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Salt production by the evaporation of SWRO brine in Eilat: a success story

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Abstract

Mekorot Water Company owns and operates a SWRO plant in Eilat for the production of 10,000 m^3/d of desalinated water. This peculiar plant, commissioned during June 1997, is practically dual purpose, for the production of desalinated water and also for the manufacture of high-quality table salt by the Israel Salt Company. The feed to the desalination plant is a blend of 80% seawater and 20% BWRO brine from adjacent BWRO plants. The brine from the SWRO plant is blended with seawater, and this stream is fed to a series of evaporation ponds, and thereafter to the salt processing factory of the salt company. A brine discharge line and other discharge facilities are not needed. Their cost is spared. Also potential non-homogenous salinity distribution profile of the sea is prevented, leaving the sea fauna and flora at this beautiful resort city untouched. The salt production in this configuration increased by 30% compared to salt production from seawater alone. The salt produced is of the highest quality within the range of the most severe standards. It was not easy to reach these goals, and many difficulties were tackled during the first year of operation. These difficulties and the applied solutions are discussed. Also discussed are aspects of the contract between Mekorot, a governmental corporation, and the salt company, which is a private sector corporation. Issues such as operation of the seawater intake serving both the desalination plant and the evaporation ponds, the sharing of the electric power bills, the investment in the intake and the supply piping, requirements imposed on the quality of brine delivered to the evaporation pond, restrictions imposed on the dosed chemicals in the desalination plant, transfer of data between the companies and mutual responsibility are also presented. The paper stresses that salt production from SWRO brine is a lucrative application for the Gulf countries where similar site-specific conditions prevail: strong solar radiation, very low precipitation, low cost desert land, short and easy transportation to ports, and relatively good accessibility to Asian nations, which are large consumers of salt. Today the brine from desalination sites is polluting the Gulf, imposing ever-increasing environmental problems and difficulties in the operation of desalination plants. The paper analyzes the advantages of salt production vis-a-vis seawater pollution and the investment associated with brine discharge.

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1. Introduction

It is well known that recovery from desalination plants is the major operating parameter in their design and operation. There are many economical models for the optimization of this parameter. An increase in recovery increases brine salinity, osmotic pressure and the pressure profile of the desalination plant with a negative effect on power consumption and investment costs of the construction materials. On the other hand, the feed and brine flow rates decrease, with a positive effect on power consumption and investment cost of feed pipes, the pretreatment section, capacity of the process pumps, the size and the investment in the brine outfall.

In a combined complex for the production of both desalinated water and salt, the optimization schemes change considerably, as an increase in recovery results in a reduction in the size and cost of the evaporation ponds. Appling optimization programs show that the gross optimization range of recovery from a complex of seawater desalination and salt production is 55% to 60%, dependent upon site-specific conditions such as the temperature profile of the seawater during the year and the rate of evaporation in the solar ponds.

The concept of dual-purpose plants for the production of desalinated water and salt has additional economical benefits. The brine outfall facilities, and in particular the pipe entering the sea, are spared. The cost of the brine line entering the sea can be high because its length is generally a few hundred meters in order to prevent short circuits between the brine and feed streams. Also it is well known that works below seawater level are expensive.

The concept of dual production can be very lucrative for the Gulf countries where very favorable conditions for salt production prevail as listed below:

- dry climate similar to the ambient conditions in Eilat;
- low to zero precipitate during the year;
- abundance of low-cost desert land not far from the sea;
- easy connections by inland and sea transportation to the consumers — mainly Asian markets that use salt as a food additive and in industry.

2. Dual-purpose plant in Eilat for the production of desalinated water and salt

In Eilat a dual-purpose plant for seawater desalination and for salt production has been in operation for 9 years. The plant is owned and operated by the Mekorot Water Company, the national water supply corporation, owned by the Government of Israel. The salt production facilities are owned by the Israel Salt Company (Eilat) 1976 Ltd., a private, public sector corporation.

The plant has a production capacity of 10,000 m^3/d of desalinated water. The feed to this plant is a blend of 80% seawater and 20% brine from adjacent BWRO desalination plants. The advantages of the blend feed over seawater feed are obvious: the salinity and osmotic pressure profiles in the desalinator decrease substantially, with a consequent saving in energy of about 15%. Also pre-treatment, investment as well as operating costs are reduced by 20%.

The blending contains negative effects too. The concentration of calcium in the blend feed is higher by 80% in relation to seawater: 0.9 g/L vs. 0.5 g/L. This restraint causes the desalination plant to operate at a recovery of only 50%. Without this restraint, the gross optimization of