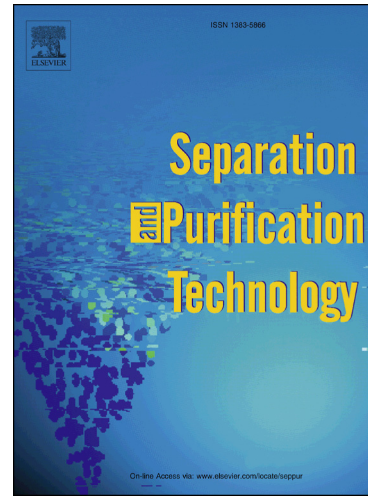

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The effect of particle size distribution on froth stability in flotation

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Abstract

Separation of particles of different surface properties using froth flotation is a widely-used industrial process, particularly in the minerals industry where it is used to concentrate minerals from ore. One of the key challenges in developing models to predict flotation performance is the interdependent nature of the process variables and operating parameters, which limits the application of optimising process control strategies at industrial scale. Froth stability, which can be quantified using air recovery (the fraction of air entering a flotation cell that overflows in the concentrate as unburst bubbles), has been shown to be linked to flotation separation performance, with stable froths yielding improved mineral recoveries. While it is widely acknowledged that there is an optimum particle size range for collection of particles in the pulp phase, the role of particle size on the measured air recovery and the resulting link to changes in flotation performance is less well understood. This is related to the difficulty in separating particle size and liberation effects.

In this work, the effects of particle size distribution on air recovery are studied in a single species (silica) system using a continuous steady-state laboratory flotation cell. This allows an investigation into the effects of particle size distribution only on froth stability, using solids content and solids recovery as indicators of flotation performance. It is shown that, as the cell air rate is increased, the air recovery of the silica system passes through a peak, exhibiting the same froth behaviour as measured industrially. The air recovery profiles of systems with three different particle size distributions (d_{80} of 89.6, 103.5 and 157.1 μm) are compared. The results show that, at lower air rates, the intermediate particle size distribution (103.5 μm) yields the most stable froth, while at higher air rates, the finest particles (89.6 μm) result in higher air recoveries. This is subsequently linked to changes in flotation performance. The results presented here highlight, for the first time, the link between particle size distribution in flotation feeds, air recovery and flotation performance. The results demonstrate that there is an optimal air rate for each particle size distribution, therefore changes in particle size distribution in the feed to flotation cells require a change in air rate in order to maximise mineral recovery.

Keywords

Froth flotation, froth stability, particle size, air recovery, flotation performance

1. Introduction

Froth flotation is a complex and widely used separation technique, which relies on differences in the surface properties of the desired particles to the unwanted particles. One of the key parameters in flotation is the particle size distribution of the feed and it has been