

Development of innovative and low carbon building materials

Summary

Utilization of waste streams can play a significant role in the cleaner production of building materials. Fly or bottom ashes, mining wastes, construction and demolition wastes etc. can be used for various purposes in practical applications, including fine and coarse aggregates for concrete in the construction industry or as a CO₂ sink via mineral carbonation. The goal of the PhD research is to recycle locally available waste materials through accelerated carbonation into new and low CO₂ emission building elements; namely low in cement, high in recycled wastes and chemically bound CO₂. With this goal in mind, carbonation conditions of alkaline waste streams and fresh or hardened pre-cast products will be studied while exploring the use of these materials as cementitious mineral additives or as recycled aggregates into novel low-cement based composites. The expected changes in the chemical structure of the new cementitious paste because of the cementitious mineral additives and chemical reactions between CO₂ and CO₂ binding phases will be investigated focusing on the mechanical and durability properties of new building elements as well as their environmental characteristics.

Research field:	Chemical, materials and energy technology
Supervisors:	Dr. Mai Uibu Dr. Can Rüstü Yörük
Availability:	This position is available.
Offered by:	School of Engineering Department of Materials and Environmental Technology
Application deadline:	Applications are accepted between June 01, 2023 00:00 and June 30, 2023 23:59 (Europe/Zurich)

Description

Job description and responsibilities:

We are looking for a motivated and hard-working PhD candidate, who will conduct an innovative research in the field of mineral carbonation and building materials. The ideal candidate should have an excellent chemical laboratory skills, and a strong interest in CO₂ and alkaline waste utilization processes.

The main expected responsibility will be to perform both experimental and theoretical studies in the field of mineral carbonation and cementitious materials to achieve a successful PhD project work. In addition, communicating your results at international conferences and in peer-reviewed scientific journals will be a key responsibility. As a doctoral student, you will participate in doctoral courses and the rest of your time will be allocated to your own research studies.

Applicants should fulfil the following requirements:

- Applicants should hold an MSc degree in the field of Chemical and Materials Engineering or equivalent degrees including mineral processing and building materials disciplines.
- Applicants should have strong communication skills in order to present their research results at national and international conferences, as well as to write research papers for publication in international peer-reviewed journals.
- Applicants should be good team players and have strong analytical problem-solving skills (creative, critical, and open-minded).
- Applicants having a good knowledge of inorganic material characterization is a plus.
- Applicants should submit a yearly research plan for the topic to prove his/her independent research skills.

We offer:

- 4-year PhD position in one of the largest, most internationalized and leading engineering research centers in Estonia from a wide range of disciplines - engineers and economists, chemists and IT developers.
- The selected PhD candidate as Early Stage Researcher will be employed by the university, working in the research group of their Supervisors (Laboratory of Inorganic Materials, Department of Materials and Environmental Technology), and is guaranteed a salary for the entire nominal duration of the doctoral programme (4 years).



- Opportunities for conference visits, research stays and networking with globally leading universities and research centers.

About the Research Group and Taltech:

Research activities of the Laboratory of Inorganic Materials have been focused on the fundamental and applied research of inorganic multicomponent systems in order to work out new innovative materials, to find application and new utilization methods for Estonian mineral resources. Some of the research directions are related to mineral carbonation, PCC and curing materials, the re-use of alkaline wastes, reduction of the environmental hazardous and human health effects of wastes and decreased usage of natural raw materials in construction sector with the aim to reach feasible, environmentally sound and optimized applications, using experimental research together with mathematical modeling.

TalTech is the sole technological research-based university in Estonia offering Bachelor's, Master's and Doctorate degrees in technology, applied science, IT, business and maritime studies. It is also the most international university in Estonia. TalTech has a green and one of the most compact university campuses in Europe. Rapid development, ongoing challenges, and internationalization are the keywords that characterize TalTech today.



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