Condensation of humid air flow on the tubes of the heat exchanger mockup

Robertas Poškas, Arūnas Sirvydas, Mohab Salem, Jurgis Jankauskas

Lithuanian Energy Institute, Nuclear Engineering Laboratory, Breslaujos 3, LT-44403 Kaunas – Lithuania, Email: mohab.salem@lei.lt

INTRODUCTION

Growing environmental concerns have spurred efforts to enhance the affordability and efficiency of renewable energy systems as alternatives to non-renewable sources. The recovery and reuse of waste heat from industrial processes provide advantages such as reduced fuel consumption, lower greenhouse gas emissions, and enhanced overall efficiency. Condensing heat exchangers, capable of capturing both latent and sensible heat from effluent gases, have emerged as a successful method for waste heat recovery.

RESEARCH QUESTION

- Does the quality of the humidified air affect condensation rate and heat recovery? Specifically, how does the humid air inlet temperature of the heat exchanger impact heat and mass transfer processes?

METHODOLOGY

The Lithuanian Energy Institute carried out experiments to better understand fluid behaviour and the condensation process. The experimental setup is demonstrated in figure (1). This research study is related to the EU Horizon 2020 iWAYS project (Innovative WAter recoverY Solutions through recycling of heat, materials, and water across multiple sectors) activities.

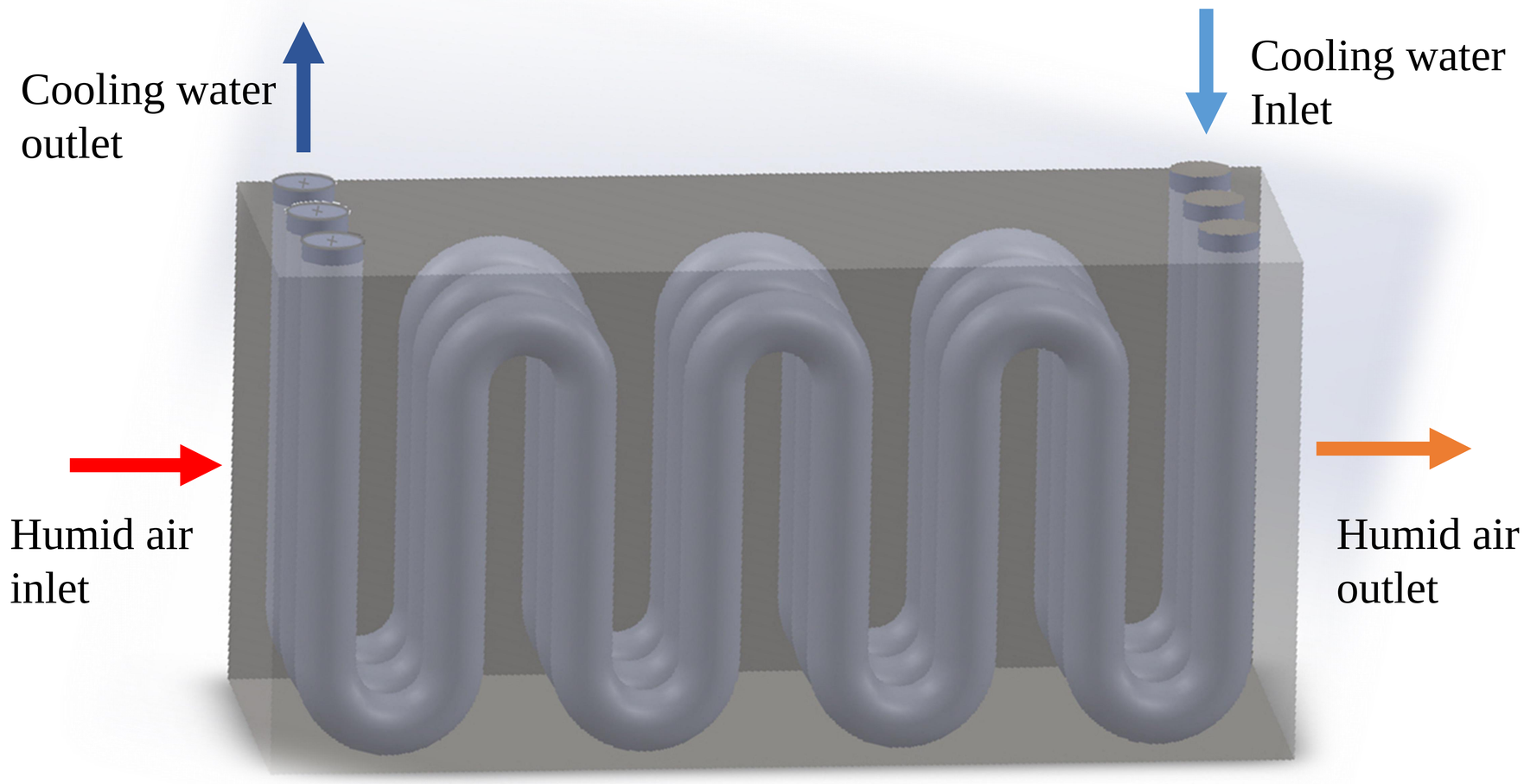

Figure (1): Experiment setup

RESULTS AND DISCUSSION

The study analyzed the influence of inlet temperatures on condensation rate and Nusselt number. Lower temperatures were found to increase the Nusselt number and increase condensation rate. Optimizing inlet temperature can enhance efficiency in condensing heat exchangers for waste heat recovery. The findings provide insights for designing heat exchangers in gas flows with non-condensable gases, contributing to improved energy efficiency and waste reduction.

CONCLUSION

The outcomes of the study provide information for the optimization of heat exchanger design in the area of limited investigations of gas flows with significant mass fraction of non-condensable gases. The study's results may provide insights and guidelines for the development and optimization of condensing heat exchangers and contribute to the wider goal of improving energy efficiency and reducing waste in various sectors.

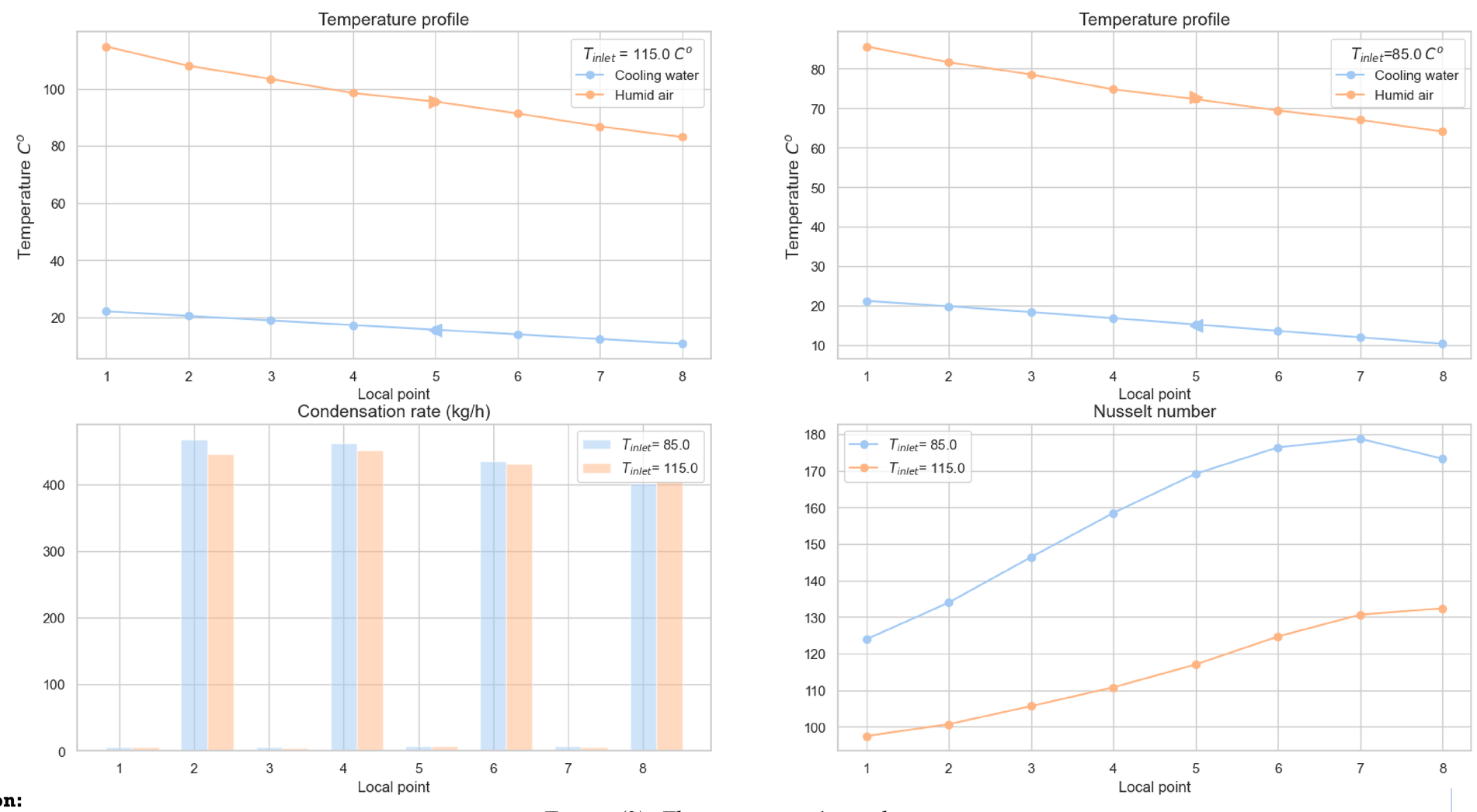

Figure (2): The experiment's results

Contact information:

Mohab Salem

PhD student, Laboratory

Lithuanian Energy Institute, Breslaujos st. 3, LT-44403, Kaunas

mohab.salem@lei.lt

+370 62212130

LITHUANIAN ENERGY INSTITUTE

RAD eleven