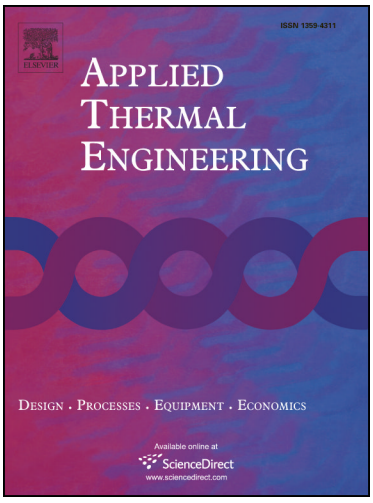

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Performance Evaluation of a Desiccant Coated Heat Exchanger with Two Different Desiccant Materials

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ABSTRACT

In desiccant cooling systems, the desiccant material reduces the humidity in the process air by removing its moisture. The reduction of the temperature is achieved by heat exchangers, evaporative coolers or conventional cooling coils. These systems draw interest because they allow the use of low quality energy which can support sustainability through energy efficiency.

The desiccant coated heat exchanger is a structure that allows the simultaneous removal of adsorption heat and dehumidification in a single element. This structure is a system element that can contribute extensively to the indoor air humidity control for new generation dehumidification in air conditioning systems. Besides, the dehumidification efficiency of this system has been found to be better than the conventional desiccant wheel. In this study, a desiccant coated small-scale heat exchanger is evaluated by simulation. Silica gel and aluminium fumarate are analysed as desiccant material coatings in this work. Simulations are performed according to two model configurations which are adiabatic and water-cooled cases respectively. Heat and mass transfer characteristics are determined for the two cases as well as the dehumidification and regeneration capacities. The performances of the two materials are compared based on the results of the simulations. Results of the study show the advantages of the water-cooled dehumidification over the adiabatic dehumidification and silica gel composite coating over aluminium fumarate coating.

Keywords: desiccant cooling, desiccant coated heat exchanger, dehumidification, heat and mass transfer, sorption.

INTRODUCTION

The thermal comfort and effects of it on the human being are significant as it is highly related to health, behavior, and productivity [1]. A reasonable degree of thermal comfort can be achieved by controlling indoor air quality parameters such as radiant temperature, air temperature, relative humidity and air velocity. Humidity control is important for several reasons. It is the major part of people's thermal comfort. Besides, when the moisture is over a certain level in a building, this might result in the growth of fungus stirring up problems in air quality. Moreover, moisture removal requires more energy consumption. In humid climates, dehumidification may correspond to a quarter to a third of cooling energy consumption [2].

Solid desiccant materials allow a high capacity of air dehumidification. This phenomenon occurs as a mass transfer process driven by a difference in the vapor pressure in the adsorbed coating layer and the flowing air. Silica gel and lithium chlorides have the most widespread use among commercially available desiccants [3].

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