ADVANCED CHARACTERIZATION OF MINERAL/WATER INTERFACE

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Work load: 10 h lectures / 15h laboratory
Number of credits: 2ECTS
Course code: 8KUEVN21

► *Intended learning outcomes:*

After completion of the course, the student will have knowledge on the surface reactivity of particulate solid matter.
The students will be able to use various techniques to measure the structural, textural and surface properties of particulate matter, and will be able to quantify several descriptive parameters.
The students will know how to handle the mostly used descriptive models, and be able to calculate thermodynamic parameters".

► *Relation with overarching learning outcomes:*

This course is focused on the OLO “Research skills and competencies (EIT OLO 5)”.
It focuses on teaching the latest techniques regarding characterization of mineral surfaces so that they can be applied in understanding mineral purification and recovery and developing innovative by flotation methods.

1. ADVANCED CHARACTERIZATION OF THE MINERAL SURFACE (J.P. Pinheiro)

► *Contents:*

1. Introduction to the colloid and surface physico-chemistry
The colloidal state - size, shape, surface area - surface energy.
Experimental methods for size determination: Laser light diffraction, dynamic light scattering, different microscopies (optical, TEM, SEM, atomic force microscopy).

2. Experimental methods to study adsorption processes at the solid-gas interface. The Langmuir and Freundlich isotherms - the energetic surface heterogeneity. The BET, BJH and other techniques to determine the textural properties of solids.

3. Adsorption processes at the solid-liquid interface. Chemical, physical and spectroscopic techniques to study the surface reactivity and heterogeneity: electrophoretic mobility, Infrared spectroscopy, XPS, Force AFM.

► *Laboratory work :*

Pratical works on: Size determination, Adsorption on mineral surfaces, electrophoretic mobility, Electron Microscopy, Infrared spectroscopy.

Demonstration: Atomic force microscopy, Gas Adsorption by BET

► *Prerequisites :*

General knowledge of physics and chemistry at first degree level.

► *Assessment methods:*

Written exam (50%) and laboratory report (50%).

The assessment in this course is both competence based since the laboratory practical's and report focuses on the learning outcomes and demands that the student demonstrates the ability to use the facts learned in the course reports and content based since the exam inquires directly about the facts learned in the course.

2. Physical chemistry of flotation (L.Filippov, A.Otsuki)

► *Objectives:*

Learn how to analyze the expression of surface forces due to the comminution of solid and during mineral-fluid interactions; characterize interfaces and deduce applications to natural and separation processes.

Description of phenomena at solid-liquid and liquid-gas interfaces in order to analyze the adsorption mechanisms of various surfactants and to choose the flotation reagents.

► *Contents :*

Introduction to particulate systems, methods of obtaining, characterization.

2. Surface - surface effects.
2.1 Free surface energy – surface tension, Capillarity - phenomena in the pores, Wettability and adhesion work, contact angle, Young-Dupre law.

2.2 Interface: Hydration of the mineral surface. Electrical Double Layer- electrokinetic phenomena, zeta potential.
2.3 Adsorption: Physisorption, chemisorption. Adsorption isotherms
2.4 Thin films, disjunction pressure P (h) - DLVO theory; Attachment - Application for aggregation and flotation.
2.5 Surfactants : classification of surfactants,
2.6 Flotation reagents: collectors – modifiers – frothers
2.7 Modelling of adsorption mechanisms on the sulfides and oxides minerals

► *Prerequisites :*

Basic knowledge in chemistry and physics

► *Form of Exam :*

1. Continuous evaluation during the training classes
2. Final written exam during 3 h.

► *Intended learning outcomes*

After completion of the course, the students will know the various forces and their parameters that control the interaction between solids and between solid and bubble. The student is expected to define the mechanisms of reagent adsorption and how this will affect the surface properties. They will be able to manipulate the solution conditions and mineral surface properties to increase flotation and mineral separation and will be able to define the optima reagents regimes used for sulfide and oxide mineral flotation

► *EIT Overarching Learning Outcomes (OLOs)*

The learning outcomes are related to apply the fundamental knowledge acquired to develop the practical solutions for the mineral surface characterization and separation processes

OLO 4: Fundamental knowledge to develop new interface efficient reagent formulations.

OLO 5: State-of-the art techniques for characterization of mineral surfaces.