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Research of the Possibility of Processing ZINC CUKS by Heat and Various Processing

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ABSTRACT: In article questions of effective processing of cake zinc production are considered which purpose is additional recovery of valuable components and a number of non-ferrous metals as a basis of increase of complexity of use of raw materials.

KEY WORDS:cake, heat treatment, leaching, firing, decomposition, oxidation, recovery.

I.INTRODUCTION

Zinc cake - an insoluble residue after leaching of a zinc cinder, has a complex composition, contains more than 20 chemical elements. Mineralogical analysis of the tested cake showed that Zn in the cakes is contained in an amount of 23% (in the form - ZnO (0.8%), ZnSO4 (1.2%), 2ZnO · SiO2 (3.9%), ZnO · Fe2O3 (5 , 6%), ZnS (11.5%)), Fe– in the amount of 17.3% (in the form - FeS (2.5%), FeO (4.3%), Fe2O3 (8.7%)) , Pb– in the amount of 6.43% (as PbO (4.4%), PbS (1.9%)), Cu - in the amount of 3.72% (as CuS (1.6%), CuSO4 (1.9%)). Au and Ag are mainly in metallic form.

Currently, pyrometallurgical and hydrometallurgical methods for processing zinc cakes are used in world practice. Pyrometallurgical methods for processing cakes are very diverse and are mainly based on the reduction reactions of zinc oxide and ferrites using carbonaceous reducing agents at relatively high temperatures, sublimation of zinc, lead, rare metals and oxidation of sublimates in the gas phase.

II. METHODOLOGY

The most widespread among pyrometallurgical methods for processing zinc cakes is the Waelz process (reduction and sublimation firing) - at a temperature of 1000 - 1200 0C with the addition of coke in an amount of 35 ÷ 45% of the mass of the processed material. At the same time, zinc sublimates and clinker are obtained - the residue from Waelz, which in turn contains many valuable components. Zinc sublimates return to the process of sulfuric acid leaching.
The disadvantages of the Weltz process are:
- high consumption of expensive and scarce coke;
- the need for high temperatures for the process;
- Unresolved issues of the extraction of other valuable components, such as Au, Ag, Pb, Cu, Fe, etc. due to the lack of rational technology for processing copper clinker.

Hydrometallurgical methods of cake processing have been developed relatively recently and are based on the dissolution of ferrites and zinc sulfide with sulfuric acid at atmospheric or elevated pressure with the conversion of zinc, copper, cadmium, rare metals and iron into solution, followed by the release of iron from the solution in the form of various compounds. Currently, there are three known schemes of hydrometallurgical processing of zinc cakes:
- cake leaching under pressure with the release of iron from the solution in the form of hematite (Fe2O3) - hematite process;
- leaching of cake at atmospheric pressure with the release of iron from the solution in the form of goethite (FeOOH) - goethite process;
- leaching cake at atmospheric pressure with the release of iron from the solution in the form of jarosite ($MeFe_3(SO4)_2 (OH)_6$) - thejarosite process.

The disadvantage of hematite technology is the need to use expensive expensive equipment - autoclaves. The disadvantage of goethite technology is significantly greater zinc loss with iron cake and the difficulty of filtering

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goethite cake. A disadvantage of the jarosite technology is the deterioration of the cleaning of solutions from impurities, and also the solutions must be additionally cleaned of residual iron.

In this regard, studies were carried out on the possibility of processing zinc cakes by the method of heat treatment with subsequent sulfuric acid leaching of the cinder. Thermo-steam treatment contributes to the transition of insoluble aqueous solutions of metal compounds into a water-soluble form.

The cinder was leached with a sulfuric acid solution. The use of sulfuric acid is technologically and economically feasible, since this produces a solution of zinc sulfate, which can be introduced into the main cycle of the zinc plant. In the laboratory, studies have been conducted on the influence of various factors (temperature, acid concentration, leaching time, pulp density, etc.) on the degree of metal extraction into the solution.

The degree of extraction of zinc and other metals during cinder leaching (S:L = 1:5) at 600^0C is in a certain dependence on the concentration of sulfuric acid (Fig. 1).

As can be seen from the results of experiments with increasing concentration of sulfuric acid in solution (up to 150 g / l), the solubility of the components of the cinder increases linearly. An increase in the concentration of sulfuric acid over 150 g / l does not give a significant increase in the degree of conversion of zinc into solution, while the transition of impurities into solution (especially iron) begins to increase. To leach thermocouple zinc cakes with sulfuric acid, a sulfuric acid concentration of not higher than 150 g / l is recommended; this can also control the degree of dissolution of the accompanying minerals.

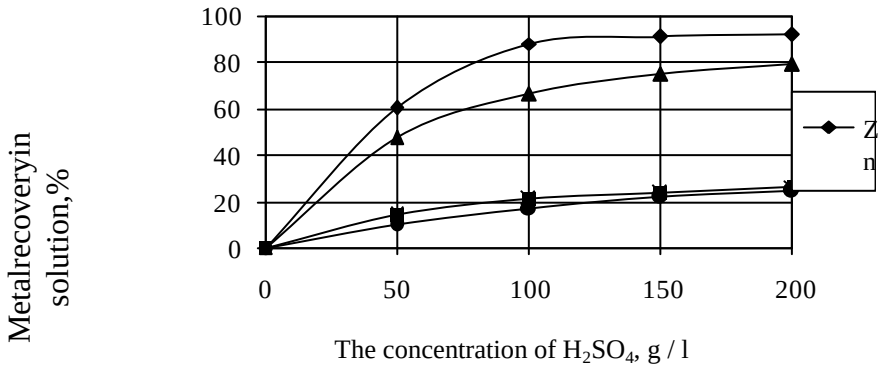

Fig. 1.The dependence of the degree of extraction of metals in solution from the concentration of acid.

A study of the effect of the duration of the process on the leaching of zinc from the product with a sulfuric acid solution with a concentration of 150 g / l shows that in the initial period (up to 60 min) the transition of zinc to the solution proceeds very intensively, and after 120 min the dynamic equilibrium of the leaching process is established (Fig. 2) .

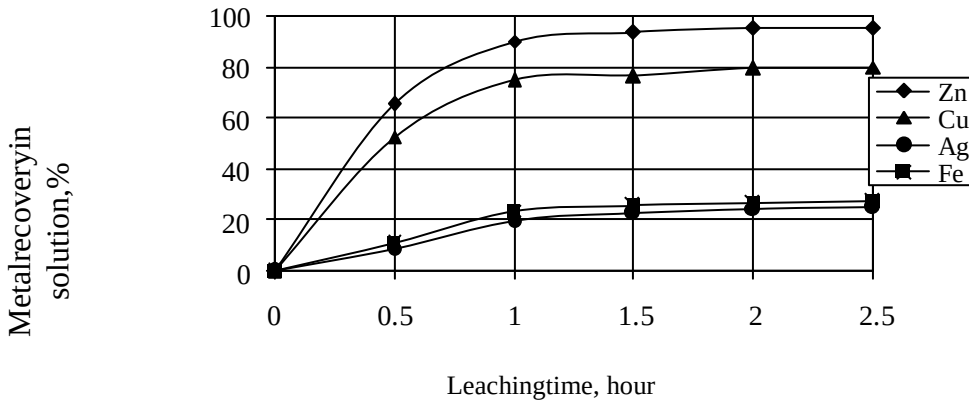

Fig. 2.Dependence of the degree of extraction of metals into the solution on the duration of leaching.

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An increase in the duration of contact between the sulfuric acid solution and the cinder can lead to an increase in the content of impurities in the solution. When leaching cinder with sulfuric acid, the oxidized minerals of zinc and copper are primarily reacted. The minerals of iron and silver interact slowly with sulfuric acid. Therefore, in order to achieve maximum zinc recovery with a minimum transition of impurities into the solution, the leaching time can be chosen 2 hours.

The speed of the vast majority of chemical reactions, as well as diffusion increase with temperature. With increasing temperature, a rather slow increase in the concentration of zinc in the solution is observed. However, starting from 400 ° C with an increase in the duration of the process, a more intensive increase in the degree of extraction of zinc and copper occurs. This is explained by the fact that, at elevated temperatures, ZnSO4 is formed more rapidly. It should be expected that with increasing temperature in the future, the dissolution rate will increase. But at the same time, it should be borne in mind that an increase in temperature slightly affects the dissolution of the useful component (zinc), while the transition to the solution of impurities increases significantly. An increase in temperature of more than 800 ° C does not significantly affect the leaching of zinc, but greatly increases the transition to the solution of impurities. The necessary hydrodynamic regime to achieve uniform pulp density is ensured by a mechanical mixing device.

III. EXPERIMENTAL RESULTS

Thus, the following optimal leaching conditions for thermocouple-treated zinc cake were established: concentration of sulfuric acid 125-150 g / l, temperature 75-800C, duration 2 hours. Under these conditions, the degree of zinc extraction into the solution is 85-95% and iron is 28.1%, and the cake yield is 58-60% of the cinder weight. The results of the study indicate the possibility of effective processing of zinc cakes with subsequent sulfuric acid leaching.

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