Magnetic active PVDF membranes for removal Fe^{2+} from water

Halyna Bubela, Viktoriia Konovalova

Department of Chemistry, National University of Kyiv-Mohyla Academy, 2 Skovoroda Street, 04070 Kyiv, Ukraine, v.konovalova@ukma.edu.ua

Keywords: magnetic active membranes, membrane modification, concentration polarization, iron removal, polymer enchenced ultrafiltration

Introduction. In the presented study, magnetic active membrane was fabricated by immobilization magnetite nanoparticles (Fe_3O_4) on the PVDF membranes surface and also by incorporating nanoparticles into the PVDF membranes matrix. Magnetic nanoparticles (MNPs) with the size 50 nm were immobilized in boundary layer of the membrane using the flexible - polyethylenimine spacer (PEI). In the rotating magnetic field, the magnetically responsive nanobrushes are moving in boundary layer of membranes reducing concentration polarization effect [1-2].

Results and discussion. The surface characteristics of developed membranes were studied using SEM, IR, AFM, WCA, and zeta potential measurements. The surface modification with PEI as polycation and hydrophilic agent led to hydrophilization of membrane surface (water contact angle decreased from 106.1 ± 3 to 74.8 ± 2), while great changes in isoelectric point of PVDF membrane (from 3.5 ± 0.2 to 7.7 ± 0.2).

In addition, membranes were tested using an ultrafiltration process and discussed in terms of iron removal from water using a polyelectrolyte-enhanced UF process with polyacrylic acid. The potential use of PVDF membranes decorated with Fe_3O_4 NPS for the removal of iron owing to high rejection values (97.1 – 99.4 %), and persistent amounts of iron in permeate (0.08 and 0.11 $mg \cdot L^{-1}$) after PAA-enhancement of UF. An optimal amount of PAA and pH of solution also have been determined (0.5 wt % of PAA and pH = 8).

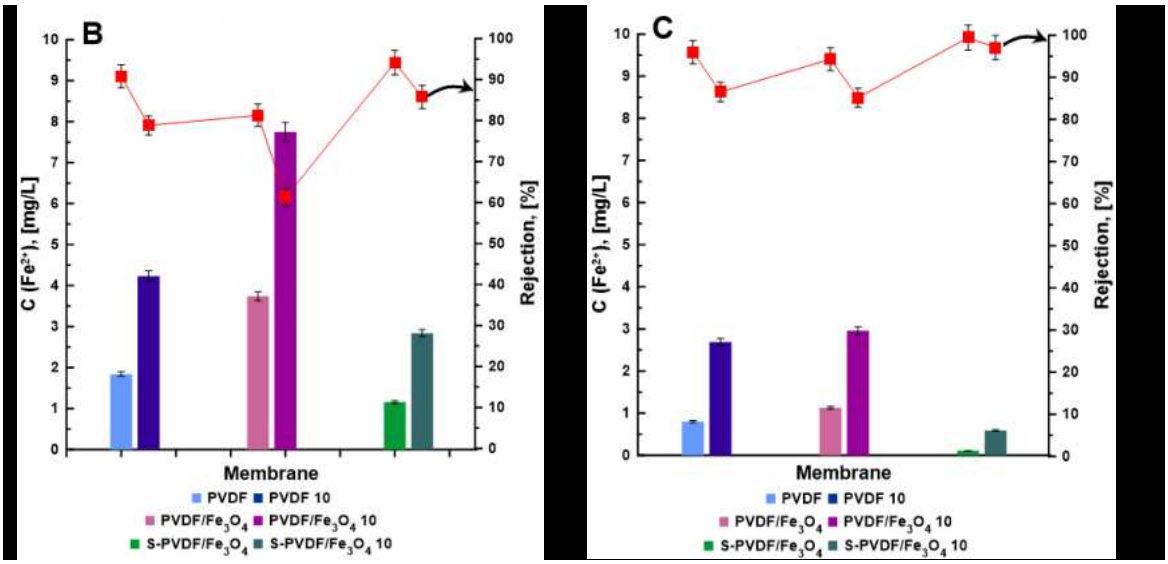

Fig. 10. Fe^{2+} concentration in permeate and rejection after enhanced ultrafiltration with 0.3 wt % of polyacrylic acid at different pH values: (B) pH = 6; (C) pH = 4.

References

[1]Q. Yang, H.H. Himstedt, M. Ulbricht, X. Qian, S. Ranil Wickramasinghe, Designing magnetic field responsive nanofiltration membranes, J. Membr. Sci., 430 (**2013**) 70-78.

[2]V. Konovalova, I. Kolesnyk, A. Burban, W. Kujawski, K. Knozowska, J. Kujawa, Improvement of separation and transport performance of ultrafiltration membranes by magnetically active nanolayer, Colloids Surf. A Physicochem. Eng. Asp., 569 (**2019**) 67-77. https://doi.org/10.1016/j.colsurfa.2019.02.061