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Mathematical Modeling of the Fouling Phenomenon in Ultrafiltration of Latex Effluent

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Abstract : An efficient and well-planned ultrafiltration process is becoming a necessity for monetary returns in the industrial settings. The aim of the present study was to develop a mathematical model for an accurate prediction of ultrafiltration membrane fouling of latex effluent applied to homogeneous and heterogeneous membranes with uniform and non-uniform pore sizes, respectively. The models were also developed for an accurate prediction of power consumption that can handle the large-scale purposes. The model incorporated the fouling attachments as well as chemical and physical factors in membrane fouling for accurate prediction and scale-up application. Both Polycarbonate and Polysulfone flat membranes, with pore sizes of 0.05 µm and a molecular weight cut-off of 60,000, respectively, were used under a constant feed flow rate and a cross-flow mode in ultrafiltration of the simulated paint effluent. Furthermore, hydrophilic ultrafilic and hydrophobic PVDF membranes with MWCO of 100,000 were used to test the reliability of the models. Monodisperse particles of 50 nm and 100 nm in diameter, and a latex effluent with a wide range of particle size distributions were utilized to validate the models. The aggregation and the sphericity of the particles indicated a significant effect on membrane fouling.

Keywords : membrane fouling, mathematical modeling, power consumption, attachments, ultrafiltration
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