed that inorganic dust is primarily released from the inert material storage. The amount of dust emissions was 0.128 g/s, or 1.07 tons per year. While the figure appears modest, persistent emissions can significantly degrade ambient air quality over time. In the inert material storage (sand and gravel) — inorganic dust emissions were recorded at 0.213 g/s, or 1.23 tons per year (see Figure 1). This value is slightly higher compared to the gravel storage, mainly due to dust generation during the storage of sand and gravel as well as during loading and unloading processes. In the mineral mixtures storage, ground dust emissions amounted to 0.107 g/s, or 0.62 tons per year. Although this figure is relatively low, it still negatively affects overall air dustiness. In the mixing unit, the amount of dust released into the air was 0.053 g/s, or 0.44 tons per year. This is one of the lowest values, which can be explained by the partially enclosed nature of the technological processes. In the transfer unit, dust emissions amounted to 0.158 g/s, or 0.95 tons per year, representing an average value. The mechanical handling and transportation of materials contribute to dust generation. In the receiving unit, dust released into the air was 0.106 g/s, or 0.89 tons per year. This value is nearly the same as that of the inert material storage, with the primary source being the processes of material receiving and unloading. In the asphalt production unit, various harmful substances are emitted into the air, including:

In the asphalt production unit, various harmful substances are emitted into the air. Carbon monoxide is released at a rate of 0.646 g/s, amounting to 5.39 tons per year. Nitrogen oxide emissions reach 0.13 g/s, or 1.09 tons annually, while sulfur oxide is emitted at 0.253 g/s, totaling 2.12 tons per year. Benzo(a)pyrene is released in much smaller quantities, at 0.000004 g/s, equivalent to 0.000048 tons per year. Inorganic dust emissions from this unit amount to 0.36 g/s, or 2.88 tons per year.

Among these values, the particularly high levels of carbon monoxide and dust increase the degree of environmental risk. In addition, the presence of carcinogenic substances such as benzo(a)pyrene poses a significant hazard. In the bitumen melting unit, several pollutants were identified. Carbon monoxide is emitted at 0.067 g/s, or 0.81 tons per year; nitrogen oxide at 0.014 g/s, or 0.17 tons per year; sulfur oxide at 0.025 g/s, or 0.302 tons per year; benzo(a)pyrene at 0.000002 g/s, or 0.000024 tons per year; and hydrocarbons at 0.0021 g/s, or 0.0252 tons per year. Although these values are considerably lower compared to the asphalt production unit, the presence of hydrocarbons and benzo(a)pyrene still increases environmental risk. In the bitumen storage unit, hydrocarbon emissions were recorded at 0.02 g/s, or 0.47 tons per year. Although this amount is not large, the volatilization process contributes to the accumulation of harmful substances in the air. From the welding unit, welding dust (0.0011 g/s or 0.0034 tons per year) and manganese oxide (0.00016 g/s or 0.0005 tons per year) are emitted into the atmosphere. Although the quantities of these substances are relatively low, they represent a significant environmental factor due to the presence of health-hazardous components in metallurgical dust.

The analysis showed that the main source of pollution at the enterprise is the asphalt production unit, which emits tens of tons of carbon monoxide, sulfur oxide, and inorganic dust annually. In the other units, primarily dust and hydrocarbon emissions are observed. Additionally, even small amounts of carcinogenic substances such as benzo(a)pyrene increase the environmental risk of the enterprise. Emissions can be effectively reduced by deploying dust collection systems, gas-cleaning filters, and closed-loop technologies.

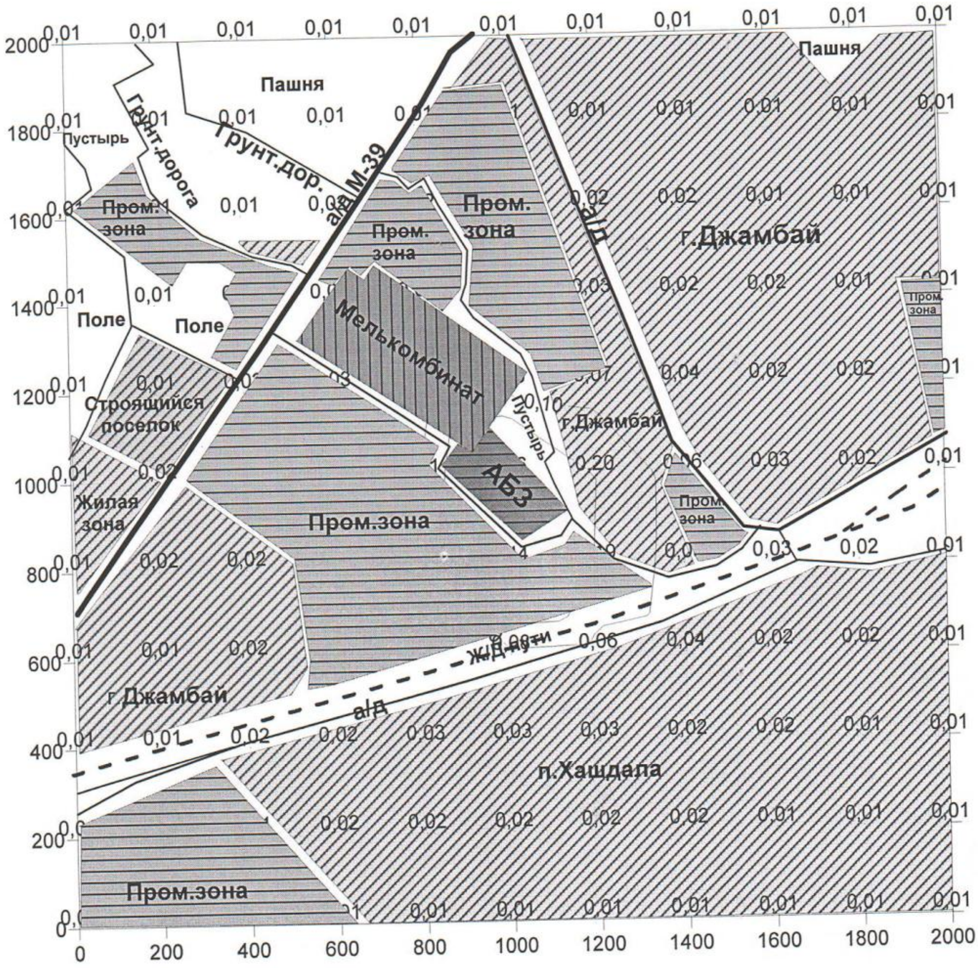

Figure 1. Schematic Diagram of Inorganic Dust Dispersion into the Atmosphere at the Enterprise

Measures to Reduce Pollution under Unfavorable Weather Conditions without Reducing Production

To reduce the amount of pollutants released into the atmosphere under unfavorable weather conditions without significantly reducing production volumes, the following technical and organizational measures should be implemented.

Operating gas and dust cleaning equipment at maximum efficiency can reduce emissions by 20–40%.

Using low-polluting fuels (for example, replacing coal with natural gas) can reduce SO_2 and particulate emissions by 30–60%.

Optimizing technological processes and properly adjusting combustion modes can decrease CO and NO_2 emissions by 10–20%.

Regulating ventilation and waste flows can reduce emissions by 5–15% over a short period.

Strengthening online monitoring and rapid control allows for the detection of excess emissions and helps reduce them immediately by 5–10%.

Overall, implementing the above measures can reduce atmospheric pollution at the enterprise by an average of 20–30%.

Conclusion

The analysis showed that the main sources of pollutants at the enterprise are the asphalt production and bitumen melting units. High levels of carbon monoxide, sulfur oxide, nitrogen oxide, and inorganic dust in these units increase the overall environmental risk. In particular, the asphalt production unit emits several tons of harmful gases and dust annually. Furthermore, the presence of carcinogenic substances such as benzo(a)pyrene poses a serious threat to both the environment and human health.

In other units (inert material storage, mixing, transfer, receiving, etc.), mainly dust emissions are observed. Although their quantities are relatively low, they remain a significant factor reducing overall air quality.

To reduce pollution under unfavorable weather conditions, the effective use of gas and dust cleaning equipment (20–40%), the use of low-polluting fuels (30–60%), optimization of technological processes (10–20%), regulation of ventilation flows (5–15%), and strengthening of online monitoring (5–10%) can collectively reduce atmospheric pollution at the enterprise by an average of 20–30%.

Therefore, the implementation of modern gas-cleaning equipment, enclosed-cycle technologies, and energy-efficient technologies at the enterprise will not only reduce environmental risk but also ensure sustainable and environmentally safe development of production.

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