Salt-Rejecting Continuous Passive Solar Thermal Desalination Via Thin-Film Condensation

Tech ID: 33308 / UC Case 2023-889-0

BACKGROUND

A renewed focus on advanced desalination technologies has emerged in response to the pressing global challenge of freshwater shortage. Passive solar desalination, a cost-effective approach, has shown great promise in addressing this critical issue. Current state-of-the-art systems predominantly rely on wicking structures for water evaporation, aiming to achieve high solar-to-vapor efficiency by minimizing heat loss. Nevertheless, these wicking structures present a fundamental limitation – the inability to reject salt continuously. While extensive efforts have been directed toward salt-rejecting evaporators that enhance solar-to-vapor efficiency, the efficacy of condensers has proven to be a significant bottleneck in achieving high overall solar-to-*water* efficiency, the metric that is most critical to a robust desalination technology. Current solar desalination approaches can boast high evaporation efficiencies, but global freshwater shortages require more holistic solutions that reach new heights in solar-to-water efficiency.

DESCRIPTION

Researchers at the University of California, Santa Barbara, have pioneered a salt-rejecting passive solar desalinator that offers continuous desalination and salt rejection with industry-leading efficiency in realistic conditions.At the core of this technology is the solar absorber-emitter, a component that converts light from the solar spectrum, which goes mostly unabsorbed by water, to the infrared spectrum, which water mostly absorbs. By flowing saltwater on a radiative-absorbing, porous, hydrophobic evaporator membrane, salt continuously diffuses away from the membrane while heated water vapor condenses on a cooler microporous membrane below. This design leverages thin-film condensation to enhance condensation heat transfer. By condensing within the microporous membrane instead of forming droplets, the distance between the condenser and evaporator membranes is minimized, significantly reducing the vapor transport resistance and achieving a solar-to-water efficiency of 32.9% under one-sun illumination. This desalinator demonstrated a record-high continuous desalination and salt rejection test duration of 7 days. This invention is a seminal advancement in the field of passive solar desalination and signals a promising and sustainable future for freshwater production.

ADVANTAGES

- Achieves continuous desalination and salt rejection at a solar-to-water efficiency of 32.9% for a record high 7-day test duration under one-sun illumination.

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OTHER INFORMATION

KEYWORDS

Solar Desalination, Passive Solar Desalinator, Salt-Rejecting Technology, Continuous Desalination, Solar-to-Water Efficiency, Water Desalination, Freshwater Production

CATEGORIZED AS

- **Energy**
  - Solar
- **Environment**
  - Other

RELATED CASES

2023-889-0

- Eliminates efficiency decay caused by salt accumulation
- Thermally isolates the evaporation and condensation surfaces, producing a large difference in vapor pressure and promoting high efficiency
- Circumvents typical convection heat loss
- Removes the need for a solar concentrator, which drastically simplifies the design and reduces costs

APPLICATIONS

- Solar Desalination
  - Industrial Water Production
  - Agricultural Water Management
  - Humanitarian Water Aid

This technology is available for licensing.

PATENT STATUS

Patent Pending

RELATED MATERIALS

- Salt-rejecting continuous passive solar thermal desalination via convective flow and thin-film condensation - 05/16/2023

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Metal-Elastomer Composite Edge Seal for Vacuum Insulated Glass Windows

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