Colloidal stability, Latex & Emulsions

Course coordinator: taton@enscbp.fr

European credits ECTS: 6

Teaching Language: English

Supporting files: English

	Number of course slots (1h20)	**Number of course slots (4h)**
Magisterial	30	
Tutorials	9	
Practical		

Description

- Acquiring the basic concepts of colloidal stability.
- Describing the different interactions between particles in a dispersion to foresee the dispersion stability.
- Acquiring the basic concepts of emulsions
- Acquiring the basic concepts of the rheology of particle suspension
- Acquiring basics on paint rheology and cement media

Outline

Part 1: Polymerization reactions in dispersed media

Introduction

- Macromolecular engineering
- Terminology – Vocabulary - Definitions
- Interest and main applications of dispersed media
- Natural latexes vs. synthetic latexes
- Stabilization
- Film formation resulting from a latex
- Polymerization reactions (chain- vs. Step-growth)
- Seeded process
- Features and main characterization techniques

Polymerization in dispersed media (mechanisms, kinetics)

- Advantages – Various cases
- Polymerization in dispersion
- Polymerization in suspension
- Polymerization in emulsion
- Polymerization in inverse emulsion
- Polymerization in miniemulsion
- Polymerization in microemulsion

Raw materials

- Monomers
- Surfactants
- Initiators
- Transfer agents
- Additives

Examples of industrial latexes

- Acrylic-type
- Acetate-type
- SBR

Examples of hybrid organic / inorganic latexes

- Strategies – Interest
- Composites latexes by polymerization in situ from a metallic oxide
- Nanocomposites based on clay
- Coating of a latex by an inorganic component

Controlled radical polymerization in dispersed media

Part 2: Colloidal stability

Colloidal dispersions

- Definition
- Classification
- Examples
- Preparation methods
- Introduction to formulation
- Introduction to colloidal stability

Gravity instability and method to counter it

- Origin
- Rate of precipitation
- Slowing of particles movement

Surface instability and method to counter it

- Surface energy
- Ostwald ripening

- Dissolution-crystallization process
- Mechanisms of Aggregation
- Types of aggregates

Stabilization by electrostatic approach

- Van der Waals interactions; the Hamaker theory
- Expression of van de Waals energy between particles and influence of different parameters
- Electrostatic interactions: origin, range and intensity
- DLVO theory
- Definition of the critical coagulation concentration

Other types of interactions

- Steric interactions
- Bridging interactions
- Depletion interactions

Part 3: concepts of emulsions

Overviews about emulsions

- Definitions
- Different types of emulsions
- Drop size distribution
- Clarification: emulsions, microemulsions, nanoemulsions, miniemulsions

Interfaces and energies

- What is the meaning of "immiscible fluids"?
- Surface energy of an emulsion
- Metastability or thermodynamic stability?
- Surface stabilizer
- Adsorption: spontaneous, reversible or irreversible

Elaboration of emulsions

- Mechanical energy
- Phase inversions

Dispersion states/interactions

- Reminder of the interaction between drops and consequences on the dispersion state of emulsions
- Creaming/sedimentation
- Special focus on depletion

Metastability of emulsions

- Ostwald ripening
- Coalescence

Mechanical properties of emulsions

- Dilute regime
- Concentrated regime

Multiple emulsions

- Definition
- Fabrication
- Destabilisation mechanisms

Pickering emulsions

- Definition
- What particles?
- Adsorption at interfaces and limited coalescence
- Original properties

Emulsions comprising solid oils

- Definition
- Partial coalescence
- Gelling of emulsions
- Churning

Emulsion-based materials

- Solid foams
- Capsules

Part 4: Rheology of particle suspensions

Generalities

- Steric interactions
- *Origin of the stress in particle suspension*

Case of Hard spheres.

- *Einstein Law, Batchelor, Krieger Dougherty…*

Recall on interactions, stabilization forces, consequences on the viscosity of suspensions

- *Shape effect*
- *Behavior of suspensions under shear flow, Peclet Number*

Basics on extensional viscosity

Applications: Paint Rheology, cement media