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Increase in Efficiency of Processing of Collective Zinc-Lead Concentrates

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ABSTRACT: In article questions of increase in efficiency of processing of collective zinc-lead concentrates without their preliminary selective division are considered. Our developments on processing of collective zinc-lead concentrates are directed to that in the maximum degree to receive sulfates of zinc and lead transferring zinc to solution, and lead in cake. Thermodynamic calculations show that formation of sulfates most intensively proceed in the range of temperatures of 800-950 ° C. It is offered to carry out roasting of a collective concentrate to furnaces of the boiling layer in the gas environment.

KEYWORDS: ore, a collective concentrate, selective divisions, zinc and lead concentrates, roasting, the boiling layer, the steam-air environment, ferrito-and a silicate formation, extent of leaching.

I.INTRODUCTION

In the present time to the main sources of receiving zinc sulphidic polymetallic copper and zinc-lead and zinc-lead ores are.
In sulphidic ores zinc usually is present at a type of blende or the vurttsit which structure answers a formula of ZnO and also the nZnS marmatit • mFeS.
In these ores along with blende, there are sulfides of lead, copper, cadmium, manganese, silver, arsenic, an antimony and cobalt. Blende often in the form of impurity contains rare elements - indium, thallium and germanium and also gold in quantity from thousand to the 100-th shares of percent [1].
Lead in sulphidic zinc ores is presented usually in the form of a galenite of PbS [2].
In world practice floatation enrichment of collective zinc-lead ores was widely adopted. At the same time in the beginning receive a collective concentrate which then is divided on selection into a zinc and lead concentrate [3].
This scheme is quite difficult, demands a for actions of a large amount of import reagents and the equipment. Besides, this scheme inevitably provides mutual losses of metals. So, the zinc concentrate contains 1.5-2.5% of lead which are practically not extracted at further processing. In a lead concentrate the content of zinc fluctuates within 4-14% which are also lost with production wastes. Content of zinc and the lead lost are comparable to production wastes, and sometimes more, their content in initial ores [4].
It provisions caused the necessity of search of new technologies of processing of collective concentrates without their preliminary division.
One of such technologies is distillation melting in mine furnaces (Imperial smelting) and KIVTsET-TsS processes [5].
Feature of processes – joint processing of a zinc collective concentrate with Zn relation: Pb=2:1 [6].
Way were widely adopted thanks to the following advantages:

1) Big capacity of the unit on zinc (up to 200 t/day) and on lead (up to 100 t/day);
2) To high treatment of zinc and lead;
3) High performance of work.

II. LITERATURE SURVEY

Process provides the agglomerating roasting of concentrates, as a rule, with blasting (in mix with reverse drosses, pusyery and a quantity of limestone and quartz). For removal of sulfur and agglomeration of material in strong and

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porous agglomerate. Such agglomerate contains 25-45% of Zn, 15-25% of Pb and about 20% of dead rock. The best gas permeabilities of furnace charge apply agglomerate to providing mainly in the form of pieces of 60-90 mm in size. The furnace charge loaded into the furnace consists of agglomerate and coke. Coke is previously warmed up to 800 °C, agglomerate is loaded cold. Agglomerate and coke with reacts with the hot blasting (600-800 °C) coming to the furnace through furma therefore lead and slag which gather in a furnace throat from where they are periodically released in a settler for division according to density are formed.

Melting is conducted on slag of structure, by %: 32 CaO; 25 SiO_2; 20 FeO; and 11 Al_2O_3, having temperature of melting of 1250 °C. 3-4% of Zn of 0,5-0,8% of Pb contain slag. It is granulated and sent to a dump.

The oven gases with a temperature of 950-1000 °C containing 3,9% of Zn, 11,3% of CO_2, and 18% of CO send to the condensers equipped with the rotor mixers shipped in a bathtub of the melted lead.

From steam-gas mix a type of liquid zinc 87% of metal, in a look pusyer of 4%, in the form of drosses and slimes of 8% are condensed. To Pusyer, drosses and slimes return in agglomeration furnace charge. In piece zinc takes 91-93% of Zn, in slag lose 6,5% of zinc, other losses consist of 2,5%. As a part of draft zinc of 98,5-99,8% of zinc, the others - impurity.

About a third makes a pusyer of total number of turns, received in the system of a wet half-catching, about a third of a turn drosses received on a metal bathtub surface in the condenser, the rest of turns is presented by the oxidized drosses. The general the amounts of zinc passing into these reverse products makes 14,7% of the mass of zinc in initial furnace charge.

This technology hardly has the prospect of application in the conditions of Uzbekistan for the following reasons:

1) For its application the big capital investments comparable to construction of new zinc plant are required;
2) In slags about 6-8% up to 6-8% of zinc are lost, and is in ballast circulation up to 15% of the initial content of metal in initial furnace charge;
3) The quality of the received zinc very low, for its cleaning is required applications of electrolytic cleaning;
4) The big consumption of coke which is required imported with expense of currencies;
5) Strict requirements to quality of initial materials, etc.

In our opinion, the most perspective will be those new technologies which are guided by the technologies which are available the equipment, applied local raw material resources [6].

III. METHODOLOGY

On the technology applied now, the sulphidic zinc concentrate after selection is processed on the classical scheme: roasting in BL furnaces - leaching - cleaning of impurity - electrolysis. Cleaning after leaching processes Wealz process. Waste process of clinker contains a large amount of non-ferrous, rare, precious metals and also metal iron and carbon. So far optimum technology of processing of clinker it is not developed. On applied in the Almalyk mining and metallurgical company technology, copper and precious metals is extracted from clinker. And also metals as zinc, lead and some other are lost forever.

Roasting in BL furnaces along with advantages has also some shortcomings. The basic from them is what in process of roasting at temperature of 1050-1150 °C is formed ferrite zinc silicates which it is poorly dissolved when leaching and in large numbers pass into cake. As a result of it concentration of zinc in caka reaches 22-26% that significantly worsens technical and economic and technological indicators of process. Cakes are required to special operation-Wealz process. But even in this case considerable losses of zinc with waste are inevitable.

Each sulfide of metal has the temperature of ignition. Some values of temperatures of ignition of particles of 0,10-0,15 mm in size: % °C: $CuFeS_2$ - 364; FeS_2 422; FeS 460; ZnS 637; PbS 720.

It is known that moistening of air leads to decrease in temperature of ignition [7].

This situation became a basis of our development of technology of roasting of sulphidic zinc concentrates in BL furnaces at lower temperatures, but with addition in blasting up to 10% of the water vapor which is warmed up to 800 °C. Decrease in temperature of roasting to 850-950 °C will significantly lower ferrite and a silicate formation that to raise extent of transition of zinc to solution when leaching also actually will not be need for a Wealz process of zinc cake.

Zinc sulfide oxidation by oxygen of a gas phase is carried out on one of the following schemes [8].

$$ZnS + 2O_2 = ZnSO_4$$
$$ZnS + 3/2O_2 = ZnO + SO_2$$
$$ZnS + O_2 = Zn + SO_2$$

Dependences on conditions the final products of oxidation of sulfide can be sulfates, oxides or metals.

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Our developments on processing of collective Pb-Zn of concentrates are directed to that in the maximum degree to receive sulfates of zinc and lead transferring zinc to solution, and lead in cake. Thermodynamic calculations show that formation of sulfates most intensively proceed in the range of temperatures of 800-950 °C [9].

Especially it is necessary to cancel a role of water vapor. Earlier it was noted that reduces temperature of course of oxidizing processes a little. However we in literature did not find an explanation for this fact. In our opinion, with participation of water vapor course of the following processes is possible.

When roasting sulphidic concentrates in BL furnaces at temperatures of 950-1050 °C, there is a formation of oxides of metals. Formed oxides enter interaction with sulfide of the same metal on reaction:

$$MeS + 2MeO = 3Me + SO_2$$

For this reaction:

$$lgk = -lg\frac{18215}{T} + 1.39lgT + 0{,}2$$

$P_{SO_2} \geq P_{SO_2(out)}$ (partial pressure of SO_2) in the technological unit), then interaction is probable. In principle interaction of sulfide and oxide it is possible to receive any metals. However the temperature since which is characteristic of each metal becomes probable reaction between MeS and MeO with formation of metal. And it has to go easily for oxides and sulfides of those metals which have a sum of sizes of affinity to sulfur and oxygen is rather small (Cu, Pb, Bi, Sb) [10].

So, reaction of $Cu_2S+2Cu_2O= 6Cu+SO_2$ becomes possible already at 750 °C. At 1100 ° C of $P_{SO_2} = 1{,}01 \cdot 10^6 Pa$.

Approximately also easily reaction proceeds

$$PbS + 2PbO = 3Pb+O_2$$

Already at 900°C P_{SO_2} reaches $1{,}01 \cdot 10^5$. With temperature increase sharply also the equilibrium pressure of sulphurous gas increases.

The reactions received on these metals are the catalyst for dissociation at high temperatures of a molecule of water on the making elements. The fact that as a result of disintegration of a molecule of water atomic oxygen is emitted is remarkable. Atoms of oxygen is very chemically relevant and get into a lattice of sulfides of metals with the put formation of sulfates of metals. Schematically processes can be presented as follows:

$$MeS \rightarrow MeSO \rightarrow MeSO_2 \rightarrow MeSO_3 \rightarrow MeSO_4$$

It is offered that atomic oxygen as a result of chemisorption on the surface of sulfide forms metastable sorption complexes with the increasing saturation oxygen, up to formation of sulfate of metal [11]. When roasting polymetallic zinc-lead concentrates, this process will come to the end with formation of sulfates an zinc and lead.

One of the essential moments complicating receiving zinc on classical technology is education when roasting ferrite and silicates of zinc. These connections, it is generally formed at temperatures of roasting of 950°C and above degrees. When moistening blasting water in couples temperature of roasting is 850-900 °C that significantly reduces possibilities of ferrite and a silicate formation. It has to increase significantly through extraction of zinc in solution when leaching.

IV. RESULTS AND DISCUSSION

We conducted researches on roasting of collective zinc-lead concentrates without their preliminary division in couple of air mix.

Results of researches are presented in fig. 1 and 2.

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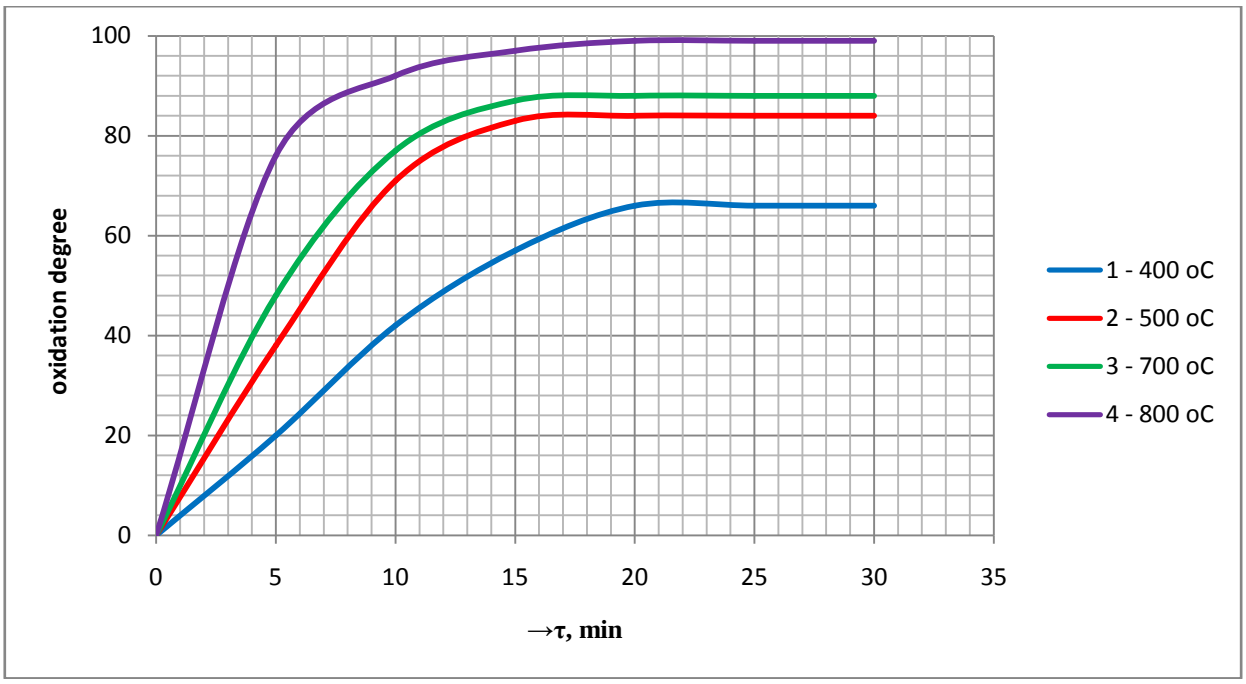

Fig. 1. Lead sulfide oxidation speed steam-air mix.

1 – 400 ° C;
2 – 500 ° C;
3 – 700 ° C;
4 – 800 ° C

From fig. 1. it is visible what when heating to temperature of 400-500 °C of PbS is oxidized with formation of sulfate, the main sulfates and oxide of lead:

$$2PbS + 3O_2 = 2PbO + 2SO_2$$
$$PbS + 2O_2 = PbSO_4$$

Ozone translates PbS and $PbSO_4$.
Availability of water vapor leads to formation of PbO and H_2S;

$$PbS + H_2O = PbO + H_2S$$

Reactions of interaction between sulfides of lead and water the ferry intensively proceeds within the first 10-15 minutes and reaches value of 90% and above. Further temperature increase for the purpose of an intensification of process is inexpedient, so it can lead to sulfate decomposition.
Results of researches on zinc sulfide oxidation by water vapor (fig. 2) show that reaction intensively proceeds the first 15-20 minutes.

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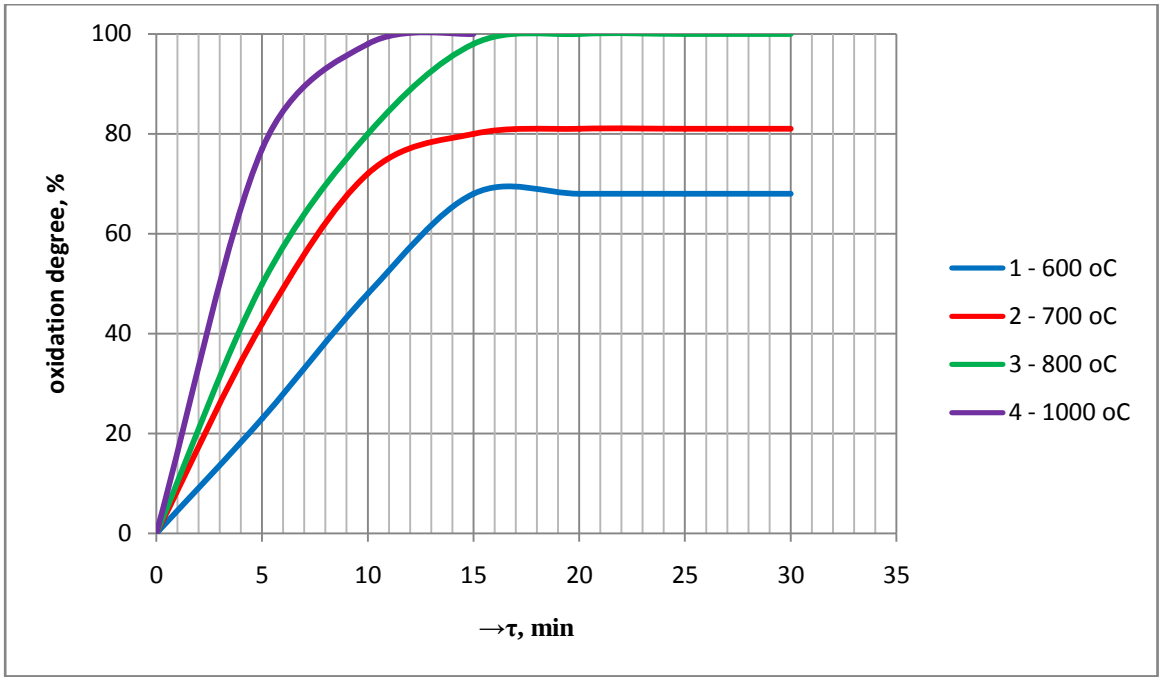

Fig. 2. Zinc sulfide oxidation speed steam-air mix.

1 – 600 ° C;
2 – 700 ° C;
3 – 800 ° C;
4 – 1000 ° C

Heating to 600-700°C leads to formation of ZnO up to 10-20% and to emergence of phase $ZnSO_4 \bullet ZnO$. With temperature increase to 950-1050 °C in usual conditions of 95-98% of zinc is in a type of ZnO and only 2-5 in the form of ZnS [12]. At this temperature of sulfates of zinc it is not revealed since it decayed on reaction.

$$ZnSO_4 = ZnO + SO_3$$

The volume the fact is very interesting that during roasting of 10-25 minutes in the range of temperatures 800-950°C in water vapor of significant amounts of the formed ferrite and silicates of zinc us is not revealed.

V. CONCLUSION AND FUTURE WORK

We conducted researches on leaching of the received collective candle end.
Leaching was carried out on the same technology which is used at zinc plant Almalyk it is mountain iron and steel works. As a result of the made experiments it was established that 94-96% an zinc from a candle end passed into solution. Zinc content in cake it is not exceeded by 2-4%. What is comparable with zinc content in clinker, ZnS received when processing on classical technology.
It is one more certificate of togas that zinc in a candle end, generally is in a type of soluble oxides and sulfates. Difficult soluble connections (ferrite and silicates of zinc) in significant amounts it is not formed.
In the conditions of roasting oxide and sulfate of lead almost entirely passes in cake and which can be processed on traditional to the scheme:

Agglomeration - mine melting – refinements.

Thus, on the main of the conducted researches it is possible to make a choice that collective lead-zinc concentrates can be processed in common, without their preliminary division. At the same time significantly improves technical and economic and technological indicators of zinc production. Through extraction of zinc in electrolyte when leaching increases the account of decrease in ferrite and a silicate formation, actually we unlock need of a Wealz process of zinc cake. In total it can do will give essential technical and economic effect.

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