# CONCENTRATION OF BIOETHANOL BY CELLULOSE ESTER MEMBRANES

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We have been investigating the permeation and separation characteristics of aqueous ethanol solutions produced from the fermentation of biomass through polymer membranes by pervaporation, evapomeation (EV) and temperature-difference controlled evapomeation (TDEV) techniques. It was revealed that the membrane performance was influenced significantly by the structure of polymer membranes and consequently the control of membrane structure was one of important factors for an improvement of the membrane performance.

In this paper, to obtain a fundamental knowledge for the effect on the membrane structure in concentrating bioethanol by TDEV, in which temperatures of the liquid feed solution and the membrane surroundings can be controlled, cellulose nitrate (CN) and cellulose acetate (CA) that have remarkably different affinity for ethanol are selected as membrane material, and various asymmetric membranes which have different physical and chemical structure were prepared by wet method. The permeation and separation characteristics for aqueous bioethanol solutions through these CN and CA membranes in TDEV were studied.

The surface free energies of the CN and CA membranes were determined from the results of contact angle measurements for water and methylene iodide. The surface free energy of CN membrane was lower that that of CA membrane. Also, the amount of bound water in CN membrane was smaller than that of CA membrane. These results suggest that the CN membrane has higher affinity to ethanol.

When asymmetric CN and CA membranes having similar physical structure were applied to the permeation for an aqueous solution of 10 wt% ethanol in TDEV, in which temperatures of the liquid feed solution and the membrane surroundings were 40 and 25 $^{o}$C, respectively, the ethanol concentration in the permeate of asymmetric CN membrane was higher than that of asymmetric CA membrane. In cellulose ester membranes that have similar physical structure and different chemical structure, it was found that the ethanol/water selectivity of CN membrane with higher affinity to ethanol was greater. The permeation and separation mechanisms of the ethanol/water selectivity through porous membranes in TDEV are discussed in detail.