*Research Paper*

BUILDING SERVICES ENGINEERING RESEARCH & TECHNOLOGY

Building Serv. Eng. Res. Technol.
2023, Vol. 0(0) 1–18

DOI: 10.1177/01436244231179456
journals.sagepub.com/home/bse
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# Evaluation of new dew point evaporative cooler heat and mass exchanger designs with different geometries

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## Abstract

In this study four new geometries of heat and mass exchanger for dew point evaporative cooling are investigated and their performance is compared to that of the commonly used flat plate and corrugated plate exchangers. In the proposed exchangers, each dry channel is completely enclosed by its adjacent wet channels, and each wet channel is completely enclosed by its adjacent dry channels (related detailed information is presented graphically in this paper). In addition, a robust numerical model was developed and is examined under various operational and geometrical conditions. The analysis showed that the proposed dew point evaporative coolers improve the chilled air temperature, water consumption, cooling capacity, and energy efficiency. In particular, the circular concentric tube exchanger, under certain operating conditions (inlet air temperature, humidity ratio, and velocity of 40°C, 6 g/kg, and 3 m/s, respectively), could produce the lowest chilled air temperature of 9.6°C and the highest wet bulb and dew point effectiveness of 148% and 99%, respectively. Additionally, water consumption is reduced to 1.34 L/hr for an inlet air velocity of 1 m/s. A triangular tube exchanger achieved the highest cooling capacity and coefficient of performance, but consumed the largest amount of water. Our geometrical analysis demonstrates that the overall performance of dew point evaporative cooling systems can be improved by employing new geometries for heat and mass exchanger channels.

*Practical application*: The dew point evaporative cooler is an environmentally friendly air conditioning system used in buildings. It is considered the strongest candidate to replace vapour-compression refrigeration systems because it consumes considerably less electricity while achieving high performance. Our research demonstrates that through revised geometry it is possible to further improve the performance of the system leading to improved energy and water efficiency.

## Keywords

Air conditioning, dew point evaporative cooler, heat and mass transfer, numerical simulation

Received 11 January 2023; Revised 2 May 2023; Accepted 7 May 2023

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