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OBTAINING IRON CONCENTRATE FROM DISPOSAL SLAG OF THE ALMALYK MMC COPPER Smelter

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Annotation: With the pyrometallurgical method of processing copper concentrate, the melt is divided into two liquid layers, one of which is an alloy of sulfides (matte), the other is an alloy of oxides (slag). Pure copper is obtained from the sulfide alloy during its further technological processing. Today, more than a billion tons of copper production slag have accumulated in the dumps of JSC AGMK and there is no technology for their processing.

Keywords: established – molybdenum, pyrometallurgical, silver, analysis, magnetite, zinc, magnesioferrite, chalcocite, sphalerite.

Introduction

Copper smelting slag is mainly a waste product. The slag yield is quite large. For each weight unit of smelted matte there are up to 50-100 units of slag [1-3].
At the same time, dump slag is a valuable technogenic raw material, in which significant concentrations of metals have been established - molybdenum (790 g/t), Fe (51%), zinc (0.52%), lead (0.4%), Ni (0.10%), gold (4.3 g/t), silver (4.1 g/t), UEPG (0.87 g/t), cadmium (17.3 g/t), Jn (4.9 g/t), Bi (40 g/t).

Materials and Methods

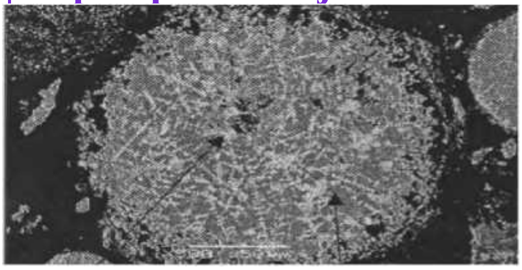
The slag yield is mainly determined by the composition of copper concentrates and fluxes. The content of copper and other components in the slag depends on the composition of the slag and the nature of the smelting.
An analysis of the chemical composition of copper smelter waste slag samples is presented in Table 1.

Chemical composition of waste slag from the copper smelter of JSC AGMK

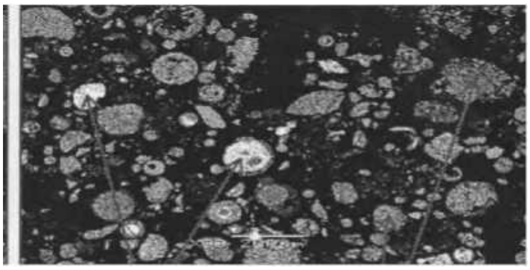
Table 1

Components	**Si**	**Zn**	**Pb**	**Fe**	**S**	**SiO_2 _**	**$A1_2O_3$**	**CaO+MgO**
Content. %	0.6	0.46	0.2	33.0	1.3	34.0	7.4	5.0

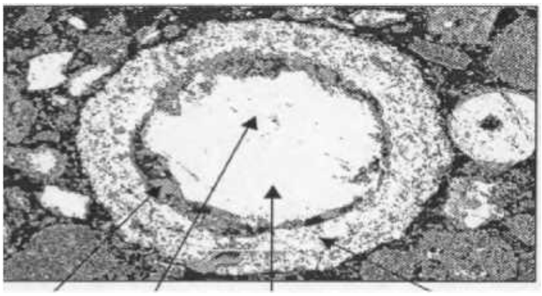
As a result of the use of modern analytical studies, many mineral forms of the presence of elements present in slags have been established: silicates - spinel ($MgAl_2O_4$), which forms solid solutions with Fe - $FeAl_2O_4$, Zn - $ZnAl_2O_4$, Cr - $FeCrO_4$ (ferochromite), magnetite (Fe_3O_4), magnesioferrite ($MgFe_2O_4$); glass, quartz (SiO_2); fayalite ($2FeOSiO_2$) isostructural with forsterite, metal oxides - cuprite (CuO), hematite (Fe_2O_3) and similar minerals; metal sulfides - pyrrhotite, troilite (FeS), chalcocite (Cu_2S), sphalerite (ZnS_2), galena (PbS), bornite (Cu_3FeS_4) and chalcopyrite-like minerals ($Cui_{\pm x} Fei +_{x} S_{2 \pm x}$). Microprobe studies as a result of scanning a polished section of slag with a probe have established that all non-ferrous metals are bound to sulfur to one degree or another. Data from raster images (Fig. 1) when scanning over the polished section area showed that a clear correlation cS is observed in the distribution of Cu and Fe .



a) Cu_2 (NiFeCo)O



b) Cu - zamor . Cui $_{\pm x}$ Fei $_{ts}$ S $_{2\pm x}$



c) quartz, Cu_2 8, anilite

Figure 1. Microphotograms of thin sections of a scanning microscope

As can be seen from table. 1 and fig. 1 large percent of the slag is iron and silicon.
In order to increase the concentration of copper in the slag, we undertook a study on the extraction of iron. Waste slag from the copper smelter of the Almalyk MMC was used as the feedstock for processing metallurgical production . Waste copper smelting slag in an amount of 500 g was crushed in a laboratory ball mill.
The ratio of liquid to solid (L:S) during grinding was 2:1. Grinding was carried out for 120 minutes (2 hours). After grinding, the pulp was drained from the mill. Determination of the granulometric composition by class was carried out by manual sieve analysis.
Classification was carried out on sieves with mesh sizes of 0.25 mm and 0.1 mm. After dividing into classes, the samples were dried in ovens at a temperature of 150-160°C and weighed.
under-ground products weighing 12 g (+0.25 mm) remained. On sieves of class 0.1 mm, the amount of remaining material was 312 g (+0.1 mm). The amount of material passing through the 0.1 mm sieve was 170 g (-0.1 mm). The distribution of crushed slag by class is shown in Table 2.

Distribution of crushed slag by class

Table 2.

Class, mm	Weight, g	Yield by class,%

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+0.25	12.0	2.4
-0.25+0.1	312	62.4
-0.1	170	34.0
	494 (loss 6 g)	98.8

We conducted research on slag enrichment using the method of hydraulic classification, jigging, and a screw separator for comparison. It is known from literary sources that these methods are widely used in practice and provide fairly objective information about the technical and economic indicators of the process.

Laboratory studies were carried out to determine the effectiveness of hydraulic classification on a single-spiral classifier with a trough length of 1.6 m, a width of 0.28 m and a spiral diameter of 0.28 m. For the experiments, pulp was prepared with T: F = 1:10 to 1:20 , which was fed into the trough of a spiral classifier. The efficiency of particle separation was studied depending on the duration of residence of the material in the apparatus and the sieve composition of the starting material. As the results of the study showed, the separation of grains on a hydraulic spiral classifier takes 15-20 minutes, while the separation efficiency is not high, and the initial grain size does not have much influence. This means that this method is ineffective for solving problems of effective separation of iron and its oxide compounds into an independent product. A study on the enrichment of copper smelting slags with iron by the jigging method was carried out in a laboratory two-chamber diaphragm jigging machine of the MOD- 2 brand. According to the results of the study, it can be said that the extraction of valuable components (iron) into the concentrate is also low, although the yield of the concentrate was 49-50%. The use of this technique does not provide effective technical and economic indicators and cannot be recommended for industrial implementation. One of the possible methods for separating valuable components during the processing of copper smelting slag is the use of a screw separator. The results of the studies showed that the extraction of valuable components when using a screw separator is slightly higher than in previous series of experiments. In this case, the total recovery was, %: $FeO+Fe_2O_3$ -72.2; Fe- 89.5; MnO-70.4. However, losses from tailings are significant, which significantly reduces the technical and economic indicators of the process. Experimental enrichment studies concentration table was carried out on a laboratory single-tier table LKS - 1Ya. The table is designed for enrichment of material with a particle size of 3 mm, table productivity 15-20 kg/h; The deck stroke is adjustable within 8-16 mm; number of strokes per minute 275 325; deck inclination from 0 to 10"; water consumption 0.5 m7h.

The experimental study was carried out as follows:

First, enough water was supplied to cover the entire surface of the table with a thin layer. Copper smelting slag was fed into the loading box of the table in the form of pulp, obtained after grinding with a ratio of L:T = 2:1. The amount of solid in the pulp was 1 kg. While observing the formation of a fan on the table, the tilt and amount of water in the middle and end parts of the table were adjusted. The slope was adjusted so that the boundary of the coarse fraction of the tailings fell into the first tailing receiver. Having passed all the material, slightly reducing the tilt of the table, we used a brush to wash away the material that had settled on the deck without stopping the table. Having washed off all the material, the table was stopped, each of the resulting fractions was dehydrated and dried. After sample preparation, the chemical composition of the products was analyzed and the content of Fe_{MeT} , FeO , Fe_2O_3 was determined . Also, microscopic and IR analysis was carried out. The results of chemical analysis for all enrichment methods are given in Table 4.

Comparative analysis of the extraction of iron components from copper smelting slags by various enrichment methods.

Table 4

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Enrichment methods	Extractable valuable components	Recovery, %
		Concentrate
Jigging	$FeO + Fe_2O_3$	42.3
	Fe	28.6
Screw separator	$FeO + Fe_2O_3$	38.6
	Fe	32.7
Concentration table	$FeO + Fe_2O_3$	63.0
	Fe	78.2

Summarizing the above various enrichment methods , we can conclude that the most effective method of high recovery of iron and their compounds is enrichment on a concentration table, which occurs by repeating the concentration process multiple times in the intervals between grooves. The concentration table simultaneously provides high extraction of heavy metals.

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