Chapter 6

Conclusions and Recommendations

The separation and concentration of solvent from synthetic mixtures and acetone-butanol fermentation broth by the pervaporation process were carried out at various feed temperatures (40-80°C), permeation pressures (2-10 torr) and membrane thicknesses (0.25-1.0 mm.). The phenomena of separation by pervaporation were predicted by solution-diffusion model. The following conclusions of this study were obtained.

1. From these experiments we can conclude that the optimum conditions for solvent separation of both the synthetic mixtures and the acetone-butanol fermentation broth at feed flowrate of 1 L/h by the pervaporation process were: feed temperature of 60°C, permeation pressure of 2 torr and membrane thickness of 0.25 mm., respectively. These conditions can provided the solvent flux, solvent concentration in permeate, membrane selectivity of solvent and mass recovery of solvent in synthetic mixtures of 15.62 g/m^2.h, 34.53%wt., 37.28, and 6.65%wt., respectively, and that in fermentation broth were 12.09 g/m^2.h, 31.76%wt., 32.89,and 5.15%wt., respectively.

2. Distribution coefficient showed the performance of sorption process. Solute with high distribution coefficient were more preferentially incorporated into silicone rubber membrane than others. Distribution coefficient of butanol was higher than other solutes and increased as temperature increased.

3. Permeation flux, mass recovery, permeability and diffusivity were increased as feed temperature increased, whereas permeation concentration and membrane selectivity were irrelavant to a change of feed temperature.

4. Increasing permeation pressure resulted in low permeation flux, mass recovery, permeability and diffusivity. Permeation pressure did not have any effects on permeation concentration and membrane selectivity.

5. Thick membrane provided low permeation flux, low mass recovery, high permeation concentration and high membrane selectivity. Permeability and diffusivity were constant at all membrane thickness.

6. In pervaporation of binary and multicomponents mixtures, permeation flux, permeation concentration, membrane selectivity, mass recovery, permeability and diffusivity of solute decreased as the number components increased, especial for solutes with high distribution coefficient.

7. Permeation flux, permeation concentration, membrane selectivity, mass recovery, permeability and diffusivity of solutes in fermentation broth were lower than that in synthetic mixtures. This indicated that the effect of residual sugar and other solute that were not in synthetic mixtures.

8. For solutes with the same functional group, permeability increased as molecular weight increased, whereas diffusivity increased as molecular weight decreased.

9. Sorption stage in pervaporation process which could be described by solution-diffusion model, was the limiting step of solvent separation by the pervaporation process.

10. The performance of extractive fermentation with microfiltration by pervaporation was higher than that without microfiltration. This results reflected the effect of glucose concentration and cell concentration on the fermenter.

Recommendations.

Further development in solvent separation and concentration from acetone-butanol fermentation by the pervaporation that sould be carried out are:

1. The effect of feed glucose concentration of pervaporation unit in extractive fermentation by pervaporation should be studied.

2. The pervaporation process can be extended to cascade membrane module for higher productivity.