ABSTRACT

Reverse osmosis (RO) membrane systems are widely used in the desalination of water. However, flux decline due to fouling phenomena in RO remains a challenge. To minimize fouling, a reliable index is necessary to predict the fouling potential of the RO feed water. The ASTM introduced the silt density index (SDI) as a standard fouling index to measure the fouling potential due to colloidal and suspended particles. For decades, the SDI is worldwide accepted and applied. There are growing doubts about the predictive value of this parameter. In addition there are several deficiencies observed, affecting the accuracy and reproducibility e.g. no correction factor for temperature, nor for variations in membrane resistance, and no linear correlation with the concentration of colloidal/suspended particles. This paper gives an overview of our work on limitations, improvements and alternatives for the SDI. Firstly, the influence of the applied 0.45 μm test membrane on the SDI will be investigated. Variations in SDI values can be attributed to differences in properties of these membranes. In order to quantify the influence of pressure, temperature and membrane resistance on the SDI a mathematical relation was developed between the SDI and the MFI0.45, assuming cake filtration. In addition, also other fouling mechanisms were incorporated in the model using the well-known blocking laws. Based on a cake filtration fouling mechanism and assuming 100% particle retention, the models were used to normalize the experimental SDI values for temperature, pressure and membrane resistance to the SDI+. By applying this normalization, the results of SDI tests carried out under different conditions and/or with different membranes can be compared easily as was proven experimentally in the lab and at a seawater desalination plant. Finally, an alternative filtration index will be introduced, the volume-based SDI_v. The SDI_v compares the initial flow rate to the flow rate after filtering a standard volume of feed water using MF membranes with an average pore size of 0.45 μm. Our experimental results show that SDI_v is independent of the membrane resistance. In that way, it eliminates most of the disadvantages of the SDI and has great potential to replace the SDI in the field.

Keywords: Fouling index; Silt density index (SDI); Modified fouling index (MFI)