Schemes for salt recovery from seawater and RO brines using chemical precipitation

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Received 10 March 2014; Accepted 16 June 2014

ABSTRACT
Disposal of brines from seawater desalination plants affects marine ecology and significant financial burdens. Recovery of salts from brines improves both sides of the problem and avails opportunities for new state of the art desalination/salt production complex. Three important separation processes could be adopted to formulate the corner stones for state-of-the-art salt recovery production line, namely chemical treatment, nanofiltration (NF), and ion exchange. This paper explores the performance of selected precipitants on saline solutions presenting synthetic seawater, natural seawater, and two reverse osmosis (RO) brines obtained from desalination plants located on Mediterranean (B1) and Red Sea (B2) shores. Sodium carbonate enabled 95.5, 89, and 95% recovery of calcium (Ca) seawater, Mediterranean, and Red Sea RO brines, respectively. While, values of magnesium (Mg) recovery from chemically treated schemes lie between 85.6 and 91.3%. Also, phosphate precipitation enabled two-stage recovery of Ca and Mg range from 75 to 98% for Ca and 24 to 47% for Mg. Moreover, analysis of our experimental results and other reported data on chemical softening enabled identification of three integrated salt recovery schemes from seawater and RO desalination brines. The first scheme is basically applicable for new desalting plants or even as stand-alone solution for chemical recovery from seawater. The second scheme could be applied when retrofitting current desalination plants where state-of-the-art NF is introduced and the generated NF brine is subjected to two-stage chemical and ion exchange treatments. The third scheme targets currently operating plants where RO brines could be directed to chemical precipitation for maximum Ca removal and subsequently decalcified streams could be processed for Mg removal using ion exchange. Optimization of the developed schemes is currently underway to identify comparative capital outlays and other relevant financial indicators.

Keywords: Seawater; Brine; Precipitation; Calcium; Magnesium; Chemicals recovery

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