LITHUANIAN ENERGY INSTITUTE

ADMISSION TO PHD STUDIES FOR THE YEAR 2025

DOCTORAL RESEARCH TOPIC:

Research of industrial waste potential and thermodynamic modelling

RESEARCH FIELD:

Energetics and Power Engineering (T 006)

BRIEF DESCRIPTION OF RESEARCH TOPIC:

The EU's main objectives are to achieve energy efficiency, energy independence and a transition to zero emissions in the industrial and construction sectors. Non-biodegradable or non-recyclable wastes are generated in various industries or technological processes, the availability, potential and potential added value in the new construction or industrial sectors have not been explored and widely applied. The efficient and innovative use of waste can significantly reduce dependence on primary resources, reduce the environmental impacts associated with extraction and recycling, and enhance climate neutrality. Sustainable, environmentally friendly technologies, such as geopolymerisation, can use several waste and by-products to produce thermally stable alternative binders and contribute to the EU's zero-emission targets.

The physicochemical composition of industrial wastes varies and is constantly changing with the changing technological parameters of the energy sector. This is why the efficient use of wastes in developing new geopolymer materials remains a topical issue.

The polymerization process parameters and the waste materials' physicochemical composition influence the nano- and mesoscale structural changes of the material being developed. The combination of different wastes (organic/mineral) can have a synergistic effect on the geopolymer's porosity, thermal, and mechanical properties and durability at high or low temperatures and in aggressive or high-humidity environments.

The origin of the waste changes the chemical reactions and binding phases, which can be optimized by geochemical modeling based on the thermodynamic modeling of heterogeneous systems. This includes analyzing the metastability, dispersion, and solid-liquid equilibrium of mineral phases by Gibbs free energy minimization. Thermodynamic modeling combined with experimental results would allow for assessing the durability of the material at a given temperature and medium.

Identifying synergistic relationships and patterns in the structural changes of waste-like geopolymeric materials would allow the development of special-purpose materials with higher energy efficiency, contributing to reducing greenhsouse gas emissions.

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