



15 PhD positions in the EU Horizon 2020 Marie Skłodowska-Curie MSCA-ITN Project REDMUD (European Training Network for Zero-Waste Valorisation of Bauxite Residue, Project 636876)

Applications are invited for 15 PhD positions (“Early Stage Researchers”) to be funded by the Marie-Sklodowska-Curie Innovative Training Network “REDMUD – European Training Network for Zero-Waste Valorisation of Bauxite Residue” within the Horizon 2020 Programme of the European Commission. REDMUD is a consortium of high profile universities, research institutions and companies located in Belgium, Finland, Sweden, Germany, Estonia, Greece, Portugal and Hungary.

Number of positions available : 15 PhD positions

Research Fields

Chemistry - Inorganic chemistry - Materials Engineering – Metallurgy – Building Materials – Industrial ecology – Environmental Engineering – Environmental Radioactivity

Keywords

bauxite residue; red mud; rare earths; critical raw materials; industrial waste residues; aluminium; life cycle assessment (LCA); naturally occurring radioactive material (NORM)

Career Stage

Early Stage Researcher (ESR) or 0-4 yrs (Post Graduate)

Benefits and salary

The MSCA programme offers highly competitive and attractive salary and working conditions. The successful candidates will receive a salary in accordance with the MSCA regulations for early stage researchers. Exact salary will be confirmed upon appointment [Living Allowance = 37.320 euro/year (correction factor to be applied per country) + Monthly mobility allowance = 600 to 1100 euro depending on the family situation]. In addition to their individual scientific projects, all fellows will benefit from further continuing education, which includes internships and secondments, a variety of training modules as well as transferable skills courses and active participation in workshops and conferences.

On-line Recruitment Procedure on www.redmud.org (see Appendix 1 for full description)

All applications proceed through the on-line recruitment portal on the redmud.org website. Candidates apply electronically for one to maximum three positions and indicate their preference. Candidates provide all requested information including a detailed CV. During registration, applicants will need to prove that they are eligible (three aspects: respect ESR definition, mobility criteria, English language proficiency). The deadline for the on-line registration is 19 November 2014. The REDMUD Recruitment Committee selects between 20 and maximum 30 candidates for the Recruitment Event which will take place in Leuven (19 December 2014). The selected candidates will provide a 15 minute presentation and will be examined by the Recruitment Committee. In order to facilitate their travel, selected candidates (from outside Belgium) will receive a fixed, lump sum of 250 euro. The final decision on who to recruit will be communicated the day after the Recruitment Event. The selected ESRs are to start as quickly as possible (in practice: target 1 March 2015).

Applicants need to fully respect three eligibility criteria:

Early-stage researchers (ESR) are those who are, at the time of recruitment by the host, in the first four years (full-time equivalent) of their research careers. This is measured from the date when they obtained the degree which formally entitles them to embark on a doctorate, either in the country in which the degree was obtained or in the country in which the research training is provided, irrespective of whether or not a doctorate was envisaged.

Conditions of international mobility of researchers: Researchers are required to undertake trans-national mobility (i.e. move from one country to another) when taking up the appointment. At the time of selection by the host organisation, researchers must not have resided or carried out their main activity (work, studies, etc.) in the country of their host organisation for more than 12 months in the 3 years immediately prior to their recruitment. Short stays, such as holidays, are not taken into account.

English language: Network fellows (ESRs) must demonstrate that their ability to understand and express themselves in both written and spoken English is sufficiently high for them to derive the full benefit from the network training.

The available 15 positions

ESR 1: Carbothermic reduction removing metallic Fe with controlled cooling to create specific phases for increased leaching efficiency

Objectives: To use carbothermic reduction for conversion of the iron oxides into metallic iron (pig iron), with a controlled cooling of the molten slag for creating specific phases, which can be easily leached for trace metal recovery; To control the composition of slag by addition of adequate fluxes and to investigate the formation of different slag phases; To carry out thermodynamic calculations of the reduction treatment.

Host: RWTH Aachen (Germany)

Supervisor: Prof. B. Friedrich (BFriedrich@metallurgie.rwth-aachen.de)

Duration*: 36 months

ESR 2: Iron oxide removal from BR through microwave roasting and magnetic separation

Objectives: To use microwave-assisted reduction of hematite to magnetite in BR by lignite as carbon source; To evaluate different process parameters (e.g. reaction time, BR-to-lignite ratio, microwave power); To determine the phase composition at different reduction stages; To investigate the magnetic separation of magnetite from the residue.

Host: NTUA (Greece)

Supervisor: Prof. I. Paspiliaris (paspiliaris@metal.ntua.gr)

Duration*: 36 months

ESR 3: Direct electroreduction of iron oxides from BR

Objectives: To investigate the direct electroreduction of hematite to metallic iron in BR slurries in highly alkaline electrolyte solutions; To study the electroreduction mechanism by different electrochemical methods (cyclic voltammetry, coulometry, electrodeposition experiments); To study to influence of insoluble compounds like SiO_2 and Al_2O_3 on the reduction process.

Host: KU Leuven (Belgium)

Supervisor: Prof. J. Fransaer (jan.fransaer@mtm.kuleuven.be) & Prof. B. Blanpain

Duration*: 36 months

ESR 4: Recovery of aluminium oxide from BR

Objectives: To study the dry chlorination through BR or slag roasting in a chlorine gas atmosphere with carbon as deoxidant, to convert Al_2O_3 into AlCl_3 ; To absorb gaseous AlCl_3 in a mixed alkali chloride melt or in a suitable low temperature molten salt (ionic liquid) system and to electrodeposit

metallic aluminium in one step from the molten salt system; To optimise the different process parameters for both the chlorination step and the electroreduction step; To study the electroreduction of aluminium by different electrochemical methods (cyclic voltammetry, coulometry and electrodeposition experiments).

Host: Aluminium of Greece (Greece)

Supervisor: Dr. D. Kosmetatos (AoG) & Prof. D. Papias (NTUA) (panias@metal.ntua.gr)

Duration*: 36 months

ESR 5: Selective leaching for Ti recovery

Objectives: To use experimental design to determine the optimum parameters for leaching of titanium from BR by mineral acids; To investigate the influence of different Ti phases on the leaching process; To develop kinetic methods to describe the leaching process; To investigate to recovery of Ti as TiO₂ from the leachates.

Host: RWTH Aachen (Germany)

Supervisor: Privat Dozent Dr. S. Stopic (sstopic@ime-aachen.de)

Duration*: 36 months

ESR 6: Ionic Liquid leaching for reactive metals (Ti, Sc, REE) recovery

Objectives: To use ionic liquids for the selective dissolution of different metals from BR; To investigate the influence of different process parameters; To develop methods for the recovery of the dissolved metals from the ionic liquid solutions.

Host: NTUA (Greece)

Supervisor: Prof. D. Papias (panias@metal.ntua.gr)

Duration*: 36 months

ESR 7: Process Intensification for rare earth element recovery from BR

Objectives: To intensify the leaching of REEs from BR by different mineral acids by the use of ultrasound reactors, and to determine the optimal process parameters; To use carbon dioxide for the neutralisation of BR.

Host: KU Leuven (Belgium)

Supervisor: Prof. T. Van Gerven (tom.vangerven@cit.kuleuven.be) & Prof. K. Binnemans

Duration*: 36 months

ESR 8: Recovery of rare earths with supported ionic liquid phases

Objectives: To use supported ionic liquid phases (SILPs) to recover REEs, and especially Sc, from acidic leachates; To develop models to describe the sorption of the metal ions on the SILPs; To investigate different ionic liquid/solid support combinations in SILPs; To perform separation experiments with SILPs in chromatographic columns.

Host: KU Leuven (Belgium)

Supervisor: Prof. K. Binnemans (koen.binnemans@chem.kuleuven.be)

Duration*: 36 months

ESR 9: Separation of REEs using inorganic metal phosphate ion exchangers

Objectives: To develop 2D and 3D metal phosphates (MePO) for selective separation of REEs from acidic bauxite residue leaching solutions; To perform experiments in chromatographic columns for the separation of mixtures of REEs into the individual elements.

Host: U Helsinki (Finland)

Supervisor: Dr. R. Harjula (risto.harjula@helsinki.fi) & Dr. R. Koivula

Duration*: 36 months

ESR 10: Selective recovery and purification of Sc compounds from leach solutions

Objectives: To recover scandium from acidic leachates of BR by selective precipitation as Sc(OH)₃; To

develop a continuous process of chemical precipitation in a cascade line of reactors in order to achieve selective precipitation of different metals present in the solution; To perform a thermochemical analysis (DTA, TGA) to determine the speciation of scandium complexes in the solution at different pH values.

Host: MEAB (Germany)

Supervisor: C. Dittrich (MEAB) (carsten.dittrich@meab-mx.com) & Prof. B. Friedrich (RWTH)

Duration*: 36 months

ESR 11: Fe-rich hydraulic binders from BR

Objectives: To synthesise Fe-rich, low-carbon hydraulic cements with novel properties for specific applications, while being able to describe the role of Fe and other minor elements (Na, Ti) during the clinkering and hydration process.

Host: TITAN (Greece)

Supervisor: Dr. M. Chaniotakis (Titan) (haniotakise@titan.gr), Prof. G. Angelopoulos (Patras University), Dr. Y. Pontikes (KU Leuven)

Duration*: 36 months

ESR 12: Fe-rich inorganic binders from BR

Objectives: To synthesise Fe-rich, low-carbon, inorganic polymer cements with satisfactory properties for construction applications, while being able to describe the role of Fe and other minor elements (Na, Ti) during the polymerisation process.

Host: KU Leuven (Belgium)

Supervisor: Prof. B. Blanpain, Dr. Y. Pontikes (Yiannis.pontikes@mtm.kuleuven.be)

Duration*: 36 months

ESR 13: Analysis of the secondary and trace bauxite elements distribution through the Bayer process and its by-products

Objectives: To analyse and characterize bauxite ores from different origins, alumina precipitates, calcined alumina, BR and spent Bayer liquor to track the metallic elements throughout the Bayer process; To develop a model to predict the behaviour of trace elements (and especially Sc, Ce, Th, Ga and V) in relation to the initial bauxite feed.

Host: Aluminium of Greece (Greece)

Supervisor: Dr. V. Vassiliadou (AoG) (vicky.vassiliadou@alhellas.gr), Dr. M. Taxiarchou (NTUA)

Duration*: 36 months

ESR 14: Comprehensive Life Cycle Assessment (LCA) of BR valorisation and enhancement of LCA methodology to include Naturally Occurring radioactive Material (NORM)

Objectives: To perform LCA analysis of the BR valorisation processes developed in the project, and to enhance state-of-the-art LCA methodology to consider NORM and risk scenarios. .

Host: KTH (Sweden)

Supervisor: Ass. Prof. A. Bjorklund (KTH), Prof. K. Van Acker (KU Leuven)

Duration*: 36 months

ESR 15: Systematic study and NORM-LCA methodology development of NORM aspects in the BR valorisation chain

Objectives: To evaluate Naturally Occurring Radioactive Material (NORM) considerations for BR valorisation processes developed in the project, and to enhance state-of-the-art NORM mass balance methodology taking into account Life Cycle Analysis (LCA).

Host: University of Tartu (Estonia)

Supervisor: Ass. Prof. A. Tkaczyk (atkaczyk@umich.edu)

Duration*: 36 months

[* Note: Indicated duration is the direct funding period provided by the EC. However, additional funding for the remaining period to complete the PhD will be provided by the Host Institutes.]

Public Abstract REDMUD: To tackle its (critical) raw material dependency, Europe needs comprehensive strategies based on sustainable primary mining, substitution and recycling. Freshly produced flows and stocks of landfilled industrial residues such as mine tailings, non-ferrous slag and bauxite residue (BR) can provide major amounts of critical metals and, concurrently, minerals for low-carbon building materials. The European Training Network for Zero-Waste Valorisation of Bauxite Residue (REDMUD) therefore targets the vast streams of new and stockpiled BR in the EU-28. BR contains several critical metals, is associated with a substantial management cost, whereas spills have led to major environmental incidents, including the Ajka disaster in Hungary. To date, zero-waste valorisation of BR is not occurring yet. The creation of a zero-waste BR valorisation industry in Europe urgently requires skilled scientists and engineers, who can tackle the barriers to develop fully closed-loop environmentally-friendly recovery flow sheets. REDMUD trains 15 researchers in the S/T of bauxite residue valorisation, with emphasis on the recovery of Fe, Al, Ti and rare earths (incl. Sc) while valorising the residuals into building materials. An intersectoral and interdisciplinary collaboration of EU-leading institutes and scientists has been established, which covers the full value chain, from BR to recovered metals and new building materials. Research challenges include the development of efficient extraction of Fe, Al, Ti and rare earths (incl. Sc) from distinct, Naturally Occurring Radioactive Material (NORM) classified BRs and the preparation of new building materials with higher than usual Fe content. By training the researchers in pyro-, hydro- and ionometallurgy, electrolysis, rare-earth extraction and separation technology, inorganic polymer and cement chemistry, Life Cycle Assessment (LCA), NORM aspects and characterisation, they become the much needed scientists and engineers for the growing European critical raw materials industry.

Beneficiaries: *KU Leuven, Helsinki University, RWTH Aachen, NTUA, UT, MEAB, Aluminium of Greece, TITAN*

Partner Organisations: *University of Patras, Universidade de Aveiro, Bay Zoltan, Tasman Metals*

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Appendix 1: Recruitment Procedure REDMUD - Full description

The Recruitment Committee (General Coordinator (GC) and one Supervisor per Beneficiary) oversees the recruitment of the 15 ESRs during the Recruitment event (19 December 2014, Leuven). Initially, the search for the appropriate candidates is based on normal recruitment strategies (e.g. publication on ec.europa.eu/euraxess, etc.; personal contacts of the network partners). The pre and final selection will be made in a collective process, led by the Recruitment Committee (RC), which consists of experts highly experienced with selection procedures. The candidates apply for maximum three specific projects and list their order of preference. Applications are made on-line through the redmud.org website. Between 20 and 30 fellows are invited to the Recruitment Workshop (Leuven, 19 December 2014). In order to facilitate their travel, selected candidates (from outside Belgium) will receive a fixed, lump sum of 250 euro.

Each candidate gives a presentation and is interviewed. The committee selects the ESRs (1) based on their scientific background and potential, (2) based on the expected benefit of scientific exchange between the trainees' home countries and institutions and the hosts, and (3) in accordance to gender equality and minority rights. The candidates are ranked and a collective decision is made, taking into account the order of preference. The envisioned Supervisor gets the final say. In this way a complementary team of ESRs can be assembled. All recruitment is in line with the European Charter for Researchers, providing the overarching framework for the roles, responsibilities of both researchers and employers. The Code of Conduct for the Recruitment of Researchers functions as a set of principles and ensures that the selection procedures are transparent and fair. The recruitment strategy of REDMUD fully complies with the Code of Conduct definition of merit. For example, merit is not only measured on researcher's grades, but on a range of evaluation criteria, such as team work, interdisciplinary knowledge, soft skills and awareness of the policy impact of science. The RC has members of each gender and considers the promotion of equal opportunities and gender balance as part of the recruitment strategy. Special efforts are made to attract women and fellows from new EU member states. REDMUD aims at a participation of 50% women in the network. Among equally qualified applicants, women receive preferential consideration. Researchers are employed on fixed term contracts and are registered as staff candidates for PhD degrees. Therefore, they are entitled to pension contributions, paid holidays, and other employment benefits as governed by the universities and industrial companies.

In case not all ESRs can be recruited during the collective Recruitment Event, the recruitment procedure is "decentralised", meaning that the Involved Supervisors will continue the search for good candidates and have the authority to decide which person they recruit. However, the GC will be kept informed at all times when new eligible candidates appear. The GC will make an official complaint in case the Code of Conduct for the Recruitment of Researchers is breached. The Involved Supervisor is then expected to find another candidate. Recruitment problems will also, if still needed, be discussed during the Recruitment Committee meeting (Month 6) in order to deliver specific action plans to target specific networks relevant for any missing ESR positions.

Recruitment committee: Koen Binnemans, Yiannis Pontikes, Jan Fransaer (KU Leuven), Risto Harjula (UHelsinki), Bernd Friedrich, Srecko Stopic (RWTH), Anna Bjorklund (KTH), Dimitris Panias (NTUA), Alan Tkaczyk (UT), Carsten Dittrich (MEAB), Vicky Vassiliadou (AoG), Manolis Chaniotakis (TITAN). Peter Tom Jones will facilitate the whole procedure.

Key dates:

1. 19-11-2014: Deadline for on-line application for ESR positions (www.redmud.org)
2. 24-11-2014: Circulation of communication list "preselected candidates"
3. 19-12-2014: Recruitment Event (Leuven) for preselected candidates
4. 20-12-2014: Circulation of Communication list "recruited REDMUD ESRs"