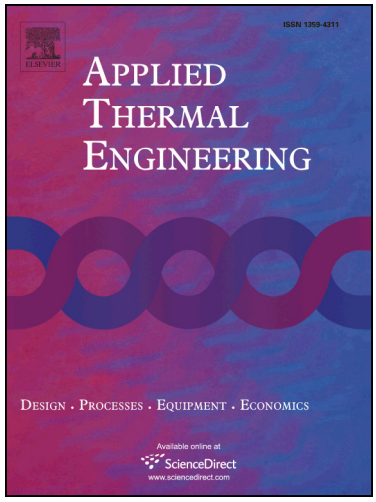

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THE NUMERICAL MODEL FOR DIRECT EVAPORATIVE COOLER

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ABSTRACT

This paper presents a numerical model for a compact direct-contact cross-flow air/water heat exchanger where evaporating water cools down an air stream, and where an innovatively designed metallic direct evaporative pad enhances air-water interaction. The numerical model implements energy and mass conservation equations of humid air and water in a one-dimensional geometry by applying correlations for heat and mass transfer coefficients. The system of ordinary differential equations is solved by central-finite discretisation using Matlab. The effective hydraulic diameter is isolated as the only unknown model parameter, and is determined by a parameter estimation using experimental data available from a producer of such a direct evaporative pad. The numerical model is able to predict the air outlet temperature, with an maximal error of 1.33 % compared to experimental data for different inlet temperature and humidity values. Humid air properties inside and at the outlet of the direct evaporative pad, the pad effectiveness and the water consumption can be evaluated by the presented model. The use of the numerical model is demonstrated with examples analysing the impact on heat exchanger effectiveness of a changed geometry (design analysis) and of varying air inlet conditions for a given geometry (operational analysis).

Keywords

Direct Evaporative Cooler, Numerical Model, Moist Air, Pad Effectiveness

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