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