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Vapor-selective Nanostructured Membrane Heat Exchangers for Cooling and Dehumidification

A new membrane heat exchanger separates sensible and latent loads for vastly improved energy efficiency in HVAC, targeting 2x efficiency gains and fast ROI in high-performance buildings.

Researchers at Purdue University have developed a membrane heat exchanger which separates vapor from air. This concept allows for the separation of sensible (temperature) and latent (humidity/phase change) loads in one device, allowing vastly more flexibility to optimize for energy efficiency. Currently, HVAC systems overcool outdoor air to its dew point to dehumidify the air through condensation, and then, the air is reheated to the desired indoor temperature. This inefficiency of overcooling and reheating has long been accepted as the industry standard and best available process. The Purdue system targets 2x efficiency improvements compared to vapor compressions systems and a seasonal COP of 12. Cost estimates indicate a payback of up to 2 years in target climates, and with long-term reductions in membrane pricing, costs could approach a target of $1,000 for this element of a residential cooling system. In addition to these substantial energy savings, benefits include improved air quality (from more outside air), improved comfort, rapid ROI, new part load capabilities, reduced heat exchanger size, and zero water consumption. This solution has the potential to serve as a major breakthrough in the field of high performance buildings.

Advantages:

-Substantial energy

-Improved air quality (from more outside air)

-improved comfort

-Rapid ROI

-New part load capabilities

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Category
GreenTech/Water & Resource Management

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-Reduced heat exchanger size

-Zero water consumption

Potential Applications:

-High performance buildings

TRL: 3

Intellectual Property:

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Keywords: membrane heat exchanger, sensible load separation, latent load separation, HVAC efficiency, dehumidification, energy savings, vapor compression alternative, high performance buildings, seasonal COP 12, residential cooling system, Heat Exchanger, Heat Transfer, HVAC, membranes