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Formulation and Rheological Characterization of Premix Emulsification

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Emulsion formulations are used in food, cosmetic, and pharmaceutical industries. The emulsion stability in the process and in the product is still an issue. Mechanisms like flocculation, creaming, and coalescence result in the breaking of an emulsion. Surface-active agents are used to prevent these phenomena. Therefore, the rheological aspects of an emulsion are of high interest for emulsification processes.

Water-oil (WO) and oil-water (OW) emulsions are created using ultrasound emulsification as well as emulsification by a porous structure. The surfactants used to stabilize the emulsions are varied. Also the ratio of dispersed to continuous phase is varied from 1:1 to 1:4 and the dispersion

time is modified under the aspect of emulsion stability.

Surfactants have a high impact on the droplet interface. A model experiment shows the effect of surfactants on rising droplets towards a liquid interface and on the coalescence process. The droplet velocity decreases with increasing surfactant concentration on the droplet interface. Stagnant caps are forming which immobilize the interface and thus cause the decrease in the rising velocity and the coalescence time. The surfactant adsorption is analyzed using dynamic interfacial tension measurements of a pendant drop. It is shown that the surfactant molecules need up to several minutes to completely load a

droplet interface. The surfactants' adsorption speed can be related to the decrease in interfacial tension, and the dilatational modulus provides information about the resilience of the surfactant film against deformation. The loading time and the adsorption speed of the surfactant molecules prove the importance of the dispersion time an emulsion requires to stabilize.

Premix emulsification is analyzed in simulation and results from computational fluid dynamics (CFD) using the open source software OpenFOAM (Version 2.1.1) and the commercial software Fluent (Version 14.5, Ansys) are compared to experimental findings.