LABORATORY OF BIOPHYSICS

WAGENINGEN UNIVERSITY & RESEARCH

Rheo-MRI study of strongly confined flow of fat crystal dispersions

BRUKER

Fat crystal dispersions (FCDs) are used in production of foods, such as chocolate and butter. During the production process, as well as during customer use, for example during mastication, FCDs flow in millimeter- or even micrometer-sized gaps. Generally, flow in such strong confinements is non-Newtonian and susceptible to flow instabilities caused by shear-banding, wall-slip and other complex particle-particle interactions. Specifically for FCDs, an additional level of complexity is added since the morphology of the dispersed particles strongly depends on crystallization, which also dictate the resulting flow behaviour. Hence, it is very difficult to predict the flow behaviour of FCDs, and optimize production conditions such as applied pressures, temperatures and crystallization rates.

Our group at BIP has developed a novel technique, sub-mm rheo-MRI with temperature control (Fig. 1a), which enables us to peer into the spatially-resolved flow behaviour of complex materials, such as FCDs (Fig. 1b). The technique aids elucidating the dependence of flow instabilities on flow rates, temperatures and sample preparation conditions.

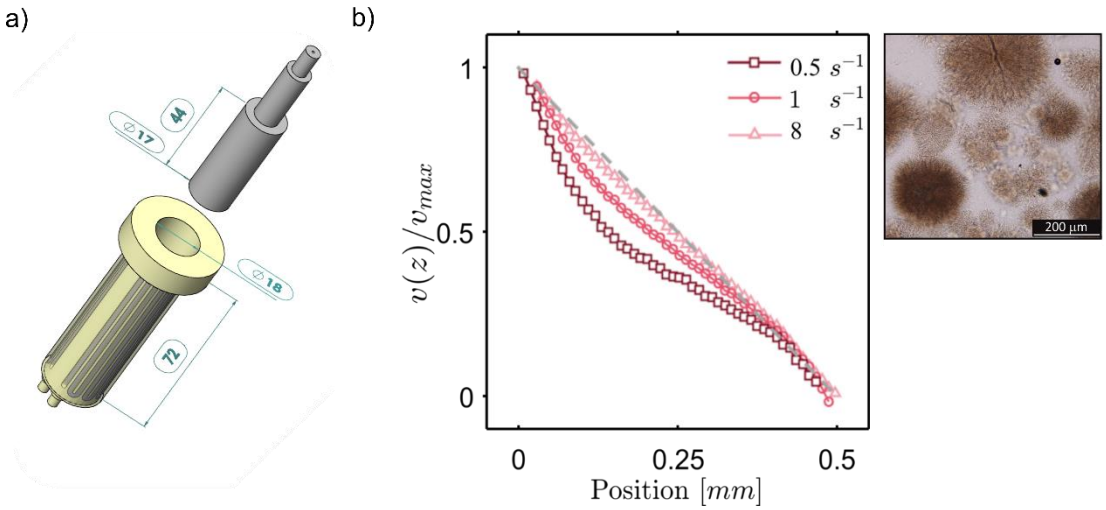

Figure 1: a) Sub-mm rheo-MRI Couette cell with a temperature-control circuit b) ^{1}H rheo-MRI velocity profiles acquired in the sub-mm CC and a micrograph of a FCD crystallized at 0.2 °C/min.

This project involves applying our novel narrow-gap rheo-MRI setup in combination with classical rheology to characterize the flow behavior of FCDs as a function of flow and crystallization conditions. Experiments are carried out on the in-house NMR spectrometers and rheometers, and data analysis is done using in-house developed scripts (MATLAB). Results are then interpreted in terms of structural microscopic dynamics of the system.

Further information:

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