Methodical preconditions of liquidation of negative influence of technogenic waters of the mining territory on environment

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Methodical preconditions of liquidation of negative influence of technogenic waters of the mining territory on environment

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Abstract. The paper deals with the problems arising from the impact of man-made water on the components of the environment. Such waters are formed in the formation of mining facilities, as well as in the process of mining and processing of minerals. Generally, such mining facilities are not taken into account and so not under environmental protection measures. In order to decrease negative influence of such objects, authors suggest: first – give them a status of "technogenic water object", second – rate and systematize these objects for further rehabilitation and usage in future. The technique of liquidation of negative influence of technogenic waters on environment is offered, and also the positive experience of application of this technique is considered.

1. Introduction

Mining and primal working up of mined mineral deposits are followed by negative influence of mining works on the environment. Among factors of negative influence the important place is held by man-made waters, produced during forming the objects of mining industry and as result of mining and working up of useful minerals [1-3, 6-7].

This study is important today because at present time in Sverdlovsk Region are located the following ascertained technogenic water objects: submerged open-pits – 72; with total area of 3600 hectares, sized from 1 to 1000 hectares, under-borrow water flows – up to 1,2 hectares, land-flooded territories – near 400 hectares. Methodic suppositions for development of effective actions to liquidate man-made waters negative influence on environment are the following:

- revelation of man-made waters source during mining and mineral processing;
- definition of technogenic water objects in mining territory;
- technogenic water objects properties definition which necessary for development of effective measures of harmful influence liquidation.

2. Material and methods

In this work methods of ecological monitoring and graphical modelling were used. The work is based on large quantity of literary data and data of geochemical filming.

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3. Results and discussion

Man-made waters appear during satiation of atmospheric or underground waters by harmful impurities in open and subterranean excavations. They come on surface in process of mine or open-pit pumping. After mineral deposit working off man-made waters replenish natural atmospheric or underground water in wasted open-pit, or reaches the surface by flow from liquidated mine galleries [8]. In other case, man-made waters appears as under-borrow waters, which forms by filtration through borrow mass [4] and borrow surface wash-outs (figure 1). During pulp filling of concentrating factory liquid scrap yards (figure 2), water also falls through hydraulic facility system to the surface. In dams deformations with flow of clarified waters may occur. Moreover, man-made waters list widens by industrial wastes of mining industry, transport and any engineering communications.

Therefore, technogenic water object is artificial reservoir, watercourse or any other object with specific forms of permanent/temporal water concentration.

Figure 1. Burrows of Korkinsky open pit. Erosive scours have seen.

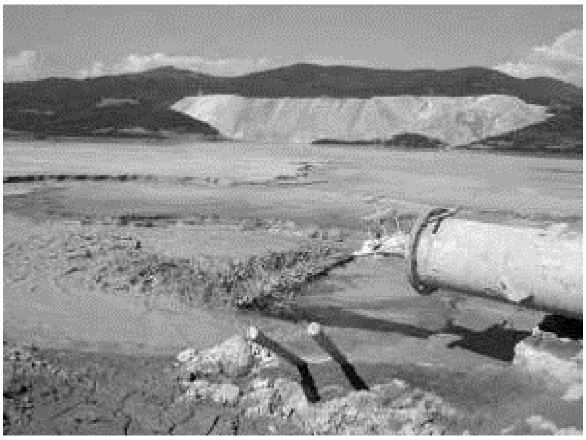

Figure 2. Discharge of dressing works pulp into the tailings dam.

Man-made waters consist both of solid suspensions, water-soluble compounds of minerals and of different elements of mining maintaining technological process (explosive elements, technical reagents of ore solution, engine oil, fuel and etc.).

During monitoring investigation, we analyse situation in Polevskoy in Sverdlovsk region, were Severskoy storage pond is situated. This storage pond is under influence of copper mining plant on Gumeshevskoye ore deposit. At present time, experimental industrial underground lixiviation system works on Gumeshevskoye ore deposit, so copper mining realizes through lixiviation solution supply in multilevel wells. This lixiviation solution represents by technologic sulphuric acid water solution (concentration 10-30 g/dm^3). During unloading of wells, three main polluting drainages are formed, falling into Severskoye storage pond [5]. Chemical analysis of 154 water probes, taken from 7 storage pond ranges, showed standards exceeding on following components: sulphate ion – 1,16 of critical concentration (CC), copper – 100 CC, zinc – 5 CC, manganese – 1,9 CC. In 76 probes taken from three drainages which flows into the storage pond exceeding pollutants quantity are: copper – 2140 CC, zinc – 4604 CC. These findings allow concluding that Severskoye storage pond is actually a technogenic reservoir in which water quality is formed by polluted flows [14].

These findings are confirmed by ecological and hydrobiological investigations in Southern gulf of Severskoye storage pond. During these investigations, species composition, development and structural-functional characteristics of fish fauna, were studied. It was fished out 24 perches, 14 breams, 13 pickerels, 5 roaches, 2 ides and 1 crucian carp. Ichthyologic material analysis shows that in spite of fish good feeding base in this pond, rate of fish growth is medium or low. In bone tissue increased content of copper was determined (5,35 mg/kg), and in 70,2% of caught fish appears manifestations of toxicosis (damaged caudal fin and body ulcers) (figure 3). These findings confirm high toxic environment for fish.

Areas, polluted and overflowed by objects of mining industry, make up sizable territories (figure 4). In a number of cases, land flood in inhabited settlements was observed [2, 6].

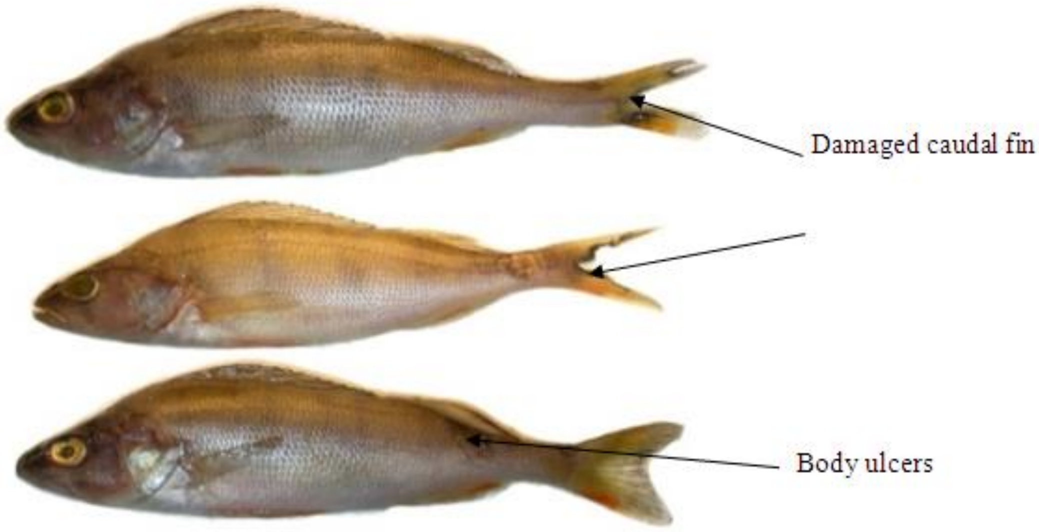

Figure 3. Perches of Southern Gulf of Severskoye storage pond with different manifestations of toxicisis.

As a whole, authors consider that technogenic water objects must be systematized and clustering in groups, types and sorts as shown on table 1.

Table 1. Technogenic water objects systematization.

Group	Type	Sort
Surface waters	Watercourse	- drainage ditches for open pit pumping, drainage waters, clarified waters, liquid wastes hoarders; - mine pumping – equipped watercourses for man-made waters from open pits or mines; - streams from waste banks;
	Watercourses from man-made springs	- man-made rivers – not-equipped watercourses from technogenic sources (outflows from underground excavations, rock piles and liquid wastes hoarders dams);
	Pond	- water-bearing pits, ditches, peat bogs; - liquid wastes hoarders (mud hoarders, waste enrichment depots, sedimentation ponds); - submerged ground holes, formed after underground mining; - mining ponds;
	Swamp	- man-made swamps formed as a result of watering by technogenic rivers;
Underground waters	Deposit fields	- man-made (mine`s) waters.

Figure 4. The territory of former Levikhinsky mines (western part of territory – land polluted by manmade waters).

4. Conclusion

In order to work out measures to prevent negative influence of manmade waters from mining industry objects on adjacent territory, authors suggest the following classification of manmade waters:

- Unite in different groups manmade waters which formed during and after exploitation of mineral deposits;
- Separation of manmade waters on underground and surface (clarified) waters;
- Allocation of dangerous (toxic, carcinogenic and radioactive), relatively dangerous and not dangerous manmade waters;
- Separation of manmade waters on risk group (risk of sudden landflood) and group of continuous water flood on the surface;
- Divide manmade waters on industrial and mining groups;

Suggested typification allows developing recommendations on lowering the negative influence of manmade waters on environment.

During working out of mineral deposit, the main task for mineral developer is effective usage of environmental measures in nature conservation activity of mining industry, and optimal usage of following measures: pumping mine – sedimentation pond – purification facilities – dumping of renovating water or its recycling in mining industry. Authors suggest forming drainages near burrow bases to direct manmade waters into sedimentation ponds. Another solution may be burrows surface isolation from atmospheric waters penetration. And the most optimal measure is industrial assimilation of mining waters (extracting useful elements). Also, for diversion of manmade waters, is necessary to organize rainwater drainage to move water to the purification facilities.

Authors suggest executing following rehabilitation actions complex after mineral deposit extraction:

- to inventory mining industry objects and polluted lands on adjacent territory;
- evaluate level of negative influence of mining industry objects on investigated territory and actual level of critical concentration;
- evaluate level of ecological damage of investigated territory by its monitoring organization;

After evaluation of ecological damage cumulated on mining industrial complex territory authors suggest making one of following decisions:

- neutralize polluted waters and lands;
- organize burrow surface isolation;
- use industrial recycling of waste products.

Also, technogenic water objects can be classified as:

- forming during building of mining industrial complex and mineral deposit exploitation;
- developing during liquidation of mining industrial complex objects.

The financing source in first case is at the expense of mineral developer, and in second case the financial source of realized measures, according to existing legislation, is local governments on which territory waste piles is situated.

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