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# Dynamic wetting of concentrated granular suspensions

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Concentrated granular suspensions are employed in a variety of applications including 3D printing, painting, etc. In a wetting process, the contact line dynamics and the internal structure of the suspension interact. Along the contact line, particles interact with each other and the substrate. This process can be characterized using individual particle analysis and average suspension descriptions. There is a markedly high shear rate at the droplet's contact line. This localized shear rate profoundly affects suspension's non-Newtonian rheological behaviour.

Recent researches have affirmed the applicability of the hydrodynamic solutions like Cox-Voinov relation to granular suspensions, highlighting the importance of particles approaching the contact line area to influence the effective wetting viscosity. Despite these efforts, the impact of particles on the overall flow field and microstructure of densely packed granular systems along the contact line remains unexplored.

In this study, we use fluorescently labelled tracer particles in a refractive index-matched Silica suspension to investigate the flow field close to the contact line. Two distinct dispersion media are employed to study the significance of inter-particle interactions within our experimental framework. We utilize a configuration consisting of a pinned droplet on a moving substrate and by employing astigmatism particle tracking velocimetry (APTV), we precisely track the 3D motion of tracer particles within the concentrated suspension. Particle trajectories give the flow profile of a droplet near the advancing contact line. Furthermore, side-view images enable for the characterization of the drop shape. The dynamic response of the suspension to shear stresses is characterized using amplitude-sweep rheology measurements.

The angle of repose measurements demonstrates frictional contact between submerged particles. Near the advancing contact line, we observe distinct behaviours based on the interaction between particles resulting from the choice of dispersion medium. When using 2,2′-thiodiethanol (TDE) as the dispersion medium it leads to weakly interacting particles, the flow field indicates a violation of the hydrodynamic solutions like Cox-Voinov relationship, with particle friction becoming a significant factor. Conversely, when strong particle interactions are present, using sodium thiocyanate (NaSCN) salt solution as the dispersion medium, the suspension exhibits a yield stress behaviour. In this scenario, particles migrate toward the high shear rate zone near the contact line, and the suspension behaves more like a liquid close to the moving substrate, with particles approaching the contact line and moving parallel to it. These observations are substantiated by rheology and angle of repose measurements. Near the receding contact line, the suspension adheres to its previous layer and moves on top of it. This results in a dynamic curvature of the receding contact line, which undergoes a transient dynamic before reaching stationary state.

**Keywords**: Dynamic wetting, Granular suspensions, Rheology

**Hauptautoren:** ROSTAMI, Peyman; AZIZMALAYERI, Reza; WITZMANN, Thomas; KLEIN, Christopher; PATEL, Himanshu P.; AUERNHAMMER, Günter K.

**Vortragende(r):** AZIZMALAYERI, Reza

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