Development of Novel Filtering System with Thermo-sensitive Porous Membrane

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Summary

We have proposed a novel filtering system that employs a thermo-sensitive membrane, which makes it possible to use the phase transition of *N*-isopropylacrylamide (NIPAM) for membrane cleaning. The NIPAM grafted membranes were prepared using the plasma-graft polymerization technique on a porous PVDF hollow-fiber substrate (pore size = 0.65 μm). The influences of the concentration of NIPAM monomer and grafting time on grafted amount were investigated. A thermo-sensitivity of the NIPAM grafted membranes was evaluated by measuring the pure water flux (PWF) with pure water at T = 313 K (above the LCST) and at T = 293 K (below the LCST). Then, the applicability of temperature-swing operations (method 1 and method 2) was studied. After the membrane was fouled by filtering the protein solution (at T = 313 K for method 1 or T = 293 K for method 2), pure water (at T = 293 K for method 1 or 313 K for method 2) was filtered to clean the membrane. The effect of temperature swing operation on the membrane performance was evaluated with the recovery ratio of PWF. The ratio obtained for the NIPAM grafted membrane was higher than that for the substrate. The result indicates that adsorbed protein can be removed by alternating the operating temperature above and below the LCST. In addition, the ratio obtained by the method 1 was higher than that obtained by the method 2 for the NIPAM grafted membrane. The influence of shear rate on removing the adsorbed protein was suggested because the values of recovery ratio depended on the water flux at cleaning.