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# Selective Aggregation of Fine Critical Minerals for Improved Recovery in Froth Flotation

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**ABSTRACT**

Recovery of valuable critical mineral particles by froth flotation is most efficient when the particle size is between about 50 and 150 microns. Finer particles lack the inertia to successfully collide with and attach to the air bubbles while coarser particles are heavy, so they easily detach from the bubbles. Our research group is developing solutions to the challenges associated with fine and coarse particle recovery. Between 5 to 30% of the valuable mineral can be lost as fine tailings. Improving recovery of fine particles will increase the amount of metal recovered from a resource so less ore is needed to meet demand. Flocculation-flotation is used to improve recovery of fine hematite, chalcopyrite, and spodumene, that are typically discarded during desliming. Techno-economic analysis indicates that the additional value can be on order $10-50 M per year depending on the commodity and mineralogy. The first step is selective aggregation of the valuable mineral particles in order to produce aggregates with size amenable to recovery by flotation. Inexpensive commercial polyacrylamide flocculants are suitable for this purpose. The aggregate size and structure are characterized using an in-situ probe using images and image derived chord length distributions. Then the aggregates are made hydrophobic by addition of an appropriate collector. The approach is successful in improving flotation recovery of hematite and spodumene (from quartz). In other cases such as chalcopyrite, the polymer is not effective in improving recovery, even when the valuable particles are aggregated because the hydrophilic polymer limits the aggregate hydrophobicity. The key challenge for this technology is the unwanted entrapment of gangue particles within the aggregates of the valuable minerals resulting in reduced concentrate grade.

**KEY WORDS**

Flocculation, Flotation, Critical Minerals

**BIOGRAPHY**

George Franks is Professor in Chemical Engineering at the University of Melbourne. His degrees are in Materials Science and Engineering (Bachelor MIT, 1985 and PhD UCSB, 1997). His research includes minerals processing, ceramic powder processing and suspension rheology. His work in minerals processing relates to development and application of novel polymeric reagents in solid/liquid separation and froth flotation. His work in materials processing is related to processing of complex shaped ceramics with unique microstructures such as 3D printed multi-scale porous ceramics. He is co-Deputy Director of the ARC COE for Enabling Eco-Efficient Beneficiation of Minerals. He has 159 papers in international peer reviewed journals, 7 book chapters and four patents with 6690 citations and h-index = 47. https://chemical.eng.unimelb.edu.au/ceramics

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