Preliminary techno-economics assessment of developed desalination/salt recovery facility based on membrane and thermal techniques

Mohamed H. Sorour, Heba A. Hani, Hayam F. Shaalan*, Ghada A. Al-Bazedi

Chemical Engineering and Pilot Plant Department, National Research Center, El-Bohouth Street, P.O. Box 12622, Dokki, Giza, Egypt, Tel. +2012223284428; email: hayam64@hotmail.com (H.F. Shaalan)

Received 10 March 2014; Accepted 16 June 2014

ABSTRACT

Successful management of desalination plants should incorporate integrated processing of seawater feed and brines. An integrated 20,000 m³/d zero desalination discharge (ZDD) facility, merging desalination and salt recovery, has been developed incorporating both membrane and thermal processes. Chemically pretreated seawater has been directed to nanofiltration (NF) separator for almost complete removal of divalent salts. NF brine loaded with magnesium has received further concentration by multiple effect evaporator and the reject obtained from reverse osmosis (RO) processing of NF permeate has been further directed to state-of-the-art ion selective electrodialysis (ED) to enable downstream production of magnesium and sodium salts. The material balance of the developed integrated desalination/salt recovery ZDD facility enabled total water recovery of about 70%. The average product salinity after mixing approached 74 mg/l. The total amount of recovered raw magnesium, calcium and sodium chloride salts were 215, 47 and 754 ton/year, respectively. The financial indicators revealed that the total capital and annual operating and maintenance costs (O&M) as well as unit cost were 99.5 M$, 13 M$/year and 2.48 $/m³, respectively. The total annual revenues of water and chemicals approached 27.5 M$/year. Thus, the initial net profit was about 11.1 M$/year. About 0.98 $/m³ could be realized via selling of recovered salts. These results confirm the promising features of the developed desalination/salt recovery ZDD facility. It is worth mentioning that with different possible financial risk factors, such as market fluctuations and taxes, the net profit would decrease to approach 7.7 M$/year and 3.1 M$/year, respectively.

Keywords: Desalination; Salt recovery; Membrane; Thermal; Techno-economics; Revenues

*Corresponding author.


1944-3994/1944-3986 © 2014 Balaban Desalination Publications. All rights reserved.