High efficient removal of lead(II) and nickel(II) from aqueous solution by novel polysulfone/Fe_3O_4–talc nanocomposite mixed matrix membrane

ABSTRACT

Novel mixed matrix membranes were prepared from polysulfone (PSf), talc and Fe_3O_4–talc nanocomposite by phase inversion technique. PSf/Fe_3O_4–talc membranes showed higher lead and nickel rejections compared to PSf/talc membranes, which reaches to 99.4 and 96.2% for lead and nickel ions, respectively, at feed pH 5 and lower rejections at pH 3.5 and 2. Higher surface area in Fe_3O_4–talc nanocomposite than talc could be considered as a main reason of higher heavy metals removal in PSf/Fe_3O_4–talc membranes. The heavy metals removal enhances with the increase in nanocomposite content from 7 to 9 wt.% because higher numbers of vacant sites in membrane morphology were available for adsorption. Heavy metals rejection reduces in higher nanocomposite concentrations (11 and 13 wt.%) due to the formation of macrovoids in membrane substructure. In addition, a reduction in the metal ion rejection was recognized by enhancement in feed solution concentration and applied pressure. This is caused by difficulty for the remaining vacant sites to be filled with the heavy metal ions because of repulsive forces between the adsorbed solute molecules on the surface and solute in bulk phase. The interactions of lead and nickel ions with nanocomposite placed on the membrane top layer were revealed by the scanning electron microscopy with energy dispersive X-rays.

Keyword: Polysulfone; Nanocomposite; Mixed matrix membranes; Heavy metals removal