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Study of the Copper Flotation from Copper Smelter Slag, Using Seawater as Operation Water

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Abstract **-** Teniente smelting technology produce high copper concentration slag, which are treated to reduce the quantity of copper in the slag. The slag concentration in this slag is higher than some copper mineral weight percent. At the same time, seawater is an alternative for froth flotation, given the current prevailing water crisis. The present paper study of froth flotation of copper, from smelting slag, using not desalinated seawater as fresh water. The higher copper recovery obtained was 77.27%.

Keywords**:** Copper-Slag-Seawater-Froth Flotation

1. Introduction

In Chile, there are two main problems in mine industry that affects the communities existing nearing to a mine operation: Environmental passives and water disposition. The environmental passives are the subproducts generated by the mineral concentration, to produce a purified mineral product. The water disposition is the capacity of being able to use suitable water for all the operations that requires it.

The environmental passives are hard to stock, keeping them away from the communities. These passives have a copper content that makes them attractive to remain concentrate them. In the present case, the passive studied is copper final slag, which may have a 0.8% of copper, being much more than some mines.

Chile has been in a water deficiency in the last years, that requires an innovative approach to reach the highest recovery of copper from any source. One approach to consider is to settle the seawater, to perform as a modifier of pH [1]

The present paper studies the feasibility of use seawater as process water in the froth flotation of copper, from copper smelting slag.

2. Materials and Methods

For the development of the present work it was used seawater as process water, that was obtain from the Valparaiso's bay. The slag used is the final slag from the copper process and it was obtained from Las Ventanas Smelter. A sample of the fine grinded sample is shown in the Fig. 1. To achieve the granulometric profile, the slag was crushed and grinded in a laboratory scale grinding ball mill. The product was screened, and the #200 taylor mesh undersize were used for these experiments.

Fig. 1, Under #200 Taylor mesh fine grinded material

The mass of slag used for the flotation tests are present in the Table 1.

Table 1, Initial mass of the performed experiments

Experiment	Mass, g
1	503,51
2	504,86
3	350,5
4	325,8

The froth flotation was carried out using 25 g/t of Metil isobutyl carbinol (MIBC) as a frother and 25 g/t of AP3976 as a collector.

The froth flotation tests were performed in a Salas engineering company flotation cell, as its seen in the Fig. 2.

Fig. 2, Salas Engineering company flotation cell

The flotation procedure initiates by adding the final smelting slag to the cell, after that it was charged the water till reach the solid percentage of 35%. After the addition of seawater, it was added the flotation reagents. The flotation cell was activated without air insufflation for three minutes to ensure the homogeneity of the mix.

After the homogenize time, it started to insufflate air, at a speed of 1,1 cm/s, in the present study its 5 litters per minute. minute. The sampling is started first by extracting froth for one minute, then froth was extracted for two minutes, after that, that, it was sampled froth for three minutes, and finally was extracted for four minutes. The principal variable studied was was the settling time of the seawater: The basal case it is the seawater with no settle time, and the other case was with 10 10 days of settling. The reason of this modification is previous research performed in Chile [1]

Once the sampling was fulfilled, the samples were sent to atomic absorption to obtain the copper and iron concentration in the samples.

3. Results

In the concentration experiments, the results obtained is plotted in the Fig. 3 and Fig. 4, where is shown the results for the two conditions that were studied.

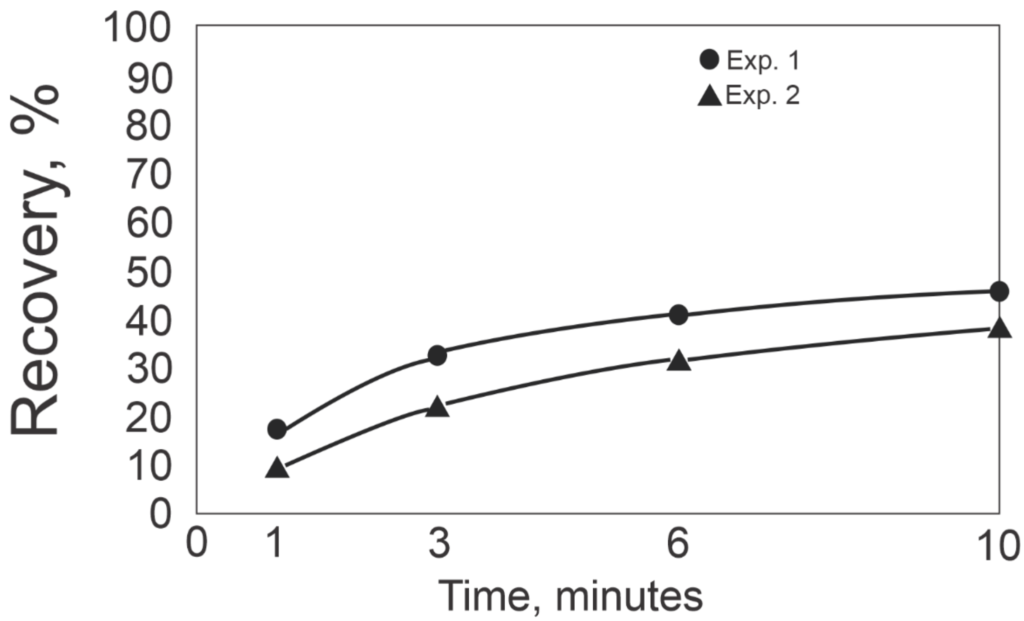

Fig. 3, Recovery of copper with seawater without settling time

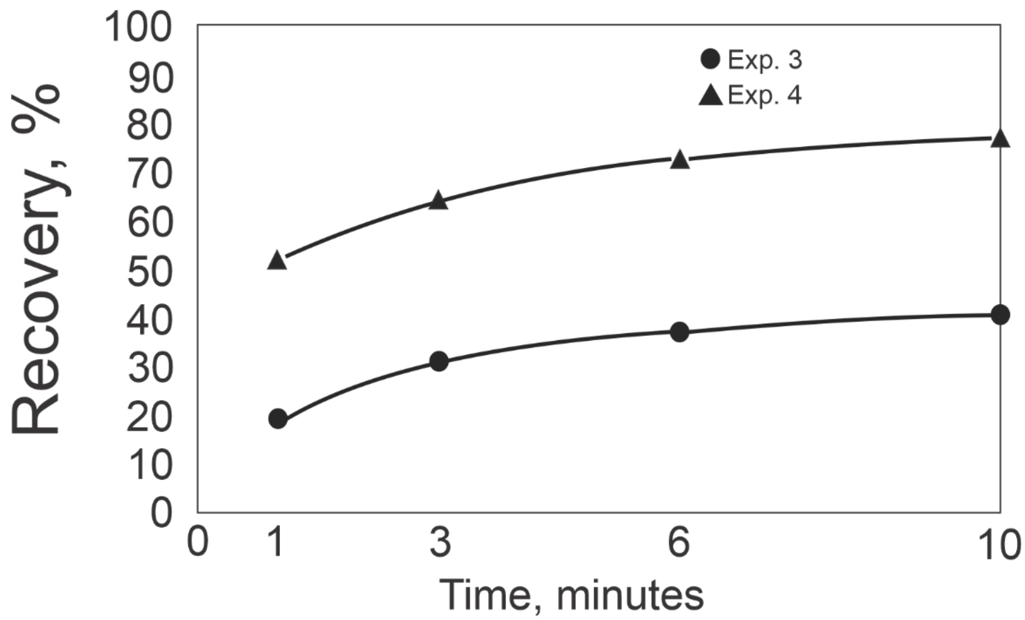

Fig. 4, Recovery of copper with seawater with settling time

In the Fig. 5 and Fig. 6, are plotted the iron recovery in the different cases of studies.

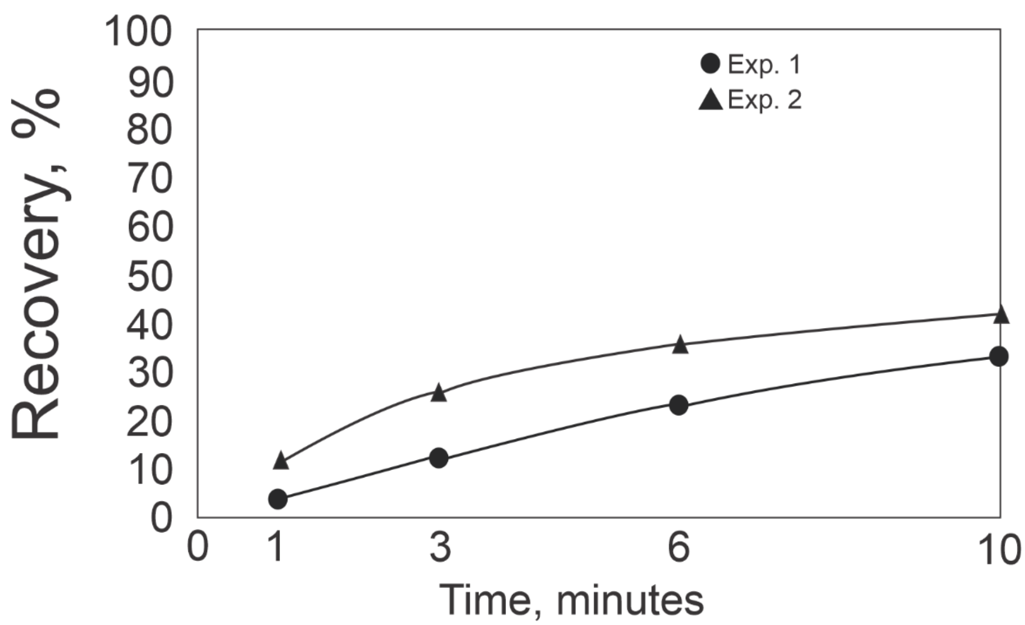

Fig. 5, Recovery of iron with no settle seawater

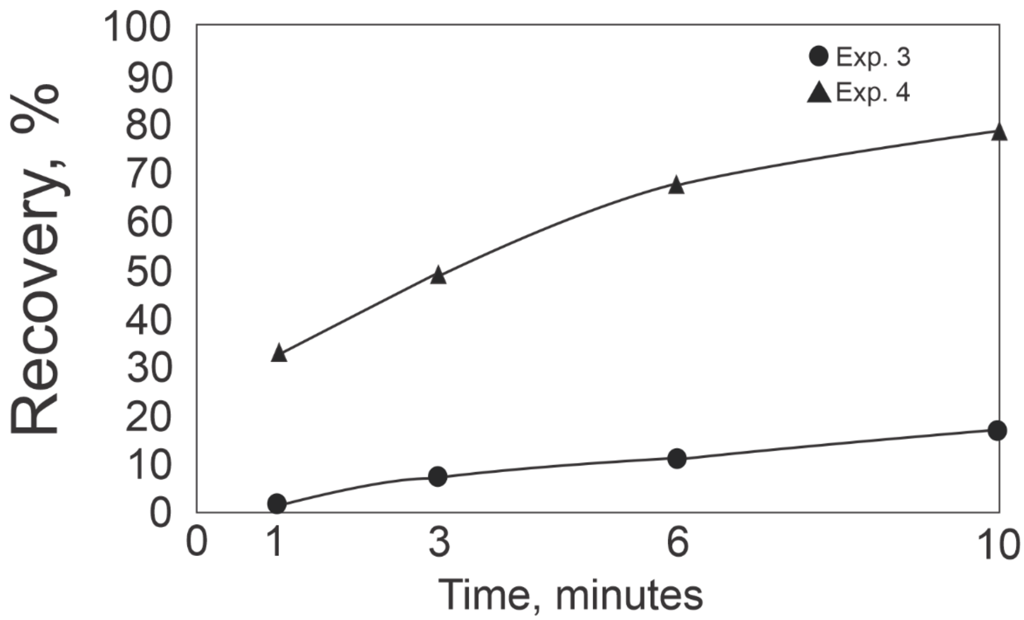

Fig. 6, Recovery of iron with settle seawater

Its evident, that the Iron has the same behaviour of the copper. The quantity of iron that represent the concentrate do not perform

4. Analysis

According to the recovery of copper, the effect of the seawater tends to inhibit the flotation of copper from slags. In the no settle seawater case the recovery obtained has the maximum recovery of 46%, which is low in comparison with copper recovery from minerals ore using seawater as process water. In the case where the seawater was settled, the maximum recovery of copper obtained was 77,27%, which is comparable to the recovery obtained with copper recovery from minerals ore using seawater as process water [2].

This situation is attainable to the nature of the seawater, that produce changes to the surface charges, known as zeta potential [3]. In this case the seawater blocks the effect of the reagents on the surface of the slag, changing its nature, making the reagents less effective [4]. The ions present in the seawater reacts with the chemical units that forms the chemical structure of the reagent, inhibiting its effectiveness. The settle seawater works better, because it was found that this produces a change in the pH, comparable with the addition of lime [1].

The iron concentration in the different samples remain constant. The recovery of copper was lower in the situation when the seawater was no settle because the iron present in the slag stay as an ion. As a result of that, the iron could stay as part of the tail, because the ions that conforms the seawater decrease the concentration of the iron in a mixture [5] [6].

According to previous research, the ions present in the seawater, are comparable with the ions present in the flux used in copper smelting that helps to improve the copper slag properties to make them more manageable [7]. These ions allow the oxides to low their melting points, helping to decrease the energy required to keep the slag liquid [8].

5. Conclusion

The froth flotation of copper from copper smelter slag, using seawater as a process water could not achieve a recovery to match the same process for a copper ore. This changed when the experiments were performed using settled seawater, where the obtained recovery is a 77,27%.

The iron recovery in this process, followed the same tendency of copper, which introduce some opportunities of improvement in this area. The following tasks to develop are look for a depressant that allow to decrease the iron and a new collector to increase the copper recovery in this situation.

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