

Flotation is a selective process of solid particles separation, based on the difference in their surface properties, using air bubbles. Throughout its over 100-year history, this process has found its application in many different branches of industry. Flotation is used to purify wastewater, paper de-inking, plastics recycling, and even the separation of bacteria and proteins in bioengineering. However, its most important and widest application is in the mining industry, for the separation of mineral ores.

In flotation, the gas bubbles are introduced to agitated suspension of particles with different surface properties, where they collide with each other. During the bubble-particle collision the intervening thin wetting film is formed, which stability determines whether the bubble will attach to and particle. That's also when, between the surface of bubble and particle, the forces that are responsible for the stability of the film start to act. The film stability is key parameter determining a successful attachment, which is considered as one of the most crucial and fundamental act of flotation separation process. When the net surface force is attractive, the intervening liquid film ruptures and the three-phase contact is formed. One of the crucial parameters influencing the stability of the film is the hydrophobicity of the solid surface. A surface is hydrophobic if it tends to not adsorb water or be wetted by water. Particles that are weakly wetted by water attach to the air bubbles and they are raised upward to the foam layer that is formed above the surface of the liquid, which is the product of the flotation process. The particles that are well wetted by water remain in the liquid (flotation tailing). Therefore, the interactions between bubbles and particles are a very important part of the flotation process, on which the efficiency of the process depends. Hydrophobicity is the source of so called attractive hydrophobic forces, which start to dominate over repulsive forces when the hydrophobicity of solid surface exceed a certain degree. Despite the significant progress made in recent years to understand hydrophobic forces, the underlying phenomena of particle attachment to the bubble are still not fully understood. There are still some unresolved research questions in this area that we need to find answers to due to their crucial importance for flotation and mineral engineering.

The planned research is aimed at determining and systematically describing the impact of the solid surface hydrophobicity on the stability of a thin wetting film intervening between bubble and particle in flotation process. These studies will be possible to implement thanks to appropriate modification of hydrophobicity of model solid surfaces and application of experimental setup for observation and quantitative description of film stability. The first stage of the project will focus on measuring the stability of the film by determining the time needed to rupture and the changes in its thickness over time depending on the hydrophobicity of the surface. This will allow to better understand the mechanism of the film rupture depending on the degree of surface hydrophobicity. Therefore it will be possible to determine a critical contact angle beyond which the colliding bubble and particle attach. The outcomes will be correlated, in the next stage, with the results of the flotation process carried out on a laboratory scale. Examination of this impact will allow to elaborate the new model of flotation kinetics for a more effective description of the process. The results obtained during the project will allow to clarify the current knowledge in this area, and will be of great importance in the optimization of the flotation process.