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Process Optimization in Flotation Separation Plants*

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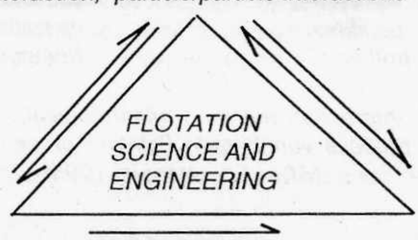
EXTENDED ABSTRACT

Flotation separation of low grade, complex and finely disseminated ores will continue to remain a formidable challenge to the mineral processing professionals for quite sometime. Innovation strategies will have to be devised to derive maximum benefits from existing operating plants as well as to meet the increasingly stringent demands of productivity, quality, yield, energy efficiency and eco-friendliness in the coming decades.

Successful flotation separations depend on the interrelation among the various physical, chemical and mechanical factors involved in the system. As summarized by Prof. Doug Fuerstenau, the science and engineering of flotation process can be represented schematically as the interactive effect between the physics of flotation, chemical control of physical phenomena and the mechanical design of flotation mechines.

PHYSICAL PHENOMENA
wettabillity phenomena, bubble/particle interaction, particle/particle interactions



CHEMICAL CONTROL	*MECHANICAL FACTORS*
wettability	*bubble generation*
frothing	*particle dispersion*
particle interactions	*macroscopic kinetics*

Fig. 1 : A schematic reproventation of the three elements of flotation science and engineering (After Fuerstenau, 1995)

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More specifically, the optimization of flotation separation plants involves a study of the mineralogical and liberation characteristics of the ore (more ore less dictated by nature), the selection of appropriate reagent combination (reagent chemistry) and the computer-aided optimization of the circuit configuration. These three components of the optimization methodology are schematically illustrated in Fig. 2.

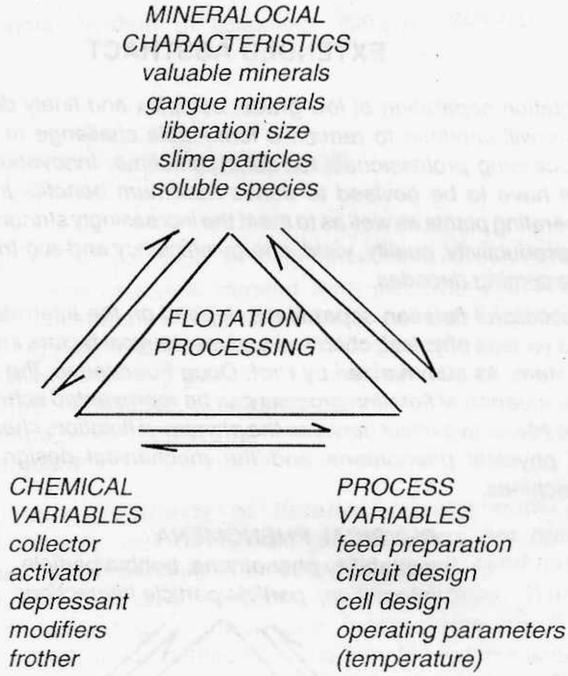

Fig. 2 : Interaction between mineralogical, chemical and process variables in flotation processing (After Fuerstenau, 1995)

Several significant advances made in the recent past, in all the above-mentioned areas of flotation science and engineering are briefly reviewed in this paper. Key aspects are presented under the following headings :

1. *Advances in automated mineralogical/liberation characterization of ores (e.g. QEM-SEM)*
2. *Computer aided plant audit and process diagnostics (e.g. PREDICT)*

3. *Process modelling and simulation of unit operations-optimization using state-of-the-art software tools (e.g. SimL8)*

   — Optimization of closed circuit grinding circuits

   — Flotation circuit synthesis

4. *Advanced process control including plan wide supervisory control*

5. *Design/selection of tailor-made reagents for specific separation science of reagents design and engineering scale-up of laboratory investigations*

6. *Fine particle flotation including column flotation, selective flocculation-flocc-flotation*

7. *Coarse Particles Flotation*

8. *Innovative combination of flotation and other separation processes e.g. column flotation combined with gravity separation for fine coal processing; conventional flotation combined with fine gravity separation (multi-gravity separator) of concentrates; Leach-precipitate flotation etc.*

9. *Recovery of by-products using auxiliary reagents, gravity separation, magnetic separation and other innovative techniques. (e.g. precious metals recovery from base metal ores, uranium recovery from copper plant tailings and recovery of lithiferrous mica fron tungsten ores)*

A comprehensive methodology to optimize the operating flotation plants using state-of-the-art tools is thus presented in this paper. Whenever possible, the key concepts are illustrated with appropriate practical examples drawn from the author's own work and experience.

Key Words : Flotation plants, Process optimization, Processing of complex ores.