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Thermal Vapor Compression Membrane Distillation Hybrid using Vapor Selective Membrane

A novel thermal desalination system achieves high efficiency by operating at high temperatures, recovering heat and water from brine, and using a steam ejector instead of an energy-intensive vacuum pump to handle high-salinity feeds.

Researchers at Purdue University have developed a thermal desalination system with multiple novel components to improve efficiency. Most thermal desalination technologies operate at low temperatures. Also, high vapor flux thermal desalination technologies rely on a vacuum pump to maintain a vacuum, which consumes substantial electrical energy. The Purdue technology can operate at high temperatures and recover heat and water from rejected brine and does not require a vacuum pump. The capability of the system to operate at high temperature allows for the use of concentrated solar power and provides large amounts of energy for separation. Instead of using a vacuum pump, which is energy-intensive and requires maintenance, the system maintains the vacuum created by an upstream steam ejector to effect separation with a novel vapor selective membrane distillation unit. The efficiency is improved by making using of higher temperature heat to both provide enhanced water recovery, and create a partial vacuum that reduces the diffusion resistance of water vapor while also reducing heat losses. Additionally, the system can handle high-salinity feeds; a total dissolved solids concentration greater that 100,000 ppm can be accommodated.

Advantages

- operates at high temperatures

- does not require a vacuum pump

- recovers heat and water from rejected brine

- accommodates high-salinity feeds

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Category
GreenTech/Water & Resource Management
Energy & Power Systems/Power Generation

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Applications

- thermal desalination

Technology Validation: The system has a first-law efficiency of over 10, which is above that of most other thermal desalination technologies.

TRL: 5

Intellectual Property:

Provisional-Patent, 2020-11-24, United States | Utility Patent, 2021-11-23, United States | PCT-Patent, 2021-11-23, WO | CON-Patent, 2025-03-14, United States | NATL-Patent, N/A, United States

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