일반강연 B-3

올레핀촉진수송에의한막분리공정의해석

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Analysisofthesingle-stagemembraneprocessby facilitatedolefintransport

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1.Introduction

The separation performance of facilitated olefin transport membrane was observed with the unusually large difference of selectivity between pure gas and mixed gas. Such difference can be attributed to plasticization. In an effort to investigate the possible effect of plasticization, we carried out a theoretical analysis of the effect of various feed conditions in the cocurrent permeation through facilitated olefin transport membranes. The permeability and selectivity of membranes are assumed to be independent of the feed concentration and pressure, although they would be sensitive to the feed concentration for the facilitated olefin transport membranes. A model for cocurrent single stage membrane and a on orthogonal collocation on finite element method (OCFEM) in an external process simulator, gPROMS, based on the equation-oriented approach to solve the differential model equations, were developed.

2.Solution method

Partial differential and algebraic equations (PDAEs) are developed and solved using the gPROMS simulation software (Process Systems Enterprise Ltd). A spartial discretisation technique is employed for the solution of the distributed model. This converts the system of PDAEs into a set of ordinary DAEs, which can be solved by gPROMS using implicit numerical integration techniques [1].

3.Result and discussion

In order to analyze the efficiency of the permeators, the permeate concentration and residue concentration were plotted against the real length depending on the feed conditions.

Figure 1 shows the effect of feed flow rate on performance with theselectivity of 40, propylene permeance of 40 GPU, propane permeance of 1 GPU, the feed pressure of 40psi and feed flow rate of 1.8cm^3/min. Figure 2 presents the permeate concentration dependency on feed pressure. The permeate concentration is increased by increasing feed flow rate and also by increasing feed pressure within a certain limit. But the membrane length should be decreased above a certain pressure.

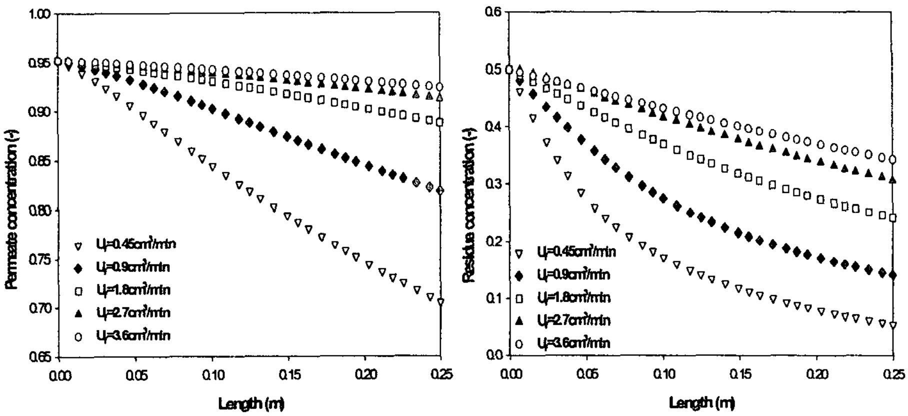

Figure 1. Effect of feed flow rate (U_f) on permeate and residue concentration as a function of the membrane length.

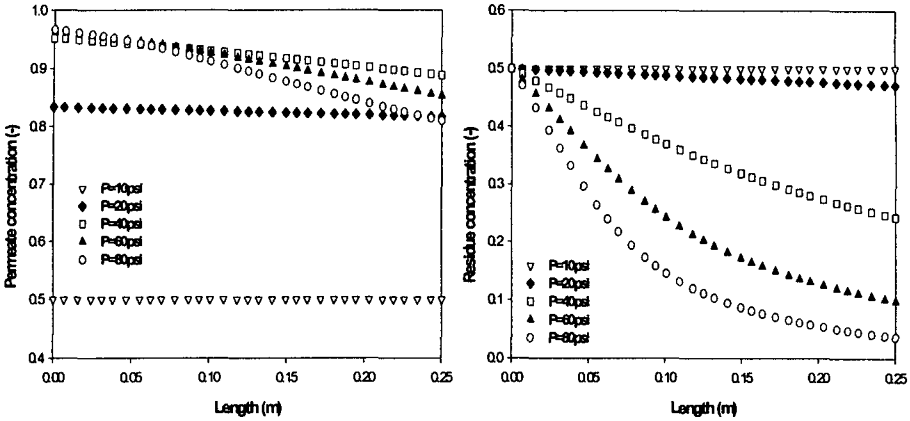

Figure 2. Effect of various feed pressure (P) on permeate and residue concentration as a function of the membrane length.

Figure 3 shows the effect of feed concentration, but all the above data obtained from the assumption that membrane permeabilities and selectivities are independent of pressure and concentration. In real system, the separation performance is influenced by feed concentration. From these data, the permeate flux increases with membrane length at constant membrane width, but the partial pressure difference is significant in the membrane with membrane length. Therefore the membrane length should be optimized at each feed conditions. Partial pressure of the less permeable gas is increased significantly with increasing membrane length. Thus one of the reasons for the large selectivity difference between pure gas and mixed gas may be due to property changes of membrane by plasticization. Therefore, the concentration dependent permeability and selectivity will be experimentally obtained by varying the feed composition. From these data, we will investigate the origin of the large difference of selectivity between pure gas and mixed gas and will obtain more exact result.

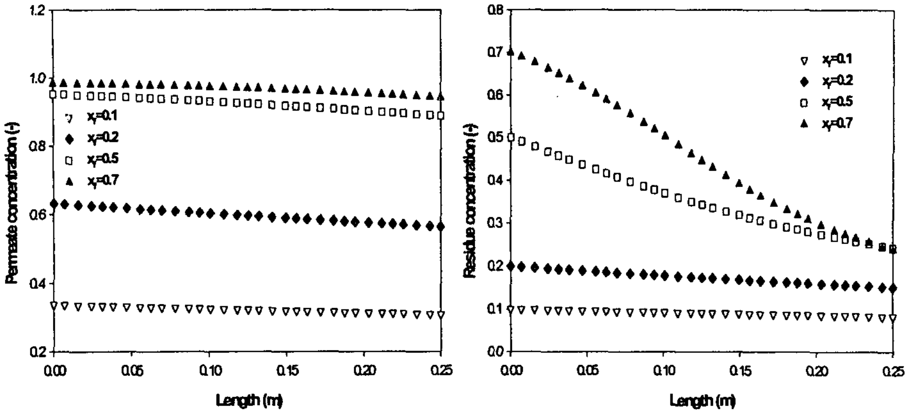

Figure 3. Effect of various feed concentration (x_f) on permeate and residue concentration as a function of the membrane length.

4.References

1. Marriott, J. I.; Sorensen, E.; Bogle, I. D. L. *Comp. & Chem. Eng.* 2001, 25, 693.