포스터 발표 P-37

MEUF 시스템에서 양쪽성/ 비이온 나노고분자입자를 이용한 오염물과 금속의 제거

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Removal of pollutants and metal ions using non-ionic amphiphilic nanopolymer particles in micellar-enhanced ultrafiltration system

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1. Introduction

Surfactant-based process such as micellar-enhanced ultrafiltration (MEUF) was recently proposed to remove multivalent metal ions from aqueous streams because of the synergetic effect of two techniques such as reverse osmosis and ultrafiltration which showed the high selectivity and flux, respectively [1]. To overcome the disadvantages of the MEUF, micelle-like non-ionic amphiphilic nanopolymer particles (NANPs) were applied to the system, forming the micelle-like nanoparticles at the low concentration. The NANPs used in this study have hydrophilic groups on the surface and a hydrophobic backbone in their core, in the result of a microphase-separated structure similar to that of surfactant micelles. The NANPs were cross-linked to enhance their stability for removing various metal ions from the wastewater. The purpose of this work is to evaluate the potential of NANPs for the removal of dissolved organic pollutants and metal ions from aqueous

phase using MEUF.

2. Theory

In the MEUF process, a surfactant is added to the aqueous stream containing the organic solute. The surfactant concentration in the combined stream is considerably greater than the critical micelle concentration (CMC), so that the surfactant consists mainly of micelles in equilibrium with a small concentration of monomeric surfactant [2]. The solute largely solubilizes in the micelles, with only a small fraction of the solute remaining insolubilized at equilibrium. When this solution is forced through an ultrafiltration membrane having pore diameters smaller than the micelle diameters, the micelles (and the solubilized solute within them) are rejected by the membrane [3]. If micelle rejection were 100 %, the permeate would be very pure, containing the surfactant at a concentration near or below the CMC and the organic solute at a concentration equal to or less than that of the insolubilized molecules.

3. Experimental

A dead-end stirred cell filtration system was used to characterize the filtration performance with NANPs. Before all filtration experiments, membranes were soaked in deionized water for 24 hours prior to use to remove any organic components and metal ions and compacted at a transmembrane pressure 4 kgf/㎠ for 2 hours [4]. The constant water flow rate was noted down to calculate membrane permeability at each operating pressure(1, 2 and 3 kgf/㎠). The water permeability of the membrane was measured before the next run. Experiments were carried out to study the effects of applied pressure, NANPs concentration and toxic organics and metal compounds concentration on the permeate flow rate and rejection. The flow rate was measured and recorded as a function of time. Runs were taken at variously applied pressures at a fixed feed solution concentration to observe their influence on flow rate and rejection. Pressure in the cell was maintained by nitrogen gas. The stirrer speed was kept constant at 250-300 rpm by magnetic stirrer. All the experiments were conducted at room temperature.

4. Results and discussion

Fig. 1 shows the molecular structure of NANPs which are composed of hydrophobic and hydrophilic segments. Furthermore, the double bond at the end chain can be available for cross-linking, in the results of improvement of stability.

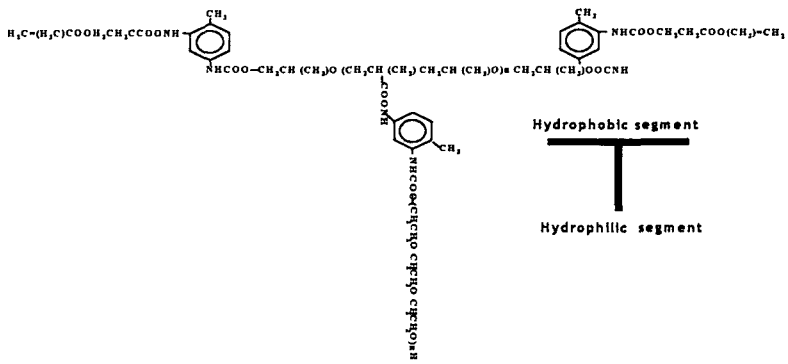

Fig. 1. Molecular structure of NANPs

Figure 2-(a) shows the rejection rate of NANPs with a variety of concentration at a constant pressure of 3 kgf/㎠. The NANPs in phenol solution showed a relatively low rejection rate above 50 %, whereas the rejection rate in the benzene was over 85%. The rejection rate of 4-nitrophenol decreased with the concentration of NANPs.

Influence of metal ions on the rejection rate is shown in Fig. 2-(b). The experiment was conducted at 3 kgf/㎠ using NANPs solution whose concentration is 1,000 mg/L. According to the result, rejection rate of nickel ion is over about 85 %. On the other hand, the Cs ions showed the low rejection ratio due to the univalent ion.

Consequently, ultrafiltration using ANP particles is very effective at low concentration of NANPs to remove the toxic organic solutes and metal ions.

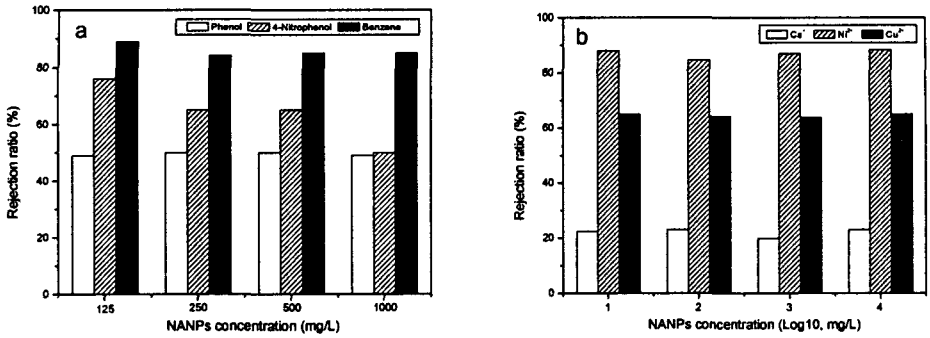

Fig. 2. (a) Rejection of phenol, 4-nitrophenol and benzene based on NANPs (using 0.025㎛ MCE membrane, 3 kgf/㎠, and 1,000 mg/L concentration of organic components), (b) rejection of metal ions based on NANPs (using 0.025㎛ MCE membrane, 3 kgf/㎠, and 1,000 mg/L concentration of metal ions)

5. References

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