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Iron oxide modified polyethersulfone/cellulose acetate blend membrane for enhanced defluoridation application

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ABSTRACT

Fluoride removal in drinking water is usually performed through cost and energy intensive membrane techniques such as reverse osmosis, dialysis and electro-dialysis. Defluoridation using an effective and low cost ultra filtration membrane system is reported in this work. Iron (III) oxide (Fe_2O_3) nanoparticles modified polyethersulfone (PES)/cellulose acetate (CA) blend membranes were fabricated by phase inversion method. Composite membranes were prepared by incorporating incremental amounts of Fe_2O_3 nanoparticles. Synthesized membranes were analysed for morphological studies and ultra filtration characteristics. It was observed that the inclusion of iron oxide nanoparticles influenced the membrane structure resulting in enhanced ultra filtration properties. All of the iron oxide nanoparticles incorporated PES/CA membranes possessed increased hydrophilicity, porosity, water uptake and pure water flux as compared to pristine PES membrane. Membrane with 0.5 wt% Fe_2O_3 nanoparticles exhibited a maximum water flux of 156 L m^{-2} h^{-1}. Fluoride removal performance confirmed the defluoridation potential of the Fe_2O_3 nanoparticles blended PES/CA membranes. Maximum fluoride removal efficiency of 70.3% was observed for a single ultra filtration run. SEM and AFM examinations showed the structural alterations in the composite membranes due to the nanoparticles addition. Reusability studies confirmed the enhanced durability of the blended membrane. Domestic application of the composite membrane was carried out by assessing its fluoride removal ability in natural water samples obtained from fluoride endemic area.

Keywords: Iron oxide; Polyethersulfone; Cellulose acetate; Defluoridation; Membrane

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