

Chemical Composition of Calcined Zinc Concentration Tumurtiin-Ovoo, Mongolia

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Abstract— Tsairt Mineral LLC is a joint venture between Mongolian and China. The company develops the Tumurtiin-Ovoo zinc project, in Sukhbaatar province, Mongolia. Samples for investigation were taken Tsairt Mineral LLC's zinc concentration and roasted from 600-1000°C, 10 hours. We detected chemical composition by ICP, XRF devices.

This study shows Tumurtiin-Ovoo zinc concentration chemical composition of calcined at different temperature and non roasted zinc concentration.

Keywords— Tumurtiin-Ovoo; zinc concentration; chemical composition;

I. INTRODUCTION

Tsairt Mineral LLC is a joint venture between Metal Impex, a Mongolian firm and China Non-Ferrous Metal Industry's Foreign Engineering and Construction Company. The company develops the Tumurtiin-Ovoo zinc project, in Sukhbaatar province, Mongolia. The deposit was discovered in 1974 by Mongolian and German surveying teams. In 1980 the resource at the deposit was calculated to be 9.2 million tons of ores (grade B, C1 and C2 according to the Mongolian standards), which was interpreted to be 951 thousand tons of pure metal. 90% of the ore are sulfides, and the rest are carbonates and silicates [1]. The joint venture was established in 1998, and the mine and concentrate plant went into production in 2005. The company mines 350-400 thousand tons of ore a year. The average grade of zinc is 13.6%, and the mine life is planned to be 25 years. The company sells about 90-110 thousand tons of 50% zinc concentrate a year.

We have been studying to produce product from Tumurtiin-Ovoo zinc concentration. There are some hydrometallurgical method to produce product from zinc concentration [2, 3, 4]. We published about roasting investigation and detect zinc with complexion III by used Tumurtiin-Ovoo zinc concentration, before this investigation [5, 6]. The next step of our research is to determine the chemical composition of zinc concentration. Extend of this purpose we are introducing chemical composition of zinc concentration Tumurtiin-Ovoo, Mongolia.

II. METHODOLOGY

Zinc concentration is a mineral which mainly consists of mixture elements of zinc, calcium, silica, aluminum, iron, sulfur and small amounts of other elements. Zinc concentration is a raw material of zinc oxide, electro winning zinc and manufacture of sulfuric acid [3, 8, 9].

First, we investigated chemical composition of non roasted zinc concentration by ICP. This investigation was done at Akita University, Japan. Before ICP, sample was dissolved high pressure leaching by multiwave-3000 device. About 0.1 g sample of ten thousand by mass with accuracy added 20 ml concentrated nitric acid (61%) and dissolved with high pressure leaching. Leaching condition was: $t_{max}= 260^{\circ}C$, $P_{max}= 60bar$, 1hour. During leaching process in nitric acid, other elements dissolved completely except silica. So filtered solution and separated from silica as solid quartz. The solution was used for ICP investigation. The quartz was used for weight analysis to determine amount of silica. Non roasted zinc concentration's oxygen content was detected by XRF.

Sulfur is a volatile mixture in zinc concentration. We also have a possibility, to detect what temperature sulfur removed completely from zinc concentration and what temperature roasted zinc concentration has maximum zinc content by using chemical composition.

Then we roasted zinc concentration from 600°C to 1000°C, during 10 hours and investigated chemical composition at calcined zinc concentration by XRF device at School of Applied Sciences, Mongolian University Science and Technology (MUST).

III. RESULTS ANALYSIS AND DISCUSSION

Following table shows total chemical composition of non roasted zinc concentration.

TABLE 1. NON ROASTED ZINC CONCENTRATION'S TOTAL CHEMICAL COMPOSITION (Weight %)

Al	Si	S	Ca	Mn
0.177	0.131	30.870	0.436	4.310
Fe	Cu	Zn	Pb	O
5.712	0.282	51.529	0.752	5.801

This table shows, non roasted zinc concentration contains 51.529% Zn, 30.87% S, 5.712% Fe, 4.31% Mn as mainly content. This zinc concentration is the second degree by Mongolian zinc concentrate standard [6].

TABLE 2. ROASTED ZINC CONCENTRATION'S TOTAL CHEMICAL COMPOSITION (Weight %)

Elements	600°C	700°C	800°C	900°C	950°C	1000°C
Al	0.202	0.281	0.424	0.188	0.350	0.273
Si	1.011	1.204	1.226	0.944	0.996	1.095
S	3.720	2.628	4.168	0.214	0.123	0.351
Ca	0.405	0.481	0.419	0.455	0.303	0.549
Mn	4.085	4.235	4.164	4.636	4.945	4.773
Fe	5.757	5.968	6.137	6.682	6.901	6.551
Cu	0.163	0.174	0.180	0.161	0.182	0.188
Zn	58.385	59.592	56.207	64.071	63.514	63.354
Pb	0.577	0.597	0.588	0.264	0.203	0.218
O	25.696	24.839	26.486	22.385	22.483	22.688

Table 2 shows Al, Si, S, Ca, Mn, Fe, Cu, Zn, Pb, O contents on calcined zinc concentrations. The temperature rose, became slightly higher content of iron, manganese and copper. The roasted at 900°C zinc concentration has maximum zinc content (64.071%). Sulfur and lead contents went down when temperature rising up. Between 600-1000°C, other elements contents were constantly.

Table 3 shows comparative chemical composition of non roasted and calcined zinc concentrations.

TABLE 3. COMPARATIVE CHEMICAL COMPOSITION (Weight %)

-	Non roasted	600°C	700°C	800°C	900°C	950°C	1000°C
Al	0.177	0.202	0.281	0.424	0.188	0.350	0.273
Si	0.131	1.011	1.204	1.226	0.944	0.996	1.095
S	30.87	3.720	2.628	4.168	0.214	0.123	0.351
Ca	0.436	0.405	0.481	0.419	0.455	0.303	0.549
Mn	4.310	4.085	4.235	4.164	4.636	4.945	4.773
Fe	5.712	5.757	5.968	6.137	6.682	6.901	6.551
Cu	0.282	0.163	0.174	0.180	0.161	0.182	0.188
Zn	51.529	58.385	59.592	56.207	64.071	63.514	63.354
Pb	0.752	0.577	0.597	0.588	0.264	0.203	0.218
O	5.801	25.696	24.839	26.486	22.385	22.483	22.688
Total	100%	100%	100%	100%	100%	100%	100%

This table shows non roasted zinc concentration's highest element is zinc and equals 51.529%. Except zinc, sulfur also has higher content than other elements. Non roasted zinc concentration contains 30.87% sulfur and sulfur content decreases when roasting process.

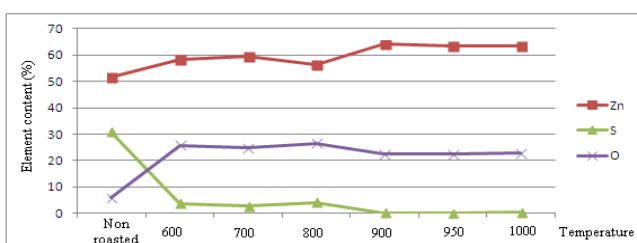


Fig.1. Zinc, sulfur, oxygen content comparison of non roasted and calcined zinc concentrations from 600-1000°C

Fig.1. shows non roasted zinc concentration contains 51.529% zinc. Maximum zinc content was 64.071% roasted at 900°C's zinc concentration. Roasted at 900-1000°C zinc concentration has less than 0.36% of sulfur. This result shows, sulfur removed from zinc concentration during 900-1000°C. Non roasted zinc concentration contains 5.801% oxygen, after roasting process oxygen content rose up and 900-1000°C roasted zinc concentration contains about 22% oxygen.

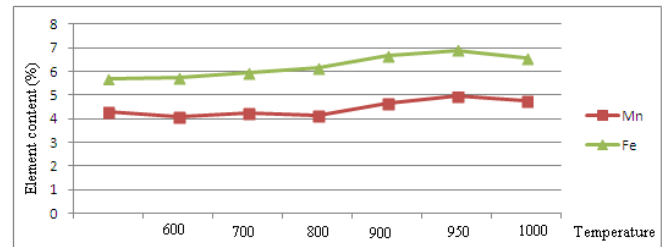


Fig.2. Manganese and iron content comparison of non roasted and calcined zinc concentrations from 600-1000°C

Fig.2. shows, non roasted zinc concentration contains 4.31% manganese, 5.712% iron and after roasting process manganese and iron content increased small size. The zinc concentration also contains Al, Si, Ca, Cu and Pb.

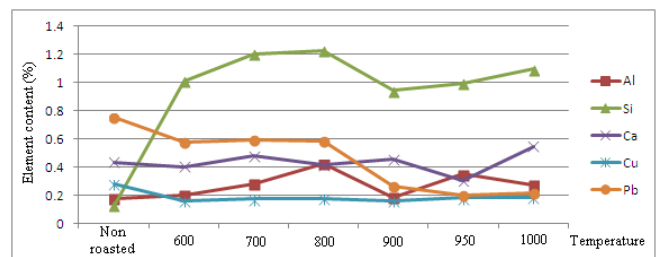


Fig.3. Al, Si, Ca, Cu, Pb comparison of non roasted and calcined zinc concentrations

Fig.3. Shows, the content of these elements had very little change on non roasted and calcined zinc concentration.

IV. CONCLUSION

We detected non roasted and roasted zinc concentrations chemical composition by used ICP, XRF devices. Tumurtiin-Ovoo zinc concentration (non roasted) contains 0.177% Al, 0.131% Si, 30.87% S, 0.436% Ca, 4.31% Mn, 5.712% Fe, 0.282% Cu, 51.529% Zn, 0.752% Pb and 5.801% Oxygen.

From 600°C to 1000°C calcined zinc concentrations chemical composition was given on table 2. Non roasted zinc concentration contains 51.529% zinc and maximum zinc content was 64.071% roasted at 900°C's zinc concentration. Roasted at 900-1000°C zinc concentration has less than 0.36% of sulfur. This result shows, sulfur removed from zinc concentration during 900-1000°C. Non roasted zinc concentration contains 5.801% oxygen, after roasting process oxygen content rose up and 900-1000°C roasted zinc concentration contains about 22% oxygen.

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