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Influence of grinding conditions on spodumene flotation

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ABSTRACT

Spodumene flotation traditionally relies on wet grinding after crushing the run-of-mine ore, a process that significantly contributes to water consumption in lithium ore beneficiation. With increasing emphasis on water security in sustainable mineral processing, this study investigates the feasibility of dry grinding as a frugal use of water alternative, with a focus on its influence on flotation performance.

Bench-scale flotation experiments were conducted on spodumene ore subjected to both wet and dry grinding. The feed, concentrate, and tailings were subsequently characterized using scanning electron microscopy in tandem with powder XRD, energy-dispersive X-ray spectroscopy (EDS), X-ray photoelectron spectroscopy, zeta potential analysis, and surface charge mass titration to assess bulk and surface speciation characteristics.

Marked differences in mineral surface and interfacial chemistry and flotation response were observed between the wet and dry grinding environments. While wet grinding exhibited marginally higher energy efficiency over dry grinding, it also resulted in accelerated media wear and heightened risks of pulp contamination. Dry grinding generated finer mineral particles with higher surface charges. The results indicate that dry grinding, when integrated with surface activation techniques such as mechanochemical treatment, can enhance both flotation recovery and selectivity while significantly reducing water requirements.

KEY WORDS

Sustainability; Beneficiation; Flotation; Grinding; Spodumene; Lithium

BIOGRAPHY

Philipa Amoakoa Opoku is a PhD candidate in Mining and Metallurgical Engineering at the Western Australian School of Mines, Curtin University, where her research focuses on the beneficiation of lithium ores. She holds a BSc in Chemical Engineering and an MSc in Energy and Sustainable Management. With three years of experience as an operations engineer, she brings valuable insights from the energy sector. Philipa is passionate about sustainability and committed to developing innovative techniques that enhance resource efficiency and reduce environmental impact.

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