

## Technologies for Environment Protection at Mines of Non-ferrous Metallurgy and Their Introduction in Practice

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**ABSTRACT:** Mines of non-ferrous metallurgy account for third part of solid, liquid, dust-like and gaseous materials polluting soil, water reservoirs and atmosphere. The main sources of pollution are: dumps of non-commercial ores and broken rock, ore tailing piles; mine water; mine dust; harmful waste of mines (acids, iron cut and so on); public waste from mine settlements; dust from different kinds of roads. In the paper worked out technologies are presented for environment protection.

### 1 INTRODUCTION

As a result of mining operations at any mine 15-20 thousand ha are occupied and 40% of them are used for rock dumps and ore tailing piles forming. As of 1999, total quality of solid waste of mining-and-metallurgical complex of the Republic of Kazakhstan was 9 million tons. They occupied land area of 2752 km<sup>2</sup>. For environment protection at mines it is necessary to create and to introduce technologies which exclude pollution and transform waste into innocuous and useful products saving funds and labor.

### 2 RESULTS AND DISCUSSION

Waste-free technologies were worked out and introduced for processing of oxidized copper ore of Zhezkazgan deposit by heap leaching at Aktehiy-Spasskiy open cast. During the utilization of this technology the following technical-economic indexes were received: production of a unit on ore - 110 000 tons, copper content in ore - 12 %, copper quantity in ore - 1320 tons, copper extraction into solution was 91.5 %, silver- 60%; copper extraction into precipitate was 94.8 %, silver - 100 %>. Solid waste of this process was used as filler for preparing of filling mixtures, used at Northern-Zhezkazgan mine. This allowed increasing of strength of filling mixture by 2 times and decreasing cement consumption by 20-30%. At Kazakhstan's mines there are large reserves of oxidized and lean ores, some of which may be processed by the method of heap leaching, and this will allow widening of mineral

raw materials base of mining enterprises and decreasing ore losses.

Today a tendency is observed of increasing of worked-out space of mines using for location of harmful waste. Experience of worked-out mine workings using is not so large in the Republic of Kazakhstan in comparison with foreign countries where this problem was paid attention taking into account its high technical and technological efficiency. Technologies were created by us for worked-out space of mines using for location of harmful waste of mines and mine settlements (iron cut, washing acid from ore processing and so on). When burying of harmful waste, including liquid component, constructions of cofferdams are used, technologies of constructing of which were run in when deposits mining with consolidating stowing. Harmful industrial waste location in worked-out mine workings will allow decreasing costs on burial by 2 times in comparison with their surface burial and ensuring minimum influence on environment and maximum technical-economic effect.

We also worked out and introduced technologies of dust suppression at ore tailing piles, rock dumps, roads of open casts and mines. For dust suppression at ore tailing piles emulsions were worked out on the basis of bituminous rock with bitumen content 10-20%, including sodium silicate and surface-active materials. When this emulsion was used dusting surface remained homogeneous for 6 months. For dust suppression at tailings piles of copper ores of Zhezkazgan deposit emulsions were the most effective, when they were prepared from bituminous rock including 5% of sodium silicate, 1% of surface-active materials with bitumen concentration 10 and 20%' (patent). When testing surface of ore tailing

piles, covered with bituminous emulsion (bitumen concentration was 10%), under air temperature 20-25°C the surface was homogeneous during all period of observations for 6 months.

Dust precipitation from mine air is of great importance. When powerful winning and transport self-propelling machines operated different harmful pollutants are formed and they pollute mine atmosphere. It was established that through air shafts large volume of mineral dust and toxic gases are thrown into atmosphere. As a result of blasting operations toxic gases and dust are thrown into atmosphere, too. Dusts, including toxic metals: mercury, arsenic, selenium, cadmium, nitrogen and carbon oxides are the most dangerous ones. Copper-smelting and sulphuric acid productions of Zhezkazgan are sources of tens tons of CO<sub>2</sub>, SO<sub>2</sub> and other harmful compounds. In correspondence with limiting permissible concentrations (LPC) standards mine dust content in air must be not more than 0.5 mg/l, nitrogen oxides - 0.03 mg/l, carbon oxide - 1.8 mg/l. Practically in all technological processes dust concentration in air is greater by several fold of LPC. Worked-out methods of dust collecting allow air purification from dust up to 46-70% depending on the place of dust formation. And dust content in air decreases from 6.9-27.4 mg/m<sup>3</sup> up to 3.0-14.9 mg/m<sup>3</sup>. So, air of working zones needs additional purification by a way of methods of deep air purification and special apparatuses (hydrofilters, electro-

fillers, cyclones of different constructions and so on) using.

Ore tailing piles are harmful sources of environment pollution, which are of great danger for human health as far as they include up to 80 % of silicium dioxide, activity of which increases when lead and rhenium is found in air. It is known that when wind speed is 5-6 m/s movement of particles (1-100 μ) takes place at a height of 20 cm of day surface. In many regions of the Republic of Kazakhstan, including Zhezkazgan oblast, windy weather is 100-150 days a year, and wind speed is 20-25 m/s. That is why dust from ore tailing pile rises up to a considerable height and is carried off boundaries of ore tailing pile. Two compositions were worked out for dust suppression at ore tailing piles. These compositions ensure forming strong (0.18-0.21 MPa), proof against water crust which discourages wind erosion.

### 3 CONCLUSION

All worked out technologies for environment protection are covered by patents of the Republic of Kazakhstan. Their usage may decrease harmful effects of mining-and-metallurgical complex of Kazakhstan on environment and ensure widening of mineral raw materials base of mining and metallurgical enterprises.