



Restricted access | Research article | First published online May 30, 2023

Evaluation of new dew point evaporative cooler heat and mass exchanger designs with different geometries

Mohammed A Sulaiman and Ahmed M Adham [View all authors and affiliations](#)[OnlineFirst](#) | <https://doi.org/10.1177/01436244231179456>[Contents](#)[Get access](#)[Cite article](#)[Share options](#)[Information, rights and permissions](#)[Metrics and citations](#)

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.

Become a Guest Editor
Submit a proposal >>

SAGE Discipline Hubs
Read the latest content

Get full access to this article

View all access and purchase options for this article.

GET ACCESS

References

1. International Energy Agency. *Key world energy statistics 2021*. Paris, France: International Energy Agency, 2021.

[Crossref](#)[Google Scholar](#)

2. Afshari A, Nikolopoulou C, Martin M. Life-cycle analysis of building retrofits at the urban scale: a case study in United Arab Emirates. *Sustain* 2014; 6: 453–473.

[Crossref](#)[Google Scholar](#)

3. California Energy Commission. *Building energy efficiency standards for residential and non-residential buildings*. Sacramento, CA: California Energy Commission, 2022.

[Google Scholar](#)

4. International Renewable Energy Agency. *World energy transitions outlook*. Masdar City, UAE: International Renewable Energy Agency, 2022.

[Google Scholar](#)

5. Liu Y, Li JM, Yang X, et al. Two-dimensional numerical study of a heat and mass exchanger for a dew-point