

RO/FO Required Data - Draft

Due one week after experiment (individually to section TA, "representative example" for inter-group exchange)

Include as a heading: Your name, Names of group members, Dates experiment was performed

I. FORWARD OSMOSIS

1. **Tabulate** experimental variables:
 - a. Membrane(s) and orientations tested.
 - b. Pressure(s) tested [bar]
 - c. Draw and feed flowrate(s) tested [L/min]
 - d. Draw and feed concentration(s) tested [M]
 - e. Temperature(s) tested [°C]
2. Conductivity probe calibration curve(s): plot concentration [M] v Conductivity [uS]. Add linear fit with equation.
3. **Plot** water flux, J_w [LMH] (y-axis) versus ΔC_{eff} [M] (upper x-axis) **AND** Water flux [LMH](y-axis) versus Osmotic Pressure Effective $\Delta \pi_{eff}$ [bar] (lower x-axis). Report slope, which is membrane permeability, **A** [lmh/bar]. Note $\Delta C_{eff} = C_m - C_p$
4. **Plot** salt Flux, J_s [mole/m²s] versus ΔC_{eff} [M]. Report the slope, which is the salt water permeability, **B** [m/s].
5. **Tabulate** the external concentration polarization (**CP**), or the ratio of ΔC_{eff} to ΔC_{obs} .

II. REVERSE OSMOSIS

1. **Tabulate** experimental variables:
 - a. Membrane(s) and orientations tested
 - b. Pressure(s) tested [bar]
 - c. Draw and feed flowrate(s) tested [L/min]
 - d. Temperature(s) tested [°C]
 - e. Draw and feed concentration(s) tested [M]
2. Conductivity probe calibration curve(s): plot concentration [M] v Conductivity [uS]. Add linear fit with equation.
3. **Plot** water Flux J_w [L/m² hr] versus Transmembrane Pressure [bar]. Report slope, which is membrane permeability, **A** [lmh/bar] (**Figure 1**).
4. **Plot** salt Flux J_s [mole/m²s] versus ΔC_{eff} [M]. Report the slope, which is the salt water permeability, **B** [m/s].
5. **Tabulate** for your experimental treatments (note corresponding parameters in part 1 above)
 - a. Observed percent salt rejection, **%R**

$$\%R = \left(1 - \frac{C_p}{C_b}\right) \times 100\%$$

where C_p = permeate concentration

C_b is the bulk feed concentration

- b. Concentration polarization (**CP**) modulus

$$CP = C_m / C_b$$

where C_m is the feed-side membrane interface concentration.

- c. Intrinsic percent salt rejection, **%R_{int}**

$$\%R_{int} = \left(1 - \frac{C_p}{C_m}\right) \times 100\%$$

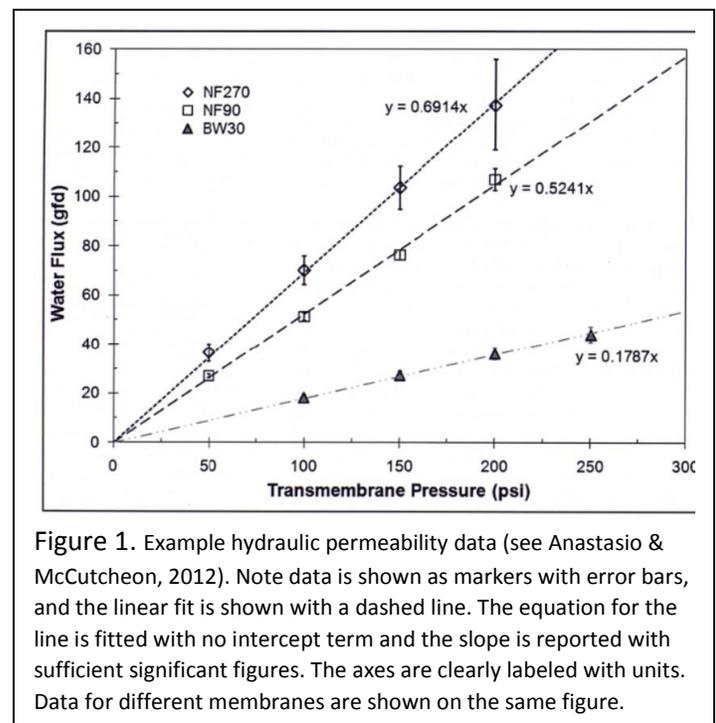


Figure 1. Example hydraulic permeability data (see Anastasio & McCutcheon, 2012). Note data is shown as markers with error bars, and the linear fit is shown with a dashed line. The equation for the line is fitted with no intercept term and the slope is reported with sufficient significant figures. The axes are clearly labeled with units. Data for different membranes are shown on the same figure.

Reference:

Anastasio, D.; McCutcheon, J. R. Teaching Mass Transfer and Filtration Using Crossflow Reverse Osmosis and Nanofiltration: An Experiment for the Undergraduate Unit Operations Lab. *Chemical Engineering Education*. **2012**. 46(1) 19-28.