Experimental Study of Scale Formation in Horizontal Tube Evaporators

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In many cases the efficiency of evaporation processes is strongly diminished by scale formation on heat transfer surfaces. A common type of evaporation plant is a horizontal tube evaporator. Feed solutions consisting of inversely soluble salts, which trickle onto the outside of the horizontal tubes, cause incrustation problems. This leads to an additional heat conductivity resistance, the so called fouling resistance.

Due to the increasing problem of water scarcity in the world the research work is focused on the process of seawater desalination where scaling is a major reason for loss of efficiency and high cleaning costs. A typical process for seawater desalination is the multiple-effect distillation (MED) process on horizontal tubes. To reduce scaling and corrosion low temperature plants are employed. However, with these low temperature plants the advantageous features of the MED process like low primary energy consumption cannot be fully used yet.

Research work is carried out to study the formation of crystalline scales on horizontal tubes. For this purpose a technical size horizontal tube evaporation plant has been constructed providing the opportunity of simulating different operating states. The aim of the experiments is to investigate crystalline scale layers of calcium carbonate, calcium sulfate and magnesium hydroxide.

The effects of various process parameters such as fluid temperature, heat transfer surface temperature and heat flux on the crystalline scale layers are discussed. The influence of the composition, the salinity and the pH of the test solution (artificial seawater) on the incrustation is presented.