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Lowering desalination costs by alternative desalination and water reuse scenarios

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ABSTRACT

Reverse osmosis (RO) has contributed to a large extent in positioning membrane desalination as one of the best available technologies to meet water demand in dry coastal areas. However, membrane desalination may still be perceived as an energy consuming and high cost desalination technology. Seawater Osmotic Dilution (SOD) may lower the energy consumption and the water cost by decreasing the salt content of seawater; and, at the same time SOD can become a sustainable technology that does not impact marine environments considering that less concentrated brines are discharged into the sea. The main objective of this study was the economical evaluation of SOD for the purpose of decreasing desalination costs. The authors have investigated the attractiveness and viability of SOD opportunities compared with standard RO membrane desalination. Three process configurations (desalination, desalination and reuse, SOD) were defined for a coastal area location, where the possibilities of water availability are limited to mainly the ocean. For each configuration, three different water production capacities (1.000, 10.000, and 25.000 m/day) were studied and evaluated economically in terms of capital expenditure (CAPEX) and operational expenditure (OPEX). The results show that SOD can produce desalinated water with 27% energy reduction compared with seawater reverse osmosis desalination; and that operational costs of desalination can be reduced by 31%. Water volume balances of each configuration demonstrate that SOD has a high potential in dry coastal areas with limited availability of fresh water. For SOD with a commercial price of forward osmosis (FO) membranes at 30–60 US$/m and a membrane flux of 7–14 L/m-h, SOD becomes a viable technology for lowering costs of desalination, with payback times of less than 1.5 years when compared with desalination.

Keywords: Desalination; Forward osmosis; Water cost; Water reuse

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