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Preventing formation of dry patches in seawater falling film evaporators

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ABSTRACT

When a liquid film is falling across a heated surface, the film structure results in a variation of heat transfer and interface temperature thus facilitating the film rupture. The variation of heat transfer lefts behind a thermal topology on the heating surface that may suffice to initiate formation of vapour bubbles. Once formed, vapour bubbles grow and act on the film flow as obstacles, disturb the film and may cause film rupture with stable dry patches and salt deposition on the heating surface. Even if the liquid film remains continuous, any growing bubble results in salt deposition on the heating surface in the bubble foot region, and in both cases the heat transfer in the film becomes deteriorated. Consequently, bubble formation in evaporating falling films is to be prevented in the praxis. In the present contribution first the conditions of bubble nucleation in an evaporating falling film are formulated. From these conditions the minimum heating surface temperature required for nucleate boiling in the film is determined. This temperature is considered to represent the upper limit for the convective heat transfer in the film without bubble formation. The obtained results are illustrated in the second part of the paper, adopting a falling film evaporator equipped with horizontal tubes as example. The tubes, arranged one below the other and sprayed outside with seawater, are heated inside by condensing vapour.

Keywords: Falling film; Bubble nucleation; Dry patches; Heat transfer