WASTE & BY-PRODUCTS PROCESSING

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Work load: 30 h lectures and 30 h exercises
Number of credits: 5 ECTS
Course code: GEOL0315-1
Source: http://www.emerald.ulg.ac.be/?q=waste-and-products-processing

► *Objectives:*

Course objective is to introduce the notions of "urban mining" and the use of unit operations known from the mineral processing technology within the treatment of solid wastes and their by-products. Students will be acquainted with the current statistics and demand-to-supply trends of economically important raw materials and the emerging technologies driving their use. The course will raise the question on how recycling could contribute in overcoming materials shortage and which are the technological challenges in management and processing of EoL "End-of-Life" goods, likewise what are the limits of recycling. The course will discuss specific separation units developed for the waste processing industry (shredders, sorters, eddy-current and ballistic separators). Practically relevant examples including emblematic case studies of (re)processing of solid wastes and their by-products will be given highlighting the technological efficiencies and flow-sheets rearrangements.

► *Course Contents:*

- Introduction to urban mining concept.
- Technical basis of recycling.
- Demand supply fundamentals
- Current situation in the area of metals recycling.
- Recycling activities as complement to primary mining activities
- Emerging technologies and demand for raw materials.
- Recycled metals as a substitute to primary raw materials
- Requirements for quality/quantity of recyclates
- Challenges in unit operations and technological concepts.
- Specifics in liberation of value-added fractions belonging to "secondary" resources
- Case studies of re-processing EoL streams (End-of-Life batteries, End-of-Life vehicles, e-scrap, plastics and composite materials)

► *Intended learning outcomes (ILOs):*

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

- Understand how the methods originally developed for mineral processing industry have been adapted in the solid waste processing sector
- Understand how the complex composition of the waste resources and the intrinsic value of materials they contain influence the choice of process chain
- Understand the main stages involved in processing of metal-bearing EoL goods
- Get acquainted with practical scenarios of processing solid wastes containing valuable materials
- Get aware about processing advances in recovery of critical metals from EoL streams

► *Prerequisites and co-requisites:*

- Notions of metal production and value chains as well as process engineering are desired.

► *Planned learning activities and teaching methods:*

Ex-cathedra theoretical lectures
Practical exercises in lab: Computer dismantling; fractions purifications by physical separation; metals recovery by leaching and solvent extraction; circuit development; metals balancing
Site visits

► *Recommended or required readings:*

A detailed Power Point course presentation is available through the e-Campus portal
Recommended books
Christensen T., (ed.), Solid waste technology and management, Blackwell publishing, 2011
Tchobanoglous G. et. al. Integrated solid waste management: Engineering principles and management issues, McGraw-Hill, 1993
Worrell, W., Vesilind P. A., Solid Waste Engineering, Second edition, SI edition, 2012
Williams Paul T., Waste treatment and disposal Wiley-Blackwell; 2005, 2nd Edition
Metal Recycling: Opportunities, Limits, Infrastructure; UNEP Report, Lead Author : Markus REUTER, 2013

► *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 assessed over regular Q & A sessions during and after lectures, but also through student's

performance in lab exercises and final report presentation. The final report itself is intended to result in elaboration of a real flowsheet and hence will serve as a vehicle to illustrate the application of the competences acquired during the course.
Final grade (% of credit):
Written exams - 70 %; Practical reports - 20 %; Report from technical visit – 10 %

► *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. A good example of this OLO is the way the students will perceive the characterization related challenges in quantifying EoL goods and how these characteristics will turn to be a decisive factors in choosing the appropriate processing scheme.
OLO 4: The practical experience which the student will gain in process oriented characterization of specific waste streams during the lab sessions will inevitably pose research questions related to the choice of one or another way of material fragmentation in order to liberate the constituents for their further down-stream processing. The students will have to anticipate considering several factors to warrant the choice of final processing method.
OLO7: Reporting group findings and discussing practical implications of results.