Synopsis of Original Research Paper

Studies on stabilization mechanisms of powdered emulsions and foams

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Colloidal particles can be irreversibly adsorbed at fluid interfaces, such as oil-water and air-water interfaces. The particle adsorption leads to stabilization of dispersed systems of two immiscible fluids and particle-stabilized, that is, Pickering-type emulsions and foams can be prepared. These materials show some unique properties as a result of adsorption of the particles at the fluid interface. One of the striking phenomena is that liquid drops can be dispersed in air with the liquid-air surfaces coated by liquid-repellent particles. When the liquid is water, a water-in-air material, named dry water, is produced by aerating water in the presence of extremely hydrophobic silica particles. The dry water is a free-flowing powder which can contain significant quantities of water as micron-sized drops. A powdered oil-in-water (o/w) emulsion, that is, oil-in-water-in-air (o/w/a) material is a dispersed system in which the continuous phase of a particle-stabilized o/w emulsion is dispersed in air by encapsulating the water globules with hydrophobic particles. During their preparation, oil droplets in water globules are forced to move due to high-shear mixing, leading to creaming of the oil droplets and possible wetting of the oil droplets on the hydrophobic particles which induces destabilization. In order to prepare powdered o/w emulsions efficiently, the extent of creaming of the oil droplets has to be suppressed. We describe how to achieve this by mixing two oils of different density and prepare powdered o/w emulsions from oil mixtures exhibiting a decreasing density difference with water. As the extent of creaming is reduced, enhanced stabilization of the powdered emulsions occurs. By applying the strategy used to stabilize the powdered o/w emulsions, a powdered aqueous foam, that is, air-in-water-in-air (a/w/a) material can be prepared.