An assessment of in-tube flow boiling correlations for ammonia-water mixtures and their influence on heat exchanger size - DTU Orbit (11/09/2019)

Heat transfer correlations for pool and flow boiling are indispensable for boiler design. The correlations for predicting in-tube flow boiling heat transfer of ammonia-water mixtures are not well established in the open literature and there is a lack of experimental measurements for the full range of composition, vapor qualities, fluid conditions, etc. This paper presents a comparison of several flow boiling heat transfer prediction methods (correlations) for ammonia-water mixtures. Firstly, these methods are reviewed and compared at various fluid conditions. The methods include: (1) the ammonia-water specific flow boiling correlations from the open literature, (2) the ammonia-water specific pool boiling correlations from the open literature extended to flow boiling by using the pure fluid correlation by Gungor and Winterton, and (3) the classical wide-boiling correlations. Secondly, their influence on the required heat exchanger size (surface area) is investigated during numerical design. For this purpose, two case studies related to the use of the Kalina cycle are considered: a flue gas based heat recovery boiler for a combined cycle power plant and a hot oil based boiler for a solar thermal power plant. The results indicate that the nucleate boiling contribution to flow boiling is small compared to the flow boiling contribution for the investigated conditions. Furthermore, the use of the different flow boiling correlation methods resulted in evaporator size differences within 6% for the heat recovery boiler and 28% for the oil based boiler.