Propylene absorption by using PVDF Hollow fiber membrane contactors with various membrane structures
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1. Introduction
Membrane contactors for gas absorption have been attracting attention as an alternative technology, which overcomes the disadvantages of conventional gas absorption apparatuses. Several kinds of hydrophobic microporous membranes have been used for membrane contactor. However, among these membranes, PVDF hollow fiber membrane has been attracted much attention regarding its noticeable advantages over other polymers.

Mixture of olefin and paraffin is used as fuel gas in industries. However, light olefins with high purity can be used as a valuable feed for petrochemical complexes.

In this work, different kind of PVDF hollow fiber membranes were used to absorb propylene. Results were compared with that of the commercial poly(tetrafluoroethylene) (PTFE) hollow fiber membrane.

2. Experimental
Different kinds of membranes prepared in our laboratory were used in the module fabrication. Each membrane modules was fabricated by potting a single hollow fiber membrane in a shell. The effective hollow fiber membrane length was about 25cm. Pure propylene was used as a feed gas and was fed to the shell side at the flow rate of 31 cm$^3$/s at 298 K and atmospheric pressure. An aqueous silver nitrate solution was used as absorbent and supplied to the tube side of the module. Gas flow rates at the inlet and outlet of the module were measured by a soap film flow meter and gas absorption rate was determined by their difference. Gas phase pressure was atmospheric pressure and the liquid phase pressure was controlled about 0.045 atm higher than the gas phase pressure.

3. Result and discussion
Fig.1 shows the propylene absorption flux for different prepared membranes with different membrane inner diameter at the absorbent flow rate of 12.2 cm$^3$/min and the silver nitrate concentration of 4000 mol/m$^3$. As shown in this figure, propylene absorption flux of the prepared membranes was comparable with that of the PTFE membrane. Membrane C showed extremely low absorption flux, because it has a skin layer near the outer surface as shown in Fig. 2. It is seen in Fig. 1 that except for membrane C absorption flux decreases with increasing the fiber inner diameter. Except for membrane C, agreements between observed and simulated results are satisfactory, if we consider that no fitting parameters were used in the simulation.

Fig.1. Propylene absorption flux for different membrane. Absorbent flow rate=12.2 cm$^3$/min, AgNO$_3$ concentration=4000 mol/m$^3$. Membrane inner diameter was shown inside the parenthesis.

Fig.2. SEM images, cross section-near the outer surface of membrane B and C.

Fig.3. shows the effect of absorbent flow rate and concentration on propylene absorption flux for PTFE membrane. It was observed that propylene absorption flux increases by increasing absorbent flow rate and concentration. Observed and calculated results agree satisfactorily.

Fig.3. Effect of absorbent flow rate and concentration on propylene absorption flux for PTFE membrane.

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