CONFLUENCES IMFT

Institut de Mécanique des Fluides
2 Allée du Pr Camille Soula, Toulouse

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Homogenization of dairy products: a simple mechanism of fat globules fragmentation

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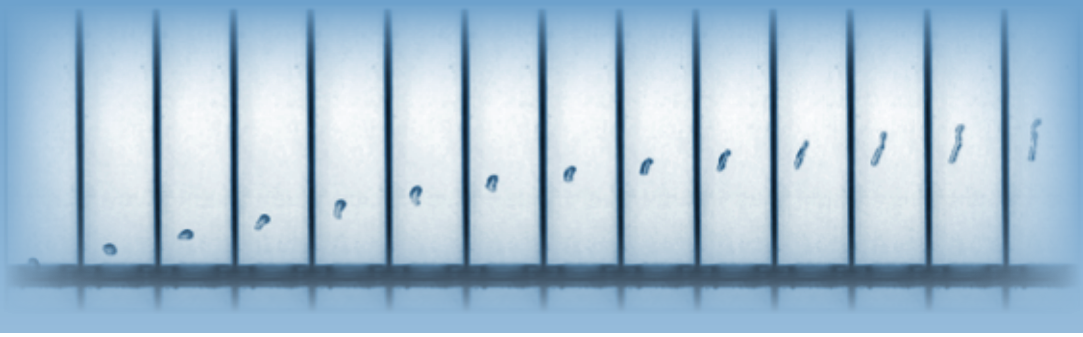

High-pressure homogenization is a low temperature size reduction process of oil-in-water emulsion droplets, widely used in food industry. The flow geometry in High-Pressure Homogenizers (HPH) involves pressure drops of tens of MPa and velocities of the order of 100 m/s, providing high shear rates that disrupt and break the emulsion droplets. Milk is a natural emulsion of micrometer-sized droplets, called milk fat globules, which have a highly viscous core rich in triglycerides surrounded by a biological membrane, constituted by a trilayer of polar lipids and membrane proteins. Homogenization of milk or cream, a longstanding routine operation in dairy industry, hence involves the breakup of a complex interface in a complex flow, and predicting the size distribution of fat globules in homogenized milk or cream is still out of reach. However, we have recently brought to light a simple mechanism of fragmentation of milk fat globules in homogenization of milk or cream. It is shown that the size distribution can be described by a simple function of the inlet size distribution, considering that each fat globule breaks into a single or few classes of fragments, each fragment diameter being proportional to the parent globule diameter. This original fragmentation mechanism can be interpreted through a simple deformation model of fat globules as elongated filaments, which eventually breaks up through a deterministic process. The combination of the flow geometry in the HPH and the high internal viscosity of the fat globule (high Ohnesorge number) explains this deterministic breakup process. We believe that this simple model constitutes an interesting tool for food engineers, in order to optimize the operating parameters of HPH (pressure, temperature, number of cycles) for a given application, as well as for HPH manufacturers, in order to test the efficiency and the behavior of their equipment.

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