

Course Specifications

Valid in the academic year 2023-2024

Metal Extraction and Recycling (E065472)

Course size		(nominal values; actual values may depend on programme)					
	Credits 6.0 Study time 180 h						
Cours	e offerings and tea	ching methods in academic y	ear 2023-2024				
A (semester 2)		English Gent		lecture			35.0h
					seminar		
	B (semester 2)	Dutch	Gent				
Lectu	rers in academic ye	ar 2023-2024					
	Bellemans, Inge TW11			TW11	lecturer-in-charge		
	Vervynckt, Stephani	e		TW11	co-lecturer		
Offered in the following programmes in 2023-2024					crdts	offering	
	Bridging Programme Master of Science in Sustainable Materials Engineering				6	А	
	International Master of Science in Sustainable and Innovative Natural Resource Management				6	Α	
	Master of Science in Chemical Engineering				6	А	
	Master of Science in	Chemical Engineering			6	А	
	Master of Science in	Materials Engineering			6	В	
	Master of Science in	Sustainable Materials Engine	ering		6	А	

Teaching languages

English, Dutch

Keywords

Recycling, primary raw materials vs. secondary, pyrometallurgical processes, hydrometallurgical processes, electrometallurgical processes, thermodynamics, thermodynamic software and databases, extraction and separation of metals, environmental and safety aspects

Position of the course

This course covers the basics regarding metallurgical processes (pyro-, hydro- and electrometallurgy). In addition, the building blocks of a metallurgical flowsheet are investigated. The production process of a number of metals is studied through several case studies. Insight is gained into the recycling problems and the recycling potential. The link to industrial reality and application is always made.

Contents

- General definitions in thermodynamics, first, second and third law of thermodynamics, thermodynamic quantities, Gibbs free energy and reaction equilibrium
- Different tools: Phase diagrams (binary and ternary), Ellingham diagrams, Predom diagrams, Pourbaix diagrams, Evans diagrams
- Basic principles and processes in extractive metallurgy (pyro-, hydro-, electroand biometallurgy)
- Case studies for the production and recycling of various metals (e.g. Cu, Pb, battery materials) using pyro-, hydro-, electro- and biometallurgical processes in reality
- Flowsheet design: general rules for the design of a flowsheet
- Knowlegde management: data versus noise, design or experiment
- Quality, environmental, health and safety aspects

Initial competences

Basic chemistry knowledge from bachelor

Final competences

- 1 Knowledge of concepts regarding thermodynamics, basic processes in metal production, extractive metallurgy of different metals, recycling issues & potential and flowsheets
- 2 Application of concepts around thermodynamics and the tools provided (phase diagrams, Ellingham diagrams, Predom diagrams, Pourbaix diagrams, Evans diagrams)
- 3 Understanding modern production techniques of base metals (copper, lead) and precious metals: environmental aspects of metal production (emissions, energy consumption,...); Use of recycled raw materials; Design of flowsheets for metal production
- 4 Use and interpretation of thermodynamic software and knowledge of its limitations
- 5 Be able to design a scientifically and economically sound flowsheet

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture

Learning materials and price

Syllabus and lecture slides.

References

- P. Hayes, 'Process Principles In Minerals And Materials Production With A Focus On Metal Production And Recycling', Fourth edition, 2021
- M. E. Schlesinger, K. C. Sole, W. G. Davenport., 'Extractive metallurgy of Copper' Sth Edition, 2011
- D. R. Gaskell, 'Introduction to the thermodynamics of materials', Taylor&Francis, 2003
- F. Habashi, 'Handbook of extractive metallurgy', Wiley, 1997

Course content-related study coaching

In person: after class + by electronic appointment.

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment

Examination methods in case of periodic assessment during the second examination period

Written assessment

Examination methods in case of permanent assessment

Participation, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible in modified form

Extra information on the examination methods

- Periodic evaluation: written exam with closed book.
- Permanent evaluation: assessment of practical work (participation, attitude) and reports (preparation, participation, report, assessment PC software use)

Calculation of the examination mark

There are two parts to this course: practical work (permanent evaluation; counts for 4/20 of the total score) and exam (periodic evaluation; counts for 16/20 of the total score).

The final score is calculated on the basis of two sub-scores. Each of the sub-scores requires a minimum of 7/20 to pass the exam. If this is not the case and the final score would be a mark of 10 or more out of 20, it will be reduced to the highest

unsuccessful mark (9/20). For the purpose of retake examinations, transfer of partial scores is possible, provided that the student has obtained at least 10/20 for this part.