HDR PROJECT SUMMARY

DEVELOPMENT AND OPTIMISATION OF MINERAL CARBONATION TECHNOLOGY FOR IRON-CONTAINING INDUSTRIAL WASTE AND MINE TAILINGS

HDR PROJECT DESCRIPTION

Australia's large volumes of iron oxide-rich mine tailings create an opportunity for mineral carbonation to sequester carbon and use the carbonated products across different industries. This project focuses on mineral carbonation of hematite and goethite through an aqueous carbonation process. A variety of acids – including acetic acid, the by-product of biomass production – will be used in the dissolution step, when Fe^{+2} ions are introduced to facilitate the process. The work will compare the performance of different acids to explore optimal dissolution conditions. The carbonation step involves introducing CO_2 into the pH-adjusted solution at ambient temperature and pressure.

PROJECT OBJECTIVES

This project promotes circularity by carbonating mine tailings and utilising the carbonated materials across different industry sectors such as construction. It will contribute to HILT CRC project *RP2.013 Integrated CO_2 capture and sequestration through mineral carbonation* by providing fundamental knowledge about mineral carbonation of iron-oxide-rich minerals that are abundant in bauxite residues (red mud). This PhD work complements that of two existing PhD students in RP2.013 and facilitates research collaboration with Åbo Akademi University, Finland, on the topic of mineral carbonation. Furthermore, the utilisation of carbonated materials strengthens the work undertaken in RP2.013.

PROJECT SCOPE

Implementing a pH swing reactor design can significantly enhance the efficiency of mineral carbonation. This approach alternates between acidic and basic conditions to optimise carbonation's dissolution and precipitation phases. By carefully controlling the pH levels, the mineral dissolution and CO_2 capture rates can increase, thus reducing reaction times and energy consumption. Design of a pH swing reactor optimised to the specific mineralogy of iron oxide-rich mine tailings could substantially improve process efficiency.

Furthermore, the life cycle assessment (LCA) of the project will provide a detailed evaluation of the carbon cycle of the process and environmental impacts associated with mineral carbonation. An LCA can help identify the carbon footprint, energy consumption and potential environmental benefits of using carbonated products in construction applications. By analysing each process stage – from raw material extraction to the end-of-life of the carbonated products – LCA can highlight areas for improvement and optimisation. Moreover, comparing different carbonation processes through LCA can guide decision-making towards more environmentally friendly practices.

QUALIFICATIONS AND EXPERIENCE

Candidates are required to have:

- A solid foundation in a relevant engineering discipline, such as chemical engineering.
- A keen interest in conducting laboratory work and hands-on experiments.
- A strong desire to collaborate effectively within a team-oriented environment.

To determine your eligibility for studying at The University of Adelaide, visit adelaide.edu.au/graduate-research

Further enquiries

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SUPERVISORS

- Dr Alireza Salmachi
- Dr Alfonso Chinnici
- Professor Graham Nathan

EXTERNAL SUPERVISOR

- Professor Mikko Hupa
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PROJECT PARTNER

- The University of Adelaide

PROJECT TYPE

- PhD

DATE ADVERTISED

- 28 November 2024

HILT CRC POSTGRADUATE PROGRAM

Are you interested in receiving training from world-leading researchers, whilst working with industry partners on real-world problems?

Join the HILT CRC postgraduate program for a research career in de-risking decarbonisation for heavy industry.

Through engagement with industry and universities we are committed to training the heavy industry workforce of the future through practical, demand driven research projects with world-leading teams and facilities.

We offer Higher Degrees by Research (HDR) through a PhD or Masters qualification for up to 3.5 years duration, providing you with the opportunity to acquire world-leading training in a field of growing demand to take your engineering career further.

By joining our postgraduate research program, you will work on real industry problems and challenges with the potential for immediate high-impact practical results to decarbonise heavy industry.

When undertaking a research degree with us, you will also gain:

Expert knowledge – designed specifically for the heavy industry sector and draws on your foundation of engineering knowledge by developing further skills tailored to transitioning the steel, iron, alumina and cement industries to reduce heavy industry's carbon emissions.

Invaluable networking opportunities and professional development – benefit from opportunities to collaborate and network with multiple industries and research experts and teams via participating in the HILT CRC specialised webinars, yearly conferences, and master classes.

Career outcomes – linked with industry and government, you will gain hands on industry experience to help you develop the skills required to operate in a new low-carbon economy, become an expert in your field, and enhance your employability.

A platform for communicating your findings – your research findings may be presented at industry conferences, published, commercialised and in turn, create a positive impact on society.

Financial Support and Scholarships

We can provide full, co-funded or top-up scholarships to eligible postgraduate students (Higher Degree by Research students at both Master and PhD levels) across our three research programs at our partner universities. The distribution of funding is at the discretion of the principal (main) supervisor of the project and may be used for student stipend, costs associated with the research project or other expenditure related to the project.

Any student interested in undertaking a postgraduate scholarship is encouraged to review the Scholarship Guidelines and complete the HDR Scholarships Application Form. Details for how to apply for postgraduate scholarships are included in the guidelines.

How to Apply

All HILT CRC prospective postgraduate students are required to enrol in their degree through their host institution as per the normal university application process. Therefore, students need to meet the requirements stipulated by the host university to enrol (e.g. appropriate Honours or Masters degree).

Further Information

For more details about the postgraduate research opportunities and projects, and financial support with HILT CRC, contact us at hdr@hiltcrc.com.au