PhD Thesis Title: Studies on Insight of a Column Flotation Cell using Coal

Author: Satish Shukla

Department: Chemical Engineering

ABSTRACT

Flotation columns (i.e. column flotation cells) are simple and relatively inexpensive means of achieving gas-liquid-solid contact. Since their inception, flotation columns have proven their importance in various industrial as well as environmental problems (such as: de-inking of paper pulp, industrial waste water treatment, soil remediation, bio-leaching of mineral ores, upgrading ever decreasing mineral grades and recovery of coal fines). Almost 40 % of the world's electricity production is accomplished using coal. Hence clean coal of high calorific value is in demand. During mining, blasting, crushing and grinding, production of coal fines (which is generally 10 % of raw coal) in large quantities poses environmental problems. Therefore current industrial practice is to recover and upgrade the coal fines using flotation technique and utilize it as fuel. Among the flotation cells, flotation columns are cheaper in construction, easy to operate, consume less floor area, and require less maintenance (as there is no moving part inside) than mechanical cells. Therefore, flotation column is attracting the interest of researchers over conventional one. Literature review revealed that not much work has been done to get an insight of column cell. Hence, in the present work, studies have been carried out using coal in a flotation column. Like other surface based phenomenon (i.e. mass transfer, heat transfer, absorption and reaction between gas and liquid phases) flotation is also a surface based phenomenon. In flotation, physical separation of solids is achieved by attachment of fine hydrophobic particles on bubble surface. Hence, its metallurgical performance is sensitive to changes in column's hydrodynamics. Present work explores the effect of operating variables (i.e. feed flow rate, gas superficial velocity, slurry/coal concentration, frother concentration) on hydrodynamics (i.e. gas holdup, pressure characteristics and mixing characteristics) of collection zone of column flotation cell. Correlations to predict the hydrodynamic parameters (viz.; gas holdup and vessel dispersion number) have been developed. Comparison among developed and published correlations has also been made. In addition, effect of feed inlet orientation on metallurgical performance (i.e. recovery and grade) of flotation column has also been investigated.

Keywords: Slurry bubble column, Flotation Column, Coal, Froth flotation, Hydrodynamics, Gas holdup, Pressure characteristics, Mixing Characteristics