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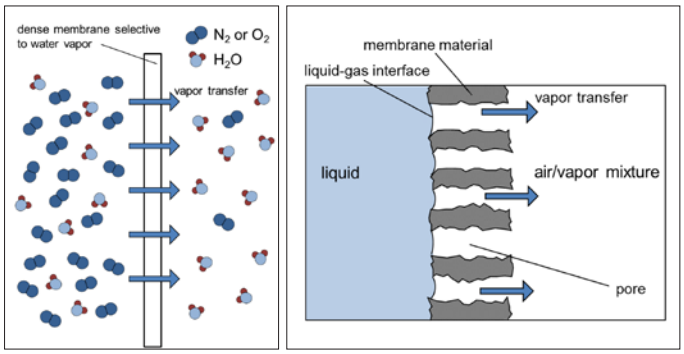
NATIONAL RENEWABLE ENERGY LABORATORY

Evaluating Membrane Processes for Air Conditioning

Highlights in Research and Development

NREL compiles state-of-the-art review on membrane processes for air conditioning to identify future research opportunities.

Researchers are pursuing alternatives to conventional heating, ventilating, and air-conditioning (HVAC) practices, especially cooling and dehumidification, because of high energy use, environmentally harmful refrigerants, and a need for better humidity control. Advancements in membrane technology enable new possibilities in this area. Membranes are traditionally used for industrial separations such as reverse osmosis and gas separation and may offer unique energy-saving opportunities for air conditioning.



Recent advancements in membranes enable new air-conditioning processes. Left: A dense membrane permeable to water and nearly impermeable to air. Right: A porous membrane enables a large contact area between liquids and air for high water vapor transfer rates. Image by Jason Woods, NREL

Over the past 15–20 years, researchers have explored possible uses of membranes to heat, cool, and dehumidify air. Interest in this area remains high, as demonstrated by U.S. Department of Energy grants through the Advanced Research Projects Agency-Energy (ARPA-E). In a 2010 ARPA-E program on air conditioning, 40% of the projects that received funding focused on membranes. In support of this technology, NREL scientists assembled a comprehensive review of current membrane research to provide a resource for the research community and guide future studies.

The membrane does not inherently save energy; however, it can enable or improve processes that do. Membranes can provide a means to remove moisture from the air without cooling the air to the dew-point temperature and can improve energy recovery processes that exchange moisture between two separate airstreams. Membranes can also improve absorptive and evaporative processes that are used in technologies such as absorption chillers, liquid desiccant dehumidifiers, and evaporative coolers. These technologies are energy efficient but have not yet reached their market potential.

This review article summarized recent research and identified research gaps for each application. More research and development is needed for membrane technology to compete against the inexpensive and established HVAC technologies. In this relatively new field, this review article guides future research, informs new researchers, and stimulates new ideas.

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Reference: Woods, J. (2014). "Membrane processes for heating, ventilation, and air conditioning." *Renewable and Sustainable Energy Reviews* (33); pp. 290-304. NREL/JA-5500-60005. *http://dx.doi.org/10.1016/j.rser.2014.01.092*

Key Research Results

Achievement

NREL researchers organized a comprehensive review article that summarizes recent research on how membrane processes can enable energy-efficient ways to heat, cool, and dehumidify air.

Key Result

This review provides an objective assessment of recent research achievements and research gaps related to using membrane processes for HVAC systems.

Potential Impact

This effort helps guide research by identifying opportunities and knowledge gaps that could advance the science and increase the market acceptance of energy-efficient membrane air conditioning.

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

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