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Possible Ecological Consequences of Liquidation of Mines of Mirgalimsai Deposit

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ABSTRACT: the hydro-geological conditions of the mirgalimsai deposit region were analyzed, a description is presented of potential sources of environmental pollution and possible ecological consequences of full flooding of mines, ways of decreasing costs are suggested in preventing ecological catastrophe in the conditions of non-operating mines of the deposit.

1 INTRODUCTION

Mining operations İn the Mirgalimsai deposit were stopped in 1995 because of the low profitability of mining the remaining reserves. This deposit is filled with more water man any other in the mining industry İn CIS countries, with an average mine inflow of 12,000 m^3/h over many years. Such substantial mine inflow is caused by the fact that the Mirgalimsai deposit is situated in the center of a depression cone asymmetrical in form with a radius of influence 25-30 km in the southeast direction and 9-13 km in the northwest direction. Its appearance and development is a result of mine working driving. The development of the system of mine workings and the opening-up of deeper levels were the cause of the increase in mine inflows. The depression cone also developed, Water enters the mine workings through fractures in the riverbeds of the rivers Bayaldyr, Biresek and Kantagi.

2 ANALYSIS AND CONSEQUENCES OF WATER DISCHARGE

Today at mmes of the Mirgalimsai deposit, only a mine pumping complex is operated, sustaining water at the mark of level 13. The annual costs for the maintenance of this complex are about 1 billion tenge, including costs for electrical energy of 641.3 million tenge.

In relation to the high expenses for the maintenance of die mine pumping complex, a decision was made concerning wet conservation involving full flooding of the mines. However, with the liquidation of mine pumping and flooding of mine workings above level 13, a catastrophe could occur in terms of movement of the surface of industrial zones and residential areas of the city of Kentau and disturbance of the ecological conditions in the region. This problem was discussed by the Kazakhstan government and the special state municipal enterprise "Kentaulikvidrudnik" was founded. Its mission is solely to pump large volumes of water from "closed down" underground mines at the expense of budget financing, and no ore mining takes place. The necessity of continuous pumping of water from non-operated mines is due to the fact that large volumes of toxic materials were buned in the worked-out space. This is because a chamber-and-pillar system with goaf stowing was employed during underground ore mining at "Atchpolimetar mining and processing integrated works. As a filler, in order to save cement, solid wastes from the preparation process were used - ore tailings. During processing of polymetal ores by the flotation method, toxic reagents were used at some technological lines of the preparation plants, including extreme poison - sodium cyanide. Two ore tailings piles were formed, - Bayaldyrskoye and Kantaginskoye, which are located near Kentau. As a result of technical-in-genesis activity, as joint investigations of the VNIMI, "Atchpolimetar' JSC and SME "Kentaulikvidrudnik" institutes show, the ore tailings used for filling worked-out space include 183,00 kg of cyanides. In addition, they include other toxic materials: 7,486 tons of sodium sulphide, 876 tons of xanthate, 342 tons of oleic acid, 47 tons of shale resin, and 472 tons of phenol.

There is a common water-bearing regime in the Turkestan region, located in an area of a large depression cone, with a wide mouth at the surface, and under it the Mirgalimsai deposit is situated. Water from water-bearing seams moves through the

cone walls up to level 13, where 22 pumps operate twenty-four hours a day, pumping water up to level 9. From level 9, where pumps are placed, the volume of water of a river is pumped up to the surface. In the case of the pumps stopping, because of the electricity being cut off, lack of money or other factors (breaking of pumps), non-planned flooding of levels may take place. Thus, in 1997, because of a shortage of electricity supplies, non-planned flooding of level 19 took place. Water flooding from overlying levels would dissolve toxic materials, and even if the pumping station at level 9 were saved, on the surface in the cities of Kentau and Turkestan, springs would be contaminated with toxic water, as Turkestan is situated 212.0 m above sea level, and level 9 is 261.8 m above sea level. If the pumping station of level 9 were to be disabled, then the region (the largest part of the southern Kazakhstan region) would lose its water reserves. Failure of the pumping stations of the closed down mines of the Mirgalimsai deposit would cause catastrophic pollution of underground waters with highly toxic materials and create an ecological disaster area in a densely populated region of Kazakhstan. The negative consequences of cessation of the operation of the pumping complex and full flooding of the mine workings and extracting area would be to wash out rocks non-stable to water (limestone), placing in layers of chamber, block and barrier pillars, and it would cause their destruction and caving of the surface. Most of die residential and industrial areas in the city are in the proposed zone of caving, and moving them requires serious investigation.

However, the existing economic situation of the country requires tfiat the project of conservation of the mines of the Mirgalimsai deposit be carried out at lower cost, while still taking into account the danger of disturbance of the ecological conditions in the region.

A feasibility study carried out jointly by the institutes VNIMI (Saint Petersburg, Russia), "Kazgiprotsvetmef* (Ust-Kamenogorsk, Kazakhstan), and SME "Kentaulikvidrudnik" (Kentau, Kazakhstan) showed that wet conservation of mines above level 13 is not appropriate with relation to the causes given above.

In order to reduce the cost of the conservation of mines with savings from a reduced form of mine pumping, recommendations have boen made on decreasing costs for mine pumping maintenance and holding the water level at the mark of level 13. They include water-pumping adit driving from level 4 up to the surface, and small hydraulic-electric stations constructed for additional production of electrical energy.

Water-pumping adit driving will ensure savings in the electrical energy consumed by the pumps of up to 20-25% at the expense of decreasing the height of water pumping up to 81 m.

In order to use the energy of the underground waters, the construction of a small hydraulic electricity station has been proposed at the mouth of a water-transferring mine working, and this will allow the partial supply of mine pumping by electrical energy. Obviously, full use of the potential energy of the water would be realized with the placing of a hydro-generating device at level 13 with a water head of 110 m. With an average annual water inflow 0=12,000 m^3/h and water column height H=l 10 m, the calculated capacity of the small underground hydraulic electricity station would be 2,000 kw.

For additional refunding of expenses for electrical energy in mine pumping, it has also been proposed that small hydraulic electricity stations be constructed at the surface on the riverbeds of the Bayaldyr, Biresek and Kantagi rivers. If the average annual water consumption were 15.0-16.0 m^3/h, the total capacity of the surface hydraulic electricity stations would be 4,000 kw.

As preliminary calculations show that these measures (water-pumping adit driving and construction of small hydraulic electricity stations) would ensure up to 45-50% of the electric energy for die pumps, there would be a saving in electricity equivalent to 300 million tenge a year,

In addition, relief in the up-river areas of these rivers would allow the construction of a series of small hydraulic electricity stations, which would increase electricity production and lead to a saving in the budget which is provided by the state to maintain pumping of the mines of the Mirgalimsai deposit.

3 CONCLUSION

For the prevention of possible flooding of the top levels of the Mirgalimsai deposit with catastrophic consequences, because of problems with electricity supplies, it is necessary to construct independent sources of electricity in order to decrease the costs of maintaining the mine pumping complex. An alternative of full flooding of mines is proposed, fixing the water at the mark of level 13 with constant mine pumping in more favourable conditions than are present today, so that part of the energy consumed (up to 50%) will come from independent sources. Such a system of supply for the pump motors, with automatic blocking for sudden drops in voltage or full cut-off from the city supply, would exclude the possibility of sudden cessation in the operation of the mine pumping complex, flooding of the top levels and the catastrophe that could follow these events.