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Impact of pulp rheological behavior on selective separation of Ni minerals from fibrous serpentine ores

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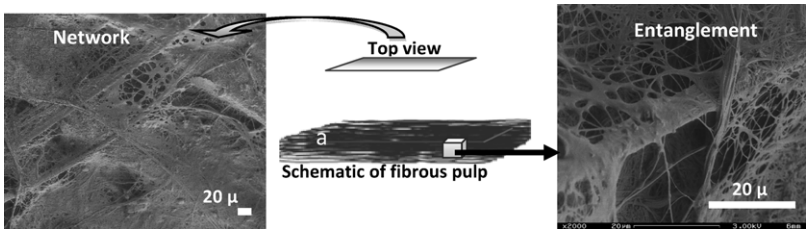
HIGHLIGHTS

- Fibrous particles entangle in suspension leading to formation of large networks.
- Pulp viscosity is dictated by characteristics of fiber networks, not individual fibers.
- Pulp viscosity affects bubble/particle dispersion.
- Smaller network pore sizes hinder bubble percolation through pulp phase.
- Bubble/particle dispersion affects efficacies of sub processes critical for value mineral separation.

GRAPHICAL ABSTRACT



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ABSTRACT

Froth flotation based on selective separation of the Ni minerals from ores containing large amounts of fibrous serpentines (chrysotile) has been a long lasting challenge. One underlying reason has largely been considered to be slime-coating. The findings from this investigation, on the other hand, show that the pulp rheological behavior of the flotation pulp is the underlying basic reason. Flotation pulp (25% solids) appeared atypically viscous in the flotation tests carried out with copper ore containing either chrysotile or nylon fibers, where fibers (1–6% by wt fibers) were deliberately added in the grinding stage. With an increase in the pulp fiber (chrysotile and nylon) content, an increase in the pulp yield stress values and a corresponding decrease in the Copper recovery were observed. Notably, pulp was immovable when the copper ore contained more than either 6% of chrysotile or 2% of nylon fibers. Increase in the pulp yield stress values has been proposed to be due to the entanglement of fibers, further resulting in the formation of fiber networks in the pulp. The height, texture, and consistency of the froth phase were observed to be different with increases in the pulp yield stress values. Thus, the above findings evidently suggest that pulp rheological behavior plays a critical role in effective flotation beneficiation of ore containing fibrous minerals. Most importantly, at lower (~2% by wt in ore) fiber concentrations a subtle change (e.g., increase in pulp yield stress) in rheological behavior may result, however, could possibly contribute to a decrease in the value mineral recovery.

1. Introduction

A widely acknowledged challenge in ultramafic Ni ore beneficiation is slime-coating, i.e., electrostatic attraction between positively charged serpentines on negatively charged Ni sulfide minerals [1–3]. Slime coating problems are dealt with by processing under

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