



Dual pretreatment-concentration hybrid process of salty water feed and reject of desalination plants

Aiman Eid Al-Rawajfeh^{a,*}, Mohammed A. Zaitoun^b, Ahmad Al-Maáberah^c,
Alaa M. Al-Ma'abreh^d

^aDepartment of Chemical Engineering, Tafila Technical University (TTU), P.O. Box: 179, 66110 Tafila, Jordan, Tel. +96232250034; Fax: +96232250431; email: aimanr@yahoo.com

^bDepartment of Medicinal Chemistry and Pharmacognosy, Faculty of Pharmacy, Yarmouk University, Irbid, Jordan, email: m.zaitoun@yu.edu.jo

^cArab Potash Company, Dead Sea, Jordan, email: ahmad.ma@arabpotash.com

^dDepartment of Chemistry, Al-Isra University, Amman – Jordan, email: alaa.almaabreh@iu.edu.jo

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ABSTRACT

Among the frequent problem encountered in seawater desalination is scales formation. Scale may form because of the composition of the make-up, but mostly develops as a result of further change occurring during the desalination process from the hardness causing salts (i.e., Ca²⁺ and Mg²⁺ that deposit as scale). An ion exchange unit containing natural aluminum silicate or synthetic magnesium silicate materials is used as a pretreatment step, and utilized to split the feed water into two streams; the first is NaK-rich and the second is CaMg-rich in a so called "Auto-regeneration (AR) process". The NaK-rich stream is then pumped to a desalination unit either thermal unit (MED or MSF) or membrane unit (RO), while the CaMg-rich stream is either recycled or pumped to a nanofiltration (NF) unit to soften the Ca and Mg ions in the stream, and additionally to partially remove the bicarbonate and carbonate ions. This makes the NF step to serve also as a CO₂ deaeration unit, which consequently decreases the release rates of carbon dioxide in the thermal unit. Additionally, these steps concentrate the salty water of two streams; that is, NaK-rich or CaMg-rich streams. The NaK-rich stream can be also used in a forward osmosis (FO) step for further water recovery and brine concentration. The pretreatment process is very cost-effective because it uses a control unit to send a signal to open the control valve for splitting the treated water to the target stream.

Keywords: Desalination; Scale prevention; Pretreatment; Softening; Splitting the feed; brine concentration, Brine mining

* Corresponding author.