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EVOLUTION UNDER SHEAR FLOW OF DROP SIZE DISTRIBUTION OF BIOPOLYMER MIXTURES

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Aqueous biopolymer mixtures are commonly used in food industry. The rheological properties of such materials are strongly dependent on the biphasic microstructure of the system, which is generally made up by droplets dispersed in a continuous phase. The flow behaviour of polymer blends is quite complex, since the flow history modifies the morphology (i. e., size and shape of the dispersed droplets) due to coalescence and breakup. For this reason, the rheo-optics of model food emulsions have been the subject of many investigations, aimed at a rationale design of the microstructure obtained during processing. In this work, we studied the time evolution of the drop size distribution of aqueous biopolymer mixtures in shear flow. The equilibrium phases are separated by centrifugation and re-mixed in proper amounts to have mixtures with known volume fractions of the two phases. The so obtained samples are sheared in a parallel plate apparatus and observations are carried out by video optical microscopy. The drop size distribution is measured as a function of time by optically sectioning the sample via 3D motorised scanning and digital image acquisition. Image analysis algorithms have been developed for automated processing of a large number of images, and the results have been tested by statistical methods. Flow conditions have been chosen in order to prevent drop breakup and thus focus the study on drop coalescence only. Both the mixture composition and the flow conditions have been varied in order to study the influence of several parameters (including shear rate, viscosity ratio and volume fraction of the dispersed phase) on the rate of coalescence.

SOME HYDRODYNAMIC CHARACTERISTICS OF STIRRED VESSEL FLOWS OF DILUTE POLYMER SOLUTIONS POWERED BY AN HYPERBOLOID IMPELLER

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The hyperboloid impeller is advantageous in processes involving low viscosity fluids and microorganisms, one such case being waste water treatment plants, because it has the capacity to sustain an overall gentle flow with a fairly low power consumption while at the same time it avoids destruction of useful microorganisms. However, these characteristics are based on investigations with Newtonian fluids whereas such applications involve non-Newtonian fluids.
In this work, results of measurements of the power consumption and mean and turbulent velocities in the wall jet of a stirred vessel flow, powered by an hyperboloid impeller, are presented. The fluids were aqueous solutions of tylose, CMC and xanthan gum (XG), at weight concentrations ranging from 0.1% to 0.6%, which exhibited varying degrees of shear-thinning and viscoelasticity. The hyperboloid impeller parameter k of Metzner and Otto (1957) was found to be equal to 27.2 ± 4. In the Reynolds number range of 103 to 3 x 104 the mixing power was reduced for all non-Newtonian fluids, but never by more than 13%. The flows of the 0.2% CMC and 0.2% XG solutions were found to be less turbulent that those of water, especially for the latter fluid where a reduction in axial rms in excess of 50% was found in the wall jet. This was attributed to elasticity effects and especially to the high zero shear viscosityof the latter fluid.

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