# IFPRI Project Abstract

## Dynamic and structural investigation of capillary suspensions

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## *Project Objective:*

Structure and function and inherently related. Using a model system for dense and capillary suspensions, we will investigate the microstructural changes during interesting rheological transitions, e.g. yield, using confocal microscopy. Capillary suspensions, particles suspended in a bulk fluid with a small amount of immiscible secondary fluid added to form a percolating network of capillary bridges between the particles are of particular interest as they show a wide range of rheological behavior.

## *Approach:*

Changes to the microstructure of a suspension of fluorescently labelled silica particles are investigated using a confocal microscope. Using particle detection and semi-local measures, we can compare the structure of the samples with their bulk rheological response.

## *Recent Results:*

This year, we finalized the work on particle roughness. By varying the roughness, we could switch between bridges and films (wetting between asperities) with increasing roughness. By increasing the secondary fluid content, we could match $G'$ in the LVE, but there is still a dependence of the roughness on $G''$, the flow point, and on the structure (as captured using the coordination number and clustering coefficient). We repeated several experiments, particularly the medium amplitude oscillatory shear (MAOS) measurements, to ensure repeatability and accurate interpretation of the data. This work appears in *Colloids and Surfaces A* (DOI: 10.1016/j.colsurfa.2022.129224) and is freely available on arXiv (https://arxiv.org/abs/2203.07779).

The focus, however, this year has been on the confocal-rheometer setup. This setup is now operational and preliminary experiments have been conducted. These experiments show the solid body rotation present in capillary suspension networks where flocs move as single objects. This is more pronounced for rough particles; for the smooth particles, particle/bridge rotation and particle rearrangements happen before the $G''$ peak whereas rearrangements for the rough particles only occur after the $G''$ peak and usually occur in the form of rearrangements of small clusters rather than individual particles.

## *Next Steps:*

The rheo-confocal setup will now give us more information on the dynamic changes to the network. The initial experiments conducted for the smooth and rough particles will be continued where the particle movement and structure will be quantified, focusing on mechanism of yielding. Some additional improvements should be made and we will then implement better detection of the fluid bridges to look at the bridge size distribution. We have also started experiments with nanoparticles in the bridges.