# Synopsis

The flotation process is widely used for upgrading valuable minerals in the field of mining. Many diverse minerals, including most of the world's base and precious metals are processed by flotation process. Most valuable products produced by flotation pass through the froth phase of the flotation process. The froth phase has attracted more research in recent times because of its significant role in determining the mineral grade and recovery achieved from a flotation operation. The complex processes that occur in the froth phase – detachment, re-attachment, coalescence of bubbles, and competition for attachment sites, mixing and transport all combine to affect the net transfer of mineral particles into the concentrate.

Bubbles are formed at different sizes in the pulp phase and coalesce at different rates and as a result the bubble size distribution varies from point to point in the froth phase. Substantial coalescence gives rise to loss of bubble surface area and hence loss of recovery. Competition for attachment sites gives rise to an increase in grade.

No method for measuring the variation of froth bubble size distribution (FBSD) was available until Bhondayi and Moys developed one. The method measures the intrabubble impact distance in the froth using a probe dropped at known height through the froth. The average of these intra bubble impacts was considered to be a proxy for froth bubble size distribution; this was calibrated using FBSD. However the measured in the laboratory using photographs taken through the transparent wall of a laboratory cell. A 31 % of error was found and compared to the photographic method, which indicated that the technique over-estimates the actual froth bubble size distributions. This is due to the use of an average IID (proxy) as an estimate of the bubble.

In response to the known of actual froth bubble size distribution FBSD in order to quantify the complex processes in the froth phase, an application of a stereological technique/model was developed and tested to obtain estimates of the actual froth bubble size distribution FBSD in lab flotation and Mintek pilot rougher cells as a function of froth height, frother dosage and superficial gas velocity. The model was first validated for a system of flotation with variable froth height in a transparent Wits lab flotation cell. The two-parameter normal distribution model FBSD was considered to fit the model-predicted intrabubble impact distance distribution IIDDs to measured intrabubble impact distance distribution IIDDs. The model was seen to accurately predict the FBSD compared to actual FBSD data obtained from above-mentioned conventional photographic method using a calibration scale attached to the transparent flotation cell wall, wherein the experimental IIDDs were accurately fitted by the model-predicted IIDDs. Similar estimation of froth bubble size distribution was also found with the inversion matrix technique. Secondly, the model was then evaluated for flotation condition with variable frother dosage in the Mintek pilot plant rougher cell. The model was seen to estimate the actual FBSD, wherein the IIDDs were precisely predicted compared to experimental IIDDs. Finally, the model validity was then tested for various systems of flotation conditions with variable superficial gas velocity. The model was seen to estimate the actual FBSD for these cases compared to both model-predicted IIDD and experimental IIDDs. The performance of the present model for these systems of flotation was seen to estimate froth bubble size in froth phase from measured IIDD information. Froth bubble size increases with increasing in froth height, and decreases with increasing in frother dosage and superficial gas velocity. Froth height, frother dosage and superficial gas velocity have a strong effect on froth bubble size distribution.

**Keywords**: Flotation froth, bubble size distribution, modelling, measurement, probe, intrabubble distribution.