INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	**Ph.D.**

Thesis Title: **RHEOLOGY AND MICROSTRUCTURE OF SHEAR THICKENING SUSPENSIONS**

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SHORT ABSTRACT

The thesis focuses on the experiments studies on rheology and microstructure of discontinuous shear thickening suspensions. In the current study, we present a systematic rheological study on the fumed silica suspensions to understand the effect of fluid and particle parameters on the critical shear rate and shear thickening ratio. A careful sample preparation method was adopted to disperse the fumed silica particles in polyethylene glycol solution, and we achieved discontinuous shear thickening at low particle concentration. It was observed that the critical shear rate in shear thickening suspension is strongly influenced by both carrier fluid and particle concentration. However, the shear thickening ratio is mainly influenced by the particle parameters and the contact forces between the particles. Increasing the amount of smaller particles in the suspension significantly decreases the maximum viscosity and shifts the onset of shear thickening to higher values of critical shear rates with a much smaller shear thickening ratio. Further, a possible mechanism has been proposed based on the influence of carrier fluid and particle size distribution to explain the rheological behavior of shear thickening suspension. Experiments to determine the role of additives on the behavior of shear thickening fluids (STF) were also carried out. This involved preparing shear thickening suspensions with the addition of fillers to the fumed silica particles for a given weight fraction and a carrier fluid. Addition of Graphene oxide particles exhibited higher relative viscosities, whereas the addition of Multi-walled carbon nanotubes (MWCNT) and Mica particles showed a decrease in the shear thickening ratio and an increase in critical shear rate. Finally, we report experimental studies on rheology and microstructure in discontinuous shear thickening of fumed silica suspensions using Rheo-Microscopy experimental setup. The formation of particle clusters was observed after the critical shear rate, and their size increase during the shear thickening. At higher shear rates, these clusters were found to break down due to strong shear forces, and a continuous decrease in viscosity was observed. The suspension viscosity and the first normal stress difference (N_1) variation with the shear rate showed similar dependence. The sign of the first normal stress difference was negative during shear thickening, which is consistent with the hydrodynamic model of cluster formation. The oscillatory shear measurements were also performed, and the samples displayed strain thickening similar to shear thickening. Finally, the similarity between the steady and dynamic shear rheology at high strain amplitudes was observed using the modified Cox-Merz rule.