

FLOTATION REAGENT SELECTION AND SUITABLE DOSAGES FOR ZINC OXIDE ORES OF THE CHO DIEN MINE, BAC KAN PROVINCE, VIETNAM

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1. Introduction

In recent years, the production of zinc ingot 99.95% Zn of zinc smelting plants in Vietnam has only reached 12,000 tons (lower than the design of 15,000 tons/year). Due to lack of raw materials from zinc sulfide ore. Meanwhile, the reserves of zinc metal in oxide ore in Vietnam are about 226,618 tons, mainly concentrated in Cho Dien mine, Bac Kan province. But currently, in Vietnam, there is no technically feasible technology to enrich this ore to supply zinc smelting plants.

The study sample is Cho Dien mine zinc oxide ore with a zinc content of 7.78%. The sample is a strong weathered ore containing a lot of clay humus and fine contamination. Properties of the study sample given in Table 1.

This report presents the scheme of flotation of Cho Dien mine zinc oxide ore with fatty acid collector and the effects of reagents: Na₂CO₃; Sep-X; Tan-XS; Liquid glass and kerosene to the flotation process. Aims to separate smithsonite and hemimorphite minerals from goethite; hematite; quartz and illite. To obtain zinc ore with a content of 20 - 25% Zn with a yield of 55 - 60%.

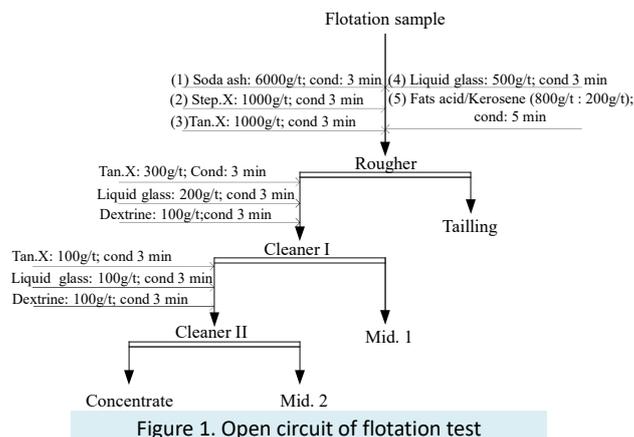


Figure 1. Open circuit of flotation test

Table 1. Properties of the study sample

| Size fraction, mm | Yield, % | Zn Content, % | The mineral composition of the (~%) | | | | | | | | |
|-------------------|---------------|---------------|--|----------------|-------------|----------------|--------|----------|----------|--------|--------------------------------|
| | | | Hemi-morphite | Chalcoph-anite | Smithsonite | Macphers onite | Quartz | Goethite | Hematite | Illite | Other minerals |
| + 6 | 36.48 | 9.36 | 6 - 8 | 10-12 | 27-29 | 3 - 5 | 2 - 4 | 20-22 | 7 - 9 | 7 - 9 | 5%Ca;Do |
| 3 - 6 | 11.92 | 9.5 | 10-12 | 12-14 | 21-23 | 3 - 5 | 4 - 6 | 20-22 | 10-12 | 7 - 9 | - |
| 1 - 3 | 7.22 | 9.12 | 13-15 | 9 - 11 | 11-13 | 3 - 5 | 6 - 8 | 23-25 | 14-16 | 8 - 10 | - |
| 0.2 - 1 | 12.16 | 9.26 | 16-18 | 5 - 7 | 14-16 | 3 - 5 | 11-13 | 20-22 | 7 - 9 | 11-13 | Ca |
| 0.1 - 0.2 | 3.58 | 7.22 | 11-13 | 5 - 7 | 6 - 8 | 4 - 6 | 18-20 | 17-19 | 6 - 8 | 16-18 | 4%Do |
| 0,02 - 0,1 | 7.13 | 5.15 | 3 - 5 | 2 - 4 | ≤ 1 | 3 - 5 | 11-13 | 11-13 | 4 - 6 | 47-49 | 7%Clorite |
| - 0.02 | 21.51 | 3.81 | ≤ 1 | - | ≤ 1 | 6 - 8 | 8 - 10 | 19-21 | 9 - 11 | 30-32 | 8%Clorite; 7%Kin; 3%Fels |
| Total | 100.00 | 7.78 | Note: - Ca: Canxite; Do: Dolomite ; Kin: Kintoreite ; Fels: Felspate. | | | | | | | | |

Table 1. Flotation results of Open and Closed circuits

| Open circuits | | | |
|-----------------|---------------|--------------|----------------|
| Product | Zn Content, % | Yield, % | Zn Recovery, % |
| Concentrate | 26.31 | 17.1 | 57.89 |
| Middlings 1 | 7.77 | 13.34 | 13.33 |
| Middlings 2 | 11.37 | 6.75 | 9.88 |
| Tailings | 1.93 | 43.39 | 10.78 |
| Total | 8.86 | 80.58 | 91.88 |
| Closed circuits | | | |
| Product | Zn Content, % | Yield, % | Zn Recovery, % |
| Concentrate | 24.11 | 18.98 | 58.9 |
| Tailings | 4.16 | 61.6 | 32.98 |
| Total | 8.86 | 80.58 | 91.88 |

2. Results and discussions

Because the ore contained a lot of slime and clay, that slimes should be removed before flotation. After de-slimes ore used for flotation research with harvesting, the yield, content and recovery of zinc are: 80.58 %; 8.86 %Zn and 91.88 %, respectively. After the flotation process, it was found that the ore sample was not effective when recruited according to the following regimes: (1) sulfidization and then flotation by cationic collector (Armac C, Armac T); (2) sulfation and activation by ion Cu⁺⁺ and then flotation by xanthate collector and (3) flotation with anionic/cation Cl-collectors (Armac C/xanthate). The sample is only as effective as a mixture of fatty acids/ kerosene collectors when using Na₂CO₃ to adjust the pH = 9 – 9.5; use Step - X to dispersants; use Tan-XS, Na₂SiO₃ and Dextrine to depressants. Schematic open and closed flotation circuits shown in Figures 1 and 2. Flotation results according to the selected open and closed circuits are shown in table 2. In this closed circuit flotation obtained concentrate with a content of 24.11 %Zn containing mainly hemimorphite and smithsonite. And chalcophanite almost goes into the tail ore.

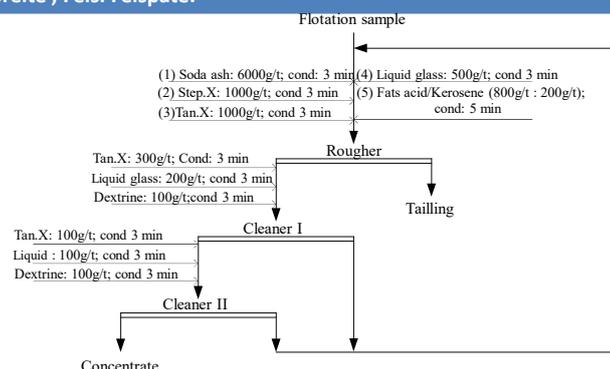


Figure 2. Closed circuit of flotation test

3. Conclusions

- The study sample is difficult to flotation because: (1) has a complex material composition; (2) it is difficult to depressants gothite and Illite during flotation and (3) cannot recover all three minerals containing zinc hemimorphite, smithsonite and chalcophanite under the same flotation regime;
- Closed circuit flotation results according to the Figure 2 have obtained zinc ore with a content of 24.11 %Zn and a recovery of 58.9%. According to the results of Xray analysis, it was found that chalcophanite was almost impossible to recover into the concentrate; Tan - XS can depressant gothite but its content in the concentrate is still above 10%;
- The Closed circuit flotation as shown in Figure 2 can be used to float zinc oxide ore at Cho Dien, Bac Kan mines. However, more research is needed to improve flotation efficiency.