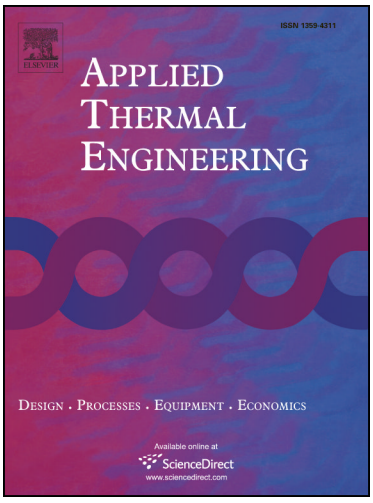

Research Paper

Performance evaluation of a membrane-based flat-plate heat and mass exchanger used for liquid desiccant regeneration

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Performance evaluation of a membrane-based flat-plate heat and mass exchanger used for liquid desiccant regeneration

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Abstract

Liquid desiccant dehumidification system has gained much progress recently for its considerable energy saving potential without liquid water condensation. Within the system, regeneration is of great importance since diluted desiccant solution after dehumidification needs to be re-concentrated. The operational characteristics of a membrane-based flat-plate heat and mass exchanger used for liquid desiccant regeneration are investigated in this study. The liquid desiccant and air are in a cross-flow arrangement, and separated by semi-permeable membranes to avoid carry-over problem. The regeneration performance is examined by numerical simulation and experimental test. Solution side effectiveness, temperature decrease rate (TDR) and moisture flux rate (MFR) are applied to evaluate heat and mass transfer in the regenerator. Effects of main operating parameters are assessed, which include dimensionless parameters (i.e. number of heat transfer units NTU and solution to air mass flow rate ratio m^*), solution inlet properties (i.e. temperature $T_{sol,in}$ and concentration $C_{sol,in}$) and air inlet conditions (i.e. temperature $T_{air,in}$ and humidity ratio $W_{air,in}$). It is found that m^* and NTU are two of the most important parameters and their effects on the regeneration performance are interacted with each other. There is hardly benefit to the performance improvement by increasing NTU at low m^* or increasing m^* at low NTU. Even though the regeneration performance can be improved by increasing m^* and NTU, its improvement gradient is limited when $m^*$and NTU exceed 2 and 4 respectively. It is also found that increasing solution inlet temperature is an effective approach to enhance the regeneration performance, while air inlet temperature and humidity ratio have negligible effects on it.

Keywords: liquid desiccant, regeneration, numerical modelling, membrane-based flat-plate exchanger

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