A review of hybrid desalination systems for co-production of power and water: analyses, methods, and considerations

Gina M. Zak\textsuperscript{a}, Amin Ghobeity\textsuperscript{b}, Mostafa H. Sharqawy\textsuperscript{c}, Alexander Mitsos\textsuperscript{a,*}

\textsuperscript{a}Department of Mechanical Engineering, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139 USA
Email: amitsos@alum.mit.edu
\textsuperscript{b}Hatch Ltd “Specialized Engineering, Analysis and Design (SEAD)”, 2800 Speakman Dr. Mississauga, Ontario, L5K 2R7 Canada
\textsuperscript{c}Department of Mechanical Engineering, King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia

Received 8 January 2012; Accepted 29 November 2012

\textbf{ABSTRACT}

The production of freshwater from seawater is a growing necessity throughout the world. In arid areas with high temperature and salinity seawater, thermal desalination and power plants (dual-purpose/cogeneration plants) are often employed for the production of power and water. In other areas, reverse osmosis is commonly employed. However, both technologies are inherently challenged with economic and performance issues. As a response to these issues, hybrid desalination, that is, employing both thermal and mechanical desalination methods, has been increasingly utilized over thermal desalination plants alone. In this article, an overview of thermal desalination, seawater reverse osmosis (SWRO), and co-generation of power and water is presented, specifically with regards to the motivation for utilizing hybrid plants, for example, process limitations and areas of potential improvement. In addition, a review of the considerations for design and economics of hybrid desalination plants is presented, for example, existing system configurations, thermoeconomic analyses, and improvements of seawater pretreatment are discussed. Finally, studies for the optimization of hybrid desalination systems are reviewed. Specifically, the use of objective functions, continuous optimization methods, and optimal hardware configurations are discussed with respect to the key considerations of hybrid desalination plants.

\textbf{Keywords:} Hybridization; Optimization; Literature review; Thermal desalination; Seawater reverse osmosis; Nanofiltration

\*Corresponding author.

1944-3994/1944-3986 © 2013 Balaban Desalination Publications. All rights reserved.