

HOST ORGANIZATION

CERENA - Centro de Recursos Naturais e Ambiente
<https://cerena.tecnico.ulisboa.pt>

 Available
HOST ORGANIZATION DESCRIPTION [Read more](#)**ADDRESS**

Instituto Superior Técnico, Av. Rovisco Pais

AREA OF KNOWLEDGE

Physical Sciences, Mathematics and Engineering Panel

GROUP OF DISCIPLINE

Geology, Earth Sciences, Environmental and Atmospheric Sciences, Mining, Geological Engineering, Oceanography, Hydrology

GROUP LEADER

Prof. Leonardo Azevedo
leonardo.azevedo@tecnico.ulisboa.pt

RESEARCH PRODUCT / RESEARCH GROUP

SMART Project Information
<https://cerena.ist.utl.pt/projects/smart-distributed-ai-system-marine-plastic-debris-monitoring>

POSITION DESCRIPTION

Research Project / Research Group Description

The candidate will develop an exciting research topic under the ongoing project SMART - diStributed AI systeM for mARine plastic debRis monitoring - (see link below) on the development of physics-informed neural networks (PINN) for spatiotemporal modeling of maritime floating debris, with a focus on plastics drifting the oceans. As plastics are a threat to our precious oceans the objective of the work is to go beyond the state-of-the-art by coupling the automatic identification of floating maritime debris from satellite images with high-resolution ocean models into a physics-informed deep-learning algorithm. This numerical tool will allow modeling the spatiotemporal evolution (i.e., forecasting and hindcasting) of the system and should be easy to use so it can be immediately adopted by relevant stakeholders and public entities devoted to ocean clean-up. The main activities of the project comprise development and implementation of PINN to replicate high-resolution ocean models; the development and implementation of PINN to model the spatiotemporal evolution of particles in high-resolution ocean models.

The successful applicant will join a multicultural and highly motivated team of PhD and young researchers, at CERENA/Instituto Superior Técnico, with international collaborations on computational earth modeling. Our group develops innovative multi-scale approaches to model different earth systems covering the deep subsurface, the shallow subsurface, and the ocean. These methods are applied to the sustainable management of natural and energy resources.

Job position description

The research work will build upon the current developments on marine litter detection from satellite images and will be developed in three different phases: i) the implementation of machine learning methods to identify different types of marine litter from Sentinel-2 images accounting for uncertainty; ii) development and implementation of physics-informed neural networks to be used as a proxy of high-resolution ocean models already developed by a partner of the SMART consortium; iii) coupling i) and ii) to model the spatiotemporal evolution of the litter using deep learning.

These methods will be developed over an already existing deep learning framework at CERENA. The research tasks will be developed jointly with partners of the consortium and feedback from national and international entities (e.g., Portuguese Space Agency and ESA) are anticipated.

The candidate will be registered at the Earth Resources PhD Program at Instituto Superior Técnico, a high-quality and flexible doctoral program that brings together top-level training and teaching for young students. Former PhD students develop their skills in earth modeling using computational methods and are now leading professionals in academia and industry in fields related to mineral and energy resources.

Candidate's requirements: Candidates must hold an internationally recognized master's degree or present evidence of its completion in the nearest future) in a field of science and engineering related to CERENA activities (i.e., earth and energy resources engineering, geophysics, spatial data science). Prior experience in computer sciences and machine learning (i.e., basic knowledge of programming) is preferred. Additionally, candidates must be able to work independently, have a strong research-ethical approach, be creative in solving experimental challenges, and be experienced in writing technical/scientific reports in English (in speaking and writing). **Portuguese language knowledge is not a requirement.**

OTHER RELEVANT WEBSITES

Personal Page of Supervisor
<https://fenix.tecnico.ulisboa.pt/homepage/ist168809/resume>

Doctoral Program in Georresources
<https://fenix.tecnico.ulisboa.pt/cursos/dgeo>

Link to the Post-Graduation office where students can find all information on being a PhD student at IST
<https://posgraduacao.tecnico.ulisboa.pt/en/>

Institutional website from the host research center with information associated with the Group Leader and ongoing projects
<https://cerena.pt/>

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Physical Sciences, Mathematics and Engineering Panel

GROUP OF DISCIPLINE

Geology, Earth Sciences, Environmental and Atmospheric Sciences, Mining, Geological Engineering, Oceanography, Hydrology

GROUP LEADER

Prof. Maria João Pereira
maria.pereira@tecnico.ulisboa.pt

RESEARCH PRODUCT / RESEARCH GROUP

Project description at CERENA Website
<https://cerena.pt/projects/pharmastar-sustainable-valorization-endogenous-plants-serra-da-estrela-natural-park>

POSITION DESCRIPTION

Research Project / Research Group Description

This work aims to develop algorithms based on statistical learning and machine learning methods to map and quantify wild herbaceous plant species using remote sensing images. The identification of herbaceous plant species in multispectral remote detection images is difficult and challenging when the landscape is complex. In this case, the measured spectra are often mixtures of the spectra of more than one species, posing increased difficulties. Thus, accurate estimation requires unmixing which is an ill-posed inverse problem that involves estimating all or part of the number of endmembers and their abundances in each image pixel. The development of the work in two phases is expected: i) Regional scale: digital processing of Sentinel 2 satellite and Worldview images to identify pilot areas and ii) Pilot areas: multispectral survey with UAV and in situ sampling of species with a field portable spectroradiometer, followed by digital image processing for mapping and quantitative analysis of plant species. The use of images in different spatial resolutions is important to calibrate and validate the algorithms developed.

This work will be integrated into a multidisciplinary Pharmastar research project (funded by PROMOVE LaCaixa) that aims to investigate the use of endemic species from a protected area for the development of new pharmaceutical products to prevent diabetes. It is of the utmost importance to evaluate the location and stocks of these species under investigation to assess the sustainability of future industrial and commercial exploitation of pharmaceutical products. The uncertainty assessment of maps and of quantitative estimates is crucial for risk assessment.

Job position description

The successful PhD candidate will be given support and independence to lead their project under the guidance of Maria João Pereira and will be integrated into a multidisciplinary team composed of data scientists (Amílcar Soares, Manuel Ribeiro, and Leonardo Azevedo) and remote sensing experts (Sandra Heleno and Gabriel Goyannes) within Environment group of CERENA. This will provide excellent conditions for receiving expert training in data science and remote sensing. Furthermore, the project will be developed through active participation within the multidisciplinary PharmaStar project consortium.

The duties of the job involve: a) developing novel algorithms for the unmixing of pixels signals for mapping vegetation species; as well as integrating these methods into public repositories and toolboxes; b) participate in field surveys for acquisition of optical images using an UAV and ground truth samples; c) Process images to obtain maps and quantification of stocks and assess uncertainty, and d) submitting the results to international journals and conferences.

Candidate's requirements: Candidates must hold an internationally recognized master's degree (or evidence of its completion soon) in a field of science and engineering related to IST and CERENA activities. Candidates should have a strong research-ethical approach, be creative in solving challenges, must be able to work independently, and be experienced in writing technical/scientific reports in English (in speaking and writing). Preference will be given to candidates with knowledge of digital processing of optical remote sensing images and programming skills. Portuguese language knowledge is not a requirement.

OTHER RELEVANT WEBSITES

Link to the Post-Graduation office where students can find all information on being a PhD student at IST
<http://posgraduacao.tecnico.ulisboa.pt/en/>

Doctoral Program in Georresources
<https://fenix.tecnico.ulisboa.pt/cursos/dgeo>

Link to Prof. Maria João Pereira at CERENA webpage
<https://cerena.ist.utl.pt/user/636>

Institutional website from the host research center with information associated with the Group Leader and ongoing projects
<https://cerena.pt/>

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AREA OF KNOWLEDGE

Physical Sciences, Mathematics and Engineering Panel

GROUP OF DISCIPLINE

Geology, Earth Sciences, Environmental and Atmospheric Sciences, Mining, Geological Engineering, Oceanography, Hydrology

GROUP LEADER

Prof. Gustavo André Paneiro
gustavo.paneiro@tecnico.ulisboa.pt

RESEARCH PRODUCT / RESEARCH GROUP

Profile of Prof. Gustavo Paneiro at CERENA
<https://cerena.ist.utl.pt/user/573>

POSITION DESCRIPTION**Research Project / Research Group Description**

Heat waves, whose occurrence has been increasing throughout the last decades, are one of the main hazards associated with climate change. Consequently, wildfires have been increasing throughout the world, particularly, in the Iberian Peninsula (e.g. Nunes et al 2019; Sarro et al. 2021). Moreover, droughts and extreme temperatures also increase fire risk in the extraction industry, especially in the activities developed in open-pit mining.

To the best of our knowledge, studies and results that relate the effect of temperature on jointed rock masses are scarce. The proposed work aims to overcome this gap through the development of extensive experimental and numerical research work based on the development of physical and mechanical tests (e.g. specially designed triaxial compression tests, direct tensile strength tests) and the use of dedicated discrete and finite element methods software. The development of such works aims at the determination of rock-mass thermal characterization to assess its thermal decay due to an external heat source like fire and, consequently, rock mass stability analysis. Case studies including igneous (e. g. granite rock masses) and sedimentary (e. g. calcareous rock masses), either in Portugal and Spain will be considered.

High scientific impact in the field of geosciences is the first expected outcome and will lead the researcher to international recognition. As a general outcome, the obtained results can be used as the basis for the assessment of measures to be taken after the occurrence of wildfires in near-rock mass outcrops and excavations. Consequently, it will help the decision-making of specialists and geoscience engineers to overcome rock mass stability problems after, e.g., the occurrence of a fire.

Job position description

Candidates must hold an internationally recognized master's degree (or evidence of its completion in the nearest future) in a field of science and engineering related to IST and CERENA activities, namely in the field of Geosciences.

Candidates should have experience with experimental work, must be able to work independently, have a strong research-ethical approach, be creative in solving experimental challenges, and be experienced in writing technical/scientific reports in English (in speaking and writing). Portuguese language knowledge is not a requirement.

The Candidate will be acquainted with the leading edge technologies in laboratory testing in the field of Geosciences and Rock Engineering, e.g., triaxial servo-controlled compression test apparatus, nano-CT scanning, and all the consequent image analysis techniques.

OTHER RELEVANT WEBSITES

- Link to the Post-Graduation Office (PGO), the management office of all IST PhD programs

<https://posgraduacao.tecnico.ulisboa.pt/en/>

- Doctoral Program in Georresources description

<https://fenix.tecnico.ulisboa.pt/cursos/dgeo>

Sustainable recovery of critical raw materials to leverage clean energy transition and assessment of economic and technical feasibility | CERENA - Centro de Recursos Naturais e Ambiente**HOST ORGANIZATION**

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AREA OF KNOWLEDGE

Physical Sciences, Mathematics and Engineering Panel

GROUP OF DISCIPLINE

Geology, Earth Sciences, Environmental and Atmospheric Sciences, Mining, Geological Engineering, Oceanography, Hydrology

GROUP LEADER

Dr. Rui Jorge Coelho de Sousa
ruijcsousa@fe.up.pt

RESEARCH PRODUCT / RESEARCH GROUP

Website of CERENA Group where different information is included about facilities, the team, research lines, projects, publications and others.
<https://cerena.pt/>

POSITION DESCRIPTION**Research Project / Research Group Description**

Minerals are critical components for the rapidly growing clean energy technologies. An increasing demand is expected as clean energy transitions gather pace. Lithium, nickel, cobalt, manganese and graphite are essential to battery performance, durability and energy density. Rare earth elements are important for permanent magnets for wind turbines and Electrical Vehicles (EVs) motors. Copper and aluminum are essential for electricity networks. EVs and battery storage displaced consumer electronics to become the largest consumer of lithium and are set to take over from stainless steel as the largest end user of nickel by 2040. The rapid rise in demand for critical minerals poses huge questions about the availability and reliability of supply. The shift to a clean energy system will be strongly dependent on minerals supply and cost and strongly dependent on the exploitation of primary earth resources through the mining industry. According to the principles of sustainable resources, it is critical to minimize the exploitation of primary resources by compensating through the processing of secondary resources (mine tailings and electronic waste). Recycling is needed to secure access to raw materials and to improve resource management, energy efficiency and environmental impacts.

This project aims to research and develop clean and eco-friendly methods to recover critical raw materials (CRMs) for the clean energy transition from raw materials (primary and secondary resources). First, according to the energy transition requirements, it would be necessary to screen potential raw materials that can be used to recover CRMs. Then, a strict lab routine must be implemented to design the processes to recover the different CRMs from the identified raw materials. Finally, a feasibility analysis, from the technical and economic perspective will be carried out to identify the most promising processes and raw materials that can leverage a sustainable shift to the clean energy transition.

Job position description

Project will be supervised by Rui Sousa and supported by experts on **resources sustainability** (Maria João Pereira), **hydrometallurgy** (Aurora Futuro), **environmental impacts** (Maria de Lurdes Dinis), **circular economy** (M. Cristina Vila) and **energy transition** (Leonardo Azevedo). The candidate will work at the intersection between the **Raw Materials, Environment and Energy** groups of **CERENA**.

Job duties involve: a) **raw materials characterization** – physical and chemical properties to identify potential sources of elements to feed the energy transition requirements; b) **designing laboratory experiments** of physical and chemical processing to recover critical elements from diversified material as raw ores, tailings and electronic waste; c) **analyzing data** to define the most promising sources of critical elements and provide reliable feedback regarding the economics of the process and d) submitting the results to international journals and conferences.

The ideal candidate must hold an internationally recognized Msc degree, or equivalent experience, in one of the following disciplines: mining, materials, chemical or environmental engineering, geology or chemistry and be interested in topics such as **sustainability, circular economy and energy transition**. Candidates should have experience with experimental work, must be able to work independently, have a strong research-ethical approach, be creative in solving experimental challenges, and be experienced in writing technical/scientific reports in English (in speaking and writing). Portuguese language knowledge is not a requirement. Previous experience in programming and data analysis would also be an asset (not mandatory).

The candidate will be integrated into a PhD program at FEUP or IST according to the research pathway that the candidate will define together with the project team.

OTHER RELEVANT WEBSITES

-Link to Doctoral Program in Mining and Geo-Resources Engineering – FEUP

https://sigarra.up.pt/feup/en/CUR_GERAL_CUR_VIEW?pv_ano_lectivo=2022&pv_origem=CUR&pv_tipo_cur_sigla=D&pv_curso_id=700

- Link to the Post-Graduation office where students can find all information on being a PhD student at IST

<http://posgraduacao.tecnico.ulisboa.pt/en/>

Supervisor Research Gate Profile

<https://www.researchgate.net/profile/Rui-Sousa-12/research>

EU action to face the global race for the supply and recycling of critical raw materials

https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT_22_5523

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AREA OF KNOWLEDGE

Physical Sciences, Mathematics and Engineering Panel

GROUP OF DISCIPLINE

Chemistry and Chemical Engineering

GROUP LEADER

Prof. Henrique Anibal Santos de Matos
henrimatos@tecnico.ulisboa.pt

RESEARCH PRODUCT / RESEARCH GROUP

IProPBio-Integrated Process and Product design for sustainable Biorefineries
<http://iprobio.sdu.dk/>

POSITION DESCRIPTION

Research Project / Research Group Description

The bio-based economy in Europe involves 22 million people and turns over roughly 2.4 billion euros. The full realization of its huge potential, however, requires expert knowledge and synergy of different competencies. In particular, key questions and bottlenecks awaiting clear answers are:

- > How to design and integrate flexible and product-tailored processes for the available biomass feedstocks?
- > How to integrate chemical and biochemical routes into sustainable biorefining of the given feedstocks?
- > How to relate the biomass extraction and separation processes with the properties of the desired products and the sustainable utilization of the depleted matrices?
- > How the production processes can be integrated into circular economy strategy?

This Project aims to define sustainable integrated conceptual process alternative technological pathways related to the availability and properties of feedstocks, and their conversion into value-added products at reduced energy consumption and environmental impact. For each pathway, an initial flowsheet will be developed. Its performance, along with the key design, operating and product criteria will be evaluated by computer-aided simulations of various scenarios. Mass and energy integration studies will be performed to reduce the consumption of material and energy utilities, improve environmental impact, and enhance profitability. Life cycle analysis will determine the net contribution of the alternative pathways to environmental pollution

Disclaimer: This doctoral project is quite connected with the project H2020-MSCA-RISE-2017 with the title: Integrated Process and Product Design for Sustainable Biorefineries (IProPBio) led by SYDDANSK UNIVERSITET (Denmark) and including other 8 partners/beneficiaries where Instituto Superior Técnico/CERENA is counted and represented by Prof. Henrique Matos (Chemical Eng. Dept.). Another partner from this project consortium is Prof. Mariano Martín from Universidad de Salamanca.

Job position description

This PhD project/position aims to define sustainable integrated conceptual process alternatives technological pathways from feedstocks to their conversion into value-added products in a sustainable context. To accomplish the proposed goals there will be four main tasks:

Task 1 – Feedstock and product selection, thermodynamic data, and property estimation. At this stage, different biomasses are considered as potential feedstock. Novel feedstocks will be identified. Besides, the work also involves the design and development of a robust and versatile thermodynamic modelling framework(TMFC)capable of predicting and correlating complex phase behaviour of strongly non-ideal systems at ambient and high pressure conditions.

Task 2– Process Synthesis creating alternatives. This process synthesis should include the best practices in terms of process safety, environmental issues, material resources usage and energy efficiency. The generation method should be able to group the flowsheets according to specific features.

Task 3 – Sustainable Conceptual Integrated Process Design. Identification of appropriate design models for complex biomass mixtures. The simulation software Aspen Plus will be used at this stage for a short-cut and rigorous process modelling. Heat and Power Integration will be included as the goals to minimise liquid and gaseous effluents to obtain sustainable process alternatives with GHG zero emissions target.

Task 4 – Process Intensification and Life Cycle Assessment (LCA). Promising process alternatives designed and optimized in the previous tasks will be used as the ideal candidates for possible process intensification. Intensified solutions will be evaluated, from the biomass pre-treatment, through its transformation and the product separations. The LCA of potential value-added products obtained from the flowsheets will be used as an assessment of the alternatives.

OTHER RELEVANT WEBSITES

- Link to the Post-Graduation office where students can find all information on being a PhD student at IST
<http://posgraduacao.tecnico.ulisboa.pt/en/>

Prof. Henrique Matos profile at CERENA, where you can access personal interest ORCID and other identifiers
<https://cerena.tecnico.ulisboa.pt/user/577>

- Lab Page - Prof. Mariano Martín
<http://diarium.usal.es/marianom3/>

Comparative study on the biorecovery of heavy metals using autochthonous and established microbial communities in several mines located in the N-W of the Iberian Peninsula | 📄 ☆ —

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Physical Sciences, Mathematics and Engineering Panel

GROUP OF DISCIPLINE

Geology, Earth Sciences, Environmental and Atmospheric Sciences, Mining, Geological Engineering, Oceanography, Hydrology

GROUP LEADER

Prof. Maria Cristina da Costa Vila
mvila@fe.up.pt

RESEARCH PRODUCT / RESEARCH GROUP

Faculty of Engineering of University of Porto
https://sigarra.up.pt/feup/pt/FUNC_GERAL.FORMVIEW?p_codigo=211751

POSITION DESCRIPTION

Research Project / Research Group Description

Biomining technologies are nowadays widely studied and increasingly applied as alternative methods to extract metals from low-grade ores, included here are mine-wastes. This could be explained by the depletion of high-grade ore reserves and the increasing environmental and social concerns that sustainable mining imposes.

In this PhD project, three different mine sites from the NW of the Iberian Peninsula will be studied. Bioleaching will be tested to decontaminate tailings, turning the pollutants into a primary resource. Metals or metalloids such as Cu, Zn, Cd, or As will be controlled. Both, autochthonous and a previously enriched mixed bacterial culture able to bioleach these metals will be tested. Numerous abandoned mines exist in this Iberian area which presents the geological characteristics required for achieving a prosperous recovery of metals by bioleaching. Bioleaching will be tested in abandoned tailings with a significant content of sulphidic minerals. That is the case of Borralha Mine in the North of Vila Real (Portugal), which is the second biggest Sn-W deposit in the country, where pyrite predominates. Also Touro Mine in the north of Galicia (Spain), a Volcanogenic Massive Sulphide deposit whose tailings cover an area of around 550 ha composed mainly of amphibolite and significant quantities of metal sulphides. La Soterraña is an abandoned mercury mine located in Asturias (Spain) mainly constituted by cinnabar, orpiment, and realgar in which iron sulphides are quantitatively the most important metallic mineral phases. The project will be innovative for the N-W of the Iberian Peninsula where, although it has potential, to date no projects have been developed to recover metals by bioleaching techniques.

The proposed work will be supervised by Maria Cristina Vila (Assistant Professor in Mining Engineering Department and researcher at Centre of Natural Resources and Environment, CERENA), working with bioleaching and bioremediation for many years.

Job position description

Candidates must hold an internationally recognized master's degree (or evidence of its completion in the nearest future) in a field of science and engineering related to ISTor FEUP and CERENA activities. Candidates should have experience with experimental work, must be able to work independently with a high sense of responsibility and plenty of availability and capabilities to perform laboratory and field work, have a strong research-ethical approach, be creative in solving experimental challenges, and be experienced in writing technical/scientific reports in English (in speaking and writing). Portuguese language knowledge is not a requirement.

Successful candidates will be enrolled in one of the following programs:

- Environmental Engineering, Faculdade de Engenharia da Universidade do Porto,

- Mining Engineering and Geo-resources, Faculdade de Engenharia da Universidade do Porto.

OTHER RELEVANT WEBSITES

Link to the Faculty of Engineering of the University of Porto
https://sigarra.up.pt/feup/en/web_page.inicial

Doctoral Program in Mining Engineering and Geo-resources
https://sigarra.up.pt/feup/en/cur_geral.cur_view?pv_ano_lectivo=2022&pv_origem=CUR&pv_tipo_cur_sigla=D&pv_curso_id=700

Doctoral Program in Environmental Engineering
<https://paginas.fe.up.pt/~estudar/cursos/programa-doutoral-engenharia-do-ambiente/>

Institutional website from the host research center with information associated with the Group Leader and ongoing projects
<https://cerena.pt/>

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GROUP OF DISCIPLINE

Geology, Earth Sciences, Environmental and Atmospheric Sciences, Mining, Geological Engineering, Oceanography, Hydrology

GROUP LEADER

Prof. Maria de Lurdes Proença de Amorim Dinis
mdinlis@fe.up.pt

RESEARCH PRODUCT / RESEARCH GROUP

Website of the principal Investigator with projects and publications
<http://orcid.org/0000-0002-4774-2533>

POSITION DESCRIPTION

Research Project / Research Group Description

The extraction of mineral resources has increased markedly in recent decades and, over the last 10 years in particular, at a faster rate than economic growth. This trend is forecasted to steadily increase in the future. Worldwide transitions towards clean energy and electric vehicles will also accelerate the trend, as renewable energy sources require larger amounts of metals than energy production from fossil fuels. There is a strong contribution of the mining sector to the Portuguese economy and exports, which only in 2019, contributed circa €900 million in exports equivalent to 8,8% of the total exports of Portugal.

The development of a smart, innovative and sustainable mine waste management strategy by integrating geochemical and mechanical behavior and transforming mine wastes into resources, and at the same time incorporating other industrial wastes, will enhance the mitigation of adverse environmental, social, and health impacts, usually associated with mining extraction.

This project aims to improve the technology separation for different waste streams to increase resource efficiency and use of waste streams as resources. The project is lined up with SDGs 9, 12, 15, with the European Policy and Strategy for Raw Materials - resource efficiency and recycling objectives and with the strategic areas of CERENA: Environmental health, Eco-friendly materials, Minerals, and waste valorization and Environmental remediation.

In this project, 2 types of mining waste will be considered: sulfide-rich wastes and arsenic-rich wastes. Two main research lines will be pursued: mine waste activation, with the development of cementitious and supplementary binders for concrete; and inhibition technology reducing the reactivity of the mine waste by incorporating other industrial residues.

This project has the support of ASSIMAGRA and ANIET, Almina Minas do Alentejo S.A. (provider of the samples) and Câmara Municipal do Fundão, owner of a historic mining wastes repository site.

Job position description

The PhD student will benefit from working with a multidisciplinary team; being involved in MSc dissertations; publishing in peer-reviewed international journals and attending international conferences. This position has a clear goal in reducing the amount of mine wastes that needs costly and complex remediation by developing innovative methods that separate sulphidic mine waste streams, for efficient transformation to usable resources, and stabilize unusable wastes. The results will contribute to a more proactive sustainable waste management addressing the green and circular economy. This includes the use of other industrial residues from the lime industry and paper mill industry, which remnants will be used in the inhibition technology. Preparation of a business strategy for upscaling the research results, and an exploitation plan for the replication, so that the technologies developed part of the project may be put to wide use. The exploitation plan aims to coordinate the exploitation of the project's results and outputs, making them available to relevant scientific communities, industry, government organisations and the broader public. To accomplish the proposed goals the work is divided into **5 main tasks: T1** Literature review, **T2** Sampling and characterization of waste streams, **T3** Pre-processing and allocation of wastes, **T4** Mine wastes activation and evaluation, **T5** Transform the reactive and undesirable mine wastes into stable geomaterials.

OTHER RELEVANT WEBSITES

Website of the principal investigator with relevant CV components

<https://www.cienciavitae.pt/171C-2133-2158>

Institutional website from the host research center with information associated with the Group Leader and ongoing projects

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Physical Sciences, Mathematics and Engineering Panel

GROUP OF DISCIPLINE

Industrial Engineering, Mechanics, Metallurgy, Materials, Nanotechnology, Aeronautical, Naval and Aerospace Engineering

GROUP LEADER

Dr. Margarida Mateus
maria.margarida.mateus@secl.pt

RESEARCH PRODUCT / RESEARCH GROUP

Link to the Innovandi Open Challenge call, under which the project (at the grant agreement preparation stage) will run
<https://gccassociation.org/innovandi/openchallenge/>

POSITION DESCRIPTION

Research Project / Research Group Description

The cement industry alone is responsible for about a quarter of all industry CO2 emissions. Approximately two-thirds of those emissions result from calcination, the chemical reaction that occurs when raw materials such as limestone are exposed to high temperatures.

Operational advances, such as energy-efficiency measures, have already largely been implemented and the decreasing availability of input materials limits the emissions-reduction potential from alternative fuels and clinker substitution. With this purpose, the ongoing Clean Cement Line Project (Clean Cement Line | Secil Group (secil-group.com)) aims to develop and demonstrate a new cement production technology. This project includes four R&D sub-projects that aim to eliminate the dependence on fossil fuels, increase energy efficiency, produce electricity, integrate and improve the digitalization process, and reduce CO2 emissions. These innovations will lead to the production of a low-carbon clinker and, consequently, create a range of cement types with a low ecological footprint.

On the horizon are carbon capture, utilization, and storage (CCUS) technologies. While frequently costly, they could more than halve current emissions. CERENA/Secil have a novel and exploratory technology under study in the Innovandi-funded Project, which consists in using pillared clays in Pressure Swing Adsorption (PSA) processes to capture carbon dioxide.

Between these two projects, the Ph.D. student has the unique opportunity to embrace a new line of study in the clinkerization process. The aim of this proposal is an Industrial/Academical thesis to study the usage of these pillared clays as clinker substitutes, after achieving their self-life end.

The student must be attracted to the challenge that an industrial environment provides and have an open mind towards the iterative process of a Ph.D in new technology with a comprehensive characterization of samples, the study of the relevant process, and subsequent optimization.

Job position description

Under the supervision of Dr. Margarida Mateus (SECL) and Prof. Moisés Pinto (IST) the student will study the clinkerization process and the chemistry of the clinker and clays to master the current state-of-the-art. Besides, the student will be exposed to the industrial plant to learn more about the new technology of low-carbon clinker and where the thesis work will take place. Concerning alternative clinker technologies, these approaches need to generate a similar product performance (considering the European standards) to that of Ordinary Portland Clinker while simultaneously accomplishing the necessary reduction of CO2 emissions.

The student must perform a study of the most critical properties:

- Mechanical performance, both at an early age and later age of product life; (Centro de Desenvolvimento de Aplicações de Cimento | Secil)
- Rheological performance, enabling adequate pumping, spreading, molding, and compaction of the material;
- Reduced chemical shrinkage, since this phenomenon causes serious loss of both durability and bearing capacity of concrete structures, increasing the risk of cracking and decreasing the effective lifespan of the resulting structures;
- Chemical stability will be translated into structure durability when submitted to the natural elements.

Finally, the student must perform a technical & economic study demonstrating the integration of the pillared clays in a CCUS plant with financial viability.

Candidate's requirements: Candidates must hold an internationally recognized master's degree (or evidence of its completion in the nearest future) in a field of science and engineering related to IST and CERENA activities. Candidates should have experience with experimental work, must be able to work independently, have a strong research-ethical approach, be creative in solving experimental challenges, and be experienced in writing technical/scientific reports in English (in speaking and writing). Portuguese language knowledge is not a requirement.

OTHER RELEVANT WEBSITES

Link to the Post-Graduation office where students can find all information on being a PhD student at IST
<http://posgraduacao.tecnico.ulisboa.pt/en/>

Link to Prof. Moisés Pinto webpage
<http://web.tecnico.ulisboa.pt/moisés.pinto/index.html>

Link to Margarida Mateus LinkedIn Profile
<https://www.linkedin.com/in/margarida-mateus/?originalSubdomain=pt>

Institutional website from the host research center with information associated with the Group Leader and ongoing projects
<https://cerena.pt/>

HOST ORGANIZATION

CERENA - Centro de Recursos Naturais e Ambiente
<https://cerena.tecnico.ulisboa.pt>

● Available

HOST ORGANIZATION DESCRIPTION [Read more](#)**ADDRESS**

Instituto Superior Técnico, Av. Rovisco Pais

AREA OF KNOWLEDGE

Physical Sciences, Mathematics and Engineering Panel

GROUP OF DISCIPLINE

Chemistry and Chemical Engineering

GROUP LEADER

Dr. Rui Galhano dos Santos
rui.galhano@tecnico.ulisboa.pt

RESEARCH PRODUCT / RESEARCH GROUP

Institutional website from the host research center with information associated with the Group Leader and ongoing projects
<https://cerena.pt/>

POSITION DESCRIPTION**Research Project / Research Group Description**

The paradigm of the extensive use of fossil sources must be changed. Using green and sustainable fuels is of utmost importance to overcome the harmful effects of fossil-based energy on the environment. Hydrogen can lead to strategic zero emissions targets, renewables integration, and industry decarbonisation. Yet, H₂ use is still hampered due to its low density and explosive nature, making its storage and transport challenging. Alternatives for H₂ safe storage are needed to democratise its use.

This project aims to develop useful materials to store hydrogen simply and straightforwardly. For instance, polyurethane foam functionalised with polyaromatic scaffolds is to be produced to be used in reductive/oxidative cycles to store hydrogen chemically, among other materials. The research plan will be focused on preparing scaffolds with polyaromatic moieties to be further used in the formulation of materials for hydrogen chemical storage. The materials to be produced should capture hydrogen and deliver it upon demand. Catalysts should be used to lower the activation energy to trigger the oxidation/reduction of the material's surface. The catalyst must be anchored on the surfaces of the materials to be prepared. Studies to determine the best catalytic system that facilitated the reductive/oxidative reaction of capturing and releasing hydrogen will be performed.

Developing a PhD in this area will give the candidate a profound knowledge of renewable energy and storage, particularly regarding hydrogen in an era of change from the current paradigm of energy dependence. Such knowledge will give the candidate the tools to develop a successful career plan.

The CERENA Team at IST has been developing work on renewable energy and materials with high scientific output. IST has the facilities to develop the work plan and to overcome the challenges to be faced. Moreover, the team will give the candidate the tools to become a top researcher in the area.

Job position description

This project requires a deep knowledge of chemistry and material science as the work will involve organic synthesis and sorts of characterisation analyses, embracing the "from scratch" synthesis, and functionalisation, of bio-polyols for several materials formulations, e.g., polyurethanes, and epoxides, amongst others. The successful PhD candidate will be given support and independence to lead their project under the guidance of the group leader and will be an active participant in the project's development along with the rest of the team. The researcher will receive expert training on all characterisation techniques and also be able to supervise undergraduate students. The candidate will also be able to support practical courses as a monitor (if interested).

Candidate's requirements: Candidates must hold an internationally recognised master's degree (or evidence of its completion in the nearest future) in chemistry or materials chemistry with a strong interest in working across disciplines. Candidates should have experience with experimental work, must be able to work independently, have a strong research-ethical approach, be creative in solving experimental challenges, and be experienced in writing technical/scientific reports in English (in speaking and writing). Portuguese language knowledge is not a requirement.

Candidates will be enrolled in one of the IST PhD Programs in the field of Chemical Engineering or Mechanical Engineering (see links below). Throughout project development students will gain all needed tools and knowledge to obtain training on renewable energy and energy transition, focusing on hydrogen use and storage. This area has been deeply explored in IST and IST has several courses and modules on hydrogen production, use, and storage.

OTHER RELEVANT WEBSITES

Doctoral Program in Chemical Engineering
<https://fenix.tecnico.ulisboa.pt/cursos/dequim>

Doctoral Program in Mechanical Engineering
<https://fenix.tecnico.ulisboa.pt/cursos/demec>

Link to the Post-Graduation office where students can find all information on being a PhD student at IST
<https://posgraduacao.tecnico.ulisboa.pt/en/>

Rui Galhano profile at CERENA, where you can access personal interest ORCID and other identifiers information
<https://cerena.ist.utl.pt/user/669>