Residence Time Distribution
TKP4110
Work plan

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1 Introduction and Objectives

In this experiment, the residence time in a real non-reactive system where back-mixing is allowed will be studied and compared with that of an ideal plug flow reactor with fluid assumed to only flow in one direction. This will be done by injecting methylene blue into the reactor, and using the difference in top and bottom sensor voltage to calculate the residence time distribution for three different concentrations at three different pump rates. Regression techniques will be used to calibrate equipment, and the experimental data will be presented in appropriate figures.

2 Experimental

1. Prepare three methylene blue solutions (250 mL) of different, but known, concentrations between 10 and 150 mg/L by dissolving precalculated amounts of salt in deionized water.
2. Inject the samples quickly into the reactor to ensure that all molecules enter the system at approximately the same time. Three samples for each concentration will be injected at three different pump rates, so nine samples in total. The pump rate should be in the range 400-1200 RPM, and be the same for all concentrations.
3. A pump calibration will be performed with two samples at three different pump rates, so six samples in total. Use the same three pump rates as in the previous measurments. Register the time it takes for a known volume of deionized water to be consumed by the pump.

3 Risk Assessment

Lab coat and goggles are mandatory at all times. Gloves are required when handling methylene blue. Ingestion of methylene blue can cause nausea, vomiting or diarrhea, and skin or eye contact can cause irritation. Concentrated solutions of methylene blue are to be thrown in a waste container for organic solvents with halogens, while very diluted solutions ($\ll$ 1 mg/L) can be disposed of in the sink. The biggest hazard revolving usage of equipment is that glass equipment may break and cause small cuts.

4 Calculations

To calculate the mass, m, necessary in order to obtain the desired concentrations of methylene blue, equation 4.1 is used.

$$m = c \cdot V \tag{4.1}$$

Here c is the concentration and V is the volume. Table 4.1 shows three example calculations of the needed mass.

Sample	c [mg/L]	V [L]	m [mg]
1	25	0.25	6.25
2	75	0.25	18.75
3	125	0.25	31.25

Table 4.1: Example calculations of the needed mass using concentrations and volume.