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Development of Vacuum Planar Membrane Dehumidifier for Air-Conditioning

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Abstract : The conventional dehumidification method in air-conditioning system mostly utilizes a cooling coil to remove the moisture in the air via cooling the supply air down below its dew point temperature. During the process, it needs to reheat the supply air to meet the set indoor condition that consumes a considerable amount of energy and affect the coefficient of performance of the system. If the processes of dehumidification and cooling are separated and operated respectively, the indoor conditions will be more efficiently controlled. Therefore, decoupling the dehumidification and cooling processes in heating, ventilation and air conditioning system is one of the key technologies as membrane dehumidification processes for the next generation. The membrane dehumidification method has the advantages of low cost, low energy consumption, etc. It utilizes the pore size and hydrophilicity of the membrane to transfer water vapor by mass transfer effect. The moisture in the supply air is removed by the potential energy and driving force across the membrane. The process can save the latent load used to condense water, which makes more efficient energy use because it does not involve heat transfer effect. In this work, the performance measurements including the permeability and selectivity of water vapor and air with the composite and commercial membranes were conducted. According to measured data, we can choose the suitable dehumidification membrane for designing the flow channel length and components of the planar dehumidifier. The vacuum membrane dehumidification system was set up to examine the effects of temperature, humidity, vacuum pressure, flow rate, the coefficient of performance and other parameters on the dehumidification efficiency. The results showed that the commercial Nafion membrane has better water vapor permeability and selectivity. They are suitable for filtration with water vapor and air. Meanwhile, Nafion membrane has promising potential in the dehumidification process.

Keywords : vacuum membrane dehumidification, planar membrane dehumidifier, water vapour and air permeability, air conditioning
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