



# RECOVERY OF Cu-Zn-Pb-SULFIDES FROM MINE TAILINGS THROUGH FLOTATION

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## Introduction

Mineral processing plants generate huge volume of residues, also called tailings, which are usually stored in large ponds (Figure 1). The management and storage of such volumes of material are challenging and the environmental and health risks increase when dealing with tailings containing sulfide minerals. In the present study, flotation was used to enable a collective flotation of sulfide minerals contained in tailings from a sulfidic mining site in Europe. **The goal was to decrease the volume of S-rich material to be managed by generating concentrate streams with high S content and tailing streams with low S content.**



Figure 1. On the left, a pond for storage of tailings from mineral processing plants. On the right, generation of acid mine drainage from the oxidation of sulfide minerals exposed to the atmosphere.

## Material and Methods

The sample had a high grade of pyrite (gangue mineral in the processing of Cu-Zn-Pb sulfides) and low grade of Cu-Zn-Pb sulfides (mainly chalcopyrite, sphalerite, and galena) (Table 1). The sample had a relatively wide particle size distribution (+150  $\mu\text{m}$  – 5  $\mu\text{m}$ ). Due to the challenging behavior of ultrafine particles in flotation, the sample was initially divided into two fractions (A and B), which underwent different flotation routes – Flotation I, II and Floc-flotation (Figure 2).

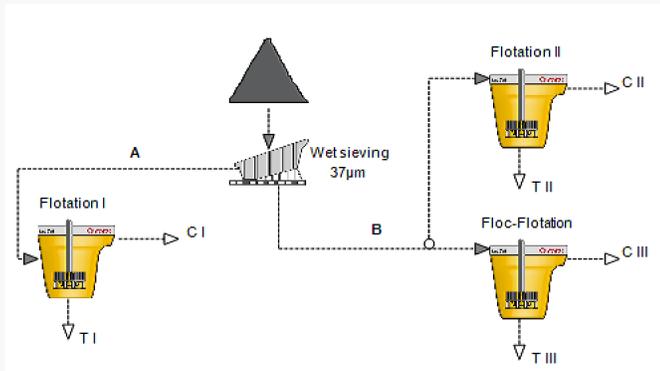


Figure 2. Processing routes studied (Flotation I, II, and Floc-flotation). A and B are the over- and undersize fraction after wet sieving, respectively.

The use of floc-flotation was evaluated for the processing of B. Floc-flotation is an innovative approach aimed at improving the recovery of ultrafine particles. It is based on selective agglomeration of targeted minerals and subsequently flotation of flocs. The experiments were performed on a Denver-type flotation machine using a 0.3 l capacity cell (Figure 3). The parameters are shown in Table 2.

Table 1: Chemical assays of samples A and B

Sample	Cu %	Fe %	Pb %	S %	Zn %
A	0.35	24.24	0.30	21.77	1.46
B	0.36	28.82	0.35	26.33	0.72

Table 2: Parameters used in the flotation tests

Solids (%)	25
pH	6 ± 0.3
Activator	CuSO <sub>4</sub> 300 g/t
Collector	SiBX* 100 g/t
Frother	MIBC 100 g/t
Flocculant	Superfloc N100**

\*Sodium iso-butyl xanthate, \*\*Non ionic polyacrylamide,



Figure 3: Flotation setup.

## Results

The recoveries of Cu, Zn, Pb and pyrite were high in all three routes studied. Flotation I had fastest kinetics, due to the coarser particle size of A. C I reached 77-97% recovery within 10 min and C II reached 63-96% of recovery in up to 16 min. The lowest recoveries belonged to Pb (Figure 4).

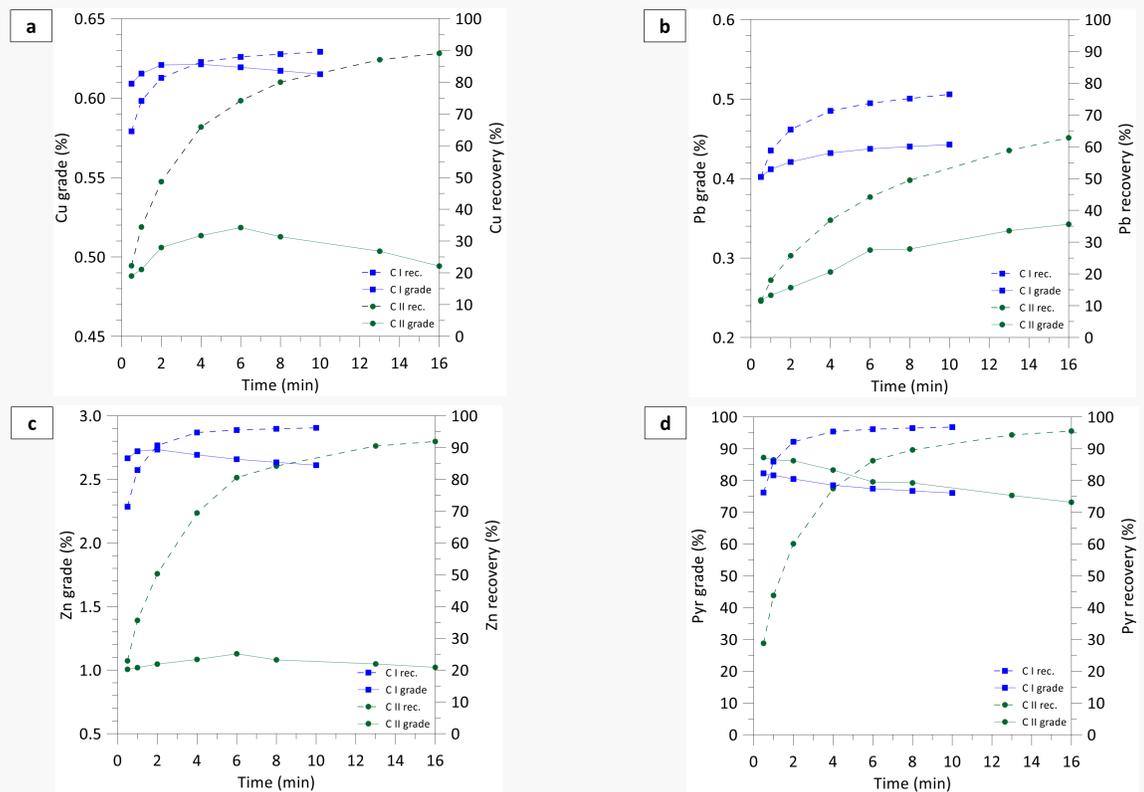


Figure 4: Grade and recovery of (a) Cu, (b) Pb, (c) Zn, and (d) pyrite in the C I and C II.

- ✓ Higher grades were achieved in C I (Figure 4).
- ✓ The S content decreased to 1.6% in 10 minutes and 3.6% in 16 minutes in T I and T II, respectively (Figure 5).
- ✓ Using Floc-Flotation, Pb recovery in C III increased by 8% and 13% using 50 and 100 g/t N100, respectively. Similar behavior was observed for the grade. Cu, Zn, and S recoveries were worst or comparable to that achieved without flocculation. In terms of grade, a light increase was observed using 10 g/t (Figure 6).

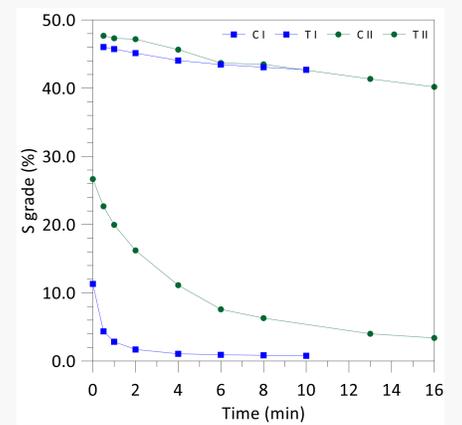


Figure 5: Sulfur grade in the concentrates (C I and C II) and tailings (T I and T II).

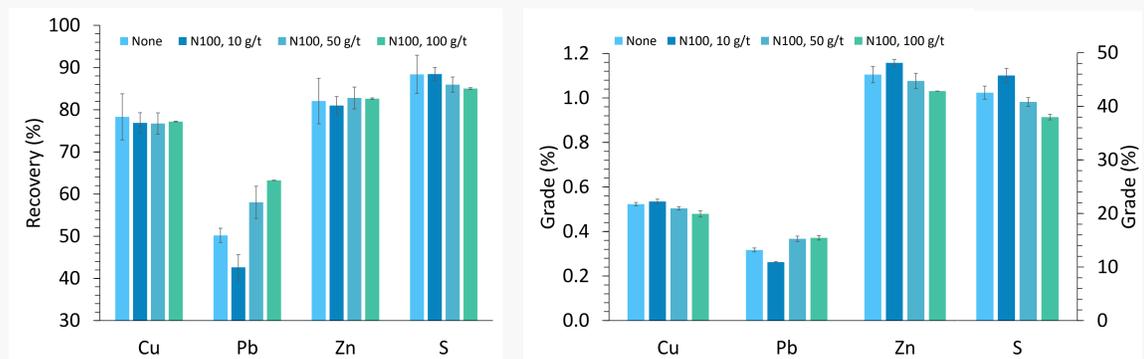


Figure 6: Cu, Pb, Zn, and S results in C III according to N100 dosage. Sulfur grade is displayed on the secondary axis.

## Conclusion

The use of flotation to recover Cu-Zn-Pb sulfides present in mining tailings was evaluated and produced results as good as 97% recovery. Moreover, residues with low sulfur content (<4%) were obtained using a single flotation step. The results can be improved by adding further flotation steps (cleaner and scavenger). The use of flocculation prior to flotation showed promising results, however more investigations are needed to improve the route.