Experimental studies on thermal spray-coated horizontal tubes for falling film evaporation in multi-effect desalination system

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Abstract

Multi-effect distillation is an important principle in desalination technology, in which the thin film evaporation of sea water takes place at the outer surface of bundle of tubes, normally arranged in horizontal. Heat of condensation inside the tube is transferred to the falling water film by conduction, thereafter convective evaporation of film takes place. Heat transfer on the outside is unpredictable due to the uncertainty in nature of film, film thickness, film dryout, etc. and film coefficient is considerably less compared to inside. Thermal spray coating on metallic surface with molten metal particles create porous surface which enhances heat transfer due to higher turbulence and nucleation sites, if sufficient temperature difference available. This paper discusses the experimental studies carried out on a 3 × 5 bundle of 25.4 mm ∅ Al horizontal tubes with thermal spray coating of aluminum. Influences on temperature profile, heat transfer coefficient, mass evaporation, etc. are studied. A comparison of sea water and fresh water is carried out for the performance of the system. The experimental setup is established at IIT Madras, Chennai, India.

Keywords: Falling film evaporation; Film heat transfer coefficient; Heat transfer enhancement; Mass evaporation