ABSTRACT

This study describes the application of closed circuit desalination (CCD) as a first pass for boiler-feed supplies with high recovery (96%) and low energy (0.34 kWh/m³) from a municipal source (553 μS/cm) comprising the scaling constituents Ca (65 ppm), SO₄ (180 ppm), SiO₂ (32 ppm), F (1.2 ppm), Ba (0.022 ppm), and Sr (0.295 ppm) in addition to modest amounts of Na (65 ppm) and Cl (18.8 ppm). The 96% recovery trials were performed using a pilot comprised of a single module (8") with three elements (ESPA2-MAX) under fixed flow and variable pressure consecutive sequential CCD conditions at flux of 27.5 lmh and feed temperature of 20.7°C. Under the specified trial conditions, average permeates of 13 μS/cm electric conductivity (~6.5 ppm) are produced with energy consumption of 0.59 kWh/m³ which translates 0.34 kWh/m³ at 25°C and pressurizing means efficiency of 75%. The process proceeds at pH 5.0 in the presence of an antiscalant (Hydrx-4192 and 4102) with recycled concentrates of high super-saturated silica (max. 800 ppm) without any signs of scaling and/or fouling. The module performance results of this study are scalable to larger CCD systems of similar process design.

Keywords: RO; Closed circuit desalination (CCD); High recovery; Low energy; Upgrade of municipal water; High silica feed; High silica super-saturation; Boiler-feed supplies