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Performance analysis of novel dew point evaporative cooler with shell and tube design through different air-water flow configurations

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Abstract

The complex design of a dew point evaporative cooler (DPEC) is the largest impediment to the globalization of such a high-performance system. Therefore, in this paper, we introduce a new design for the DPEC which eliminates the complexity barrier and significantly improves the system's performance. The new design consists of one shell and a bank of tubes. The single shell works as a working channel, while the tubes work as primary channels. A solid mathematical model has been developed which can predict the system's performance with high accuracy, as it was validated against three experimental studies. Throughout the analysis, the energy and thermal performances of the current model has been compared to the conventional DPEC with flat plate design for two air-water flow configurations, namely, parallel and counter air-water flow configurations. It was found that, under a wide range of operational and geometrical conditions, the new cooler consistently outperformed the flat plate type cooler by producing colder air by about 3.1 °C and improving energy efficiency by about 12.2%. Meanwhile, the parallel air-water flow configuration produced much colder water than the counter configuration, accounting for 15.76 °C (140%) colder.