



ISSN: 2350-0328

International Journal of Advanced Research in Science,
Engineering and Technology

Vol. 6, Issue 2, February 2019

Improvement of Technology of Heat Treatment of the Zinc Concentrate for the Purpose of Increase in Complexity of Use of Raw Materials

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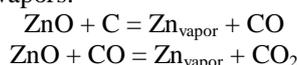
ABSTRACT: In article are considered questions of increase in efficiency of processing of collective zinc concentrates without their preliminary selective division. Our developments on processing of collective zinc concentrates are directed to that in the maximum degree to receive sulfates of zinc transferring zinc to solution. Thermodynamic calculations show that formation of sulfates most intensively precede in the range of temperatures of 1000-1100 °C. It is offered to carry out roasting of a collective concentrate to furnaces of the boiling layer in the gas environment.

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

I. INTRODUCTION

To processing of zinc concentrates in the presents time is applied pyrometallurgical and hydrometallurgical technological by schemes.

Zinc oxide restoration process at 1000-1100 °C is the cornerstone of pyrometallurgical processes, i.e. at temperatures currents of boiling of metal zinc are higher that provides allocations on at the time of education in a vaporous condition of v , therefore, its sublimation in the form of vapors:



Zinc vapors further condition. Because zinc in a concentrate is present at a form sulfide, and its restoration it is possible only from oxide, distillation is preceded surely oxidizing by roasting with full removal of sulfur. Several options of hardware registration of a pyrometallurgical way of receiving zinc are possible: in horizontal and vertical retorts, in mine furnaces with an electrical heating, electrothermies. Percent distillations are the basis for receiving vapors of zinc in an electrothermal part of the KIVTSET-KS [1] unit.

Turning out to pyrometallurgical ways of zinc it is surely polluted by impurity (Pb, Cd, Fe, Cu, etc.), sublimated together with it at distillation or getting of takes out dust gases.

The pyrometallurgical way is accepted from the moment of emergence of zinc production. The share of the zinc produced to these ways and years a year is reduced and in the presents time is only several percent [2].

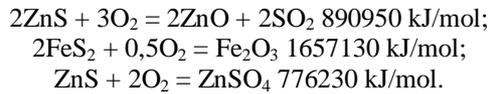
II. LITERATURE SURVEY

The hydrometallurgical way of receiving zinc, is applied in industrial scale since 1951, is the basic now. The hydrometallurgy at production of zinc is obliged to wide circulation by its considerable advantage in comparison with distillation, namely [3]:

- 1) To higher extraction of zinc and the accompanying elements;
- 2) Higher complexity raw materials use;
- 3) High qualities of zinc.

The hydrometallurgical way of receiving zinc demands obligatory carrying out preliminary oxidizing roasting of concentrates which is carried out in furnaces of the boiling layer (BL).

The chemical process of roasting of zinc concentrates in BL furnaces comes down to course of the following of the main of reaction:



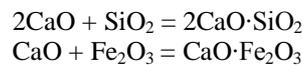
Reaction of a sulfur-formation at temperatures of roasting of 940-980 °C does not gain big development [4]. Formations of sulfates it is very useful since it is well dissolved in water solutions of acids at further candle end lixiviation and also it it is necessary for compensation of losses of sulfuric acid in a fabrication cycle.

In the course of roasting rather large amount of ZnO·SiO₂ silicate and ferrite of ZnO·Fe₂O₃ zinc is formed. Earlier by us it was shown that advantages in a candle end of these connections it is undesirable [5]. Zinc silicates because of the of instability complicate condensation of a pulp after lixiviation of formation of jellylike weight colloid flint-acid. Zinc ferrite is almost not soluble in weak solutions of sulfuric acid. In the investigation of it a considerable part of zinc is not dissolved and passes into cake. Zinc content in the cake reaches 22-24% and to increase at increase in content of iron in an initial concentrate. At Waelz process this zinc passes into clinker and reduces the general extraction of metal from initial ore [6].

III. METHODOLOGY

On Metallurgy departments of the Tashkent state technical university are conducted laboratory a research on decrease firrito-and a silicate-formation in the conditions of roasting in BL furnaces. For this purpose entered into a blend of roasting defined amount of oxide of calcium. The idea was in what lime, having bigger affinity to SiO₂ and Fe₂O₃ or ZnO, will connect oxidic silicon of connection and iron in the corresponding ferrite and silicates, and oxide of zinc remains in a free status [7].

Possible reaction:



Both of these reactions actively proceed in a temperature interval of 400-700 °C while formation of ferrite in silicates of zinc occurs at temperatures of 950-1050 °C [8].

Researches were conducted on laboratory installation, are presented in fig. 1. In the scheme it is shown as air in the camera is enriched with oxygen from 21% to 28% and mixing up with normal moves in the furnace with a blend specially prepared torch enriched with oxygen of air blew at the rate of 1,2-1,4 m³ on 1 kg of a sulphidic concentrate. At the same time the speed of blasting was made by 3-5 m/s.

IV. RESULTS AND DISCUSSION

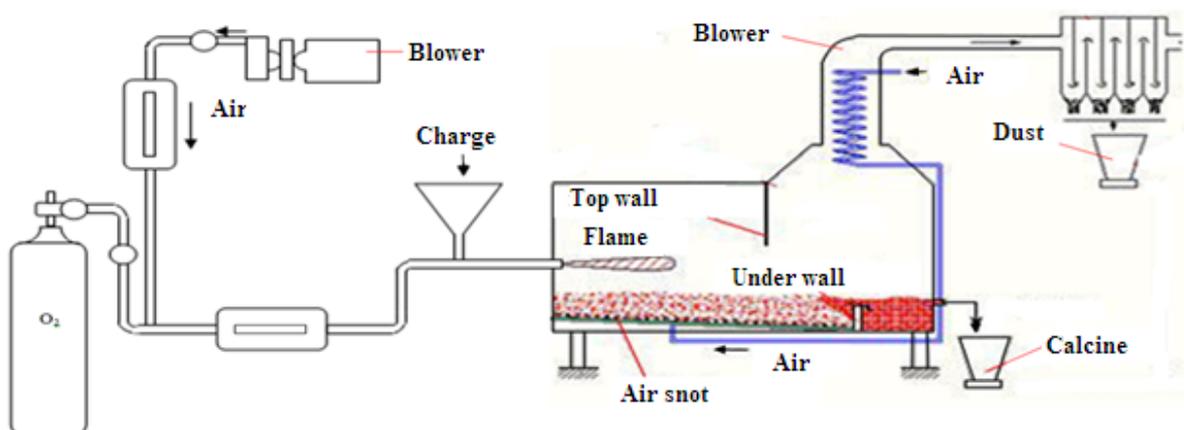


Fig. 1. The scheme of laboratory unit for giving in the BL furnace.

Results of researches are presented on in table 1.

Table 1.

No.	Composition of furnace charge		Technological process		The received results			
	Initial concentrate, gr	Lime from the mass of the concentrates of %	τ , time of min	T, °C	S in a candle end, %	Extent of formation of ZnO•Fe ₂ O ₃ %	Extent of formation of ZnOSiO ₂ %	ϵ , Zn %
1	100	-	30	900	6,8	14,4	8,3	56,9
2	100	-	60	1000	5,7	13,7	8,7	57,5
3	100	3	60	1000	5,4	6,3	6,8	71,3
4	100	3	90	950	5,1	7,6	7,2	68,2
5	150	3	120	900	4,8	7,2	7,0	69,8
6	100	5	60	950	5,7	6,9	6,4	74,3
7	100	5	90	950	5,2	6,2	6,1	75,6
8	150	5	120	950	3,9	5,7	5,8	78,5
9	100	7	60	950	4,9	7,3	6,2	74,1
10	100	7	90	950	2,1	6,2	5,4	79,2
11	150	10	60	900	2,6	5,8	5,7	76,7
12	100	10	90	900	2,3	5,4	4,3	78,6
13	100	10	120	900	1,7	4,2	2,2	85,3
14	100	12	60	950	3,4	2,0	2,4	86,2
15	100	12	90	900	2,6	1,7	1,7	88,9
16	100	12	120	900	0,8	1,3	1,2	91,2
17	100	15	60	950	2,5	2,4	2,1	92,6
18	100	15	90	900	0,7	0,6	1,2	97,5

As shown in rice 2, 3, 4, and in table 2, the completeness of oxidation of sulfides, temperature in a zone of the boiling layer depends on amount of the air given to the furnace increases with increase in oxygen concentration in blasting (from 25% to 28%) at the same time temperature of flue gases in the gas flue increases.

Table 2. Results of laboratory researches with use of the enriched oxygen for roasting of zinc concentrates in the BL, F-120 sm²

N o.	Maintenance of O ₂ in blasting	Increase temperature in the furnace, °C	Temperature in the gas flue °C	a, the specific productivity of kg/cm ² • hour	Maintenance of S in a candle end, %	Content in flue gases and the dust, %			
						SO ₂	S _s	O ₂	Dust
1	20,0	920	372	2,7	4,9	9,1	2,1	0,20	32,5
2	21,0	920	374	2,7	4,8	9,3	2,0	0,18	31,4
3	22,0	931	376	2,7	4,5	9,8	1,5	0,75	30,6
4	22,0	933	378	2,7	4,2	10,1	1,5	0,74	30,8
5	23,0	963	389	2,9	1,5	11,4	0,7	1,3	28,7
6	23,0	960	390	2,9	1,4	11,6	0,6	1,3	28,9
7	24,0	982	397	3,1	1,2	11,7	0,64	1,7	27,2
8	24,0	986	398	3,2	1,2	11,4	0,59	1,6	27,3
9	25,0	988	398	3,4	1,0	11,7	0,44	1,8	27,4
10	25,0	990	403	3,4	0,9	11,8	0,51	2,2	27,3
11	26,0	994	407	3,6	0,4	11,6	0,28	2,7	25,2
12	26,0	994	405	3,6	0,5	12,2	0,27	2,8	26,4

13	27,0	1020	412	3,6	0,6	12,6	0,25	3,1	26,3
14	27,0	1020	412	3,6	0,8	12,7	0,27	3,2	26,5
15	28,0	1034	416	3,8	0,4	12,9	0,26	4,2	25,4
16	28,0	1038	415	3,8	0,3	13,2	0,20	4,1	26,1

From table 2 it is visible that at a purge in usual air temperature in the gas flue made $T = 372\text{ }^{\circ}\text{C}$, at blasting enrichment by oxygen up to 28% temperature of flue gases in the gas flue rises up to $416\text{ }^{\circ}\text{C}$. The excess of air against theoretically necessary for 20% is necessary for ensuring full and fast course of reactions of oxidation when roasting. In practice coefficient of excess of air 1,2-1,3 [9]. In practice adjustment of temperature in the furnace carry out by furnace charge loading change.

In vitro temperature regulated humidity of furnace charge which from 5 to 8% fluctuated by means of the gas burner and change.

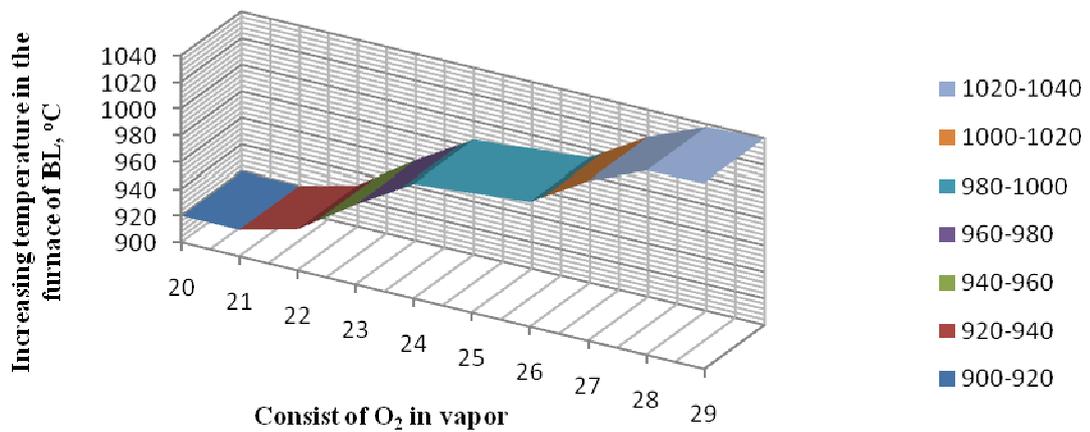


Fig 2. Dependence of temperature change in the furnace from oxygen content in blasting

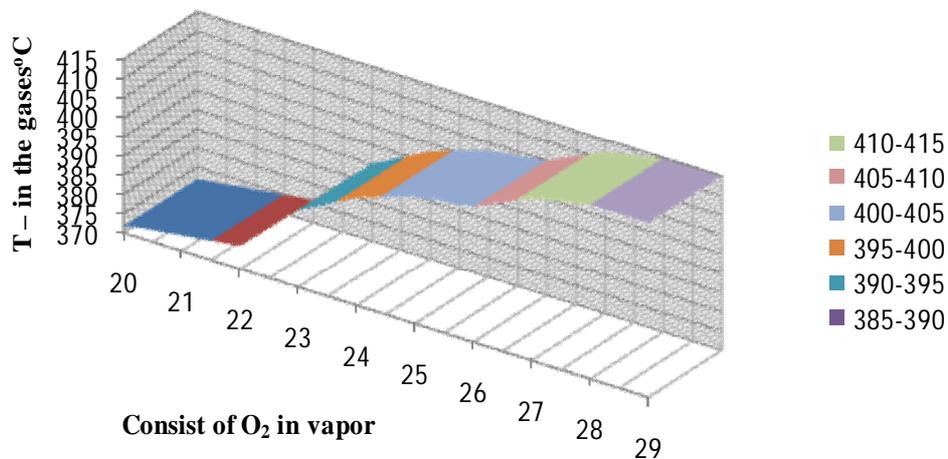


Fig 3. Dependence of temperature change in the gas flue from oxygen content in blasting

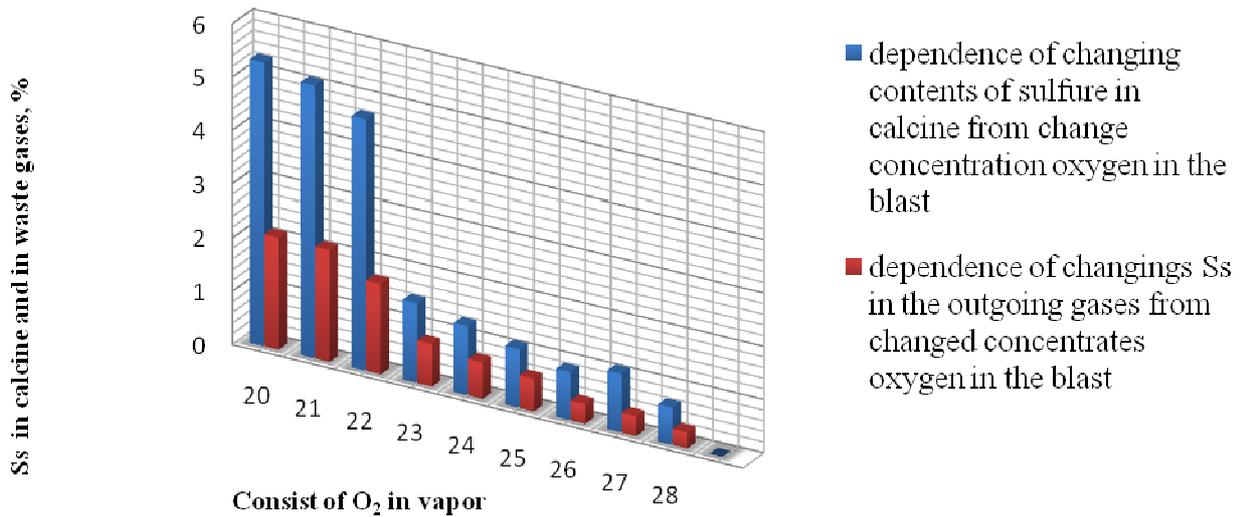


Fig 4. Dependence of content of sulfur sulphidic in a candle end are also gray in flue gases from oxygen content in blasting, %.

Application of roasting on blasting enriched with oxygen up to 28%. Allowed to increase considerably the capacity of the furnace and will reduce roasting time for 30 min. At the same time will improve quality of the burned concentrate, extent of desulfurization of process, and reduction the maintenance of free considerably increases are gray to 0,3%. Blasting enrichment by oxygen practically does not increase an operational expense. If on If spent 140-160 m³ of air for 100 kg of a concentrate, then at blasting enrichment oxygen spends about 100 m³ (but no more than 120 m³), but at the same time dusting decreases from 32,5% to 25,4% [10].

V. CONCLUSION AND FUTURE WORK

We investigated processes of oxidation of sulfides at the same time defined extent of desulfurization depending on temperature and from roasting duration. Results of researches are shown in table 3. At the same time the hinge plate made 1 kg of an initial concentrate of Handiza with humidity of W=7%. The area of sweat is F=120 sm². Duration of process changes ot5 up to 20 minutes. Temperature was regulated supply of partially natural gas. Made a consumption of air from 3 to 4,5 kg·m³ in recalculation on 1 kg of an initial concentrate.

Table 3. Results of the integrated laboratory research influence of oxygen concentration in blasting for roasting of zinc concentrates. F-120 sm².

No.	Concentration of O ₂ in blasting, %	Duration τ, min	Temperature in the furnace, °C	Air consumption on 1 kg of a concentrate, m ³	Degree of desulfurization, %
1	20	20	900	4,0	82
2	20	20	1000	4,5	86
3	20	20	1000	4,5	88
4	22	20	900	3,7	88
5	22	17	1000	3,7	90
6	22	15	1000	3,7	89
7	24	10	900	3,3	91
8	24	10	1000	3,3	93
9	26	8	850	3,0	97

10	26	8	900	3,0	92
11	26	8	1000	2,8	94
12	28	7	850	2,8	90
13	28	7	900	3,0	95
14	28	5	1000	3,0	96
15	28	5	1000	3,0	95

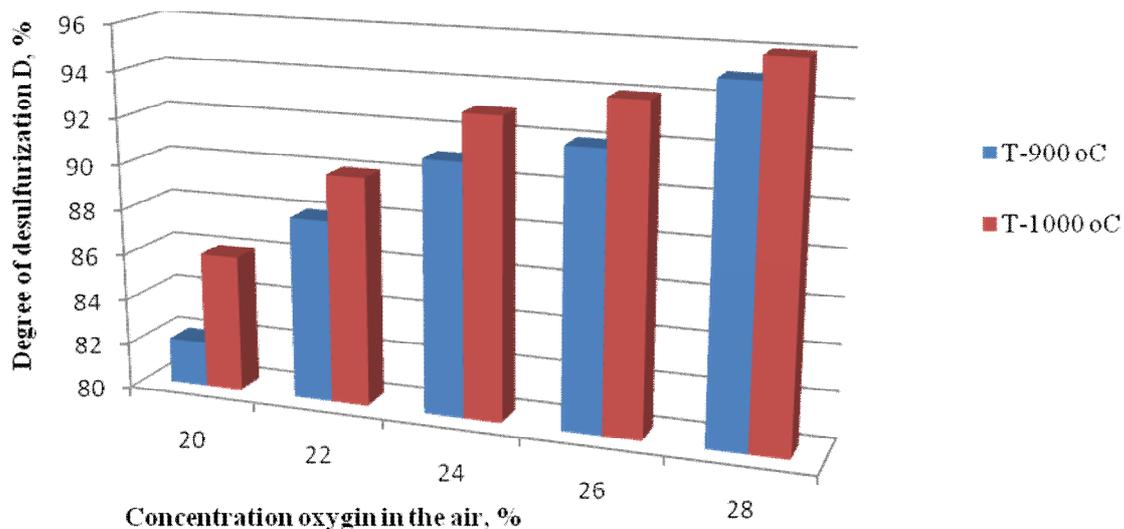
From these tables 3 it is visible that oxidation level depends on temperature in the BL furnace, and is defined to amounts of the burned furnace charge and also quantity and temperature of the arriving air. At a lack of air the concentrate burns not completely and therefore leads to reduction of productivity of process.

At a temperature of 900 °C and 1000 °C, and with various content of oxygen in blasting time for achievement of the same extent of desulfurization, turns out with the smallest duration of time. Desulfurization of 82% is reached on usual air blasting in 20 minutes at a temperature of 900°C, for the same time at a temperature of 1000°C, desulfurization increases to 88%.

At oxygen content blasting in number of 22% in 20 minutes at temperature 900°C, extent of desulfurization reaches 88%, and at a temperature of 1000°C – in 15 minutes extent of desulfurization makes 90%.

With increase in content of oxygen in blasting at low temperatures, it is lower than 900 °C, (at °C T-850 – no more than 90%) extent of desulfurization of equal 95%, it is possible to receive in 7 minutes.

The air consumption at the same time makes 2,8 m³ on 1 kg of a concentrate. The coefficient of excess of air fluctuates within 1.1. According to fig. 5 it is visible that the speed of reactions of oxidation of sulfides increases by 1.5-2.5 times.



5. Fig. Dependence of increase in extent of desulfurization on oxygen concentration in air and from temperature.

On the basis of the conducted researches it is possible to draw a conclusion that to contain increase oxygen in blasting when roasting zinc concentrates in BL furnaces carries out to reduction of formation of undesirable ferrite of connection and silicates of zinc, increases extent of desulfurization, and reduces roasting time. At the same time there is a possibility of loading in the concentrate furnace from the increased humidity that will give to economy of costs of drying of initial materials. Finally to lead raw materials to increase in complexity, to increase profitability of productions and will make products of competitiveness not world the markets.

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