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Prediction of ultrafiltration permeate flux decline by means of a shear induced diffusion model with empirical estimation of the gel layer concentration

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ABSTRACT

In this work, the shear-induced diffusion model has been used to predict flux decline in ultrafiltration. Two types of monotubular ceramic membranes were used in the experiments: Carbosep M2 ZrO_2-TiO_2 membranes with a MWCO of 15 kg/mol (Orelis, S.A., France) and TiO_2–Al_2O_3 Tami MSKT membranes of 5 kg/mol (Tami, S.A., France). Polyethylene glycol (PEG) of 35 kg/mol was used in the preparation of the feed aqueous solution. The experiments were performed at constant temperature (25°C) and at different feed flow rates (1–3 m/s), transmembrane pressures (TMPs) (0.1–0.5 MPa) and feed concentrations (5–15 g/L). In this work the gel layer concentration was empirically estimated form steady-state permeate flux values. Model predictions were compared with the experimental results and discussed. For the Carbosep M2 membranes, model predictions were better for high TMPs and low crossflow velocities. For Tami MSKT membranes, model predictions for initial permeate flux decline were worse when fouling was severe (high TMPs and feed concentrations and low crossflow velocities) than in the case of mild fouling conditions. An explanation for this is given in this paper.

Keywords: Modelling; Ultrafiltration; Gel layer; Polyethylene glycol; Permeate flux decline

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