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Gravimetric Method for Sorption Performance Measurement of Desiccant Wheel and Desiccant Coated Heat Exchanger

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HIGHLIGHTS

New apparatus of gravimetric method for desiccant device was set up.
Desiccant wheel (DW) and desiccant coated heat exchanger (DCHE) were tested.
Dynamic properties under several temperature and air velocity was investigated.
Experimental results were compared with simulation results.
Arrhenius equation could be applied for diffusion coefficient in desiccant layer.

ABSTRACT

In this study, the performance of four types of desiccant wheels fabricated by silica-based adsorbents, and that of a desiccant coated heat exchanger (DCHE) coated with a polymer sorbent, were analyzed experimentally. The static and dynamic sorption characteristics were directly measured by a gravimetric method, which measured the changes in the weight of the desiccant wheels and the DCHE during the adsorption/desorption processes. An apparatus was built in order to carry out the dynamic measurement by the gravimetric method. During the adsorption/desorption processes, an air channel at the test section was fixed to avoid air leakage. During the weight measurement, the air channel moved to prevent the desiccant wheel or DCHE from becoming tough anywhere. Then, the weight could be measured. Based on these experimental results, the sorption characteristics were clarified under various temperature conditions and different airflow rates. Then, they were analyzed by numerical simulation. As the air velocity increased, the adsorption and desorption speeds also increased. However, the equivalent diffusion coefficients in the desiccant layer were not affected by the air velocity, whereas the equivalent diffusion coefficients increased under a higher temperature.

KEYWORDS: desiccant, gravimetric method, desiccant coated heat exchanger, desiccant wheel, isothermal adsorption/desorption

1. Introduction

For a comfortable residential air environment, an air conditioning system is necessary that controls not only temperature but also humidity. In order to enhance the energy efficiency of the air conditioners and improve the residential air quality, an air-conditioning system assisted with a solid desiccant, with which the humidity can be

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