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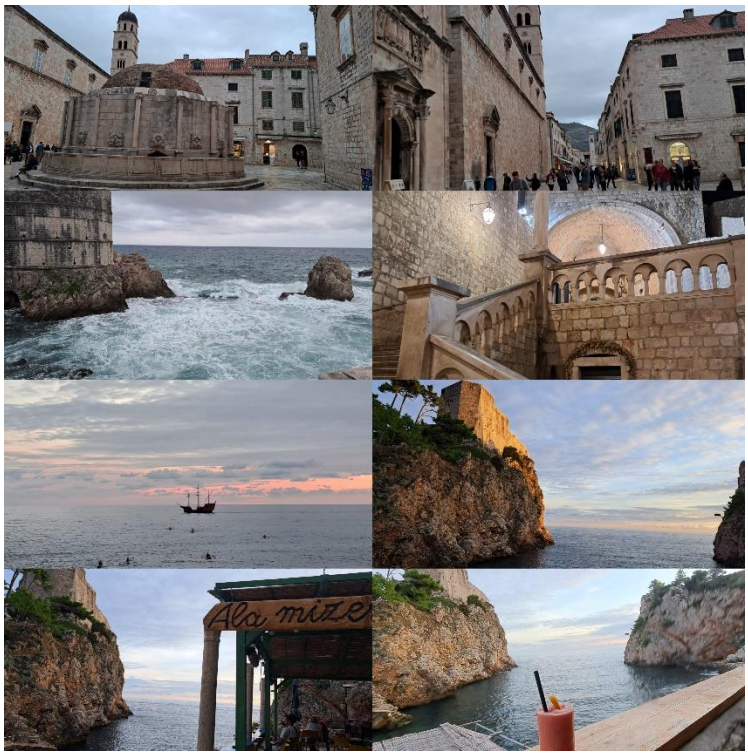
Dubrovnik International ESEE Mining School – DIM ESEE 2

INNOVATIONS IN ORE PROCESSING
16th – 18th October 2024

2024 PROMOTIONAL BOOKLET

(DRAFT VERSION)

Containing: Technical description of the workshops, lecturers` short autobiographies and lectures` descriptions



REGISTRATIONS:

https://dim-esee.eu/registration-and-fees/

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Abstract

Nowadays mineral deposits are generally becoming lower grade and mineralogically more complex. The mining industry has responded to this challenge by innovating and developing technologies that have increased efficiency and productivity, some through the increase in scale and capacity, some by challenging the norms of processing some by introducing secondary processing, and by investing in a circular economy.

The current focus of innovation in mineral processing is towards increasing production rates (with the same equipment), reducing capital and unit operating costs as well as minimising energy, water, and environmental impact while aligning with the legislative framework. Pre-concentration technologies, more energy-efficient comminution technologies and circuits, coarse particle recovery, and storage of dry-stacked tailings are examples of areas where significant fundamental innovation impacts process plant design.

The DIM-ESEE 2: Innovations in Ore Processing Course will include lectures from academic staff and industry experts along with hands-on learning challenges faced by the RM sector in the processing of ore and waste materials for the sustainable recovery of the contained mineral values. The course shall provide insights on various aspects related to innovation in the sector and highlight the importance of such innovations for the sustainability of the RM Sector. Participants will be given a unique opportunity to interact with some of the leading specialists and innovators in the field.

Lecturers

Em. Prof. Ioannis PASPALIARIS (NTUA)
Em. Prof. Katerina ADAM (NTUA)
Assoc. Prof. Maria TAXIARCHOU (NTUA)
Dr. Emmy GAZEA (Hellas Gold S.A)
Dr. Panagiotis XANTHOPOULOS (Sunlight Battery Systems)
Dr. Efthymios BALOMENOS (NTUA)
Mrs. Evangelia MYLONA (NTUA)
Dr. Panagiotis ANGELOPOULOS (NTUA)

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Prerequisites

Raw materials professionals with good command of English language and basic knowledge related to the Workshop topic, working in one of the following fields: Ore processing, Metallurgical Engineering, Mining Engineering, Environmental Engineering, Applied Earth Sciences, and similar.

We particularly encourage applications of professionals from the following countries: Armenia, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Georgia, Greece, Hungary, Italy, Kosovo, Latvia, Lithuania, Malta, Moldova, Montenegro, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Turkey, Ukraine.

Learning Outcomes

A. Knowledge-based Outcomes

- Understand the importance of critical and strategic raw materials in the ESEE section
- Get familiar with the various processing techniques for primary and secondary raw materials to produce marketable products
- Obtain an overview of the content and approval process of the regulatory EIA and ESIA studies, Environmental Auditing, and Environmental and Social Management Plans (ESMPs)
- Understand the core principles of scaling up a process from laboratory to pilot and industrial scale
- Get familiar with the characterization and disposal systems of mine waste
- Be able to select the most appropriate mine waste treatment scheme
- Articulate the fundamental principles of a project's feasibility and evaluate whether or not a project plan could be successful
- Apply the principles of their discipline to new or complex environments

B. Skill-based Outcomes

- Collaborate effectively in professional teams and in interdisciplinary contexts
- Increased confidence in their ability to problem-solve
- Better understanding of the importance of collaboration
- Apply oral, written and visual communication skills to present a coherent reply on a specific challenge set
- Demonstrate critical thinking based on their professional knowledge/skills while incorporating new subject knowledge

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PRELIMINARY PROGRAM

Every day will provide a balance of theoretical presentations by the lecturers and technical challenges for the participants. Two lectures will be delivered online.

Needs for the development of this module

This three-day course, organized in a hybrid form, will focus on the technological innovations applied in the processing of primary and secondary raw materials as well as the environmental and economic aspects of these process schemes through an integrated approach. The course will include lectures from academic staff and industry experts along with hands-on learning challenges faced by the RM sector in the processing of ore and waste materials for the sustainable recovery of the contained mineral values. The trainees will work in teams to address the challenges set by the lecturers/mentors in order to develop their critical thinking skills and take an active role in their learning.

DAY 1 – INNOVATION IN THE PROCESSING OF PRIMARY AND SECONDARY RAW MATERIALS

- Critical and Strategic Raw Materials in the ESEE region
- Innovation in ore processing for the production of marketable concentrates
- Metallurgical processing for basic metals and CRM recovery - The Case study of Bauxite

Practical session: Presentation of Challenges

DAY 2 – ENVIRONMENTAL IMPACT ASSESSMENT OF PROCESSING OPERATIONS AND ENVIRONMENTAL MANAGEMENT SYSTEMS

- Environmental Impact Assessment (EIA), Legislation/Regulations
- Mine waste management: Characterisation, treatment, and disposal systems
- Environmental and social management system (ESMS): The case study of Kassandra Mines of Hellas Gold SA
- Processing and utilisation of industrial minerals/Life Cycle Assessment (LCA)

DAY 3 – ECONOMIC ASSESSMENT OF INVESTMENTS

- Feasibility Studies
- Investments in Circular Economy: The Case study of EoL LFP Battery recycling

Practical session: Presentation of trainees' projects on challenges

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LECTURER: Panagiotis M. Angelopoulos (NTUA)

Dr. Panagiotis M. Angelopoulos has an MSc in Mining& Metallurgical Engineering (2007) and a PhD in Mineral Processing (2013) from the National Technical University of Athens (NTUA). His PhD was on the development and modeling of a new process for the production of expanded microspheres. In 2016-2017 he was IKY-Siemens scholar for PostDoc on "Process development for the transformation of low-value volcanic glass to high added value, closed-structure expanded microspheres".

Since 2014 he has been working as a postdoc researcher at NTUA on projects related to metallurgical waste valorization, processes upscaling, sustainable minerals beneficiation, and processes optimization through simulation. He has more than 55 research publications in journals and conference proceedings. Since 2020, he has been a Research, Technical, and Marketing Consultant at the Perlite Institute. In 2016, he was awarded the Academy of Athens award for his work on the mathematical modeling of the perlite expansion process. In 2023 he was elected Laboratory and Teaching Staff at the School of Mining and Metallurgical Engineering of NTUA.

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LESSON + CASE STUDY: Innovation in ore processing for the production of marketable concentrates

Xanthates is a family of highly efficient collectors, widely used in the industry of sulphide minerals flotation. Xanthates are considered toxic and hazardous to the environment, and can pose significant risks to aquatic life and human health. The need for its replacement by other more environmental friendly reagents is of vital importance towards a more sustainable extractive industry.

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The lecture will be focused on lignin; a green sustainable reagent that is alternative to xanthates. Lignin is a green substance extracted from paper or wood pulp which is practically abundant. We will focus on some results from the use of lignin as a collector in the flotation of sphalerite, pyrite, and arsenopyrite from mixed sulfides. The quality of the obtained concentrates after the application of different xanthate replacement ratios will be presented and discussed, ending up with the optimum formulas. The challenge of reagent performance evaluation on industrial conditions and our strategy to achieve this will be discussed in detail.

LECTURER: Efthymios Balomenos (NTUA)

Dr. Efthymios Balomenos studied Mining and Metallurgical Engineering at the National Technical University of Athens (NTUA) and received his PhD degree in Thermodynamics in the same school in 2006. Since 2008 he has been working in the Laboratory of Metallurgy as a postdoc researcher focusing on sustainable process development, CO_2 mitigation strategies, exergy analysis, and resource utilization efficiency. He is involved in the research management and coordination of several collaborative large-scale research projects (ENEXAL, EURARE, SCALE, ENSUREAL, RemovAl, BIORECOVER, AlSiCaL, SISAL PILOT, HARARE, ReActiv) most of which focus on Bauxite Residue valorisation or alumina production. He has more than 90 research publications in journals and conferences proceeding with more than 1,300 citations and an h-index of 19. Since 2015, he has cooperated with MYTILINEOS - Metals as a senior consultant in R&D projects. He was a recipient of the TMS Light Metals Subject Award – Alumina & Bauxite in 2017 and since 2022 he has been on the ICSOBA board of directors. In 2024, he was elected as Assistant Professor at the School of Mining and Metallurgical Engineering of NTUA.

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LESSON: Metallurgical processing for basic metals and CRM recovery

CASE STUDY: The Case study of Bauxite

The lecture will present a comprehensive overview of the metallurgical processing involved in transforming bauxite ore into aluminium oxide, and ultimately, into primary aluminium metal. Special emphasis will be placed on the Bayer process, a pivotal ore processing method in the production cycle. Additionally, the lecture will explore the concurrent extraction of Critical Raw Materials (CRMs) from the by-products of the Bayer process. This segment will delve into the specifics of extracting gallium (Ga), vanadium (V), and scandium (Sc), particularly from the Greek bauxite ore processed at the MYTLINEOS alumina refinery.

LECTURER: Evangelia Mylona

Evangelia Mylona studied Mining and Metallurgical Engineering at the National Technical University of Athens (NTUA). She worked in the mining industry for 2 years and since 1998, she has been working as a researcher at NTUA. She is currently a member of the specialized technical laboratory staff. She has more than 25 years of experience on the environmental management of industrial wastes, especially characterisation, risk assessment, treatment and development of rehabilitation technologies of extractive and metallurgical wastes. She has participated as a senior researcher in several national and EC research projects associated with the environmental management of mining activities and has co-authored more than 40 articles published in Scientific Journals and Conference Proceedings. She has been actively involved for more than 20 years in the services provided by the Laboratory of Metallurgy to mining and metallurgical industries regarding the environmental characterisation and remediation of wastes.

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LESSON / CASE STUDY: Mine waste management: Characterisation, treatment and disposal systems

The lecture will provide a thorough overview of mine waste characterisation, treatment and disposal. Critical aspects including applicable European legislation, methodology for waste characterisation and classification, risk assessment and treatment methods to ensure physical and chemical stability of waste will be covered. Waste disposal options and best available techniques to prevent or minimise any adverse effects on the environment and health will be also presented. Specific examples of treatment and disposal methods for wastes exhibiting acid rock drainage potential and/or metal leachability will be described.

LECTURER: Gazea Emmy

Chartered Mining and Metallurgical Engineer, National Technical University of Athens (NTUA) with PhD in Environmental Engineering. Environmental Manager of HELLAS GOLD SA with thirty (30) years' of industrial experience in the environmental management of the mining sector. Main activities involve design and coordination of integrated environmental monitoring and management plans, extractive waste and liquid effluents management, environmental protection and reclamation projects as well as elaboration of technical and environmental & social impact assessment studies. Participation in a number of R&D projects with more than 20 publications in international journals and conference proceedings.

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LESSON: Environmental and social management systems (ESMS)

CASE STUDY: Kassandra mines of Hellas Gold SA

Kassandra Mines encompasses Skouries Mine and Plant including an Integrated Extractive Waste Management Facility (IEWMF); Olympias Mine and Plant; Stratoni Mines, Plant and Port; Kokkinolakkas Tailings Management Facility (TMF); and Greek Nurseries, an operational nursery adjacent to Olympias, used to support closure and revegetation work.

The aim of this lecture is to present the design and implementation of the ESMS for Kassandra Mines. It will include an overview of the content and approval process of the regulatory EIA and ESIA studies, Environmental Auditing, and Environmental and Social Management Plans (ESMPs).

The focus will be given to the Environmental Monitoring Program and the Management Plans on Air Emissions, Water Resources, Noise and Vibration, Extractive Waste, Non-Mineral Waste, Hazardous materials, Traffic and Transport, Biodiversity in relation to site clearance, Cultural Heritage in relation to pre-construction screening, Stakeholder engagement and Social Performance (community development, corporate social responsibility, and community investment) and Mine Closure.

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LECTURER: Panagiotis Xanthopoulos (Sunlight Group Energy Storage Systems S.A.)

Dr. Panagiotis Xanthopoulos has been working at the R&D Department of Sunlight Group Energy Storage Systems S.A. since 2023 and he is responsible for developing and demonstrating at pilot scale a sustainable technology for recycling LFP EoL and scrap. Prior to joining Sunlight Group, Panagiotis worked as a post-doctoral researcher in the SOLVEMET Group of the Department of Chemistry of KU Leuven (Belgium) and engaged in many bilateral and EU-funded projects related to metal extraction and recovery from various waste streams. Prior to this, he carried out his doctoral research in the same group within the framework of the H2020 MSCA-ETN SULTAN project, for the remediation and reprocessing of sulfidic mining wastes. Before moving to Belgium, he worked as an Environmental Consultant at ECHMES Ltd. in Athens, where he was involved in ESG and LCA projects for Greek industries. Panagiotis earned an integrated MSc degree in Mining and Metallurgical Engineering from the National Technical University of Athens and a PhD in Chemistry from KU Leuven.

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LESSON: Investments in Circular Economy

CASE STUDY: The Case study of EoL LFP Battery recycling

LFP batteries will dominate the stationary energy market (traction, ESS) with a demand exceeding 3,000 GWh per year by 2030 due to their low cost and intrinsic safety. Nonetheless, recycling of LFP batteries at industrial scale is limited or missing within EU region mainly due to economic concerns. Without proper management of the production scrap and LFP EoL, they can pose an environmental threat and a loss of the critical raw materials incorporated. This lecture will delve into the investment plans of Sunlight Group Energy Storage Systems S.A. to

develop and upscaling an environmental and economic friendly technology for the recycling of LFP waste streams. The different unit operations will be presented in details with focus on the major challenges that one has to overcome for bridging the gap between the laboratory and pilot scale.