Microreactors - Required Data

Due one week after experiment (individually to section TA, "representative example" for inter-group exchange). Include as a heading: your name, assigned group number, names of group members, and dates experiment was performed

Provide statistical analyses when appropriate (e.g. 95% confidence interval, standard deviation, error bars, etc.). Briefly justify your chosen method of analysis for each application.

Some of the example data shows conversion of sodium hydroxide. Use malachite green conversion instead of sodium hydroxide conversion in your calculations

1. **Figure** your different reactor designs (Figure 1). You can use a photo, or CAD drawings or COMSOL images. Each design can be in its own image or combined as shown below. Be sure to **Note in the Legend** a **Descriptive Name** for each reactor design (NOT 1, 2, 3 or "first", "second", "third" etc.)

2. **Tabulate** the key dimensions of your different reactor designs (Table 1).

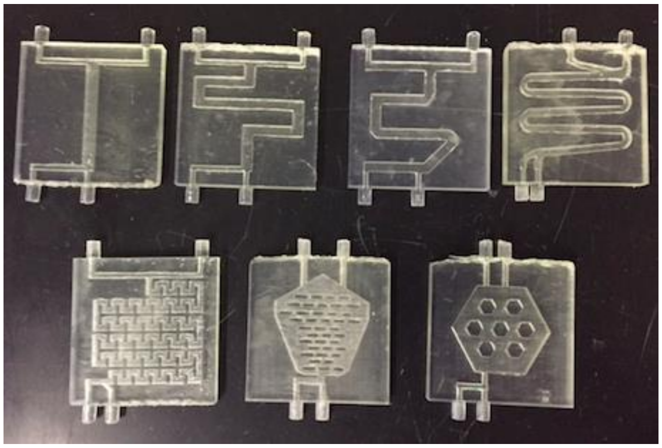

Figure 1. Example reactor designs from previous sections of CHEG 4139. **Top Row**: T Reactor and three versions of a short serpentine design: Blunt Curve Short Serpentine; Partially-Rounded Curve Short Serpentine; and Rounded Curve Short Serpentine. **Bottom row**: Long Serpentine, Mixing Chamber with Bar Baffles; and Mixing Chamber with Hexagonal Baffles.

Note: if you have reactors without constant dimensions, for example if your width varies, you must still provide a reasonable "characteristic" value for each parameter.

Briefly note and justify how you have determined the characteristic parameter value.

Table 1: Key dimensions of different reactor designs including the length, width, height and volume.

Reactor Name	Length (mm)	Width (mm)	Height (mm)	Volume (mL)
T Reactor	40	4	2	0.32
Blunt Curve Short Serpentine	100	4	2	0.77
Long Serpentine	408	2	2	1.63

3. **Tabulate** the operating conditions tested for your different designs and the predicted conversion (Table 2). Predicted conversion should be your simulated conversion at the outlet using COMSOL.

Table 2: Operating conditions tested by reactor design and associated predicted conversion of sodium hydroxide.

Reactor	Wide T Reactor (w = 4 mm)			Thin T Reactor (w = 2 mm)		
Operating Condition	**1**	**2**	**3**	**1**	**2**	**3**
Fluid Flow Rate (mL/min)	2.0	0.20	0.10	1.0	0.10	0.050
Peclet Number	1700	170	83	830	83	42
Resdience Time (min)	0.16	1.6	3.2	0.16	1.6	3.2
Predicted NaOH Conversion	0.04	0.12	0.24	0.06	0.18	0.31

4. **Plot** your experimentally-measured conversion versus residence time for each reactor design. Plot all reactor designs and different residence times on the same figure. Make sure to use the proper statistical analysis to indicate the variability in your experimental measurements.

5. **Plot** experimental conversion versus simulated conversion for different reactors operated under different conditions. In a parity plot, points that fall on or near the diagonal (45-degree line) indicates experiments and simulations are comparable. Points above the line suggest the experiment over-predicted conversion as compared to the simulation, while points below the line suggest the simulation over-predicted conversion versus the experiment. In your report you will provide an analysis of this plot (i.e., why?).

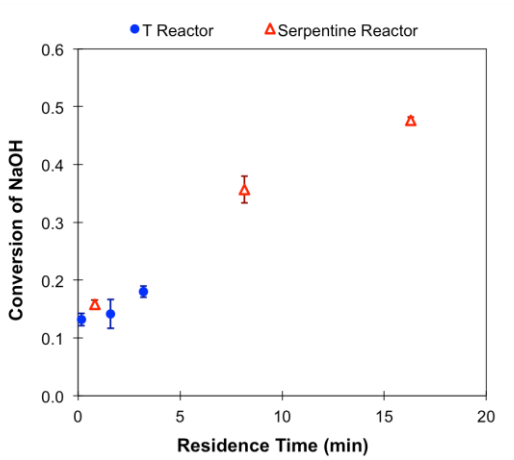

Figure 2: Experimental conversion of sodium hydroxide as a function of residence time in the T reactor (circular points) and serpentine reactor (hollow triangular points). Error bars represent standard deviation of three experimental trials.

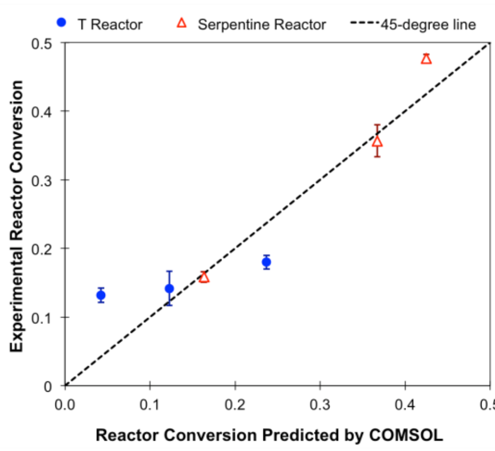

Figure 3: Parity plot of experimental conversions of sodium hydroxide versus conversion predicted by COMSOL, setting diffusion coefficients to 10^{-9} m^2/s for all species and rate constant to $2.1x10^{-5}$ $m^3/(mol\ s)$. Error bars represent standard deviation of three experimental trials.

6. Optional: **Plot** your experimentally- measured conversion versus the ratio of residence time to diffusion time.

7. As an aid to your peers, **tabulate** all the data for conversion (experimental and simulated) versus residence time. Figures are generally better than tables, and you will **not include both in your report**. This is simply to enable your peers to re-plot your data against their own more easily.