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Development of a Membrane Heat Pump for Combined Sensible and Latent Cooling

Membrane heat pumps are an emerging technology capable of outperforming current vapor-compression cooling systems. The membrane heat pump provides sensible cooling by the same principles used in an evaporative chiller. However, these systems can continue to provide sensible cooling when the working fluid (outside air) has dew points higher than the desired coil temperature. Additionally, the membrane heat pump will dehumidify the supply air. This technology is enabled by water vapor transfer membranes with air as the working fluid in partial vacuum. The membrane heat pump is very exciting from an engineering standpoint because the key components of these systems exist today with the main development challenge being design and integration. This will result in a system that is both efficient and sustainable. This poster will discuss the development of a prototype membrane heat pump. Component and system-level design for a fully scalable commercial unit will be described. Cooling capacity and the coefficient of performance derived from experimental data are compared to modeling results. The key parameters impacting cost and performance will also be discussed.

Keywords:

Alternative Energy, HVAC, Membrane, Heat Pump, Water Vapor, Thermo-Fluids