# ENVIRONMENTAL PROBLEMS OF NORTHERN ECOSYSTEMS

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## ABSTRACT

In the article results of environmental monitoring of mining works of minerals in the territory of permafrost are considered.

The environmental problems connected with the mining industry, especially in the conditions of the North are extremely important. The complexity of this question is that all pollutants and waste in the conditions of existence of permafrost collect in the top active layer of the earth below which impermeable frozen rock lies that lead to fast pollution of lands. In the article results of researches on a condition of the broken lands and the geochemical situation of the adjacent territory are given in a system: water - ground rainfall - a soil-plant. Solutions of negative consequences and nine reclamations of the fulfilled lands are offered.

***Keywords:*** *northern ecosystems, permafrost, minerals, mountain production*

## INTRODUCTION

The environmental problems connected with the mining industry, especially in severe conditions of the North are extremely important and relevant. The purpose of this work is an assessment of the extent of the influence of the mining industry of the Ust-Yansky ulus on northern ecosystems on the example of tailings dams and adjacent territories on the environment, the being potentially dangerous objects of northern ecosystems.

The mining industry in the Ust-Yansky ulus was presented during the Soviet period, generally by two large enterprises: open joint-stock company «Deputatskolovo» and «Kularzoloto»mining and processing integrated works the last went bankrupt in 1996 and stopped the activity, and waste remained which collected within 45 years. These huge enterprises had one direction - production economically of the most favorable resources – gold and tin [1]. The Deputy mining and processing works (MPW) till 90th years was considered as the largest tin mining company enterprise in Russia. The area of the industrial zone is 21 thousand sq.km. Geographically the territory of activity of Deputy GOKA occupies a significant area on extent: from an average current of river. She is lame on Yana-Indigirka Lowland to Tasapp river basins - in the West and the Uyandina River - in the southeast of this territory. Now there is a threat of break of a dam and receipt in water ecosystems of the water polluted by toksikant. These hydraulic engineering constructions remained ownerless and already became outdated and can self-destruct at any time. This problem demands the fastest permission for the prevention of environmental disasters in the Arctic.

## MATERIALS AND METHODS

The production infrastructure of Kularsky MPW was located in the territory of the Ust-Yansky ulus of the Sakha (Yakutia) Republic. This area of the Arctic zone is characterized in the cold and long winter (September-May) with temperatures from - 35 to - 55$^0$C. Summer cloudy and cold with drizzles, the average monthly temperature of July +7$^0$C. The average annual temperature of the atmosphere of the region is - 14$^0$C. The average annual amount of precipitation reaches 350-400 mm. Here continuous distribution of permafrost and its power makes 390 m. Depth of seasonal thawing varies from 0.2 to 1.5 m. The terrigenous deposits of Triassic and Jurassic systems which are broken through by early cretaceous granites and a series of uneven-age the dikeformations and also friable Cainozoic rainfall take part in a geological structure. The soil the forming breeds are presented by deposits of various sandstones with pro-layers of siltstone and argillites.

The area is presented by a combination of forest-tundra vegetation and the mountain tundra. The larch undersized also grows along streams and on slopes to absolute marks of 500-700 m. Watersheds are deprived of vegetation and is characterized by stony taluses.

Sampling from the area of the tailings dam was made by specialized inspection of the State environmental control and the analysis of the Ministry of conservation of Sakha (Yakutia) Republic. Samples of water are taken in three points since depth of a reservoir varies from 3 to 15 m. Samples of soils are taken from a storage dam below on a slope from a dam. Also samples from ground rainfall and vegetation on the adjacent area were taken. Further the maintenance of elements is in vitro determined by standard methods.

When carrying out soil researches the complex of the general standard methods of studying of geographical distribution, material structure and properties of zone and intrazonal types of soils was used.

## RESULTS

Proceeding from climatic conditions, in particular, the structure of a relief and a total number of rainfalls in combination with waterproof permafrost on the site the hydrogenic group of soils (an intra soil hydromorphism) is formed. Here transit and accumulative and geochemical landscapes which soils serve, as a rule, as a geochemical barrier on the way of migration of these or those connections were formed. In the organic matter, compounds of silicon, iron, manganese, phosphorus and minerals accumulate.

In such conditions of excess moistening gley processes in the various extent of development develop. For the permafrost of zones development of the internal gley characterized by primary development in the lower part of an active layer of earth is more typical. In the Arctic and subarctic conditions remoistening happens at the beginning of a vegetative season in everything small the thawed profile which in process of thawing of the soil leaves down a soil profile, i.e. remoistening step by step for some time covers all genetic soil horizons. At the same time, the stagnation

of moisture contributing to the development of gley processes is constantly formed over the permafrost screen.

Each mining plant when processing ore uses special reagents which then together with other chemical waste diluted with water merge in special ditches or in decreases in courses of streams or lakes, the partitioned dams made of the fulfilled ore, so-called "tails" of production [2]. At extraction of thin fractions of gold from breed the amalgamation method (with use of poisonous mercury), or recycle leach solution of gold from breed with use of potassium cyanide or sodium is used. At all stages of enrichment of breed it is used in large volumes of water which after use together with production wastes and various chemicals merges in the tailings dam - in a special complex of the constructions intended for storage or burial of toxic and other waste of the mining and processing industry. These storages, as well as the enterprise, always build near the rivers or streams (fig. 1).

*Fig. 1 General view of the enterprise*

Except the standard reagents in Deputy mining and processing integrated works ethyl xanthate, ferrosilicium and other chemicals were widely used polyacrylamide. The area of the tailings dam of the Central Concentrating Factory (CCF) of Deputy mining and processing integrated works differs in the increased content of copper, zinc, selenium, lead, iron, bismuth.

In-ground deposits of the bed of the river, it is fixed raised the content of beryllium, magnesium, nickel, lead, zirconium, tin, titanium, strontium, thallium and copper. On frequency rate of increase, concerning a background, zinc (34.25 times), manganese (20.6 times), iron (9.46 times) prevail. Also significant increase in sulfates (4.9 times), arsenic (3.5 times), magnesium (3.25 times), calcium (2.47 times) is noted.

Periodically from the tailings dam to the Irgichyan River "cleaned or clarified" waters are dumped so-called. On many indicators they exceed the maximum permissible concentration (MPC) levels. The acidity of water from time to time reached pH =2.4. In 1998-99 considerable excesses of maximum allowable concentration on oil products (by 40 times), to zinc (24-fold), to iron, (66-fold), to manganese (189-fold), copper were observed (86-fold). Later researches showed small decrease in the maintenance of minerals (tab. 1), but values remained higher than the maximum allowable concentration.

The analysis of indicators of content of harmful impurity in vegetation showed that shops of the industrial zone promote accumulation in bark of trees and bushes of chemical elements of the complex corresponding to composition of the ore processed at factory and also sands of open-pit mining. The raised concentration in tests of bark of trees from the industrial zone are noted the following elements: iron, lead, strontium, chrome, copper, aluminum. The largest growth of the depositor of harmful impurity in vegetation is observed around an industrial complex, the shop of roasting of lime (SRL), the boiler houses. Content of cobalt, strontium, titanium, nickel, chrome exceeds the background values till 6-10 times here. The peak lead load exceeding background by 100 times is noted near the tailings dam, near a highway and the ancillary facilities and the road.

*Table 1. The maintenance of minerals in waters of the tailings dam, 2004*

| № | Minerals | Average value, mg/l | MPC, mg/l | Excess of MPC, times |
|---|---|---|---|---|
| 1. | Iron | 4.84 | 0,01 | 48,4 |
| 2. | Zinc | 0,73 | 0,01 | 73 |
| 3. | Copper | 0,01 | 0,001 | 10 |
| 4. | Manganese | 1,42 | 0,01 | 142 |
| 5. | Lead | 0,01 | 0,006 | 1,6 |
| 6. | Nickel | 0,01 | - | - |
| 7. | Cobalt | 0,01 | - | - |
| 8. | Bismuth | 0,034 | - | - |
| 9. | Chrome | 0,17 | 0,02 | 8,5 |

The intense ecological situation developed on accumulative landscapes of foothill loops and covers and also in alluvial valleys on a left bank of the Yana River. Here the physical (broken condition) disturbance of the geological environment of average degree caused by exploration works and partially due to working off of scatterings is observed.

This influence is resulted by formation of local sites of formation of the technological geochemical anomalies (up to 8 maximum allowable concentrations) put by elements I, II and III of classes of ecological danger (Be, Al, Mn, Fe) [3]. Small power of an active layer of northern soils causes high concentration in it industrial pollutants and their negative impact on a soil biota. Accumulation of minerals is predetermined by pedigree structure and biotic factors [4].

Today on the hydraulic engineering constructions of Kularzoloto mining and processing works which worked near half a century there was a critical situation. After bankruptcy of mining and processing integrated works in 1996 in inflow of the Omoloy River remained ownerless tailings dam in which sewage contains the dangerous chemicals (mercury, cyanides, arsenic, lead) used in a concentrating cycle for gold extraction. Now hydraulic engineering constructions decayed, there is a real threat of break of a dam, and industrial waste wastes can get at any time to natural waterways that is fraught with negative consequences for ecosystems of the Omoloy River and coasts of the Laptev Sea [5].

## CONCLUSION

The researches conducted in an estuarial part of basins of the Omoloy Rivers and Yana testify to an unsuccessful condition of the territory connected with former extraction of tin and gold in the Northeast of Russia. The Kularzoloto enterprise which worked almost half a century in connection with the collapse of the USSR it went out of business and closed in 1996. The infrastructure and constructions of the enterprise remained ownerless. Today hydraulic engineering constructions decayed, the tailings dam is crowded and there is a real threat of break of a dam or a modulation of water with the subsequent demolition of an outdated dam, and sewage with toxic substances can get to water and land ecosystems of the Arctic.

Severe climatic conditions, lack of the equipped year-round roads, remoteness of arrangement of an object complicate carrying out scientific research for the development of unique methods of utilization of highly toxic waste in the permafrost conditions. At the same time cold damp conditions of the climate of the region cause formation of gley soils with acidic environment here. This factor defines the high migration ability of heavy metals that will promote fast pollution of extensive territories.

For prevention of environmental disaster, it is necessary to merge periodically top clarified water from a settler hollow that melt water or rains did not overflow a reservoir with waste and did not destroy a dam. These events can be held in the period of a spring high water for impoverishment of the polluted waters and the decrease in damage to a water biota. It is a temporary measure for preservation of hydraulic engineering constructions for indefinite time before capital repairs and environmental monitoring and restoration of the polluted territories by government institutions.

All above, shows the emergency on environmental safety of the region demanding the fastest recovery and remediation work. At the same time, yet effective methods of a recultivation of natural systems in severe climatic conditions of the Arctic zone are not developed today. The ownerless of the remained constructions of the closed mining and processing integrated works "Kularzoloto" causes lack of sources of financing on research and recovery work on the broken lands of the North.

Scientific research of the polluted territories of the Arctic needs to be conducted the international community since this global problem and the areas of the broken territories will increase in connection with development of new fields over time.

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