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Bimodal Demand-Response Reverse Osmosis Desalination and Pressure Retarded Osmosis Energy Generation System

A bimodal system reuses existing reverse osmosis components to flexibly generate either water or power based on fluctuating energy prices, offering cost-effective integration and enhanced efficiency for large-scale desalination and grid stability.

Researchers at Purdue University have developed a bimodal approach to make reverse osmosis capable of demand-response operation, producing either water or power, depending on current pricing. It does this by operating the reverse osmosis membranes below the osmotic pressure, and thus in a pressure-retarded osmosis mode that produces energy generation. This innovative design reuses the major components between the two processes, reducing capital investment and enabling cost-effective integration with existing reverse osmosis plants. The system optimizes operations based on fluctuating energy prices, providing significant economic and environmental benefits. It also enhances energy efficiency, supports wastewater reuse, and permits this technology to be scaled for industrial applications. This makes the technology a very promising solution for large-scale desalination systems, grid stability, and sustainable management of resources.

Technology Validation:

The validation of the technology focused mainly on modeling and economic analysis of electricity pricing, system efficiencies, and operational variables like flow rates and salinity levels. Schematics and control diagrams were used to illustrate process optimization and integration with reverse osmosis plants, alongside discussions on the feasibility of using wastewater and brine streams for improved energy generation. However, researchers did not conduct explicit experimental validation or real-world testing details.

Advantages:

-Easily Scalable

Technology ID

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Category

Energy & Power Systems/Grid Modernization & Smart Grids
GreenTech/Water & Resource Management
Energy & Power Systems/Power Generation

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View online

-Inexpensive

-Flexible

-Reduced maintenance time

Applications:

-Reverse osmosis desalination

-Generating energy via pressure retarded osmosis

-Grid services

Publication:

Purdue University. "ME Publications." Purdue e-Pubs, Purdue Libraries, https://docs.lib.purdue.edu/mepubs/56/.

TRL: 4

Intellectual Property:

Provisional-Patent, 2020-05-12, United States | PCT-Patent, 2021-06-23, WO | Utility Patent, 2021-06-23, United States | PCT-Patent, N/A, WO

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