Advances in Engineering Research, volume 182
VIII All-Russian Science and Technology Conference "Contemporary Issues of Geology, Geophysics and Geoecology of the North Caucasus" (CIGGG 2018)

Factors of Negative Impact on Environment and People's Health in the Course of Renovation Works in Building and Construction

Khanaliev G.I.
Grozny State Petroleum Technical University named after M.D. Millionschikov
Grozny, Russia
hgis@mail.ru

Apkarov I.A.
Grozny State Petroleum Technical University named after M.D. Millionschikov
Grozny, Russia
apkarovia@mail.ru

Aptaev Kh. Kh.
Grozny State Petroleum Technical University named after M.D. Millionschikov
Grozny, Russia
halid.aptaev@mail.ru

Serbiev S.S.
Grozny State Petroleum Technical University named after M.D. Millionschikov
Grozny, Russia
sterbsul@gmail.ru

Magomadov I.Z.
Grozny State Petroleum Technical University named after M.D. Millionschikov
Grozny, Russia
magomadov.isa@bk.ru

Aleroeva L.S.
Grozny State Petroleum Technical University named after M.D. Millionschikov
Grozny, Russia
liza.bonk.85@mail.ru

Mamasurov S.M.
Grozny State Petroleum Technical University named after M.D. Millionschikov
Grozny, Russia
adian.mamasurov@mail.ru

Aysungurov N.D.
Grozny State Petroleum Technical University named after M.D. Millionschikov
Grozny, Russia
aysungurov91@mail.ru

***Abstract*—This article touches upon the issue of environmental safety of technological processes of renovation work in building and construction. The process of buildings dismantling and waste demolishing is characterized by various types of work associated with mechanical effects on building structures and materials, as well as the interaction of materials leading to the formation of such waste. The article analyzes the factors that have a negative impact on the environment and the health of workers in *during* the course of renovation work. The priority directions for the greening of production and staff health are named. The main environmental measures necessary for the production of construction works are highlighted. The tasks for the improvement of environmental impact on environmental protection during renovation works are listed. The scheme of mobile dust exhausting plant is presented.**

Keywords—ecology; building; people health; building and construction activities; dust exhausting system

I. Introduction

Nowadays, the issues of environmental safety during renovation work in the republics of the North Caucasus are extremely relevant. Intensive rehabilitation of settlements, carried out in the last decade, is associated with the need to dismantle damaged and destroyed buildings and demolish the waste formed during the destruction of buildings.

This process is associated with the mechanical interaction between the waste of various building structures and materials. Taking into account that the main materials used in housing construction are either powdered substances (cement, lime, gypsum, etc.), or elements and structures made of such materials (brick, concrete, beams and panels, etc.), the processes of crushing and grinding occur during their mechanical interaction with the subsequent formation of dust-like waste.

II. Research purpose

Reducing air pollution and protecting workers from dust emissions during restoration work associated with the need to dismantle damaged and destroyed buildings.

In order to achieve this goal, the following tasks were solved:

- The determination of physical and chemical properties of dust particles released during the demolition of damaged panel buildings;
- The determination of the specific amount of dust pollution during dismantling of damaged buildings of various types;
- The development of technical solutions for localization and purification of dust emissions.

The main idea of the research work is: to reduce dust emissions during the work on buildings dismantling, through the use of mobile dust exhausting systems for localizing and cleaning dust emissions. The proposed scheme works as follows: the dusty air mixture withdrawn from the shelter through the reducing piece (9) acquires a rotational motion passing through the tangential flow curler (11).

Further, through a corrugated air pipe (10), the dust-air mixture is transmitted to a dust collector for counter-swirling flows (3) through a branch pipe introducing the primary flow (6). After the primary cleaning, the dust-air mixture leaves the separation chamber, passing through the tangential spinner (13), and part of the energy of flow swirl is converted into the energy of translational motion.

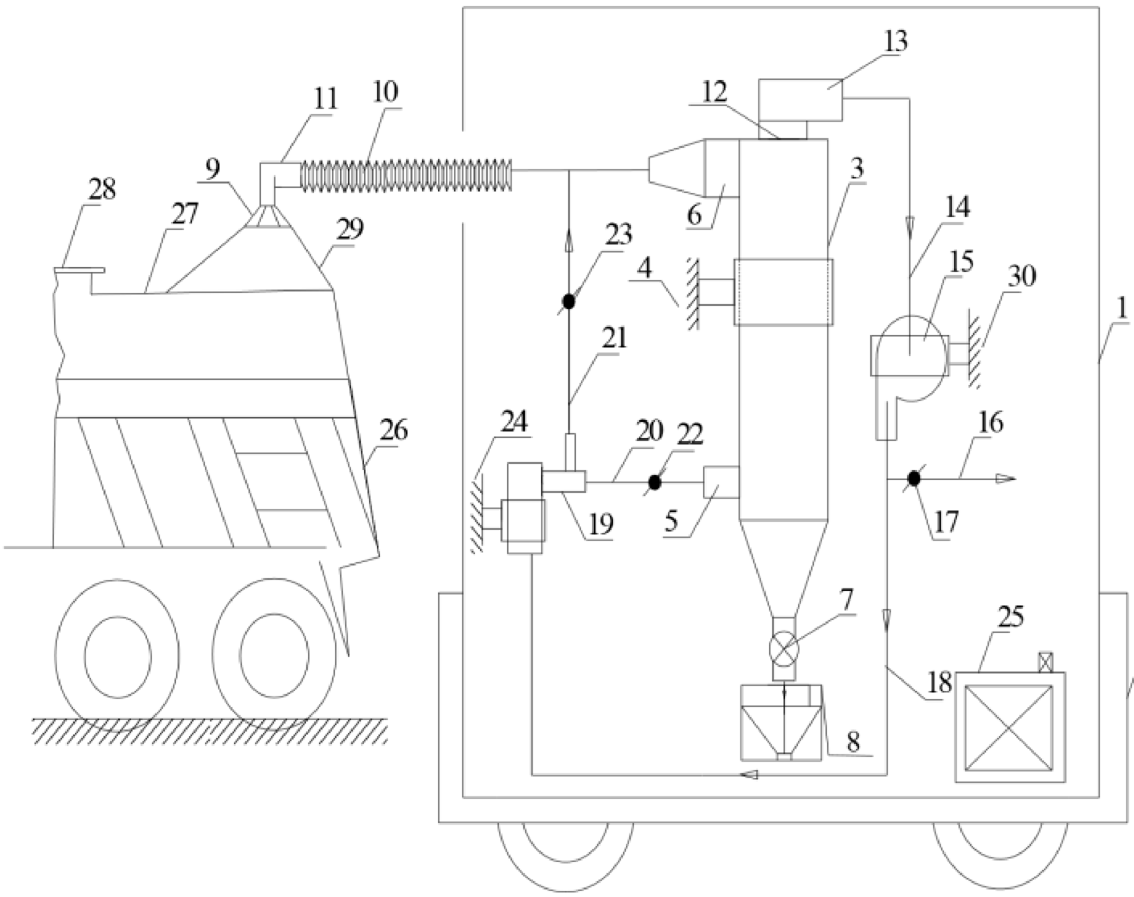

Fig. 1 - The diagram of mobile dust exhausting installation. 1- the body of installation; 2 – The base of installation in the form of a trolley; 3 – Swirling inertial dust collector; 4, 24, 30 – Bearing support; 5 - Bottom dust gas inlet; 6 - Top dust gas inlet;7 - Rotary discharger; 8 - Dust collecting hopper; 9 - Local dust exhaust; 10 - Corrugated air pipe; 11 - Tangential spinner;12 - Upper axial inlet of swirling inertial dust collector; 13 - Tangential spinner; 14, 16, 20, 21 – Air pipe; 15 - Fan; 17 - Dust flow regulator; 18 - Recirculation air pipe; 19 - Separator-concentrator; 22 – Flow regulator; 23 - Flow regulator; 25 - Power supply for exhaust fan; 26 - Technological equipment (through the example of a dump truck body); 27 – Cover for technological equipment; 28 - Bulk material door; 29 – The projection for local exhaust installation;

Later, under the action of discharging created by a fan (15), the gas stream is vented to atmosphere. In this case, a part of the flow through the recirculation air pipe (18) enters the centrifugal separator-concentrator (19), where it is divided into the net flow withdrawn through the nozzle by the air pipe (20) to the secondary inlet of the dust collector on the opposite swirling flows (3) and the dust-air flow directed through the air pipe (23) to the primary input of the flow of the dust collector of internal consumption (6).

In addition to dump trucks and railway vehicles, the proposed technical solution can also be used to localize dust emissions during the work on dismantling building structures associated with dust emission into atmosphere.

III. RESEARCH METHODS

During the research the following methods were used: the method of analytical generalization of existing scientific and technical results, laboratory and experimental-industrial research, processing of experimental data using mathematical statistics and correlation analysis using PC and certified programs.

The reliability of scientific statements, conclusions and recommendations is justified by the use of classical provisions of theoretical analysis, planning the required amount of experiments, confirmed by convergence of the results in compliance with the required criteria; experimental studies performed in laboratory and experimental-industrial conditions, with the results of other authors.

Nowadays, there are no reliable methods for engineering assessment and forecasting of environmental safety of technological processes of building and production. At the same time, the practice of construction, and especially of renovation activities, indicates the urgent need for such engineering forecasting methods. A special role here is played by the use of computational and laboratory methods of assessment, which should be evaluated and presented in the form of developed standards, environmental, sanitary and hygienic passports and other regulatory documents.

In the practice of calculating and designing, and during the renovation activities of residential buildings and industrial facilities, as well as in the organization of work processes, the principles of one-sided accounting of the influence of external loads from the environment on the created objects and structures still dominate. In this regard, the substantiation of the working properties of the objects being restored and the mode of their functioning is carried out [1].

Such a path of uncompromising technocratic intervention in nature during renovation activities in construction creates dangerous prerequisites for an irreversible (degradation) process and environmental damage in the region of construction**.** The fundamental way out of the current practice of uncontrolled technogenesis is the need for clarity of zonal classification in the region of construction. The primary exit from a clear zonal classification of industrial regions should be investigated according to the principles of anthropogenic impact on the properties of the environment [3].

The development of such a classification during renovation activities in construction requires the accumulation and careful study of information in the following areas:

1. The factors of anthropogenic impact on the environment in the area of industrial development of the territory, while establishing:

Nomenclature composition of industrial factors

$$U\,[\sum_{i=1}^{n} wi(\text{Yэ}i)] \tag{1}$$

Calculated ratios for the determination of values of *i* and U for renovation works in construction have the following form:

$$U\,[\sum_{i=1}^{n} wi(\text{Yэ}i)] \tag{1}$$

$$Ui = \frac{N[wi\,(Yi)]}{\Omega}\;; \tag{2}$$

$$U = \frac{\sum_{i<1}^{n} Ui}{\Omega}\;; \tag{3}$$

The coefficient of ecological weight on anthropogenic impact on the components of V.I. Vernadsky in renovation work in construction where: N (*wi*) - an indicator of a specific type of impact *wi*, expressed in the system of units of physical quantities;

-the size of the area exposed to industrial impact

Quantitative assessment of the level of industrial impact of an industrial facility during renovation work in construction requires a preliminary factor analysis in order to determine the values **N *(wi)*** and ***Yi***.

Approximate values of ***Yi***, established by summarizing long experience in the construction and operation of facilities, are presented in Table 1.

2. The features and indicators of anthropogenic changes, the natural landscape in the region of repaired buildings. In this case, such indicators can also be presented in a single and complex form.

For a given nomenclature of such indicators, it is advisable to use the size (in one, two or three-dimensional expressions) of the affected area (a negative impact on nature) as a generalized criterion of anthropogenic changes in the natural landscape, i.e.

$$Re = (r\,e) = fe\,(x, y, z), \tag{4}$$

TABLE I. THE CLASSIFICATION OF CRITERIA FOR INDUSTRIAL IMPACT DURING THE PROCESS OF RENOVATION WORKS IN CONSTRUCTION

Technogenic effects of an artificial object	**Industrial buildings**				**Civil buildings**			
	A	***G***	***L***	***B***	***A***	***G***	***L***	***B***
Mechanical: Short –term, Long-term	0.23 0.34	0.15 0.2	0.28 0.34	0.05 0.18	0.15 0.21	0.1 0.15	0.21 0.27	0.03 0.09
Thermal: Short –term, Long-term	0.18 0.37	0.25 0.4	0.14 0.21	0.08 0.22	0.07 0.14	0.11 0.2	0.1 0.17	0.04 0.12
Biochemical: Short –term, Long-term	0.12 0.19	0.05 0.35	0.28 0.39	0.31 0.46	0.08 0.12	0.04 0.16	0.21 0.25	0.23 0.31
Electromagnetic: Short –term, Long-term	9.1 0.12	0.15 0.2	0.17 0.26	0.2 0.23	0.06 0.09	0.02 0.08	0.1 0.19	0.09 0.12

Here ***fe*** is the function of environmental impact, which determines the response of the environment in the radius of action of ***Re.***

Taking into account the temporary nature of the interaction between an object and the environment, we have:

$$U_t = \frac{\sum_{i\geq 1}^{n}(u_i)t}{\Omega t} , \qquad (5)$$

$$Re\ [re\ (\textstyle\sum_{i\geq 1}^{n} t\ )] = f\,e\ (x, y, z\ ), \qquad (6)$$

Environmental response within the range of ***Re***

System 1.6 describes the conditionality of anthropogenic changes in the natural landscape (of gas treatment and transportation) from the values and directions of anthropogenic impact from the repaired construction site.

3. The peculiarities of natural landscapes determine the choice of the ecological model for forecasting the regional level of interaction of the object under construction with the environment.

Existing regulatory and technical requirements do not take into account the zonal principle in setting requirements for the formation of objects, by introducing criteria for anthropogenic impact on the environment. However, this issue can be resolved if there is a quantitative impact for natural landscapes in the areas of dislocation of objects that differ in the degree of technophilicity:

a) Landscapes with high recreational indicators (L1) - their safety should be provided by engineering equipment and biological melioration, constant restoration of plant communities, localization of areas of increased load on soil and vegetation cover, regular care of plantings;

b) Landscapes containing mineral deposits (L2) in their depths; their preservation imposes increased requirements on the reliability of facilities under construction;

c) Agricultural and forest landscapes that are used to produce agricultural products (L3) - their protection consists of rational, technologically and environmentally proper use;

d) Landscapes that are unsuitable for agriculture or creating recreational areas do not contain minerals (L4) - such landscapes are preferable for industrial and civil construction.

In the light of the restructuring of industrial structure and during renovation work in construction industry, the greening of production and the improvement of personnel play an important role. This is primarily related to the ecological reconstruction, industrial and infrastructure environment created by a human, which in modern conditions requires the use of new opportunities in the development of industrial structure.

The prior are the following:

- Ecological support of human life;
- The analysis and justification of importance and effectiveness of measures for the development of environmental beneficial personal qualities;
- The evaluation of the characteristics of products that determine environmental safety and support environmental hygiene of life;
- The meaning of the use and impact of production results on the environmental health of people and eco-standard of living/

The environmental susceptibility of nature, reflected in geographic zoning imposes certain restrictions on the creation of the above mentioned conditions for construction. Thus the following gradation of the main regions is ecologically expedient: the regions of the Far North **(R_1);** the central regions of the European part of the country **(R_2);** the areas of Central Asia **(R_3),** the mountain areas **(R_4).**

Each ecological group **(R_4-gr)** corresponds to a specific zone of industrial development of territory, uniquely determine the allowable level of industrial impact *Vt* and critical dimensions (boundaries) of anthropogenic changes in the natural landscape, i.e.

$$R_l = F\,[U_t\,, R_l]; \quad (1.7)$$

The gradation of construction zones in accordance with condition (2.6) into four classes is preferable:

1) $\mu_I\ (R_1L_1)$;

2) $\mu_{II}\ (R_1L_2, R_2L_1, R_2L_2,)$;

3) $\mu_{III}\ (R_1L_3, R_2L_3, R_3L_{12}, R_3L_3)$;

4) $\mu_{IV}\ (R_1L_4, R_2L_4, R_3L_4, R_4L_1, R_4L_4)$;

Where:

- ***(R_1) -*** Ecological susceptibility of the environment of the main regions of the Far North.
- ***(R_2) -*** Environmental susceptibility of the environment of the main central regions of the European part of the country;
- ***(R_3) -*** Ecological susceptibility of the environment of the main regions of Central Asia.
- ***(R_4) -*** Ecological susceptibility of the environment of the main mountain areas.

Each ecological group (R_4 -gr) corresponds to a specific zone of industrial development of the territory; it will uniquely determine the permissible level of industrial impact ***Vt*** and critical dimensions (boundaries) of anthropogenic changes in natural landscape.

This classifier can be used in the development of regulatory requirements that take into account the real ecological regime of formation, as a separate industrial facility, and gas treatment and transportation as a whole.

In accordance with Article №2 of the Federal Law "On Environmental Protection" dated January 10, 2002 № 7-FL, environmental safety is a state of protection of natural environment and vital human interests from the possible negative impact of economic and other activities, natural and industrial emergencies and consequences [7].

The focus of this definition of environmental safety is on the protection of natural environment, which, in accordance with the definition set out in the same Article №2 of the Law, is a combination of components of the natural environment, natural and nature-anthropogenic objects.

With appropriate material costs, it is possible to create favorable living conditions even with a relatively unfavorable environmental situation on any particular object of restoration. It can be ensured by: - a rational layout of the premises, the correct selection of wall materials; - draft-proofing of window openings; - installation of air conditioners and other devices for air purification; - installation of additional drinking water purifiers; - installation of technically advanced sewage systems and household waste disposal.

From this point of view, the environmental protection system must meet a number of requirements; the main ones are as follows:

- The creation of man-made, ecologically full landscapes on the site of destroyed industrial and residential buildings;
- The possibility of using ecological environment as a space for underground construction, laying of communications, placing production that does not require above-ground location, etc;
- The maintenance of the stability of basements and foundations, buildings under construction and renovation, and industrial and residential complexes as a result of the changes in bearing capability of soils lying at the base of these structures, or the development of adverse technological processes;
- The regulation of the balance of energy, mineral substance and moisture between the atmosphere and the geological environment, which meets the optimal conditions for the existence and development of landscapes and the formation of different-scale ecological systems;
- The conservation and restoration of objects of particular scientific, aesthetic or historical value (monuments of nature, national culture, reserves etc.).

The system of environmental regulation of the anthropogenic impact on the environment in the regions of restoration and construction should also be attributed to a number of the above mentioned requirements. Another important concept related to engineering and environmental support is environmental impact assessment: retrospective, operational, prospective.

The environmental review system should be organized on the same principles as the regulatory system (for current sites, territories as well as prospective). Among the fundamental concepts of engineering and environmental support in construction, a special place is occupied by the group of concepts of ecosystem reliability, which reveals through such properties as stability, balance, vitality, safety.

IV. Results

1. The issues of ensuring the environmental safety of renovation work in construction are particularly relevant when significant rate of renovation of housing stock located in the city.
2. The process of territory preparation for construction, in the situation of the presence of a significant number of buildings and facilities that cannot be

restored due to the presence of critical damage, destruction, or the stage of deep deterioration, consists in dismantling and disposal of construction waste.

3. The dismantling of destroyed and damaged buildings is characterized by intensive formation of dust-like waste.
4. In addition to the work directly related to the dismantling of damaged and destroyed buildings and facilities, the work on the transportation of resulting waste is also characterized by significant dust emission.
5. The issue of dust pollution of the environment, as well as the effects of dust emissions on workers during renovation work related to the dismantling of destroyed and damaged buildings is extremely relevant.
6. In order to solve the problem of dust emissions, it is necessary to determine the amount of dust pollution, study the physicochemical properties of dust particles and develop technical solutions for the localization and purification of dust pollution released during the dismantling of buildings.

V. CONCLUSION

As the result of the presented research the solution of the actual problem of dust pollution reduction of the environment during the course of renovation works of destroyed buildings and facilities of municipal infrastructure was proposed.

According to the results of theoretical and experimental studies, the following main conclusions can be made:

1. The dismantling of destroyed and damaged buildings is characterized by intensive formation of dust-like waste;
2. According to the analysis of the results of field studies, the data were obtained on the specific amount of dust wastes generated during the dismantling of destroyed and damaged buildings of various types;
3. It was found out that the largest amount of dust waste is generated during the loading process;
4. The use of mobile dust exhausting systems with inertial dust collectors, during the work on dismantling damaged and destroyed buildings, is an effective solution for localizing the generated dust emissions;
5. When developing technical solutions, it was found out that, the single-stage composition of dust exhausting system is the most preferable one among other dust exhausting systems, since it is characterized by smaller mass-dimensional parameters and energy consumption, which is the most important factor in mobility provision;
6. To enable the connection of mobile dust exhausting unit with pollution source, it is proposed to use a flexible corrugated air pipe, with swirling flow in order to prevent clogging;
7. During the course of experimental studies, empirical dependences were obtained characterizing the purification efficiency and the aerodynamic resistance of dust exhausting system with the proposed layout;
8. Mobile dust exhausting systems, developed on the basis of the proposed layout, are an effective solution to the problem of localization and purification of dust pollution released into the atmospheric air during the dismantling of damaged and destroyed buildings.

References

[1] V.N. Azarov, “Comprehensive assessment of the dust situation and the development of measures to reduce the dust content of the air environment of industrial enterprises”, Rostov-on–Don, 2004, p. 47.

[2] V.N. Azarov, “Method for determining the intensity of dust emissions from process equipment”, Volgograd: Volgogad State Academy of architecture and building, 2002, p. 8.

[3] I.Z. Magomadov, P.A. Sidyakin, D.V. Shchitov, I.Z. Magomadov, “Development and optimization of a mobile dust collection system designed for dedusting emissions during restoration work in construction”, Modern problems of science and education, 2014, vol. 5. Retrieved from: http://www.science-education.ru/11914537.

[4] P.A. Sidyakin, I.Z. Magomadov, R.R. Palatov, G.I. Article, “Air protection from dustiness during the dismantling of buildings and structures”, Moscow: Civil Technologies security, 2014, vol. 2 (40), pp. 82-85.

[5] I.A. Apkarov, A.F. Dorokhov, S.Kh. Keloev, “Study gas diesel workflow indicators high-speed internal combustion engine”, Proceedings of Grozny State Petroleum Technical University named after M.D. Millionschikov, vol. 9, 2009.

[6] L.S. Aleroeva, Kh.H. Aptaev, “The meaning of the use of modern tools and technologies in city urbanization”, Grozny: State and public figure M.D. Millionshchikov, pp. 240-250, 2018.

[7] I.Z. Magomadov, N.D. Aysungurov, “The increase of environmental safety of work in construction”, Makhachkala: Modern issues of transport system development, conference, p. 3, 2016.

[8] I. Z. Magomadov, Kh. H. Aptaev, S. S. Serbians, N. D. Aysungurov, “Environmental requirements for construction objects, fundamental and applied research: problems and results”, Materials of the I International Scientific Practical conference dedicated to the 100th anniversary of M.D. Millionschikov, Russia, Vol. 1, p. 6, 2017. [Grozny: Grozny State Petroleum Technical University named after M.D. Millionschikov].

[9] I.Z. Magomadov, L.M. Lavrentyeva, “Reduction of dust pollution of the air environment during the performance of renovation work of destroyed buildings and facilities of municipal infrastructure”, Internet Bulletin of Volgograd State University, Volgograd, 2014, Vol. 3 (34). Retrieved from:www.vestnik.vgasu.ru.

[10] G.I. Khanaliyev, Innovative and investment international cooperation projects of Russia with Germany and Syria, Scientific and political issue “Innovations and Investments”. 2017, vol. 3.