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Flotation performance of copper from complex low-grade ores

Theophilus Amos-Judge[1,2], George Abaka-Wood[1,2], Richmond Asamoah[1,2]

[1]Future Industries Institute, University of South Australia, Mawson Lakes, SA 5095, Australia.

[2]Australia-India Research Fund, University of South Australia, Mawson Lakes, SA 5095, Australia

theophilus.amos-judge@mymail.unisa.edu.au

ABSTRACT

The rapid depletion of high-grade copper resources necessitates the utilization of low-grade ores and unconventional sources to meet cut-off grades and supply demands. This study consolidates flotation investigations conducted on a complex Australian low-grade copper ore, aiming to develop effective methods for enhancing copper recovery and upgrading. Given the global trend of exploiting copper deposits with diminishing grades and diverse mineral associations, it is crucial to determine optimal primary conditions, particularly regarding the choice collector type and pulp chemistry (pH). A series of flotation experiments were conducted to assess the optimal process conditions using potassium amyl xanthate (PAX), sodium isobutyl xanthate (SIBX), and dithiophosphate as collectors in the presence of Methyl Isobutyl Carbinol (MIBC) frother. The study also investigates the impact of pulp chemistry (pH, collector type, and dosage) on copper recovery and grade from an Australian copper ore. Results indicate significant effects of pulp pH, collector selection, and dosage on flotation performance. At a constant pH, copper recovery reaches 98% with PAX and 64% with SIBX and DTP with 16 %, attributed to the stronger affinity of PAX for copper sulphide minerals over SIBX and DTP. However, SIBX achieves a higher maximum copper grade of 21 % compared to 16% with PAX and 1.4 % with DTP due to its superior selectivity against gangue minerals. Additionally, increasing pulp pH from 7 to 11 enhances copper recovery from 80% to 92% with PAX, 53% to 80% for SIBX and from 16.95 % to 35.8 % for DTP. A substantial decline in grade with increasing pH when using all collectors was attributed to the activation of gangue minerals at higher pH behaviour of xanthate collectors.

Furthermore, Increasing the dosage of PAX, SIBX, and DTP collectors significantly enhanced copper recovery. For PAX, recovery improved from 92% at 500 g/t to 94% at 1750 g/t and 99% at 3000 g/t. Similarly, SIBX increased from 65% at 500 g/t to 88% at 300 g/t, and DTP from 35.7% to 78% measured at 500g/t and 3000 g/t respectively, likely due to higher hydrophobicity and non-selective attachment to gangue minerals. These findings highlight the crucial role of pulp chemistry, collector type, and dosage in optimizing copper recovery and grade in froth flotation processes, providing valuable insights for improving efficiency in copper ore beneficiation.

KEY WORDS

Depressant, flotation, complex low-grade ores

BIOGRAPHY

Theophilus' research aims at improving the understanding of comminution strategy on downstream process performance. A key focus is on dry comminution with links to downstream flotation and hydrometallurgical processes, unravelling opportunities for low-grades ores and wastes processing.

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