

**MEMORANDUM**

**DATE: August 26, 2009**

**TO: Laboratory Group B**

**FROM: Tony Butterfield**

 **Engineering Training Supervisor**

**SUBJECT: Crystal Violet**

For decades our lab has been using saponification of ethyl acetate as a model reaction to test our reactors. For a change of pace, we’re looking to find an alternative model reaction. We would also like to use a reaction that could make for a good demonstration and be monitored with the naked eye.

With those motivations in mind, we are considering the reaction of crystal violet (CV) with NaOH. CV has a color in neutral solutions near what one would anticipate by the name, with a maximum absorbance at about 595 nm, but it becomes clear as it reacts with a base.



I will provide you with CV and NaOH. Both compounds should be handled with care and you should be familiar with the MSDS before you begin.

A stock 1e-4 M solution of crystal violet is commonly created in the lab and then diluted to the various needed concentrations. It is likely that a concentration of 1e-4 M will be too high for use with our spectrophotometer. One of your first tasks will be to find the maximum CV concentration at which you can get a good absorbance reading. Then, diluting from there, attempt to find the molar absorptivity of CV in neutral water, assuming Beer’s Law applies. We will, of course, want to run our reactor in such a way that concentrations of CV in our samples are within our ability to quantify. Please find that range.

While we will ultimately run this reaction in our CSTR (a task that will be left to another group), and we could obtain kinetic constants faster that way, we will focus in this project on the logistically simpler task of determining the reaction kinetics using multiple small volume batch reactors at room temperature. You may even choose to observe the reaction occur directly in the spectrophotometer cell.

For your analysis, assume this is an irreversible reaction and that the rate of reaction may be modeled by

$$r=-\frac{d[CV]}{dt}=k\left[CV\right]^{a}[NaOH]^{b}$$

where *k* is the rate constant, and *a* and *b* represent the reaction order with respect to CV and NaOH respectively. As can be seen from the model, you will need to use multiple initial concentrations of reactants in order to estimate the constants. You will want to choose these concentrations by considering the detection limits, stoichiometry, and the qualitative speed of reaction you observe in preliminary tests.

In your final report, please detail your findings and explain the theory you used to model this system and any significant deviations from theory you observe. Were any of the assumptions problematic? Also comment on the usefulness of this reaction as both a demonstrative tool and model reaction for our reactors.

If you have any questions regarding this project or what is expected of you, I hope you will feel free to contact me at any time. Good luck, and I look forward to our meeting on or before Wednesday, September 9th, 2009.