Build Water-Channels in the Positively Charged Nanofiltration Membranes for High-Performance Heavy Metalions Removal

Wanjiya Mwema
Beijing University of Technology, China

Abstract:

Heavy metal pollution aggravates the shortage of clean water, which threatens the life of people, due to the toxic properties of those heavy metals[1]. Thus, some techniques have been proposed to remove the trace heavy metal ions in the polluted water to promote the sustainable development[2]. Amongst, nanofiltration membranes, featured with nanopores, energy efficiency, and environmental friendliness, are promising for separation of heave metal ions[3, 4]. To enhance the rejection efficiency, positively charged layer deposition on the membrane surface is commonly required, which is at the cost of reducing the water permeance due to the enhanced water transport resistance[5]. Herein, to solve the issue, we proposed build water channels coupled positive charged surface to simultaneously enhance water permeance and heavy metal ions rejection. As shown in Fig. 1, porous organic polymers (POP) nanoparticles were incorporated in the membrane during interfacial polymerization of polyamine (PA) layer to construct the water channels. Then, thin polyethyleneimine (PEI) layer was deposited on the top of PA layer via chemical crosslinking to endow the membrane with positively charged features, which benefits for heave metal ions removal. After optimization of the POP size, POP content, and PEI layer thickness, the fabricated nanofiltration membrane demonstrated a pure water permeability of 14.1 L.m-2.h -1.bar-1 , which is 4-fold enhancement than that of pristine membrane (3.5 L.m-2.h -1.bar-1). Moreover, the membrane could reach above 90% rejection to various heavy metal ions, such as Cu2+ (95%), Co2+(90.5%), Fe2+ (96%), and Ni2+ (93%). Considering its capability to withstand different pressures and long-term running (100 hours) stability, the fabricated membrane has the potential to be deployed for removal of heavy metal ions from wastewater for providing clean water to those suffering from water shortage.

Keywords:

POP, positively charged membranes, nanofiltration membranes, heavy metal ions.