DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

PhD Public Defence

Title: Modeling and Control of Membrane Filtration Systems for Offshore Oil & Gas Produced Water Treatments

Location: AAU Esbjerg Campus, Room C1.119

Time: Friday 21 June at 13.00

PhD defendant: Kasper Lund Jepsen

Supervisor: Associate Professor Zhenyu Yang

Moderator: Associate Professor Jens Bo Holm-Nielsen

Opponents: Professor Henrik Clemmensen Pedersen, Department of Energy Technology, Aalborg University (Chairman)
Dr. Ming Yang, Environmental Consultancy Services Manager NEL, UK
Associate Professor Johannes Jäschke, Norwegian University of Science and Technology (NTNU), Norway

All are welcome. The defence will be in English.

After the public defence there will be an informal reception in the vestibule (C2) at Esbjerg Campus.

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Abstract:

In the offshore oil and gas sector, large quantities of gas, oil, and water are extracted from the underground reservoirs and separated. The produced water, containing traces of oil, is discharged into the sea affecting the surrounding environment. Political tendencies towards zero discharge policies and the inability of current facilities to continuously comply with discharge regulations require new technologies to be considered. In this thesis, membrane filtration is investigated as a potential technology for improving the oil-in-water separation. A major challenge with membrane filtration is fouling of the membranes, reducing capacity and increasing the capital and operating expenses, thus the objective of the thesis is to reduce the expenses by optimizing the process from a process control perspective. As the operating conditions are crucial for minimizing fouling growth, selecting control pairings that minimize interaction between the controllers improves reference tracking and disturbances rejection, thus reducing fouling growth. The backwashing and filtration durations are online adjusted to maximize fouling removal, minimize backwashing time, and account for time-varying features, thus improving the efficiency and total throughput. Lastly, the enormous energy consumption of the crossflow pumps is minimized by scheduling multiple parallel pumps energy efficiently based on the proposed model structure. By reducing fouling growth, optimizing fouling removal, and reducing energy consumption, the capital and operating expenses of crossflow membrane filtration are reduced.