

INVESTIGATION OF MASS TRANSFER COEFFICIENT OF WATER EVAPORATION THROUGH HYDROGEL SHEET

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Abstract

This study examines the evaporation characteristics of water from a water-retaining substrate overlaid with a hydrogel layer, which serves as both a liquid retention barrier and an active evaporative interface. The substrate consists of a 1.5 cm thick polyester absorbent pad that is fully saturated prior to testing, while the hydrogel layer, approximately 0.1 cm thick, is synthesized from acrylamide using ammonium persulfate as an initiator and zinc oxide as an additive. The prepared sample was mounted on a temperature-controlled heating plate with dimensions of 33 cm × 23.6 cm. Experiments were conducted under five surface orientations: upward-facing, vertical, downward-facing Upward-facing inclined at 45° and Downward-facing inclined surface at 45°. All tests were performed in a controlled indoor environment at 25 °C and 50% relative humidity, with forced airflow at a velocity of 2 m/s directed across the surface. The evaporation rate during the constant drying period was determined from measured mass loss and used to estimate the mass transfer coefficient. The findings reveal that the mass transfer coefficients for both the bare absorbent pad and the hydrogel-covered configuration exhibited similar magnitudes across different orientations and showed an increasing trend with surface temperature. Nevertheless, these coefficients remained lower than those observed for a free water surface. A correlation was proposed to predict the mass transfer coefficient relative to that of a free surface, and the predicted evaporation rates showed good agreement with experimental measurements, with discrepancies within ±10%.

Keywords: Water evaporation, Hydrogel Sheet, Mass transfer coefficient