ABE 304
Bioprocess Engineering Laboratory

PRELAB: MEMBRANE SEPARATION FOR XANTHAN RECOVERY

BACKGROUND

This lab will focus on a membrane process to concentrate and purify the xanthan gum produced during fermentation. Ultrafiltration at the 500 kDa scale will be used to concentrate the xanthan. The performance and flux of the membrane will be evaluated. The process is illustrated in Figure 1. We will use a 2.5% xanthan solution for filtration. The experiment will focus on how to concentrate the xanthan.

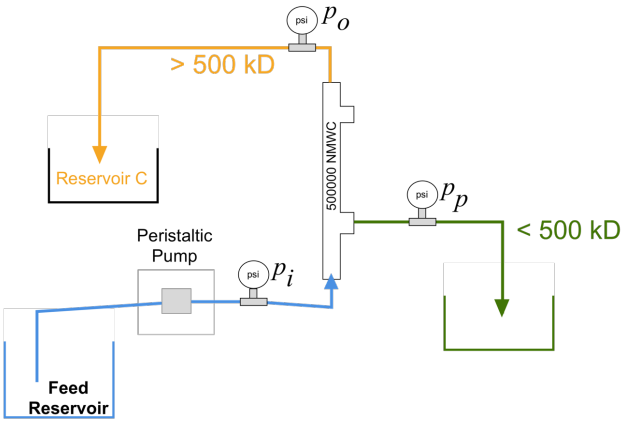

Figure 1: Schematic of membrane filtration process to concentrate xanthan gum from fermentation broth.

A focus of this experiment will be to determine if the membrane separation is mass-transfer or pressure controlled. The control region determination is accomplished by graphing the permeate flux as a function of the transmembrane pressure. The transmembrane pressure will be set for each run using a potentiometer. Equation 1 was used to set Δp.

$$\Delta p = \left(\frac{p_i + p_o}{2}\right) - p_p \qquad (1)$$

where p_i is the pressure before the membrane, p_o is the pressure after the membrane, and p_p is the pressure of the permeate.

The permeate flux, J, can be determined from the volumetric flow rate of the permeate, F_p, and the area of the membrane, A (Equation 2).

$$J = \frac{F_P}{A} \qquad (2)$$

A graph of the permeate flux as a function of the transmembrane pressure will help to determine if the membrane separation is pressure or mass transfer controlled. An illustration of the control regimes is shown in Figure 2.

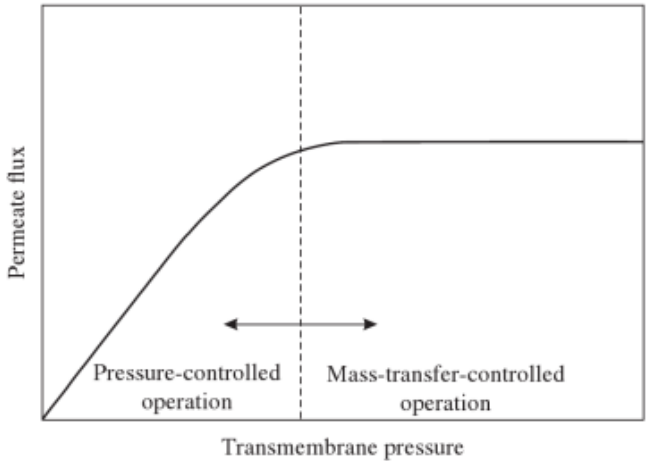

Figure 2: Membrane separation control regions shown as a function of transmembrane pressure and permeate flux. (Figure 11.29 - Doran, 2013)

PRE-LAB QUESTIONS

1. Please write a background paragraph on membrane filtration and its operating principle.
2. What is the importance of flux on membrane performance?
3. Are you expecting the xanthan will be concentrated in the retentate or in the permeate? Why is this?

The pre-lab needs to be saved as a single document – either a word document or a pdf. The TA will check your lab notebook for procedure and data tables before the start of lab.

Table 1: Example Data table for lab notebook

				Permeate Flow Rate	
Pump Setting	Transmembrane Pressure ΔP [psi]	Retentate OD	Permeate OD	Permeate Volume [mL]	Time to Collect Permeate Volume [s]
3	2				
3	4				
3	6				
3	8				
3	10				
4	2				
-	-				

REFERENCES

Doran, Pauline M. (2013). *Bioprocess Engineering Principles*. Academic Press, 2nd Ed. Chapter 11