Balaban Desalination Publications

European Desalination Society

EDS Porto 2025 (2025) 63–71
doi: 10.5004/po2024120

Desalination for the Environment: Clean Water and Energy
Alfândega Congress Centre, Porto, Portugal
27–30 April 2025

Control biofouling through membrane flux balance by interstage boosting

Haytham Abdelfatah

Fluid Equipment Development Co. – FEDCO, Monroe, MI 48162, USA, email: hahmed@fedco-usa.com; Tel. +1 7346297352

A B S T R A C T

The main problem in increasing recovery systems is membrane flux, as you need to increase the pressure to obtain product from the last element. In reality, all this extra pressure is applied to the first element, which increases its flux and recovery because it works on feed water and does not need this additional pressure. At the same time, the rear elements work with high total dissolved solids (TDS) water (high osmotic pressure) but at lower pressure compared with the front elements. Seawater desalination membrane manufacturing design guidelines recommend an element recovery of around 8% and an element flux lower than 24 LMH (L/m^2/h). These guidelines are intended to optimise the performance and longevity of desalination membranes. Regarding biofouling, which is a significant challenge in membrane processes, research has shown a strong relationship between element concentration polarisation and biofouling. Concentration polarisation can exacerbate biofouling by creating conditions that favour the growth of biofilms on the membrane surface. This, in turn, can lead to a phenomenon known as biofilm-enhanced concentration polarisation (BECP), which can degrade water quality and reduce membrane lifetime. To mitigate biofouling, it is recommended to keep the element polarisation below 13%. This helps in maintaining the quality of the permeate and the efficiency of the membrane process. By controlling element polarisation, it is possible to reduce the risk of biofouling and extend the operational life of desalination membranes. In this paper, we compare the single-stage design, each element boost pressure, 3-stage design, and 2-stage design to identify the best technical result and the optimum balance between performance and capital cost.

Keywords: Driven pressure; Flux balance; Interstage boost; 2-stage; Biofouling; Membrane lifetime