Small Scale Combined Heat and Power Generation Units: Modelling of Thermal-Hydraulic Issues, System Design, and Operation

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Overview

A dispersed generation system based on local fossil fuels or renewable energy resources (RES) is the latest trend. Heat sources of a dispersed generation systems based on RES can be of various origin, for example, solar power, biomass combustion, ground heat source or waste heat. Micro combined heat and power units (CHP) based on organic Rankine cycle (ORC) fits very well to the distributed energy generation strategy and in recent years it has become an area of intense research. With the advent of these technologies, the efficiency currently at around 10% mark, is likely to rise considerably and reach up to 25%. In the present course, application of ORC CHP unit in households, where 2-3 kW power is regarded sufficient, is considered. Primary energy is much better utilized in such CHPs than those units producing electricity alone. A CHP unit utilizes 85-90% of the energy of fuel. About 70% of energy is delivered as heat, and about 15 to 25% in production of electric energy. Based on the previous studies, economics of an ORC system is strictly linked to thermodynamic properties of the working fluid. Expected characteristics of a good fluid are: low specific volumes, high efficiency of thermodynamic cycle, high latent heat, moderate pressures in the heat exchangers, low cost, low toxicity, low ODP and low GWP among others. Most of the research work was focused mainly on subcritical cycles. However, supercritical parameters could also offer great opportunities. The analysis of supercritical fluid parameters may even lead to higher efficiencies making the micro CHP more attractive. The objective for a domestic micro CHP is to design small sized heat exchangers and for that reason not all supercritical fluids could be suitable.

Schedule	**30 OCT:** **Fundamentals of cogenerative systems design and manufacturing. Available and perspective cogeneration technologies. Ideal and real thermodynamic cycles for organic fluids. Working fluid selection. Important design issues of heat exchangers with change of phase (boiling and condensation). Differentiation between conventional size passages and minichannels. Heat transfer intensification techniques in mini and micro channels.** **31 OCT:** **Exergetical analysis of the thermodynamic cycle. Selection of optimal evaporation temperature. Overview of state-of-the-art flow boiling and flow condensation calculations techniques. Thermal hydraulic calculation procedure for flows with change of phase – part 1** **1 NOV:** **Thermal hydraulic calculation procedure for flows with change of phase - part 2** **Two phase flows in heat exchangers. Maldistribution problems. Problem solving session with examples: Diversity of micro heat exchangers.** **2 NOV:** **Flow instability problems in heat exchangers. Flow blockage in micro heat exchangers. Experimental evaluation of the ORC system performance. Recommendations for modifications. Problem solving session with examples: Diversity of micro heat exchangers.** **3 NOV:** **Examination for students** **Maximum Number of participants for the course will be limited to 50.**
You Should Attend If…	▪ You are student at all levels (BTech/MSc/MTech/PhD) or Faculty from reputed academic institutions and technical institutions. ▪ You are executives, engineers and researchers from manufacturing, service and government organizations including R&D laboratories
Fees	The participation fees for taking the course is as follows: **Students: Rs. 10000** **Faculty members: Rs. 15000** **Industry/ Research Organizations: Rs. 20000** **Participants from abroad: US $500** The above fee is towards participation in the course, the course material, computer use for tutorials and assignments, and laboratory equipment usage charges. The participants may be provided with hostel accommodation, depending on the availability, on payment basis.

The Faculty

Prof. Dariusz Mikielewicz is one of Professors of Gdansk University of Technology, Poland, he is Dean of Faculty of Mechanical Engineering (since 2016). Dr. Mikielewicz has written more than 270 papers (including 8 monographs, 9 chapters in books, 20 articles from the JCR list, more than 50 articles on an international scale). His research interests are heat transfer by boiling and condensation, intensification of heat exchange, non-conventional devices and systems for energy conversion, micro CHP, extension of the chain of biomass conversion to produce components for various processes. He was the director of 11 research projects funded by many Polish and international funding agencies such as KBN, Ministry of Higher Education, NCN also 7FP EU. He is reviewer in prestigious scientific journals from the JCR list such as the International Journal of Heat and Mass Transfer, International Journal of Multiphase Flow, and others. For his achievements, he was awarded the Silver Cross of Merit and the Medal of the National Education Commission.

Dr. Ritunesh Kumar is working as an Associate Professor in the Mechanical Engineering Department of Indian Institute of Technology, Indore. His research interests are heat transfer at micro-scale, desiccant cooling system and biofuel.

Course Co-Ordinator

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