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Summary of PhD Thesis

The dissertation, entitled *The influence of solid surface properties on the stability of three-phase systems in the flotation process*, was carried out at the Department of Process Engineering and Technology of Polymer and Carbon Materials at the Faculty of Chemistry, Wrocław University of Technology, under the supervision of Assoc. Prof. Izabela Polowczyk, PhD, DSc and Prof. Przemysław B. Kowalczuk, PhD, DSc from the Norwegian University of Science and Technology in Trondheim. The dissertation research focuses on determining the influence of the hydrophobicity of the solid surface on the stability of the thin liquid film formed between the air bubble and the solid particle during the flotation process.

The thesis consists of two main parts: a theoretical part and a research part. The theoretical part presents a review of the current scientific literature presenting the current state of knowledge in the area of the research topic addressed in the dissertation, concerning the interactions of air bubbles with body particles and the stability of the thin liquid film formed between them. The flotation process and the role played by surface wettability in the process is described. The interactions between these objects that take place during the flotation process, where one of the most important stages is the attachment of the particle to the bubble and the formation of the so-called three-phase contact (gas-liquid-solid), are discussed. The role of the thin liquid layer (thin film) that forms between the bubble and the particle during the collision, whose durability determines whether or not a bubble-particle aggregate is formed, is also demonstrated. In addition, a description of the surface interactions that play a key role in the stability of a thin film of liquid is presented. The next section takes a closer look at the mechanisms responsible for the rupture of a thin liquid film, with particular emphasis on hydrophobic attraction, which is considered to be the main driving force for film rupture and for the attachment of the bubble to the hydrophobic particle. The last chapter discusses the importance of the critical contact angle in the stability of a thin film, i.e. the angle beyond which the attractive hydrophobic forces start to dominate over the repulsive forces, thus causing the rupture of the thin film and the formation of a bubble-particle aggregate.

The research work carried out was divided into three areas. Firstly, model glass surfaces (plates and glass microspheres) whose hydrophobicity was modified under controlled conditions were prepared and characterised. The material was then used in stability studies of

the thin film forming between it and the bubble in water. These tests were carried out using a measuring setup that allowed observation of the dynamic interactions between the bubble and the surface of the solid and determination of the time required for the bubble to rupture. Another area of research focused on the flotation of a model material on a laboratory scale using a Hallimond microflotation cell. In the final stage, calculations of the energy of interactions were carried out according to the extended DLVO theory in order to compare experimental results with theoretical predictions.

The results obtained in the course of the study provided a deeper understanding of the mechanism of stability and rupture of the thin liquid film during vesicle adhesion to the solid surface, depending on its degree of hydrophobicity. The critical contact angle, i.e. the angle value above which the thin film between the particle and the vesicle breaks as a result of the predominance of attractive hydrophobic interactions over repulsive electrostatic interactions, was determined.

In conclusion, the research of great scientific significance were presented in this dissertation, which will certainly clarify the current state of knowledge regarding the stability of thin liquid films and their importance in the flotation process.