Synthesis Lectures on
Emerging Engineering Technologies

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G. K. Prashanth · Hemantkumar N. Akolkar ·
A. K. Haghi · Srilatha Rao

Seawater Desalination

Technologies and Environmental Impact

Springer

Synthesis Lectures on Emerging Engineering Technologies

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ISSN 2381-1412 ISSN 2381-1439 (electronic)
Synthesis Lectures on Emerging Engineering Technologies
ISBN 978-3-031-98230-9 ISBN 978-3-031-98231-6 (eBook)
https://doi.org/10.1007/978-3-031-98231-6

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

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Fundamentals of Saltwater Desalination

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1.1 Introduction

One of the most important water treatment methods in the world today is desalination, which is needed to encounter the rising water necessity fetched on by fast civilization, financial growth, and farming advancements [1]. The International Desalination Association (IDA) estimates that 92.5 million m^3/d was the overall capacity of every desalination facility in operation worldwide in 2018 [2]. Nearly 400 desalination plans have been contracted globally since July 2018. The desalination projects that were contracted for in the first half of 2019 had a capacity of about 4 million m^3/d, which is equal to the sum of the capacity of 2015 and 2016. 60% of this capacity came from four separate projects in the Middle East: Shaiq 3 and Rabigh 3 (980,000 m^3/d) in Saudi Arabia, and Taweelah and Umm al Quwain (1.6 million m^3/d) in the United Arab Emirates (UAE) [3]. Their freshwater supplies are insufficient to fulfil the increasing water demand; hence, these high desalination capacities are required.

Despite being seen as a vital source of freshwater globally; desalination's high cost is one of the biggest obstacles to its expansion [4]. Over the next four years, an estimated $93,700 million would be spent on desalination facilities, in accordance with the Global Water Intelligence (GWI) DesalData. The operating expenses alone account for almost $51,600 million. Power, labor, substitutions, and substances are the primary facilities that comprise running expenses, as illustrated in Fig. 1.1. Thermal and electrical energy will account for over half of operating expenses. Given that desalination was identified as the most energy-intensive water treatment technology in 2014, utilizing 75.2 TWh of energy every year, a maximum expense of energy for this task is not surprising [5]. The water treatment level, plant capacity, treatment method, and feedwater quality affect the energy needed for a desalination operation.

G. K. Prashanth et al., *Seawater Desalination*, Synthesis Lectures on Emerging Engineering Technologies, https://doi.org/10.1007/978-3-031-98231-6_1

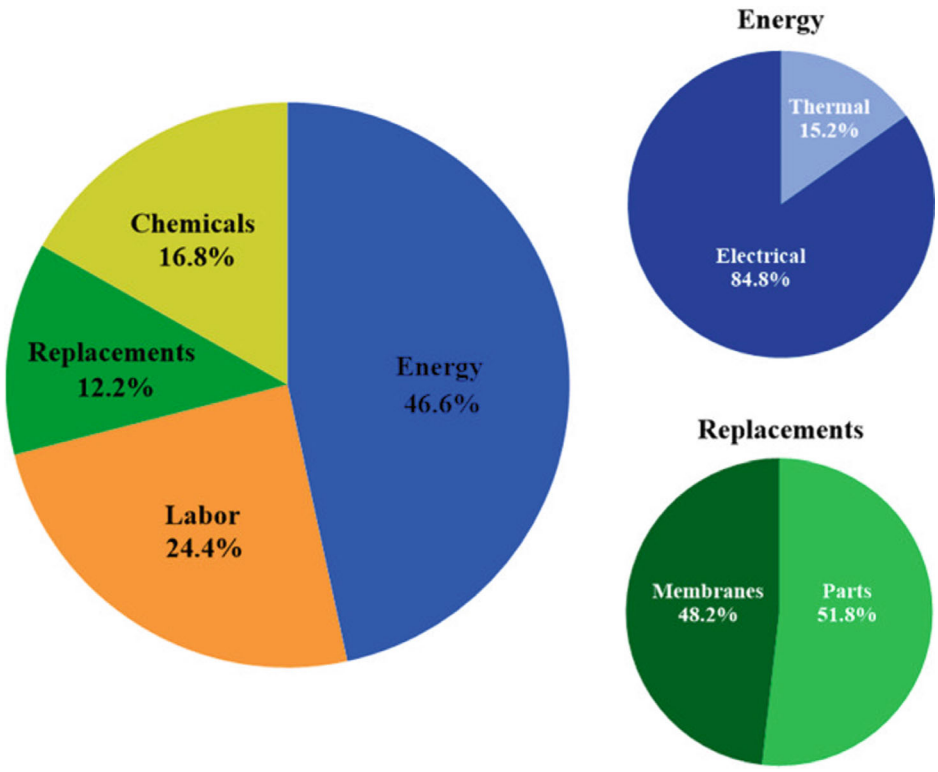

Fig. 1.1 Operating costs for desalination by industry. *Source* [6]

The varying energy required to produce 1 m^3 of drinking water if water is preserved from various sources is displayed in Table 1.1. Seawater desalination uses the most energy when compared to other water resources. Although treating surface and groundwater requires less energy, the supply from these sources is scarce to fulfil the growing necessity for freshwater.

Thus, despite the energy expenditures involved, desalination of saltwater appears to be the best way to resolve water scarceness in the ecosphere [6]. One strategy to minimize

Table 1.1 Energy needed to produce 1 m^3 of drinking water from various sources [12, 13]

Water Source	Energy (kWh/m^3)
Seawater	2.58–8.5
Wastewater recycle	1.0–2.5
Wastewater treatment	0.62–0.87
Groundwater	0.48
Surface water (pond or canal)	0.37