On the wettability of glass particles with different morphologies hydrophobized by esterification with alcohols

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The separation of fine particles is a challenging task, which requires a fundamental understanding of the interfacial properties. In our research, we focus on the selective separation of ultrafine particles by a combination of foam fractionation and conventional flotation, a well-established and efficient particle processing technique in the mineral's sector based mainly on particle wettabilities. Flotation works best for particle size ranges of 10 µm to 200 µm, but when it comes to the separation of ultrafine particles (< 10 µm) there is still lots of room for understanding and improvement. Within the German research foundation priority programme DFG-SPP 2045 "MehrDimPart" we aim at developing a novel multidimensional separation device for such ultrafine particles based on the particle parameters of wettability, morphology (shape or roughness) and size.

In this study, three differently shaped fractions of glass particles are used, among them spheres, fibres and fragments. The glass particles are functionalised by an esterification reaction with alcohols, where the wettability of the esterified particles is controlled by the length of the alkyl chain, at water contact angles ranging from approx. 40° to 100°. By liquid-liquid phase transfer, using water as the aqueous phase and cyclohexane as the organic phase, the success of the particle functionalization is studied. Those results are correlated to contact angle measurements obtained by the captive droplet method, also using cyclohexane. Furthermore, glass slides, esterified in the same way as the glass particles, are analysed by measuring static and dynamic contact angles against water using the sessile drop method. Additionally, the functionalized glass particles are studied with inverse gas chromatography, which results in their specific surface free energies, as that is related to the contact angle via Young's equation. The correlation of the various methods shed light on both the wettability heterogeneity and how it is changed through functionalization but also on the effect the morphologies have on the wettability and phase-transferability characteristics.

The obtained information on the particle wettability after esterification is set into context with their particle morphology and particle sizes.

Keywords

Wettability, Ultrafine Particles, Surface Modification, Esterification of Glass Particles, Hydrophobisation, Surface Energy Distribution, Inverse Gas Chromatography, Contact angle measurement, Flotation