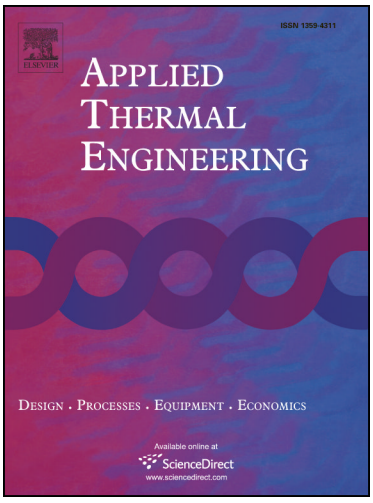

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PII: S1359-4311(17)37557-9
DOI: https://doi.org/10.1016/j.applthermaleng.2018.02.103
Reference: ATE 11885

To appear in: *Applied Thermal Engineering*

Received Date: 27 November 2017
Revised Date: 26 February 2018
Accepted Date: 28 February 2018

Please cite this article as: R.H. Mohammed, O. Mesalhy, M.L. Elsayed, L.C. Chow, Performance evaluation of a new modular packed bed for adsorption cooling systems, *Applied Thermal Engineering* (2018), doi: https://doi.org/10.1016/j.applthermaleng.2018.02.103

Performance evaluation of a new modular packed bed for adsorption cooling systems

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Highlights

- A new packed bed for adsorption cooling systems is proposed.
- The bed is modular and can be scaled for a given cooling load.
- The performance of the bed is investigated experimentally and numerically.
- The SCP produced by the bed is 2.3 times higher than typical adsorption chillers.

Abstract

A newly designed packed bed for use in adsorption cooling (AC) systems is evaluated in this research. The bed is modular and can be scaled for a given cooling load. An experimental setup is built to measure the adsorption kinetics of one module under typical operating conditions. Also, a transient three-dimensional local thermal non-equilibrium model (LTNE) is developed to study the heat and mass transfer inside the packed bed. Darcy's equation and linear driving force model are solved simultaneously to account for inter-particle and intra-particle mass transfer, respectively. Silica gel RD-2060 and advanced zeolite AQSOA-Z02 are chosen as an adsorbent for the packed bed. Good agreement between the experimental measurements and numerical results is established. The effects of operating conditions on the specific cooling power (SCP) produced by the two different working pairs are investigated. The results show that silica gel RD-2060 yields higher SCP than zeolite AQSOA-Z02 for the same operating conditions. For AQSOA-Z02/water, the bed performance is insensitive to changes in the convective heat transfer coefficient because the overall bed thermal resistance is dominated by the adsorbent low thermal conductivity. The proposed modular bed produces an SCP of 460 W/kg of silica