

The impact of mineral texture on the relationship between particle size, surface exposure and mineral liberation: A key to coarse particle flotation

One of the holy grails of froth flotation is coarse particle flotation due to the potential savings in comminution costs. While coarse particle flotation presents some equipment design challenges due to the propensity of large particles to become detached in high turbulence zones and to fall out of the froth due to their high settling velocity, these issues can be mitigated by appropriate design modifications. A more fundamental problem is that at larger particle sizes mineral liberation is inherently worse. In flotation it is actually not directly the liberation that influences the performance, but rather the amount of exposed mineral surface area that is key, with recent studies suggesting that as little as 10% surface exposure is enough to achieve good particle-bubble attachment. The relationship between surface exposure and particle size is a complex one, with the distribution of exposed surface areas being likely to depend on not only the size of the particles, but also on factors such as the texture of the grains within the original rock, the shape of the resultant grains and the extent to which the fracturing is random or occurs through particular grains or grain boundaries. This means that the suitability of coarse particle flotation will be very ore specific, but with the possibility of influencing this amenability through the choice of comminution technology and operating conditions.

The aim of this study will be to use a combination of experimental results and computer models to understand the impact of ore texture, particle size and shape and fracture behaviour on the surface exposure achieved. Most previous studies of the relationship between surface exposure and liberation have relied on sectioning the particles and analysing them with techniques such as MLA, which is inherently 2D in nature and thus introduces serious stereological uncertainties. These shortcomings can be overcome with micro-CT in which the entire 3D mineral distribution within the particle can be ascertained. This study will involve imaging intact rocks to obtain the initial mineral grain texture and then, post comminution, measuring the liberation, surface exposure and other particle properties of the resultant grains. By doing this for a number of different ore types, the relationship between texture and exposure can be explored. Ultimately, though, sample availability and equipment place a limit on the range of different textures that can be studied. We will therefore simulate virtually fracturing the original rocks with different fracture models and comparing the results statistically to those obtained experimentally. Once confidence in the methodology has been achieved, virtual intact rocks can be produced and fractured in order to systematically study the effect of texture on liberation and surface exposure. The ultimate aim is thus to be able to more easily assess the size to which the particles of specific need to be reduced to achieve good flotation performance and thus their amenability to coarse particle flotation.