Environmental and economic damage during the operation of sludge collectors

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Abstract. This article deals with the negative impact of slag dumps and sludge collectors on the environment. The development of measures to prevent, reduce (limit), compensate and eliminate potential and actual damage caused by sludge collectors of the surrounding natural environment is a highly important issue. It was also revealed that the current legislation of the Russian Federation does not account for the amount of economic damage caused to the recipient objects by environmental pollution and as a separate component of damage to atmospheric air and soils. Therefore, it is suggested to make additional changes to the order of Rostekhnadzor No. 120 “On approval of the methodology for determining the amount of harm that may be caused to life and health of individuals, property of individuals and legal entities as a result of an accident of a hydraulic structure (except for shipping and port hydraulic structures)”.

1. Introduction
Currently, the industrial sector of the Russian Federation is characterized by a high specific volume of resource and energy-intensive technologies, which in turn leads to a significant formation and accumulation of production and consumption wastes [1].

Large heat and power plants, chemical industry enterprises operate large volumes of solid, liquid waste, form waste dumps and sludge collectors. Direct impact on the environment is caused by seepage losses from sludge collectors to groundwater and soil, leading to changes in the composition of surface runoff, concentration and chemical composition of suspended solids in nearby water bodies, water supply facilities. Secondary dusting from the surfaces of sludge collectors leads to pollution and alienation of adjacent land, deformation of the natural landscape, which is the reason for the impossibility of the subsequent use of land [2,3].

Figure 1 shows the scheme of hydraulic and ash removal at thermal power plants [4].
2. Relevance the need to reduce waste from sludge collectors

According to the annual reports on the activities of the Federal Service for Environmental, Technological and Nuclear Supervision for the period 2013-2017 the total number of sludge collectors monitored by Rostechnadzor is shown in Figure 2 [5].

Figure 2. The total number of sludge collectors on the territory of the Russian Federation for 2013-2017.
At the same time, the proportion of waste used is very small - only 10% of the total output, of which about 70% are used in construction and 30% in agriculture [6].

The gap between the progressive accumulation of waste and measures aimed at preventing their formation increases the risk of environmental losses [7].

An important stage of work in this direction is the development of measures to prevent, reduce (limit), compensate and eliminate potential and actual damage caused by sludge collectors of the surrounding natural environment (Figure 3) [8].

**Figure 3.** Environmental impact factors of a sludge collector.

Figure 3 shows the factors of the impact of the sludge collector on the environment. To minimize the negative effects of placing large quantities of industrial waste in sludge collectors, tailing dumps, which are an integral part of metallurgical, chemical, energy and other complexes, it is necessary to assess the impact of accumulated sludge, slags and other waste on the state of the water, air basins and soil [9].

3. **The problem of environmental economic damage during operation of the sludge collector**

Currently, the information and methodological base of environmental and economic assessment of the quality of the environment requires improvement in order to increase interest in participating in
complex environmental projects and, ultimately, in the economic efficiency of environmental activities [10].

4. Review of environmental and economic analysis of the problem

Ecological and economic analysis of problem situations contributes to the identification of the most economically unfavorable and dangerous zones at the level of enterprises, regions, industries, as well as economically vulnerable to ecology stages of the production process. The system of criteria and methods for assessing environmental change occupies a key position in the economic analysis of environmental decisions [11].

It should be noted that in many areas of environmental protection the magnitude of the economic damage caused to the recipient objects by environmental pollution is currently not an approved regulatory indicator [12,13].

Damage from groundwater pollution is carried out directly by the cost of measures for their treatment, either on the basis of the actual volume of unauthorized discharge of wastewater, or the unauthorized disposal of waste with the following conditions. The absolute amount of pollutants entering the groundwater is determined by the accepted methods according to the concentration of pollutants and the discharge of the underground stream, or the flow rate of the well [14].

The damage from the pollution of the hydrographic network by soil due to the destruction of project and non-project dams, dams, roads, as well as the formation of scour and ravines, caused by economic activity, is set as an emergency discharge of suspended particles discharged into the hydrographic network of soil [15].

Damage caused to the soil by its destruction, burial or pollution, is estimated directly by the cost of restoring lost soil qualities, either based on the actual volume of unauthorized discharge of wastewater or unauthorized waste disposal [16,17].

In the United States in the early 60s of the twentieth century, work began on the construction of environmental quality indices, based on comparing the importance of its individual components (atmosphere, water, soil and other elements). Most consistently, these results are reflected in the Canadian index system [18].

The total environmental quality index was expressed as.

\[
I = (b_i - I_i)^{0.5}
\]

where \(b_i\) is the weight coefficients of significance of the individual components, \(I_i\) partial indices of the degree of contamination of individual components.

As a criterion indicator for improving the quality of the environment, we used the indicator

\[
I = \left[ \sum b_i \left( \frac{L_i}{S_i} \right)^2 \right]^{0.5}
\]

where \(S_i\) is the social standard of the element, the environment of the i-th species; \(L_i\) is the desired (attainable) quality value of the i-th element; \(b_i\) is the weighting factor of the i-th element.

At present, due to the absence of a complete information base, the values of \(b_i, L_i, S_i\) in each specific case are determined on the basis of expert evaluation, the results of a social survey, public opinion, and other subjective ways. Therefore, this approach has not received practical distribution.

The system of indicators of environmental safety of sludge collectors can be viewed from two positions: aimed at identifying environmental risk factors and assessing the consequences for humans, nature, and the economy [19].

The legal framework of the current legislation of the Russian Federation presents numerous methodologies developed by various research institutes and organizations, however, owners of hydraulic structures (hereinafter referred to as GTS) and operating organizations to determine the
amount of probable harm should be guided by the approved Rosstechnadzor of Russia, the EMERCOM of Russia and other relevant authorities legally valid methodologies.

On March 29, 2016, the Federal Service for Environmental, Technological and Nuclear Supervision adopted Order No 120 “On approval of the methodology for determining the amount of harm that could be caused to life and health of individuals, property of individuals and legal entities as a result of a hydraulic structure accident (except for shipping and port hydraulic structures)” [20].

The methodology contains sections devoted to the consideration of the issues of determining the likely damage to the environment as a result of a GTS accident. And if the dominant damage - damage from the discharge of pollutants into natural waters is considered in sufficient detail, then the damage to atmospheric air and soils is not considered as a separate component. In addition, due to the lack of methods for predicting the number of objects of the animal and plant world to be destroyed as a result of a possible accident of the CTA, these components of damage to environmental components are also not considered.

Thus, it should be noted that in many areas of environmental activities the magnitude of the economic damage caused to the recipient objects by environmental pollution is not currently an approved regulatory indicator. Especially difficult to compare estimates of the magnitude of damage received in different countries. Therefore, it is necessary to develop adequate natural indicators of environmental quality. The concept of environmental quality should be related to the subject of impact. Naturally, a change in its quality should be considered in the context of a change in the human environment.

5. Solution of the problem of reducing waste from sludge collectors

With this approach, there is a need to ensure the concept of the quality of the environment-forming factor of the environment with specific physical parameters. The criteria for selecting these parameters should meet the requirements imposed on the goal modeling system, reflecting its most general properties that are necessary when making decisions for evaluating social development alternatives.

6. Conclusion

In connection with the above, it is required to make additions to the order of Rosstechnadzor No 120 “On approval of the methodology for determining the amount of harm that may be caused to life and health of individuals, property of individuals and legal entities as a result of an accident of a hydraulic structure (with the exception of navigable and port hydraulic structures)”.

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