Enhancement of ultrafiltration with a $\gamma$-Al$_2$O$_3$ ceramic membrane by an electrical field

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ABSTRACT

Membrane fouling and concentration polarization are two of the main barriers for the application of the membrane separation technique in food industry. In order to increase membrane separation efficiency caused by membrane fouling and concentration polarization, $\gamma$-Al$_2$O$_3$ membrane was employed to separate bovine serum albumin (BSA) solution in the presence of an electrical field. In this paper, the influences of electric field intensity, pH of bulk solution, and operating time on membrane performance were investigated. It was found that the influence of an external electric field on the membrane process depends on the charged properties of bulk solution. For negatively charged BSA in the solution of pH 6.8, an external electric field can improve both the flux and rejection of membrane. What is more, separation process can be maintained at a quite high flux for 60 min without significant decrease in this method, and the increase of electric field intensity can improve the membrane separation efficiency. By analyzing transport resistance coefficient of membrane process, it was showed that application of electric field can sharply reduce boundary layer resistance $R_{b1}$, membrane fouling resistance $R_f$, and total resistance $R_t$. These results indicated that an electric field can decrease the concentration polarization and membrane fouling on the membrane surface, which contribute to the improvement of membrane separation efficiency.

Keywords: $\gamma$-Al$_2$O$_3$ ceramic membrane; Electric field; Bovine serum albumin; Concentration polarization; Membrane fouling

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