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EVALUATION OF LEAD AND ZINC CONCENTRATION TAILINGS AS SECONDARY MINERAL RESOUECES

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Abstract - In this work, beneficiation of galenite from lead and zinc processing plant tailings was studied by froth flotation. In the flotation experiments, collector type and amount, frother type and amount, particle size, pH and flotation time were kept constant while solid ratio and depressant dosage were varied. The experimental results revealed that a concentrate of over 45 %Pb content with nearly 80 %Pb recovery was obtained under the optimum conditions from a head sample of that contains 1,16 %Pb and 10,05 % Fe. The Fe content of concentrate was around 3 % indicating 70 % reduction according to head sample.

Keywords - Froth Flotation, Sulphide Bearing Tailings, Galenite Flotation, Environmental Pollution.

I. INTRODUCTION

The tailings of sulphide bearing minerals cause serious environmental pollution as they are the major source for acid mine drainage (AMD) due to oxidation and hydrolysis reactions in waste dumps (Aytar, et al., 2013). AMD may lead to severe contamination of lands, surface and ground water due to leaching of acidic waters (Anıl, 2014; Celebi and Oncel, 2016). Therefore, it is a necessity to reduce the amount of wastes around lead –zinc mines.

The Balya Lead and Zinc Mines are situated in the Western part of Turkey. These mines are very possible that have been worked since ancient times as they are situated near Troy. The oldest lead pieces found in Troy are thought to be originated from Balya lead mines. But regular operations in Balya with the application of scientific and modern mining methods were started about 1880s (Aykol et al., 2003).

The predominant minerals of ore are reported as galena, sphalerite and chalcopyrite while quartz, calcite, pyrite and gypsum are the main gangue minerals (Gjelsvik, 1958 and 1962; Goktepe, 2005; Cicek and Oyman, 2016). Nowadays, 2400 tons of ore is processed at the mineral processing plant by froth flotation daily producing 366 tons of Pb and Zn concentrate (Celebi and Oncel, 2016).

Over 1 million tons of gravity and flotation tailings that contain considerable amount of lead and zinc were accumulated around mine (Goktepe, 2005). It was given in the literature that the major elements in these tailings were Si, Ca, S and Fe, whereas the minor elements were identified as Pb, Zn, Cu, Mg and Mn. The determination of Fe and S as major elements shows the presence of pyrite as an unwanted gangue mineral in the tailings (Celebi and Oncel, 2016).In this study, samples were taken from the tailings dam of mineral processing plant and used in flotation studies to obtain a lead rich concentrate with highest lead recovery. The Fe content of concentrate was also intended to reduce as much as possible

II. MATERIALS AND METHOD

2.1. Sample

Samples were kindly supplied by Balya Lead and Zinc Concentration Company from the tailing dams of mineral processing plant. The sample is comminuted in the crashing and grinding plant in Balya to minus 0,200 mm then carried to Eskisehir Osmangazi University, Mining Engineering Department, Minerals Processing Laboratories. The Pb and Fe contents of sample are analyzed as 1,16 %, and 10,37 %, respectively.

The flotation reactives used in the flotation experiments were obtained from the Balya Lead and Zinc Concentration Company Laboratories. Ethyl Xanthate and Methyl Isobutyl Carbinol (MIBC) were used as collector and frother, respectively. ZnSO4 and FeSO4 were used as depressants for sphalerite and pyrite, respectively. Although NaCN is not used in the plant but in this study, NaCN was used to improve the depression of sphalerite and pyrite and obtained from Eskisehir Osmangazi University, Mining Engineering Department, Mineral Processing Laboratories

2.2. Method

Flotation experiments were carried out by using laboratory type Denver Floatation machine with a volume of 1,5liter cell at the Mineral Processing Laboratory of Eskisehir Osmangazi University. In the flotation experiments, particle size, pH, collector amount, frother amount, collector conditioning time and flotation duration were kept constant at -0,200 mm, 9,5, 25 g/ton, 17,5 g/ton, 12,5 min and 30 seconds, respectively. The dosages of $ZnSO_4$ and $FeSO_4$ used as depressants for sphalerite and pyrite

were 750 g/ton and 300 g/ton, respectively. These conditions were advised by the Balya Lead and Zinc Concentration Company Laboratory technicians. In the experiments, solid ratio and NaCN dosage were varied to determine optimum separation conditions.
After each flotation experiments, Pb content of floatation products was analyzed and Pb recovery (R_{Pb}) calculated from the Equation (1) as given below:

$$R_{Pb}= 100 \times (c \times C)/(f \times F) \quad (1)$$

where C is the amount of concentrate (%), c is the Pb grade of concentrate (%), F is the amount of feed (%) and f is the Pb grade of feed (%)

III. RESULTS AND DISCUSSION

3.1. The Experimental Conditions

The flotation experiments were carried out under the following conditions. Particle size, pH, collector amount, frother amount, collector conditioning time and flotation duration were kept constant while solid ratio and NaCN dosage were varied. The dosages of $ZnSO_4$ and $FeSO_4$ used as depressants for sphalerite and pyrite were also kept constant.

Particle size	: 0,200 mm
Pulp pH	: 9,5
Collector amount	: 25 g/t
Frother amount	: 17,5 g/t
Collector conditioning time	: 12,5 min
Collector conditioning speed	: 1250 rpm
Flotation time	: 30 sec
$ZnSO_4$ amount	: 750 g/t
$FeSO_4$ amount	: 300 g/t
Solid ratio (w/w)	: 10-40 %
NaCN amount	: 0-100 g/t

3.2. The Effects of Solid Ratio

It was reported in the literature that solidin pulp concentration is one of the most important parameter particularly in the flotation of galena from low grade lead-zinc ore (Luo et al., 2016). The grade and recovery of lead mineral increased significantly with the increase of solid content up to a point.

The optimum solid concentration was claimed to enable optimize action of reagents on mineral, and improves the flotation results (Luo et al., 2016). In order to determine the optimum solid–in-pulp concentration, the solid ratio was varied between 10 % and 40 % and the results are illustrated in Fig. 1.

The NaCN dosage was set as 75 g/ton in these experiments. The results in Fig. 1 show that Pb recovery increased from 66,45 % to 79,08% and the Pb grade increased from 38,54% to 47,25 % while Fe content decreased from 3,67% to 3,22% with the increase of solid ratio from 10% to 25 %. This results indicate an increase in Pb content from 1,16 % to 47,25 % and a decrease from 10,05 % to 3,22 % in Fe content according to head sample. A further increase in solid ratio caused a slight reduction both in Pb grade and Pb recovery while a decrease in Fe content. Therefore 25 % solid ratio was chosen as optimum value

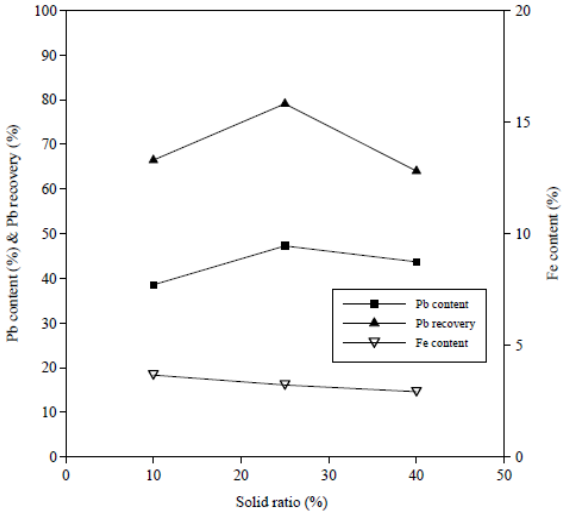

Fig.1. The effects of solid ratio on flotation results.

3.3. The Effects of NaCN Dosage

The use of cyanide in galenite flotation is generally not preferred due to environmental concern. Therefore, cyanide is not used in the Balya lead and zinc concentration plant either. But in this study, galenite flotation from plant tailings in the absent of cyanide did not produce satisfactory results although other conventional parameters that may influence the flotation performance of galenite were tested and optimized.

Cyanide is widely used to improve selectivity between galenite and sphalerite in flotation (Seke and Pistorius, 2006). Therefore, it was decided to use NaCN to improve Pb grade and Pb recovery.

In this experimental work, the NaCN amount was varied between 0 and 100 g/ton and the results are illustrated in Fig. 2. As NaCN dosage increased, Pb grade and Pb recovery increased while Fe content decreased sharply up to 75g/t. It should be noticed that excess amount of NaCN did not change the Pb grade and recovery significantly while Fe content continued to decrease.

Pb grade increased from 23,15 % to 47,25 % and the Pb recovery increased from 47,53 % to 79,08 % while Fe content decreased from 10,74 % to 3,22 % with the increase of NaCN dosage from 0 to 75 g/t. This results indicate that NaCN affects the galenite flotation, significantly. A further increase in NaCN amount caused a remarkable decrease in Fe dosage but did not affect the Pb grade and recovery.

Therefore, 75g/t NaCN dosage was chosen as optimum value.

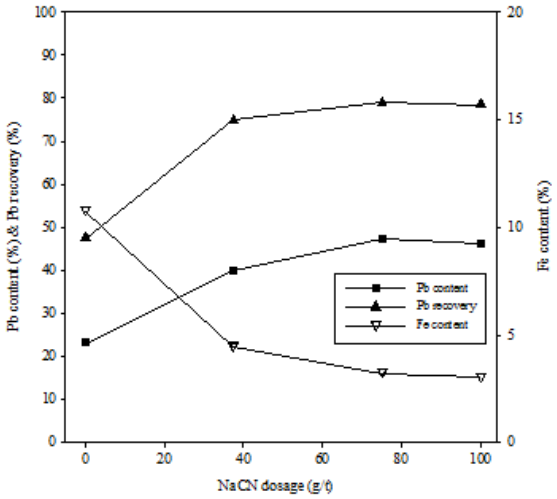

Fig.2. The effects of NaCN Dosage on flotation results.

IV. CONCLUSION

The flotation of galenite from lead and zinc plant tailings was investigated usin a laboratory scale mechanical flotation cell. The experimental results revealed that the Pb content of concentrate was obtained as 47.25% with 79,08% Pb recovery and of 3,22% Fe content under the conditions of solid ratio of 25% and NaCN dosage of 75 g/ton. Cyanide has not been used in lead and zinc flotation from the original ore in the flotation plant in Balya. But in this study, the galenite was unable to be floated effectively without cyanide from the plant tailings. The flotation of galenite without cyanide addition produced a Pb content of 23,15% with 47,53% Pb recovery and 10,74% Fe content. Therefore, NaCN usage is a necessity. The solid-in-pulp concentration is proved to be one of the most important parameter that influence the flotation of galenite. Pb grade and recovery increased with the increase in solid ratio up to 25%

REFERENCE

[1] A. Aykol, M. Budakoglu, M. Kumral, A.H. Gultekin, M. Turhan, V. Esenli, F. Yavuz, Y. Orgun, “Heavy metal pollution and acid drainage from the abandoned BalyaPb-Zn sulfide Mine, NW Anatolia, Turkey”, Environmental Geology, vol. 45, pp. 198–208, 2003.

[2] E.E. Celebi, M.S. Oncel, “Determination of acid forming potential of massive sulfide minerals and the tailings situated in lead/zinc mining district of Balya (NW Turkey)”, Journal of African Earth Sciences,vol. 124, pp. 487-496, 2016

[3] F. Goktepe, “Treatment of lead mine waste by a Mozley multi-gravity separator (MGS)”, Journal of Environmental Management, vol. 76, pp. 277–281, 2005.

[4] M. Anıl, “Parajenezlerindesülfürlümineralleriçerenmadenyataklarında oluşabilecekasit kaya (maden) drenajlarınınçevreseletkileri”, ÇukurovaÜniversitesiMühendislikMimarlıkFakültesiDergisi, vol. 29, no. 1, pp. 1-26, 2014.

[5] M. Cicek, T. Oyman, “Origin and evolution of hydrothermal fluids in epithermal Pb-Zn-Cu ±Au ± Ag deposits at Koru and Tesbihdere mining districts, Çanakkale, Biga Peninsula, NW Turkey”, Ore Geology Reviews, vol. 78, pp. 176–195, 2016.

[6] M.D. Seke, P.C. Pistorius, “Effect of cuprous cyanide, dry and wet milling on the selective flotation of galena and sphalerite”, Minerals Engineering, vol. 19, pp. 1-11, 2006.

[7] P. Aytar, C. Kay, M.B. Mutlu, A. Cabuk, “Coal desulfurization with acidithiobacillusferrivorans, from Balya acidic mine drainage”, Energy and Fuels, vol. 27, pp. 3090-3098, 2013.

[8] T. Gjelsvik, “Notes on the geology of BalyaMaden”, Bulletin of the Mineral Research and Exploration, vol. 51, pp. 19-25, 1958.

[9] (Retrieved from http://dergipark.gov.tr/bulletinofmre/issue/3877/51812).

[10] T. Gjelsvik, “Investigations of lead-zinc deposits in Northwest Anatolia”, Bulletin of the Mineral Research and Exploration, vol. 59, pp. 62-70, 1962.

[11] (Retrieved from http://dergipark.gov.tr/bulletinofmre/issue/3885/51896).

[12] X. Luo, B. Feng, C. Wong, J. Miao, B. Ma, H. Zhou, “The critical importance of pulp concentration on the flotation of galena from a low grade lead–zinc ore”, Journal of Materials and Technology, vol. 5, no. 2, pp. 131–135, 2016.

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