LITHUANIAN ENERGY INSTITUTE

ADMISSION TO PHD STUDIES FOR THE YEAR 2026

DOCTORAL RESEARCH TOPIC:

Investigation of waste heat recovery in industrial streams

RESEARCH FIELD:

Energetics and Power Engineering (T 006)

BRIEF DESCRIPTION OF RESEARCH TOPIC:

Flue gas from industrial plants is linked to the environmental impact of human activities. It will take a lot of effort to make industrial plants pollution-free, but in the face of climate change it is necessary and inevitable if we are to build our long-term prosperity. There is no shortage of initiatives to achieve this vision, both locally and internationally, to promote the transformation of industry into a sustainable ecosystem.

Flue gas emissions are typically waste streams of highly humid air or steam, which are released into the atmosphere and lose both energy and water. This problem is common to all industries. Water is introduced into the waste streams of the production processes of these industries because of the need to dry/evaporate the final product. Thus, hot air flow or a high temperature vapor flow interacts with industrial products, reducing their water content and ultimately changing their shape and size. After this process, the air/water content is higher and the temperature is lower, although the heat content is still high. In addition, the industrial process and the interaction of air and/or vapor with the products may introduce various particles into the exhaust gas streams. Generally, heat recovery and water recovery of these flue gas streams are not cost-effective due to the low temperature of the stream, the composition of the stream or the particle content, which can significantly reduce the efficiency of conventional heat exchangers for heat recovery.

Reducing emissions of flue gases or pollutants is therefore a challenging task, but it brings many benefits, i.e. a large potential of waste heat energy can be recovered and reused, thus increasing the energy efficiency of the industrial process. This is a resource that is available to any industrial company with these waste streams, but which has not been fully exploited to date. Companies that exploit these resources would not only gain a significant competitive advantage but would also benefit from meeting the emission reduction targets set by increasingly stringent legislation.

Industrial energy consumption is still heavily dependent on fossil fuels. In some energy-intensive industries, energy and fuels account for a significant share of production costs, making energy efficiency a key area for competitiveness. Therefore, a more efficient use of resources in industrial processes is not only a necessity arising from multiple global challenges, but also a prerequisite for industrial growth in resource-poor countries such as Lithuania.

Waste heat is recovered through the condensation process in condensing economizers, and they need to be improved to make the recovery process cost-effective. To achieve high efficiency in condensing economizers, a good understanding of the complex heat and mass transfer processes involved is required. Therefore, experimental and numerical studies on the condensing economizer are planned, covering hydrodynamics, heat transfer and condensation processes. This will involve the use of a two-phase flow test rig and a commercial CFD package and the development of models to evaluate the condensation process.

The aim of the work - To investigate the heat and mass transfer and hydrodynamic processes in a condensing economizer and to identify regularities to obtain valid data for the design and manufacture of more efficient heat exchangers.

The tasks of the work - To investigate the complex heat and mass transfer in a condensing economizer, the influence of non-condensable gases on condensation processes, and the influence of gas flow and cooling water parameters on condensation processes at different flow regimes

Suggested topics for the dissertation:

- Experimental investigation of waste heat recovery using an innovative heat pipe condensing economizer (supervisor Povilas Poškas)
- Numerical investigation of the effect of the non-condensable gases on the condensation process in a condensing economizer (supervisor Robertas Poškas)

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