

Enhanced Water Molecule Diffusion in Direct Air Electrodialysis Membrane-based Dehumidification System

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Abstract - An efficient dehumidification method is essential for retrofit with HVAC products. Thus we proposed a novel direct air electrodialysis membrane-based dehumidification system without phase transition or desiccant regeneration. This technology could be accomplished via directional electroosmotic migration of water molecules with enhanced diffusivity. Experimental results demonstrated that atmospheric water removal utilizing an applied external potential gradient viable. In this study, we conducted the coupled micro-transport model using molecular dynamics(MD) simulation with a macro-transport model using the finite volume method(FVM) analysis. MD Simulation results indicated a 14 times increase in moisture diffusivity with applied voltage, which corresponds to approximately 5 times of transport rate in FVM analysis. In general, the diffusion coefficient of water molecules could be increased with the direct air electrodialysis strategy.

Keywords: Air Dehumidification, Moisture Diffusion, Electrodialysis, Molecular Dynamics.