

LECTURES ON RHEOLOGY OF SUSPENSIONS/COMPLEX SYSTEMS

FORTH, SEPTEMBER 2015

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Seminar Room I, FORTH main building

PROGRAMME

September 16: Start: 09.30

Intro/Refresher Lectures on Colloid Suspension Rheology

- 1) Effects of Hydrodynamic and Brownian Forces (1.5 hrs)
 - a. Effects of hydrodynamics (without Brownian motion)
 - b. Phenomena induced by Brownian motion
 - c. Viscosity of suspensions containing Brownian hard spheres, scaling rules
 - d. Viscoelasticity with Brownian hard spheres
 - e. Glasses with Brownian hard spheres

Break: 11.00 – 11.20

- 2) Rheology of Stabilised (electrostatic and steric) Suspensions (1.5 hrs)
 - a. Rheological behavior of colloidally stable systems
 - b. Relevant electrostatic phenomena, electroviscous effects
 - c. Effect of electrostatics on the viscosity of dilute, semi-dilute and concentrated stable suspensions, scaling principles, effective hard sphere volume
 - d. Crystalline and glassy systems, effect of shear flow
 - e. Steric stabilisation, applicability of the effective volume concept
 - f. Dynamic moduli and interparticle potential in sterically stabilized systems
 - g. Limits to hard sphere scaling

Lunch Break

Second part: 14.30

- 3) Flocculated Suspensions and Gels (1.5 hrs)
 - a. Flocculation and its rheological signature
 - b. Structures in flocculated systems and gels (fractals, percolation, and other structural features), anisotropy
 - c. Rheology of semi-dilute and more concentrated attractive systems
 - d. Gelation and behaviour near gelation
 - e. Moduli and yield stresses

September 17: Start: 09.30

- 4) Rheometry of Suspensions: Specific issues (1.5 hrs)
 - a. Assessment of geometries for measuring suspensions
 - b. Measurement problems with suspensions and possible solutions
 - c. Oscillatory flows (small and large amplitude)
 - d. Yield stress measurements
 - e. Measuring thixotropy

Second part: 14.30

- 5) Emulsions and Blends (2 hrs with break)
 - a. Basic parameters used in emulsion rheology
 - b. Dilute emulsions/blends: viscous and viscoelastic effects
 - c. Flow-induced structural changes in droplet shape and size
 - d. Concentrated emulsions
 - e. Polymer emulsions (immiscible polymer blends)

September 18 Start: 09.30

- 6) Liquid Crystalline Polymers (2 hrs with break)
 - a. Rheological behaviour of lcpS
 - b. Phenomenological theory of the rheology of liquid crystals
 - c. Doi-Hess molecular theory for LCPs
 - d. Role of defects
 - e. Experimental evidence, possible scaling relations
 - f. Time effects and complications in LCPs
 - g. Filled LCPs

September 21 Start: 10.30 (in conjunction with Distruct EU ETN)

- 7) Rheo-optics on Suspensions (1.5 hrs)
 - a. Overview of techniques for suspensions
 - b. Applications of SALS/DWS at rest
 - c. Rheo-SALS and dichroism on flowing suspensions/shear thickening

- d. Applications on suspensions of non-spherical particles

September 22: Start: 10.30 (in conjunction with Distruct EU ETN)

- 8) Shear Thickening (1.5 hrs)
 - a. Experimental observations
 - b. Effect of concentration (continuous and discontinuous shear thickening)
 - c. Structure and hydrodynamics based scaling rules for Brownian and colloidally stable suspensions
 - d. Friction-based models
 - e. Complex flows
 - f. Non-spherical particles

Second part: 14.30

- 9) Non-spherical particles (1.5 hrs)
 - a. Rheological phenomena with non-spherical particles
 - b. Particle dynamics
 - c. Viscosity and viscoelasticity of relatively dilute systems
 - d. Concentration effects (maximum packing)
 - e. Fibre rheology
 - f. Platelets
 - g. Shear thickening
 - h. Non-spherical particles in viscoelastic media