일반강연 A-10

비수계용액분리를 위한 실리콘이 코팅된 나노막 제조 및 특성평가

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Preparation of Silicone-coated nanofiltration membrane for non-aqueous solution separation

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1. Introduction

Membrane separation processes in the oils and fats industry have recently been applied. A considerable work has been done in the areas of hexane recovery from oil miscella, vapor recovery, condensate return, degumming, refining and bleaching, hydrogenation catalyst recovery, waste-water treatment, and others [1]. Crude vegetable oil is refined to remove undesirable components, such as free fatty acids (FFA), after extraction from oilseeds. In alkali-refining, the FFA form soaps, which are removed by centrifuging. The deacidification process has a significant economic impact, and several drawbacks with alkali-refining have been noted: (i) oil losses due to saponification and by occlusion in soapstock; (ii) soapstock has little value even though FFA in their native state find many uses; and (iii) large amounts of water are used to wash the oil after caustic treatment, which leads to contaminated discharges and high disposal costs. With soybean and cottonseed oils, total batch refining losses can be as high as three times the FFA content [2 - 5].

The purpose of this study is to prepare the silicone-coated nanofiltration membranes with interfacially polymerized thin film layer and determine the optimum conditions for a good performance of non-aqueous alcoholic solution. Moreover, performance of various integrally skinned asymmetric membranes prepared from polyacrylonitrile (PAN), polyetherimide (PEI), polyvinylidenedifluoride (PVDF) were compared with silicone-coated NF membrane, polyamide NF membrane and commercially available NF membrane.

2. Experimental

2.1. Materials

Polyacrylonitrile (PAN), polyetherimide (PEI), polyvinylidenedifluoride (PVDF) were used as asymmetric membrane material. The polymer was dried for at least 5h at 100℃ before being used in preparing the polymer solution. N-methyl-2-pyrrolidone (NMP), 1,4-dioxane (in case of PEI), and acetone (in case of PVDF) were used for casting solution preparation. Deionized (DI) water was used as a coagulation media.

Piperazine (PIP) and 1,3-phenylendiamine (MPD) were used as a diamine blend, and trimesoylchloride (TMC) as an acid chloride for interfacial polymerization.

Polydimethylsiloxane (PDMS) consisting of two componets (prepolymer RTV 655A and crosslinker RTV 655B) was used for preparation of silicone-coated membrane.

2.2. Membrane preparation

In order to reduce the pore size, 1,4-dioxane in case of PEI (PEI/NMP/1,4-dioxane (16/28/56wt%)), acetone in case of PVDF (PVDF/NMP/acetone (15/57/28wt%)) were used as an additive. 17wt% PAN membrane was annealed into hot water. By blending of MPD and

PIP, interfacially polymerized polyamide membrane was prepared. PDMS was coated onto the polyamide membrane. Moreover, PDMS was dissolved into the TMC organic solution, and afterwords, interfacilly polymerized.

2.3. Membrane characterization

Feed solution comprising either a 1000ppm PEG 200 aqueous solution or a 1000ppm oleic acid methanol solution was pumped into cells at 200psi and 25℃. The concentration of feed and permeate was measured with HPLC having refractometer.

3. Results and Discussion

In order to prepare the integrally skinned nanofiltration (NF) membrane, the cosolvent system was used. MWCOs of the membranes were in the range of a few hundred or thousand. In case of polyamide membrane, MWCO was below PEG 200. By blending of PIP and MPD, the ratio of methanol flux and water flux could be increased. Moreover, by incorporating PDMS in the polyamide membrane, methanol flux was considerably increased.

4. References

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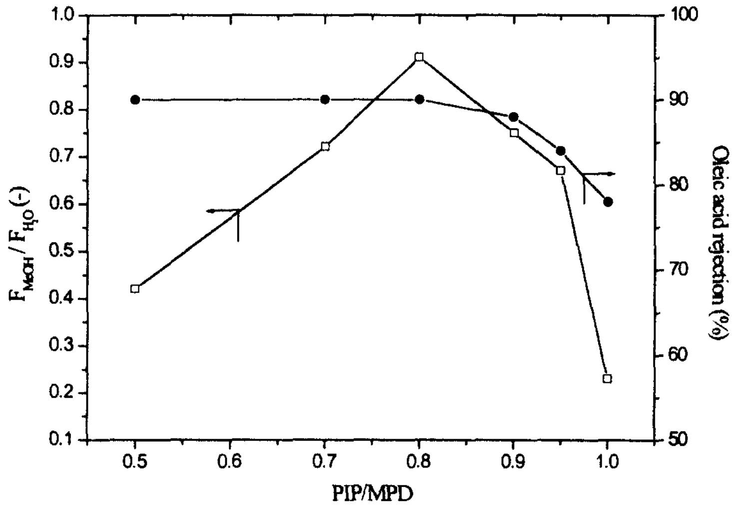

Figure Nanofiltration membrane performance (flux ratio of methanol and water and rejection of oleic acid) prepared from MPD/PIP blended amines.