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Optimization of energy costs for SWRO desalination plants

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ABSTRACT

The global expansion of seawater desalination and the associated excessive energy consumption have serious economic and environmental consequences. Various technological and operational approaches have been applied in an attempt to mitigate these impacts by improving the desalination process and by increasing plant efficiency, with the emphasis on reduction of the energy consumption and costs. In this study, a Linear Programming (LP) model was developed to optimize operation of a large Seawater Reverse Osmosis desalination plant (140 MLD). The objective was to minimize energy costs, using the extra hourly installed capacity of the plant and the advantages offered by the power pricing system, based on time and peak load demand (Time Load Tariff [TLT]). For annual production of 45 million m^3 of desalinated water (88% of the maximum possible production capacity), a reduction of 15% of the electricity bill, equal to a saving of about US$ 2 million, can be achieved reflecting a weighted average cost of 7.66 ¢/kWh vs. a normative weighted average tariff of 8.95 ¢/kWh. The results indicate that the LP model could serve as an effective decision-making tool of desalination plants that are dependent on the supply of power from the national grid, where the price of energy is based on TLT. The model can assist in the daily operation and maintenance of the plant. It can also serve as a planning tool during the design stage. The model can be used to optimize the trade-off between plant capacity and its related investment cost to the energy expenses. It can be used to compare a smaller capacity plant having a lower investment cost but higher annual energy costs, to a plant with extended capacity having a higher investment cost but lower annual energy costs.

Keywords: Seawater desalination; SWRO; Linear Programming model; Energy consumption; Electricity price; Israel

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