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Performance Investigation of a Vapor Adsorption Refrigeration System Based on Adsorption / Desorption Time and Heat Transfer

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Abstract

In the past two decades, the development of sustainable refrigeration systems such as thermally operated vapor adsorption refrigeration systems achieved unparalleled growth in the research world as compared to conventional vapor compression systems and even thermally operated vapor absorption refrigeration system. Yet, the commercial success of the adsorption refrigeration system could not be achieved due to mainly its higher space area required per kilowatts of refrigeration capacity. With the focus to look improvement on this issue, the performance of the adsorption refrigeration system has been studied concerning adsorption/desorption time and heat transfer of adsorber. It is proposed to reduce the adsorption/desorption time, due to which the concentration (ratio of the mass of adsorbed refrigerant to the mass of activated carbon) will not reach its equilibrium value, but it is possible to get a higher mass flow in a shorter period. In turn, the cooling capacity will increase. In view of this, a mathematical model has been developed to study the performance and applied to three adsorbent–adsorbate pairs, namely, Maxsorb III–ethanol, Maxsorb III–R507a, and Maxsorb III–R134a. Based on the mathematical investigations, it is observed that the cooling capacity can be improved significantly at a litter higher cost of the heat transfer mechanism.

Keywords:

adsorption isotherm, adsorption kinetics, cooling capacity, COP, heat transfer analysis, vapor adsorption refrigeration, energy systems, thermal systems

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