**Transfer behavior of saccharides in**

 **thermoresponsive polymer layered membrane.**

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**Highlights**

* The water permeation rate through the polymer layered membrane was linearly proportional to the pressure indicating the permeation mechanism was Hagen-Poiseuille flow.
* The water permeation rate steeply increased at around 30 °C.
* The effective diffusion coefficient of model components in the membrane increased with temperature.

**1. Introduction**

Membrane separation is separation technology that selectivity separates materials via pores and/or tiny gaps in the membrane structure. And membrane technology plays an important role in conserving energy during purification process. Especially, separation of saccharides is an important issue in the production process of food industry. On the other hands, smart responsive polymer has various types such as thermoresponsive, photo-responsive, pH-responsive and etc. Especially thermoresponsive polymers are easy to control[1]. In this study, thermaoresponsive polymer layered membrane is prepared and its permeation behaviors of solvent and model saccharides through the membrane are investigated.

**2. Methods**

The polymer system composed of polyacrylamide and poly (acrylic acid) was used as a positive thermoresponsive polymer exhibiting an upper critical solution temperature (UCST). Acrylic acid/acrylamide monomer solution was deposited onto a support membrane and thermally polymerized. This operation was repeated to prepare the thermoresponsive polymer layered membrane. The water permeation rate of the prepared membrane was determined from the water mass flux with N2 gas pressure. The overall mass transfer coefficient (*KOL*) was determined from a measurement of mass transfer flux of methyl orange or saccharides in the glass cells sandwiching the membrane. The effective diffusion coefficient (*Deff*) in the membrane was evaluated from the membrane mass-transfer coefficient (*km*) obtained under fully turbulent conditions. The mass transfer experiment of the model components was investigated at different temperature conditions (25 °C and 60 °C)

**3. Results and discussion**

The water permeation rate through the polymer layered membrane was linearly proportional to the pressure indicating the permeation mechanism was Hagen-Poiseuille flow. The effect of temperature on the water permeation through the membrane was examined. The water permeation rate steeply increased at around 30 °C (Fig. 1), indicating that the membrane showed UCST behavior. The *Deff* of model components in the membrane increased with temperature. The increase in the *Deff* was larger than the contributions of temperature and viscosity to the bulk diffusion coefficient. This supposed that the polymer framework of the membrane swelled with increasing temperature, which led to the reduction of mass transfer resistance. These findings indicated that positive thermosensitive control of mass transfer was successfully achieved using the polymer layered membrane.



**Figure 1.** Water permeation through the polymer layered membrane

 at various temperatures (pressure: 0.1 MPa).

**4. Conclusions**

Thermaoresponsive polymer layered membrane were prepared, and its permeation behaviors of solvent and model components through the membrane were investigated. In water permeation through the membrane, UCST thermoresponsive behavior was successfully shown. In mass transfer behavior of model components through the membrane, it is possible to control *KOL* and *Deff* by temperature and suggesting of possibility of separation.

**References**

1. Yang, W. et al., ACS Appl. Mater. Interfaces, 6, 0146−10152 (2014)