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Batch Low Salt Rejection Reverse Osmosis Desalination

A new batch low salt rejection reverse osmosis (BLSRRO) technology offers a more energy-efficient and scalable solution for high-recovery water desalination by reducing over-pressurization and utilizing various system configurations.

A promising desalination method to address water shortage, a major global issue that is expected to impact the world population, has been developed at Purdue. Desalination, a process that removes salt from water, has seen an uptake in research and various methods have been developed to use this strategy in lieu of traditional freshwater. One such method, reverse osmosis (RO), relies upon the use of a membrane to convert salt water into freshwater but has limitations due to the hydraulic pressure the membrane can sustain. New methods have been built to address this limitation: osmotically assisted reverse osmosis (OARO) and low salt rejection reverse osmosis (LSRRO). Between these two methods, LSRRO shows a few advantages that require a smaller membrane area and can sustain higher pressure but has a disadvantage in that it requires higher energy consumption.

Purdue Researchers have developed a batch LSRRO (BLSRRO) technology that has the potential to save energy within the system by reducing over-pressurization. The developed technology can be built in various configurations as well as combination of them for high-recovery desalination. The operation of this technology has the potential to save energy and can combine the multiple configurations to take advantage of the increasing osmotic pressure. Configurations include bladder-type BLSRRO, energy-recovery-device BLSRRO, and double-acting piston BLSRRO, each offering unique advantages for optimizing energy efficiency and operational flexibility in desalination processes. By integrating these configurations, the system can achieve higher water recovery rates with lower energy consumption, addressing the critical need for sustainable desalination solutions.

Technology Validation:

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

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-Membrane transport simulations were performed to determine the required salt rejection of the module for processing water with specific salinities and recovery rates

-Various configurations for the batch and semi-batch LSRRO system, including bladder-type, energy-recovery-device, and double-acting piston configurations were developed

-Energy recovery mechanisms were developed to enhance the system's energy efficiency

Advantages:

-More energy efficient over traditional desalination methods

-Combines multiple configurations for high-recovery desalination processes

-Lower potential contamination from the disposal of rejected brine

Applications:

-Desalination

TRL: 3

Intellectual Property:

Provisional-Patent, 2023-07-17, United States | Provisional-Patent, 2023-07-27, United States | PCT-Patent, 2024-07-15, WO

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