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Filtration of BSA through TiO_2 photocatalyst modified PVDF membranes

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ABSTRACT

In this study, composite ultrafilter membranes were prepared by coating Polyvinylidene fluoride [PVDF; molecular weight cut off (MWCO) values of 30 and 100 kDa] with inorganic titanium dioxide (TiO_2) nanoparticles. Hydrophilicity, flux, and rejection performance of the pristine and modified membranes using 1 g/L bovine serum albumin (BSA) under different pH conditions were compared. Reversible and irreversible filtration resistances were calculated and compared using a resistance-in-series model. Regeneration of the fouled modified membrane using ultraviolet (UV) light was also studied. Modified PVDF membrane is found to be very hydrophilic due to the TiO_2 layer, and in the case of 30 kDa membranes, it exhibits higher filtration resistances. As pH increases, the irreversible resistance decreases and is smaller than the reversible resistance due to strong repulsion forces between the BSA-BSA molecules and the BSA-membrane surface. Due to differences in membrane MWCO, the higher rejection was found with the 30 kDa membranes. The surprising result was that the modified TiO_2 layer decreased BSA rejection with enhanced filtration resistance, This could be explained by the presence of TiO_2, which prevents the formation of a gel layer, and/or the nanoparticles may change the protein structure, allowing for permeation. TiO_2-coated PVDF membranes revealed better antifouling properties and cleaning of membranes by exposure to UV light resulted in the recovery of original flux after 3 h (30 kDa) and 2 h (100 kDa), respectively. Although this work could not provide good separation of proteins via the modified membranes, these results reveal the necessity of further investigation into the interactions between proteins and nanoparticles.

Keywords: Fouling; Filtration resistances; BSA; Heterogeneous photocatalysis; Nanoparticles; Titanium dioxide

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