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EFFECTS OF OPERATING CONDITIONS ON THE FLOW THROUGH A POROUS WALL IN DEAD-END CAPILLARY MEMBRANE DURING BACKWASH

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The capillary membrane technology has become one of the effective methods for production of drinking water. This process is limited by the membrane fouling and concentration polarization phenomena which affect the lifetime and the permeability of the membrane. The particle distribution inside the capillary has been for a long time a main focus for many researches during filtration [1] and in the last time during backwash [2] in order to optimize the operating conditions. To enhance the backwash process, the flow in the porous wall and the pressure drop inside the capillary membrane were investigated numerically. This study should provide better understanding of the flow within the permeable wall and the axial and radial velocity profile. For this purpose, 3D model describing steady-state laminar flow inside the capillary membrane operated in dead-end mode was simulated. The influence of the operating parameters and the characteristic of the membrane were studied. The pressure drop in the module and the velocity profile were estimated with the consideration of the membrane fouling. The calculation of permeate flux contributes to increase the backwash performance and minimize the energy consumption. Coupling Navier-Stokes equation for the free flow and Darcy-Forchheimer [3] approach for the prediction of the flow in the porous membrane is solved. In order to validate the numerical results a laboratory scale plant was developed and the flow rate through the capillary membrane during backwash process was estimated. The experimental and the numerical results show an excellent agreement for predicting the flux at outlet at different operating pressure 1. Furthermore, the results confirm the important influence of the membrane fouling on both flux and the operating pressure. The approximation of applying a constant flux along the capillary during backwash was found to be acceptable for capillary membrane operated in dead-end mode.

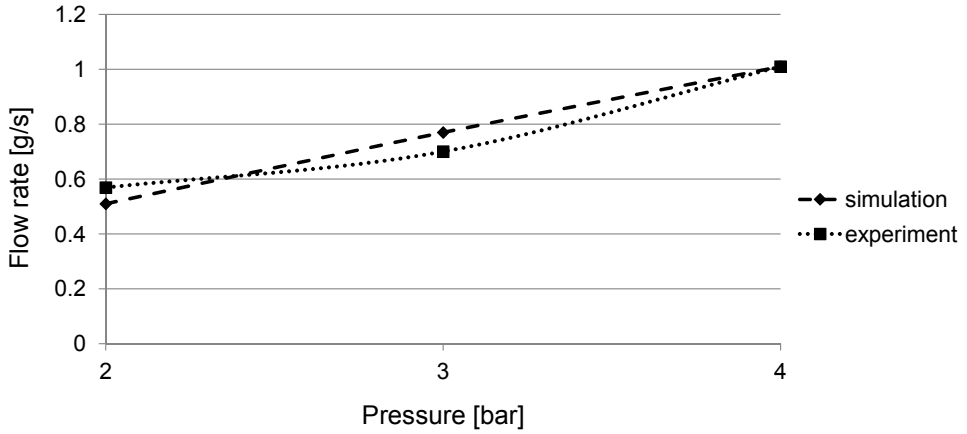

Figure 1: comparison between the results obtained by simulation and experiments

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