RESEARCH FOCUS
xalqaro ilmiy jurnali hamkorligida

DOI
10.66073/ReFocus-Conf/0910185

QR-kod maqolaning DOI sahifasini ochadi

SAHIFALAR
921–925

TIL
Ingliz

IQTIBOS UCHUN
Mahammatova Mohidil Mahmudjon qizi, Naraliyeva Nasiba Mamanovna. Ecological assessment of the environmental impact of waste from cement production enterprises // «O‘zbekiston olima ayollarining mamlakat taraqqiyotiga qo‘shayotgan hissasi» mavzusidagi xalqaro ilmiy-amaliy konferensiya materiallari (Nukus, 2026-yil 9–10-oktyabr). – Nukus, 2026. – B. 921–925. – DOI: https://doi.org/10.66073/ReFocus-Conf/0910185



# ECOLOGICAL ASSESSMENT OF THE ENVIRONMENTAL IMPACT OF WASTE FROM CEMENT PRODUCTION ENTERPRISES

***Mahammatova Mohidil Mahmudjon qizi1***
*master’s student*
***Naraliyeva Nasiba Mamanovna2***
*Prof.*
*Andijan State University, Andijan, Uzbekistan*
*E-mail: mahammatovamohidil@gmail.com*
*n_naralieva@mail.ru*

**Abstract:** This article considers an integrated ecological assessment approach to the impact of cement production enterprises on the environment, particularly air, soil, water resources, and vegetation cover. The CONCH Cement enterprise and its sanitary protection zone are considered as the study object. The stages of cement production—including raw material crushing, transportation, clinker production, clinker grinding, and storage and loading of finished cement—are analyzed as the main sources of dust-aerosol formation. The use of snow cover as a natural integral dust collector indicator, calculation of dust load, comparison with background values, soil and vegetation monitoring, and GIS-based ecological mapping are proposed. An approach is developed to integrate automated dust-gas monitoring, differential pressure monitoring of filters, recording of wind parameters, and laboratory monitoring into a unified system. The numerical indicators are model data intended to demonstrate the methodological approach rather than actual laboratory measurements.

**Keywords:** cement production, ecological monitoring, dust-aerosol, atmospheric air, snow cover, dust load, soil, ecological risk, automated monitoring, GIS, sanitary protection zone.

**Introduction.** The cement industry is one of the strategic sectors of construction materials production, and its products are widely used in the construction of buildings, infrastructure, and industrial facilities. Along with the increase in production volumes, the need for regular assessment of the environmental impact of technological processes is also increasing. Cement production includes operations such as crushing, transportation, and preparation of mineral raw materials, clinker production, clinker grinding, and cement storage and loading, some of which may generate dust and gaseous pollutants.

A significant part of the environmental problems associated with cement production is related to the emission of solid particles and dust-aerosols into the atmospheric environment. In particular, fine particles can travel long distances and subsequently settle on soil and vegetation cover. Therefore, it is not sufficient to limit assessment of the enterprise’s environmental impact to measurements at emission sources alone. The spatial distribution of emissions and their accumulation in components of the natural environment should also be monitored.

Scientific studies have used snow cover in the zone of influence of cement plants as a natural integral collector. During snowfall, solid particles contained in the atmosphere accumulate on the snow surface and provide integrated information about the dust pollution of an area over a certain observation period. From this perspective, the study of snow samples makes it possible to link atmospheric monitoring with deposition processes in the natural environment.

In the case of CONCH Cement, it is appropriate to consider atmospheric air, snow cover, dust, soil, and vegetation components as a unified system when organizing comprehensive monitoring. Such an approach makes it possible to monitor environmental impacts along the chain from the source to the components of the natural environment.

## Materials and Methods

The study object is the territory of the cement production enterprise, CONCH Cement, and the sanitary protection zone surrounding it. The ecological assessment is organized sequentially, covering stages of analysis from production sources through atmospheric air, snow and dust, soil, vegetation, and GIS-based spatial analysis.

The proposed methodological scheme can be expressed as follows: production source → atmosphere → snow/dust → soil → vegetation → ecological assessment. In this process, real-time data obtained from automated monitoring are combined with periodic laboratory analyses. As a result, data obtained for the emission source are compared with changes in components of the natural environment.

It is proposed to establish monitoring points at distances of 0.25, 0.75, 1.5, 2.5, and 3.5 km around the enterprise. In addition, a background sample should be collected from an area minimally affected by the enterprise. It is advisable to locate monitoring points not only according to concentric distances but also along the prevailing wind directions in the area. This is because dust dispersion depends not only on distance but also on wind speed, direction, atmospheric stability, relief, and particle dispersion.

When collecting snow samples, it is recommended to use snow layers with the same area and volume, store samples in separate containers, and conduct gravimetric and chemical analyses after filtration and drying in the laboratory. In soil monitoring, indicators such as pH, Ca, Mg, Fe, Al, Si, Zn, Cr, Pb, Cd, and As can be determined. The exact list of elements should be formed depending on the composition of the raw materials and fuel used at the enterprise.

## Results

Snow cover serves as a natural collector that accumulates dust particles falling from the atmosphere over time. Its advantage is that, unlike a one-time atmospheric measurement, a snow layer integrates particles deposited over a certain period. Therefore, studying the solid phase of a snow sample helps obtain a generalized indicator of dust pollution in the area.



DOI 10.66073/ReFocus-Conf/0910185

Dust load can be calculated using the following formula: Pn = m/(S × t). Here, Pn is the dust load, mg/(m²·day); m is the mass of dust collected over a specified period, mg; S is the sampling area, m²; t is the observation period, days.

To assess the change in an individual chemical component relative to its background value, the concentration coefficient is expressed as Kc = Ci/Cbackground. Here, Ci is the amount of the component at the study point, and Cbackground is the amount of the component in the background area. A Kc value greater than 1 indicates that the component at the study point is higher than the background value. However, in order to attribute such a value to a single source, wind conditions, geological background, and other anthropogenic sources must also be taken into account.

In the model series, higher dust-load values are assumed in areas close to the enterprise, with decreasing values as the distance from the enterprise increases. This tendency demonstrates a methodological hypothesis explained by the dispersion of particles under the influence of atmospheric flows as they move away from the dust source and by the faster deposition of some larger particles.

**Table 1.** Conditional model values of dust load depending on distance

| Distance, km | Dust load, mg/(m²·day) | Data type |
|---|---|---|
| 0.25 | 520 | Model |
| 0.75 | 340 | Model |
| 1.50 | 210 | Model |
| 2.50 | 125 | Model |
| 3.50 | 70 | Model |

The model series in the table shows that a value of 520 mg/(m²·day) is assumed at a distance of 0.25 km, while a value of 70 mg/(m²·day) is assumed at 3.5 km. Thus, according to the model, the dust load decreases substantially by the distance of 3.5 km. However, under real field conditions, such a decrease does not necessarily have to be regular and uniform. A monitoring point located along the prevailing wind direction may record a high value even at a greater distance.

Therefore, in future studies, monitoring points should be linked to the wind rose and meteorological observations. At each point, the sampling date, wind speed, wind direction, precipitation, snow depth, and observation period should be recorded to facilitate interpretation of the results.

Graphical representation of the model results also makes it possible to observe the spatial tendency. However, model and actual measurement results should be clearly distinguished in the graph to avoid an interpretation that could cause readers to confuse conditional values with practical monitoring results. According to the model data, the dust load is represented by a decreasing series from 520 mg/(m²·day) at 0.25 km to 70 mg/(m²·day) at 3.5 km. This tendency is adopted to demonstrate a decrease in load with increasing distance from the dust source. However, under real conditions, dust dispersion is not a one-dimensional function of distance.

The spatial distribution of dust may be affected by wind speed and direction, atmospheric stability, relief, particle size, precipitation, and the operating mode of the emission source. Therefore, in an actual study, the distance-dependent model



DOI 10.66073/ReFocus-Conf/0910185

should be expanded by incorporating meteorological factors. It is especially important to organize additional observations at points located along the prevailing wind direction.

The model series for the ratio of calcium to its background value also shows a tendency toward higher values in areas close to the enterprise and convergence toward the background value with increasing distance. The main scientific significance of this model is not to confirm actual results, but to demonstrate how laboratory data obtained in future studies can be compared.

The proposed scientific aspect of this study is to assess the impact of a cement plant not only through atmospheric emissions, but also through an integrated monitoring system combining several environmental components. In this approach, snow cover is considered a natural integral dust-collecting indicator, while soil and vegetation are considered components for assessing the spatial deposition of dust and its environmental impact.

Another aspect of the proposed approach is the integration of automated and laboratory monitoring. Automated sensors provide rapid data, while laboratory analysis makes it possible to determine more thoroughly the composition of dust and components of the natural environment. GIS spatially integrates these data, while statistical analysis serves to assess relationships among variables.

The proposed KETI methodological model is also one of the directions for developing comprehensive assessment. However, in order to transform the index into a practical environmental management tool, the indicators must be normalized, weighting coefficients justified, and the approach validated using real monitoring data.

## Conclusions and Recommendations

It is appropriate to apply a comprehensive monitoring methodology when assessing the environmental impact of the CONCH Cement cement production enterprise. The stages of raw material crushing and transportation, clinker production, clinker grinding, and cement storage and loading were considered important sources of dust pollution.

The use of snow cover as a natural integral dust-collecting indicator makes it possible to obtain generalized information about dust pollution in the area over a certain period. Calculating the dust load using the formula $Pn = m/(S \times t)$ and comparing chemical components with background values using $Kc = Ci/Cbackground$ help to quantitatively assess monitoring results.

The model results showed a decreasing tendency in dust load with increasing distance from the enterprise. The ratio of calcium to its background value was also represented by a model series decreasing with increasing distance. It should be emphasized separately that these numerical values are not laboratory results obtained at the CONCH Cement enterprise, but conditional model data demonstrating the methodological approach.

Overall, the proposed chain “production source → atmosphere → snow/dust → soil → vegetation → GIS → ecological assessment” can serve as a scientific



DOI 10.66073/ReFocus-Conf/0910185

and methodological basis for the comprehensive assessment of the environmental impact of a cement enterprise.

## References

1. Volodina D.A., Talovskaya A.V., Yazikov E.G., Devyatova A.Yu., Edelev A.V. Assessment of dust and aerosol pollution in the zone of influence of the cement plant based on the study of snow cover (Novosibirsk region). Bulletin of the Tomsk Polytechnic University. Geo Assets Engineering. 2022. Vol. 333. No. 10. P. 69–85. DOI: 10.18799/24131830/2022/10/3704.

2. Volodina D.A., Talovskaya A.V., Yazikov E.G. et al. Studies on the assessment of dust-aerosol pollution based on snow cover in the zone of influence of a cement plant.

3. Gupta R.K., Majumdar D., Trivedi J.V., Bhanarkar A.D. Particulate matter and elemental emissions from a cement kiln. Fuel Processing Technology. 2012. Vol. 104. P. 343–351. DOI: 10.1016/j.fuproc.2012.06.007.

4. Garba K.B., et al. Assessment of environmental impact on air quality by cement industry and mitigating measures: a case study. Environmental Monitoring and Assessment. 2008. DOI: 10.1007/s10661-008-0660-4.

5. Ervik T.K., Hammer S.E., Notø H., Ellingsen D.G., Thomassen Y., Weinbruch S., Benker N., Berlinger B. Physicochemical characterization of particulate matter in a cement production plant. Environmental Science: Processes & Impacts. 2022. Vol. 24. P. 1243–1256. DOI: 10.1039/D2EM00139J.





DOI 10.66073/ReFocus-Conf/0910185