DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

PhD Public Defence

Title: Characterisation of Rag Properties and their Transport in Wastewater Pumps

Location: Pontoppidanstræde 111, auditorium

Time: Tuesday 14 August 2018 at 13.00

PhD defendant: Anna Lyhne Jensen

Supervisor: Professor Lasse Rosendahl

Moderator: Professor Søren Knudsen Kær

Opponents: Professor Erik Lund, Aalborg University (Chairman)
Professor François Henri Léon Raymond CLEMENS, Delft University of Technology, the Netherlands
Docent Ronnie Anderson, Chalmers University, Sweden

All are welcome. The defence will be in English.

After the defence there will be an informal reception in Pontoppidanstræde 111 (coffee room).

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Abstract:

Accumulation of sanitary refuse, such as wet wipes, in wastewater pumps deteriorates the pump performance, ultimately leading to break-down with need of manual cleaning. To prevent this, the ability of wastewater pumps to handle wet wipes, rags and similar materials in the wastewater is a key feature which must be taken into account as the pumps are designed. Today, simulations are widely used in the design of pumps and other turbomachines. However, the complexity of simulating a flexible material such as a rag in a pump has so far prompted experimental investigation of resistance to clogging rather than simulations.

Using the Discrete Element Method, a model of a rag formed by bonded particles is developed. The model is calibrated based on experimentally obtained quantitative parameters describing the elongation-, bending- and drape properties of the rag. By implementing separate parameters for the normal bond stiffness and out of plane bending stiffness of the bonds connecting the particles which form the rag, the model successfully reproduces elongation, bending and drape obtained from experiments. By coupling the discrete element rag model to Computational Fluid Dynamics using a standard drag model for fluid-particle interaction, a preliminary simulation of the transport of a rag through a wastewater pump with a single channel impeller is achieved.

Furthermore, this study experimentally characterises motion of textile material immediately upstream of a wastewater pump and inside a pump using artificial wastewater containing rags. Clear differences in the tendency of the rags to get stuck on the tongue, stay in the volute flow or exit the pump depending on the operating point have been identified and the flow conditions inside the pump rather than at the inlet have been observed to lead to different types of clogging at different pump operating points.

The result of the preliminary simulation of rag transport through a wastewater pump resembles the motion of the rags through a pump which was observed experimentally.