

Experimental Study of Heat and Mass Transfer in Activated Carbon Fiber with Adsorbing Refrigerant

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ABSTRACT

This study aims at clarifying the heat and mass transfer characteristics in activated carbon fiber layer with adsorbing refrigerant such as methanol and water.

In heat driven refrigeration and air conditioning systems, adsorption refrigerator driven by waste heat and/or renewable energy at low-thermal temperature is one of the effective cooling technologies from the standpoint of rational energy utilization, energy saving and global environmental problem. The refrigeration system performance depends on the characteristics of adsorption reactor which is a heat exchanger having adsorbent layer or bed.

In this paper, experiments are performed to investigate the heat and mass transfer characteristics in activated carbon fiber layer adsorbing water or methanol vapor as refrigerants. Obtained data are presented and discussed to design high performance adsorbent heat exchanger. Finally, adsorption equilibrium data are presented and correlated in simple equations.

The result shows that the adsorption rate of water or methanol vapor decrease as the adsorbent layer thickness increases. It is attributed to a heat conducting resistance within the layer. This resistance comes from low density of carbon fiber that is high void fraction. The influence of volumetric rate of the layer on adsorption rate is also examined. In a compressed layer, that is in a high volumetric rate layer, an increase in adsorption rate as well as amount in adsorbed water or methanol vapor per volume of the layer has been also observed. Therefore it can be concluded that the present system has a high potential in the viewpoint of reducing the size of the adsorption reactor. Furthermore, some methods to obtain high performance heat exchanger are also discussed.