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# An Insight into Research and Investigations on Froth Flotation

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## ABSTRACT

Flotation is combination of chemical, physicochemical and physical phenomena. It separates minerals on the basis of differences in surface properties. It is important to study the chemical and physicochemical properties of mineral surfaces. The process involves injection of air bubbles into a moving stream of aqueous slurry containing a mixture of particles. In the process only hydrophobic ores are collected on the bubble surface and exit the stream. According to the investigations reported by various researchers, it is envisaged to have adequate characterization of the system under consideration. Important factors in characterization includes solid phase, aqueous phase with solutes, gas or the second liquid phase, the three kinds of interface and interline, flow and force parameters and end products. The dispersed-air flotation looked preferable than dissolved air flotation. Gas hold up, superficial velocity and bubble size are important factors in column flotation.

**Keywords:** Separation Minerals, Parameters, Kinetics, Collector, Depressant, Stability.

## I. INTRODUCTION

Froth flotation involves injection of air bubbles into a moving stream of aqueous slurry containing a mixture of particles. In the process only hydrophobic ores are collected on the bubble surface and exit the stream. Due to simplicity, these methods find wide application for separation of solid particles. Separation of base metal sulphide minerals in complex ores is one of the major applications of froth flotation. The ever varying grade and mineralogy are major challenges for the froth flotation method. Flotation is combination of chemical, physicochemical and physical phenomena. It separates minerals on the basis of differences in surface properties. It is important to study the chemical and physicochemical properties of mineral surfaces. In mineral ore processing leaching and froth flotation are two important processes. Leaching is extraction of the component from solids by using a solvent [1-3]. It finds application in recovery of various valuable metals [4-6]. The metal recovery from wastewater can be carried out by various physical, chemical and biological processes [7-12]. For separation of solids in mining ores froth flotation is used. Many investigators have carried out research on froth flotation for studying mechanism and parameters. Current review summarizes research and studies on froth flotation.

## II. AN INSIGHT INTO RESEARCH AND INVESTIGATIONS ON FROTH FLOTATION

Biswas emphasized the rationale behind characterisation in mineral separation by froth flotation [13]. According to him, adequate characterisation is required to understand the system under consideration. Important factors in characterization includes solid phase, aqueous phase including solutes, gas or the second liquid phase, the three kinds of interface and interline, flow and force parameters and end products. Hernainz and Calero discussed kinetic models based on chemical analogy for froth flotation[14]. In their investigation, they studied several kinetic aspects of flotation of celestite and calcite in a mechanical cell with sodium dodecylsulphate. They observed that both minerals float rapidly. Also they found that the flotation rate constant responds to a non-integral order equation. Udenko et.al. investigated froth flotation of Azara barite ore [15]. They carried out research with mixture of available raw materials. The burnt empty palm (Eleasis guineesis) bunch solution. In their work, they used analytical grade palmitic acid as

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collector, sodium silicate as depressant. They obtained best results between pH range of 4 and 10.They concluded that palmitic acid and palm bunch product are good collector for barite.

According to Masiya and Nheta the ever varying grade and mineralogy are two major challenges faced by flotation of major ores[16]. It is envisaged to have a continual characterisation and optimisation of flotation parameters. In their work they used the robust Taguchi experimental design method. They determined optimum condition for flotation of nickel, copper and cobalt from a nickel-copper sulphide ore. They studied parameters like collector dosage, percentage solids, depressant dosage and pH. They found that collector dosage, 80g/t; pH, 10.15; %solids, 25; and depressant dosage, 100g/t were optimum conditions. They found that pH has the most significant effect on the recovery of nickel, copper and cobalt during flotation. Also it was observed that collector dosage and percentage solids had negligible effect. Lau et.al. investigated the recovery of oil from oil/sand slurries[17]. They carried out investigation in laboratory-scale flotation cell. In their research, they investigated the effects of temperature and pH in the recovery of oil from oil/sand slurries. At pH value of 5 and temperature $50^0$C, they recovered 63.2 wt% oil. They found that at elevated temperatures, oil recovery was favourable. They concluded that the flotation process provided a promising alternative to recover oil from oil/sand slurries.

Zhang et.al. carried out an investigation on factors affecting froth flotation[18]. They used three models namely discrete, mean rate and the gamma function models. They modified these models based on the mass recovery relationships. They used three samples namely chalcopyrite, coal and complex sulphide. They observed that increase in flow rate reduced the grade of concentrate. The recovery was not affected by increase in the air flow rate. They also observed that the increased impeller speed has positive effect for fine particles. It has negligible effect on coarser particles.Yuce et.al. studied the flotation of copper ore and concentrate[19]. In their investigation they emphasized on effect of bacterial conditioning. They studied parameters such as bacterial population, conditioning time and particle size. They observed that the flotation recovery of chalcopyrite decreased sharply in first hour. At the end of 2 hours recovery ceased at 2 hours. The flotation recovery was affected badly by bacterial population. Agitation rate didn’t have any significant effect on the recovery.

Farrokhpay and Bradshaw reviewed effect of clay minerals on froth stability in mineral flotation[20]. According to these studies, achieving and maintaining optimum froth stability is an influential factor in determining froth flotation performance. Also it was realized in many investigations that clay minerals can increase or decrease the stability, thereby affect flotation performance. According to this review the type of clay minerals and the ore systems are deciding factors for the mechanism. It is necessary to systematically valuate mechanism for development of appropriate methods to ameliorate the deleterious effects for different ore/clay systems. Reza and Farahnaz investigated reduction of sulfur and ash from tabas coal [21]. They carried out froth flotation Laboratory tests. In these tests they studied the influence of various collectors, frothers, pyrite depressants and their consumption dosages on ash and sulfur reduction. For reduction of ash and sulfur content of coal, they observed that kerosene(as a collector) and pine oil (as a frother) were best choices. They also observed that sodium polyacrylic acid as a pyrite depressant improved the total recovery of coal. In his investigation Bhondayi measured particle loading on bubbles in froth flotation [22]. He found that for the bubble load meter without sampling unattached particles, salt tracer experiments indicated that the 20mm and 30mm riser worked well. Wright described the development of a machine vision system for the on-line analysis of flotation froth images [23]. He developed a system, which acquires froth image using a video camera. The system also rapidly identified the bubbles in the froth by segmenting the image using a morphological operation. This morphological operation is known as Fast Watershed Transform. He studied variations in flotation froth appearance in response to change in input. He found that the machine vision system was able to identify and characterise variations in flotation froth appearance. Kyzas and Matis carried out review on studies and investigations on flotation of biological materials [24]. According to them, typically dispersed-air or dissolved-air flotation are commonly used methods. In various research experiments, biological materials such as such as bacteria, fungi, yeasts, activated sludge, grape stalks were tested and floated efficiently. According to this review new hybrid cell of microfiltration combined with flotation was highly recommended.

Kyzas et.al. discussed research activities carried out on flotation[25]. They discussed physical chemistry to flotation. Their emphasis was on zeta-potential measurements, contact angle etc. According to them, by-product recovery was a potentially profitable aspect of flotation treatment. Also they discussed alternative bubble generation methods such as electroflotation and dissolved air flotation. It was also found in some experiments that the flocculation of particulates affected electrolytic flotation. Studies also indicated that froth flotation becomes inefficient for beneficiating fines. The dispersed-air flotation looked preferable than dissolved air flotation, according to these studies. Romanova et.al. investigated the effect of process conditions in the clark hot water bitumen extraction process on froth treatment effectiveness[26]. They considered factors such as oil sand quality, extraction shear, and extraction temperature, NaOH addition during extraction, froth treatment temperature, and froth treatment residence time. They observed that lower bitumen recovery was observed at reduced extraction temperature. Also it was observed that higher shear extraction decreases froth treatment effectiveness, although it improved bitumen recovery. Finkelstein et.al. discussed fundamentals of flotation[27]. In their investigation, they discussed the interaction between the mineral surface and reagents in solution. Dobby, in his article, described key features and concepts of column flotation [28]. Also he reviewed recent industrial applications of column flotation. Two zones are evident in the columns, the collection zone (extending from the spargers to the froth:pulp interface) and the froth zone. One of the important consideration is the available surface area of a flotation machine.The factors like gas hold up, superficial velocity and Bubble Size are important in column flotation.

## III. CONCLUSION

According to the investigations reported by various researchers, it is envisaged to have adequate characterization of the system under consideration. Important factors in characterization includes solid phase, aqueous phase including solutes, gas or the second liquid phase, the three kinds of interface and interline, flow and force parameters and end products. It was also reported that the flotation rate constant responds to a non-integral order equation. It was also indicated that the type of clay minerals and the ore systems are deciding factors for mechanism. The research experiments also explained that pH has the most significant effect on the recovery of nickel, copper and cobalt during flotation. The dispersed-air flotation looked preferable than dissolved air flotation. Gas hold up, superficial velocity and bubble Size are important are important factors in column flotation.

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