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Dependence of creaming and rheology of monodisperse oil-in-water emulsions on droplet size and concentration

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Abstract

The influence of droplet concentration (1–67 vol.%) and size ($r = 0.43$ and 0.86 μm) on the creaming stability and rheology of monodisperse *n*-hexadecane oil-in-water emulsions stabilized by sodium dodeycl sulfate (SDS) was studied. Creaming was monitored by measuring the back-scattered light from an emulsion as a function of its height. Apparent viscosity and shear modulus were measured using a dynamic shear rheometer. The creaming velocity of the emulsions decreased with increasing droplet concentration. The apparent viscosity of the emulsions increased with increasing droplet concentration, decreasing droplet size and decreasing shear stress. Emulsions gained elastic characteristics and did not exhibit creaming when the droplet concentration exceeded about 40% because of close packing of the droplets. The viscosity and creaming behavior of monodisperse emulsions could be described using the same equations as for monodisperse suspensions.

Keywords: Monodisperse droplets; Emulsions; Creaming; Rheology; SDS

1. Introduction

Emulsions form the basis of a wide variety of natural and manufactured materials, including foods, pharmaceuticals, biological fluids, agrochemicals, petrochemicals, cosmetics, and explosives [1–4]. The desired rheology and stability of emulsion-based materials varies widely depending on their intended application. Some emulsion-based materials need only remain stable for a short period (e.g. between two processing steps), whereas others must remain stable for relatively long-periods (e.g. a few weeks, months or years). For certain emulsion-based materials it is desirable to have a low viscosity (e.g. milk), whereas for others it is desirable to have a high viscosity or visco-elastic properties (e.g. mayonnaise). Manufacturers of emulsion-based materials must therefore have a good understanding of the factors that determine their rheology and stability in order to create products with the required physical characteristics.

A great deal of theoretical and experimental research has been carried out to establish the factors that determine the rheology and stability

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