MINERAL PROCESSING I

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Work load: 30h Theory (lectures), 30h Practice (lab)
Number of credits: 5 ECTS
Course code: GEOL0314-1
Source: http://www.emerald.ulg.ac.be/?q=mineral-processing-i

► *Objectives:*

The objective o f the course is to introduce the theoretical aspects of common mineral processing techniques and the associated equipment utilized nowadays in mining and extractive metallurgy practices. Students will be acquainted with the basics of solids separation principles when applied to ores and minerals, from the mine down to concentrates production. The course covers both well-established mineral processing techniques such as gravitational, magnetic, chemical and physicochemical methods likewise an emerging ones such as selective fragmentation, dry-based sorting, and novel column flotation. The increased needs in processing of finely disseminated mineral ores and ultrafine grinding for improved liberation and associated energy expenditures as well understanding the link between grinding and flotation are discussed as well.

The course is designed is such a way as to enable students to perceive right from the beginning the challenges facing the modern mineral processing industry in terms of resource efficiency through development of improved sorting equipment, circuit modeling and simulation and geometallurgical consideration. At the end of this introductory course, students will possess the pre-required background and will be prepared to follow the in-depth basic (S8) and advanced and specialized courses (S9) in mineral processing.

► *Course contents:*

Basic techniques for bulk solids characterization and their implication to fragmentation, mineral phase liberation and estimation of separation efficiency. Sampling of particulate materials.

Size reduction principles, fragmentation theories and energy requirements for size reduction. Work index of ores. Type of crushers and their integration in circuit design.

Milling, screening and classification. Milling – theoretical basis, mill rotation and critical speed aspects. Type of mills and comminution circuit arrangements. Screening – principles, type of screens and selection criteria. Classification – principles, type of classifiers, design features.

Mineral beneficiation techniques: gravity, magnetic, electrostatic, physicochemical (froth flotation), hydrometallurgy – theory and associated equipment. Examples of unit operations.

► *Intended Learning Outcomes:*

After completion of the course, the student will be able to:

- Understand the basic principles behind the major mineral separation processes and the respective equipment used in unit operations
- Understand the need for energy, mass and water reduction in achieving process efficiency
- Integrate various processing techniques to elaborate a complete flowsheet to recover of valuable mineral and metal from a particular ore
- To make a logical link between applied mineralogy, mineral processing and economics of metal production
- Apply the knowledge learned as to being capable of understanding advance courses on mineral processing operations and modeling

► *Prerequisites and co-requisites:*

- It is advisable, but not compulsory that the student possesses a basic knowledge in geology, mineralogy and process engineering

► *Planned learning activities and teaching methods:*

Practical works: Realization of complete laboratory testing of a particular ore: sampling, comminutionand recovery technics. Students will be working by group on a given ore that will be characterized during Process Mineralogy practical works. Students will present and comment their lab testing results in a report and orally defend it.

► *Recommended or required readings:*

A detailed Power Point presentation is available through the E-campus portal

<u>Recommended</u>:

Wills B., Munn-Napier T.J., Mineral processing technology: an Introduction to the practical aspects of ore treatment and mineral recovery. Seventh edition, Butterworth-Heinemann Ltd, 2006

Fuerstenau M., Han K, (eds.), Principles of Mineral Processing. SME, 2003

Gupta A., Yan D., Mineral processing design and operation: an Introduction. First Edition, Elsevier, 2006

Lynch Alban (ed) Comminutionhandbook, AusIMM, 2015

Recent Advances in Mineral Processing Plant Design by Deepak Malhorta, Hardcover: 592 pages,

Publisher: Society for Mining, Metallurgy and Exploration, Oct. 1, 2009

► *Assessment methods and criteria:*

Competence based: Intended learning outcomes will be assessed in a way as that the student being able to demonstrate the application of the learned skills. Learning curve improvement will be followed during and after lectures in forms of Q&A and problems discussion, but also through student's performance during lab sessions and especially through final report presentation. The final report aims to present the results in detail and on that basis to elaborate and defend the choice of a realistic flowsheet with mass and recovery balancing of the metal of interest. The choice should be based on literature review and the discussion should be based on proposing alternative options. Therefore it is foreseeable that the competences acquired during the course will be illustrated in a quite convincing manner.

Final grade (% of credit): Oral exam - 70 %; Practical reports - 30 %

► *Contribution to EIT's Overarching Learning Outcomes:*

The EIT OLO which is mostly matching the course is n° 6 since the student will be able to transform practical experiences into research problems and challenges. An example of OLO 6 could be given as the way students will treat mineralogical and rock hardness data in choosing the appropriate mineral processing scheme (crushing/grinding/flotation). Another example will be the need to understand the role of a grinding mill other than of a unit reducing particle size and liberating valuable minerals only. Here the students will be invited to discuss the coupled mechanisms taking place inside the ball mill when considered as a reactor preparing the pulp for flotation. The students will have to show non-traditional way of thinking when they consider the grinding process as a preconditioning step.

OLO 5: Using fundamental science knowledge to recover valuables from rocks

OLO 7: Oral presentation of group findings stemming from practical exercises