Reverse Osmosis Desalination Systems Powered by Renewable Energy: Preheating Techniques and Brine Disposal Challenges

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Short Biography

Dr. **Swellam W. Sharshir** received the B.Sc. degree in mechanical engineering from Kafrelsheikh University, Egypt, in 2008, the M.Sc. degree in mechanical power engineering from Tanta University, Egypt, in 2013, and the Ph.D. degree in thermal power engineering from the School of Energy and Power Engineering, Huazhong University of Science and Technology (HUST), China, in 2017. Postdoctoral fellow at School of Energy and Power Engineering, Huazhong University of Science and Technology (HUST) from 2018 to 2021. He has published more than 100 peer-reviewed papers in prestigious journals, resulting in more than 4800 citations in Google Scholar as of 2022. He is currently an Assistant Professor with the Department of Mechanical Engineering, Kafrelsheikh University, Egypt. His research interests include solar energy applications, desalination and renewable energy, nanomaterials applications, heat transfer, phase change nanocomposites and thermal management of batteries, etc.

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Abstract

Globally, reverse osmosis (RO) desalination systems are widely utilized as they have the cheapest freshwater production cost. On contrary, RO systems have high specific energy consumption (SEC), and membrane fouling that requires continuous chemical cleaning. Besides, the RO brine concentration, water recovery factor, and yield still a challenge. Therefore, many investigations have been conducted to enrich the applicability of RO plants and their performance. The current manuscript aimed to comprehensively review most of these studies. On the one hand, the solar-based RO plants were established to decrease the SEC, either using photovoltaic (PV) systems or solar thermal power plants; especially, the organic Rankine cycle (ORC). In addition, to enhance the RO plants' thermo-economic performance and achieved yield, preheating systems can be integrated as the power consumption and productivity proportionally varies with the feedwater temperature. Different hybrid systems have been proposed and investigated to boost the RO unit performance via preheating, such as integrating with PV cooling unit, humidification-dehumidification (HDH) process, ORC, and both HDH and ORC. On the other hand, selecting the brine disposal method is crucial, especially in the case of conventional methods. Besides, recent efforts have been conducted to both reduce the RO brine and increase water recovery. In this work, the plants' performance was introduced in different terms, namely: SEC, freshwater cost, thermal efficiencies, configurations, water recovery factors, and/or water quality. The current review has given a good sight and a complete picture about RO plants and related enhancements, which may successfully help the readers to know about the current developments in this field and help in the research continuity before fabricating the system.