Closed circuit desalination series no-9: theoretical model assessment of the flexible BWRO-CCD technology for high recovery, low energy and reduced fouling applications

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ABSTRACT
Compared with conventional BWRO techniques, the conceptually different closed circuit desalination technology for brackish water desalination (BWRO-CCD), has been analyzed with respect to its modular design and performance characteristics on the basis of theoretical model simulations of a typical four elements module (ME4; M = ESPA2-MAX) in the feed salinity range of 500–6,000 ppm NaCl, which corresponds to that of common brackish water sources with up to 7,000 ppm TDS. The model analysis results of the BWRO-CCD technology demonstrate a unique consecutive sequential desalination process with staged flow and pressure boosting without the use of staged pressure vessels and booster pumps. The theoretical model simulations of the BWRO-CCD technology over a wide range of feed salinity (500–6,000 ppm NaCl) have consistently revealed flexible and versatile performance under fixed flow and variable pressure conditions characterized by low energy consumption, high recovery, and reduced fouling characteristics achieved by means of simple designed systems of high modularity. The superb performance characteristics of the BWRO-CCD technology makes it ideal for a wide spectrum of noteworthy applications, such as treatment surface and groundwater for domestic use, desalination of clean domestic and industrial effluents, desalination of brackish water, production of high-quality permeates for industry, decontamination of drinking water including nitrate removal, boron removal from first-pass SWRO permeate, as well as many others. The theoretical model analysis results reveal that BWRO-CCD is an advanced technology which meets the criteria of high recovery and low energy consumption with reduced fouling in the simple apparatus of modular designs.

Keywords: Closed circuit desalination; CCD; High recovery; High flux; Low energy; Reduced fouling; Brackish water