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Closed circuit desalination series No 7: retrofit design for improved performance of conventional BWRO system

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ABSTRACT

Improved performance of conventional brackish water reverse osmosis (BWRO) technology is achieved by the integration with the newly conceived closed circuit desalination (CCD) technology of low energy consumption without need of energy recovery, low scaling and fouling characteristics, high recovery irrespective of number of elements per modules, wide range operational flux, and flexible control of membranes and modules performance in compliance with manufacturers' specifications. The present article describes the application of a retrofit system for 88.5% desalination of a feed source (6,500 μS/cm) whereby permeate (324 μS/cm) was obtained with reverse osmosis energy consumption of 0.555 kWh/m^3 and an overall energy consumption of 0.609 kWh/m^3—these results were unattainable by a full-scale conventional BWRO desalination complex which operated adjacent to the retrofit unit with the same feed source. The retrofit unit under review utilizes the pressurized brine flow from a conventional BWRO pass of 50% recovery as feed into a CCD system with modules of four elements each; wherein, the recovery is raised to the desired level under consecutive sequential conditions of fixed flow and variable pressure with continuous production of permeates. The new retrofit technology could apply to any existing conventional BWRO plant of high scaling and/or fouling characteristics by the conversion of the second stage of such a plant into a close circuit desalination system of short modules and flexible control; wherein, scaling and/or fouling effects are reduced substantially or completely eliminated.

Keywords: Closed circuit desalination; High recovery; Low energy; Reduced fouling; Brackish water; Improved BRWO systems

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