

Innovative technologies for processing phosphate rock and accompanying minerals

Summary

The project is aimed at solving vital environmental and economical issues – developing phosphate rock processing technologies. The most promising and environmentally least harmful methods for phosphate rock valorization are elaborated, focusing also on the extraction possibilities of valuable rare earth elements (REEs). The world's population is growing and needs more food. This means increased demand for phosphorus fertilizers. To do this, better technologies must be applied. The Green Turn means significant increase in the demand of different electric devices - from electric cars to wind turbines and batteries. Without rare earth elements this is not possible. So, finding possibilities for waste-free phosphate rock processing that enables to separate also REEs is a key to a better future.

Research field:	Chemical, materials and energy technology
Supervisors:	Prof. Dr. Andres Trikkel Dr. Kaia Tõnsuaadu
Availability:	This position is available.
Offered by:	School of Engineering Department of Materials and Environmental Technology
Application deadline:	Applications are accepted between June 01, 2022 00:00 and June 30, 2022 23:59 (Europe/Zurich)

Description

Estonia has large unexploited phosphate rock reserves, the total amount being about 700 million tons of P_2O_5 . Currently, the reserves are not used due to concerns about social and ecological impact of phosphate rock mining and processing. At the same time the European Commission has defined phosphorite ore as a critical raw material with significant supply risk. In addition, Estonian phosphorite contains valuable rare earth elements, also belonging to the list of critical raw materials being necessary for future electronic applications and for switching from fossil fuels to renewable energy sources.

Therefore, phosphorite is of great economic importance, both locally and in the EU context. So, the novelty and actuality of these studies is clearly seen. The current PhD studies will be focused on studying and developing zero-waste phosphorite ore beneficiation and processing methods, which enable to minimize the related environmental impact, but also considers the trace element composition of Estonian phosphorite in the view of possible recovery.

Responsibilities and (foreseen) tasks

- Studying the specifics and proposing suitable and environmentally least harmful technologies for the production of phosphoric acid and/or mineral phosphate fertilizers by applying near zero-waste approach;
- Estimating the formation, behaviour and possibilities for reuse of the possible hazardous by-products related to phosphorite processing (e.g. fluorine compounds and solid wastes) and filling the gaps of necessary know-how for diminishing their environmental impact;
- Characterisation of potentially harmful (Cd, Pb, U, Th) and/or beneficiary trace elements (several REEs) in phosphorite;
- Elaborating possibilities for the recovery of rare earths elements from phosphate rock.

Applicants should fulfil the following requirements:

- a master's degree in chemistry or chemical engineering
- a clear interest in the topic of the position
- a strong desire to work in chemistry lab and good analytical skills
- excellent command of English and strong writing skills

- capacity to work both as an independent researcher and as part of team
- capacity and willingness to provide assistance in organizational tasks relevant to the project

The following experience is beneficial:

- Chemical engineering background
- Physical and inorganic chemistry
- Manual skills for laboratory experiments
- Office, Excel

The candidate should submit a motivation letter and short literature overview about phosphoric acid technologies.

We offer:

- 4-year PhD position in the TalTech Laboratory of Inorganic Materials under supervision of experts in phosphate chemistry and inorganic technology
- The chance to do intensive high-level research and publish high level publications
- Opportunities for conference visits, research stays and collaboration with international and local universities and enterprises
- Possibilities to participate in different useful courses at the university and abroad

About the department

The activities of the laboratory are focused on three priority directions both globally and in the key of Estonian future:

- Expanding the resource base of critical raw materials with basic and applied research for the development of new sustainable methods for the valorization of Estonian phosphorite and associated minerals (graptoliteargillite) - for the selective separation of valuable components such as phosphorus, vanadium and rare earth elements;
- Reducing greenhouse gas emissions which is one of the key objectives of the green turn, including development of chemical-technological bases of accelerated carbonation processes for alkaline industrial wastes (oil shale ash, clinker dust) as well as oxy-fuel combustion of fuels as a promising method for CO₂ capture. The possible applications are aimed to make construction materials together with simultaneous binding of CO₂;
- Applied research to reuse oil shale ash for the production of a valuable product - precipitated calcium carbonate - on an industrial scale with the possibly complete utilization of the generated residues.

We have participated in several international and local projects - CLEANKER (Horizon 2020), FLAME (EIT-KIC Raw Materials), Resta (ETAG) etc. and have co-operation with several institutes abroad (Abo Akademi University, Geological Survey of Finland, Chalmers University etc.

Additional information

For further information, please contact prof. Andres Trikkel andres.trikkel@taltech.ee and Sen. Res. Kaia Tõnsuaadu kaia.tonsuaadu@taltech.ee or visit <https://taltech.ee/en/laboratory-inorganic-materials>



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