



Suspension Rheology

1. Introduction: Course Overview

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Objectives

The course is designed to be an introduction to the rheology of colloidal dispersions with emphasis on practical measurement and interpretation of rheological measurements on colloidal dispersions. The object is to provide the participants with:

- **Qualitative understanding of the various phenomena that contribute to the rheology of suspensions;**
- **Scaling relations and quantitative laws to predict the basic rheology of such systems;**
- **Strategies to measure, characterize and design suspensions with well defined processing or application properties.**



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Outline Day 1

- 1) **Rheological Concepts and Rheological Phenomena in Colloidal Dispersions (1.5 hrs)**
 - a) Basic rheological concepts
 - b) Introduction to Colloids
 - c) Overview of rheological phenomena in suspensions (based on case studies)
- 2) **Hydrodynamic Effects (Suspensions of Large Particles) (1 hr)**
 - a) Dilute systems: Relative viscosity and Einstein relation
 - b) Semi-dilute systems: Batchelor relation
 - c) Concentrated systems (maximum packing, viscosity-concentration relations, effect of particle size distribution)
- 3) **Suspensions of Brownian Particles (1.5 hrs)**
 - a) Mechanism of Brownian motion
 - b) Contribution of Brownian motion to the viscosity
 - c) Viscoelasticity in suspensions of Brownian Hard Spheres, scaling relations
- 4) **Colloidally Stable Suspensions (2 hrs)**
 - a) Electrostatic and Steric stabilization, resulting suspension structure
 - b) Effect of interparticle repulsion on dilute suspensions
 - c) Viscosity of concentrated stable suspensions, scaling relations
 - d) Viscoelastic effects, link to interparticle potential, scaling relations
 - e) Shear thickening


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Outline Day 2

- 5) **Flocculated Suspensions (2 hrs)**
 - a) Mechanisms of flocculation (electrostatic, depletion, bridging...)
 - b) Structure of flocculated systems (flocs, agglomerates, particle gels; their description in RDF, fractals, percolation theory, stat diagrams).
 - c) Viscosity of dilute, flocculated systems
 - d) Gels and glasses
 - e) Thixotropy (reversible time effects)
- 6) **Rheological Measurements of Suspensions (1.5 hrs)**
 - a) Special requirements and problems (based on case studies)
 - b) Measurement strategies
- 7) **Case studies(1.5 hrs)**
 - a) Flocculation vs. bridging
 - b) Electrosteric stabilization
- 8) **Advanced Topics in Colloidal Suspension Rheology (2-3 hrs)**
 - a) Suspension in viscoelastic media (filled polymers, nanocomposites)
 - b) Suspensions containing non-spherical particles (fibers, rods, ...)


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Instructor Introduction



- With over 50 years of academic and industrial research experience in the colloid rheology laboratory, including over 100 publications and patents on the topic, Professors Mewis and Wagner have prepared a short course designed for introducing a beginning colloid rheologist to the field. This course is based on a text currently in progress. Both have lectured extensively on the topic and have taught short courses at both the beginner and more advanced levels, including courses for the Society of Rheology in the US and the European Rheology Society in Europe.
- Web Cites with Detailed Instructor Information:
- Mewis: www.kuleuven.be/cv/u0010977e.htm
- Wagner: www.che.udel.edu/wagner





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