Consideration of energy savings in SWRO

Craig R. Bartels a,*, Keith Andes b

a Hydranautics, 410 Jones Road, Oceanside, CA 92058, USA
Email: cbartels@hydranautics.com
b Hydranautics, Perth, Australia

Received 29 February 2012; Accepted 30 May 2012

ABSTRACT

Seawater reverse osmosis (SWRO) processes have become the dominant desalination technology in the industry due to the low energy costs of this process. Thanks in large part to improvements in membrane and energy recovery devices, the SWRO process has become the accepted technology for desalination. In one report, current energy costs of SWRO processes have reduced by nearly 90% compared to SWRO in the 1970s and by 75% compared to SWRO in the 1980s. The best current SWRO processes require 2–2.5 kWh/m³ of electrical energy. The question is how much further reduction can be made with a conventional SWRO process. Recent theoretical analysis has shown that there is a diminishing potential for further energy savings in any desalination process. One such report has stated that the ideal SWRO energy consumption is 1.06 kWh/m³ for a 50% recovery plant treating 35,000 mg/l total dissolved solids, while the more realistic practical minimum energy consumption is thought to be 1.56 kWh/m³. With current plants at 2 kWh/m³, there seems to be only another 0.5 kWh/m³ of further savings available. New plants are now using the new high permeable membrane technology and high efficiency energy recovery devices. The energy consumption of a state-of-the-art existing plant, the Gold Coast desalination plant in Australia, is described. This plant is operating at around 3 kWh/m³ of energy consumption at 19°C and 35,500 mg/l feed salinity. The potential for further savings in a traditional SWRO plant is evaluated. Many of the new process improvements result in very minimal reduction in energy consumption. Furthermore, many of these will raise issues with flux distribution, fouling, pressure drop, and permeate quality. The impact of these issues needs to be included when trying to design a SWRO system for stable performance. One example of a hybrid system design is considered, but these will only give a marginal improvement in energy consumption.

Keywords: Desalination; Energy consumption; Hybrid design; Osmotic pressure