GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2022-2023

Biotechnology in Mining (I002846)

Course size *(nominal values; actual values may depend on programme)*

Credits 5.0 **Study time 150 h** **Contact hrs** 67.5h

Course offerings in academic year 2022-2023

A (Year) English Gent

Lecturers in academic year 2022-2023

Schlöhmann, Michael FREIBE01 lecturer-in-charge

Offered in the following programmes in 2022-2023	crdts	offering
International Master of Science in Sustainable and Innovative Natural Resource Management	5	A

Teaching languages

English

Keywords

Position of the course

Contents

1. Basics: concepts of microbial energy metabolism, chemolithotrophic growth, diversity of electron donors and acceptors, microbial redox reactions.
2. Processes in conventional metal winning.
3. Basic setup of bioleaching and biooxidation operations: heap leaching, reactor leaching, and their respective advantages and problems.
4. Microorganisms relevant for aerobic bioleaching: relevant properties, taxonomy, communities, succession.
5. Methods for the cultivation and characterization of microbial strains and communities.
6. Microbe-mineral interactions: attachment, bioleaching mechanisms, formation of secondary minerals.
7. Important pathways in energy metabolism and biomass formation: proteins/pathways involved in iron and sulfur oxidation, uptake mechanisms (siderophores), CO2 fixation, nitrogen metabolism, energetic problems.
8. Environmental challenges for and responses of bioleaching microorganisms: acidity, oxidative stress, metal toxicity, osmolarity, temperature.
9. Current trends for the improvement of aerobic bioleaching: chalcopyrite bioleaching, bioleaching of arsenic containing materials, use of salt-containing waters for bioleaching, in situ-bioleaching, bioleaching of electronic scrap.
10. Reductive bioleaching: iron- and manganese-reducing microorganisms, examples of reductive bioleaching.
11. Bioflotation.
12. Biological methods for winning metals from the aqueous phase: biological sulfafte reduction and biological iron oxidation as active treatment options, wetlands, biosorption.
13. Lab course: Techniques for cultivation of acidophilic bacteria, measurement of parameters to follow growth and leaching activity of relevant microorganisms.

Initial competences

Mandatory: Bachelor degree in a natural science or in mining- or metallurgy-related engineering. Grundlagen der Biochemie und Mikrobiologie und Mikrobiologisch-biochemisches Praktikum oder Microbiology for Resource Scientists: Lecture und

Microbiology for Resource Scientists: Lab Course oder equivalent
Recommendations: Basic knowledge in chemistry.

Final competences

In an interdisciplinary approach the students will obtain an understanding of the general concept of bioleaching for the winning of metals, and specifically of the advantages and problems of various process options. The students will understand the involvement of different types of microbes, the stresses to which the microbes are exposed and how they may react. They will also obtain an understanding of the generation and of the biotechnological treatment options for acidic mine drainage. In a lab course the students will obtain experience with methods and problems related to the cultivation of microorganisms relevant for bioleaching or mine water treatment. They will also gain experience in analytical methods to describe and control corresponding processes. In a seminar the students will gain experience with current literature and with reporting about it to other participants. In addition, the students will exercise to plan a lab-scale bioleaching process.

Conditions for credit contract

This course unit cannot be taken via a credit contract

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Excursion, Lecture, Integration seminar

Extra information on the teaching methods

S1 (WS): Lectures (2 SWS)
S1 (WS): Seminar (1 SWS)
S1 (WS): Practical Application (1 SWS)
S1 (WS): Excursion (0,5 SWS)

Learning materials and price

References

W. Reineke & M. Schlömann: Umweltmikrobiologie, Springer Spektrum, 2015.
D. R. Lovley (Ed.): Environmental Microbe-Metal Interactions, ASM Press, 2000.
D. E. Rawlings & D. B. Johnson (Eds.): Biomining, Springer, 2007.
E. R. Donati & W. Sand (Eds.) Microbial Processing of Metal Sulfides, Springer, 2007.
L. G. Santos Sobral, D. Monteiro de Oliveira & C. E. Gomes de Souza (Eds.): Biohydrometallurgical Processes: a Practical Approach, CETEM/MCTI, 2011.
A. Schippers, F. Glombitza & W. Sand (Eds.): Geobiotechnology I. Metalrelated Issues, Springer, 2014. Abhilash, B. D. Pandey & K. A. Natarajan (Eds.): Microbiology for Minerals, Metals, Materials and the Environment, CRC Press, 2015.
H. L. Ehrlich, D. K.Newman & A. Kappler: Ehrlich's Geomicrobiology, CRC Press, 2016.
R. Quatrini & D.B. Johnson: Acidophiles. Life in Extremely Acidic Environments. Caister Academic Press, 2016.

Course content-related study coaching

Assessment moments

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

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

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible

Extra information on the examination methods

For the award of credit points it is necessary to pass the module exam.

Calculation of the examination mark