CHEG 3128 – Chemical Engineering Junior Laboratory
Spring 2017 – CSTR II Assignment

In this lab, you will test i) the effectiveness of your impeller design in improving the quality of mixing in the reactor; and ii) impact of baffles on the CSTR mixing quality. Again, at the end of the laboratory period, each team will have a plot of the pH of the CSTR outlet as a function of time. However, what is needed in order to move forward to the second part of the experiment is:

1. A quantitative deconstruction of the experimental data. This has three parts. First, the raw pH data must be transformed to yield the concentration of acetic acid in the CSTR with time. Second, the team needs to compare the data that was collected in CSTR II to the data from CSTR 1. Third, the team needs to compare the experimental data to theory and explain how hydrodynamics influenced their result.

Your treatment of the experimental data as well as the literature reading and design will need to be formalized as a written lab report – the suggestion is that the new data and sections should be integrated into your CSTR I report. You are also able to fix errors in the CSTR 1 report for this version. The due date for this report is 14 days after your team runs the CSTR II lab. The report will be scored out of 100 points. The report format is detailed below.

a. The report must be printed on 8.5"x11" paper with 1 inch margins. The font size must be no smaller than 11 point font and no less than single spacing
b. The report should be NO LONGER than 10 pages, including figures. For each page over the limit, your team will be penalized 10 points. Be clear and concise.
c. These are the sections that must be included and their content (and suggested page length)
    a. Cover page – Laboratory Title, names of team members, date lab was completed, data lab report is submitted.
    b. Objective Statement – What were the main goals of the lab and how did your team try to achieve them (1/4 page)
    c. Theory – This should include the derivation of the ideal CSTR equation, a discussion on factors influencing mixing and deviations from "perfect" mixing. You should also discuss general approaches to improving reactor mixing, (1.5 pages)
    d. Experimental Procedure – In paragraph form, what did was done in both lab sessions? (0.75 page)
    e. Raw Data – show the plot(s) – both pH vs. t and [Acetic Acid] vs. t. Remember to include figure captions (0.5 page). It would not be a surprise if this was very similar to the CSTR I report.
    f. Analysis – Include derivation equations used to transform the pH into [Acetic Acid]. Use the experimental to discuss what was learned regarding the type of mixing in the reactor and what can be done to improve the quality of mixing (1.25 pages)

g. Impeller Design – What was "wrong" with the impeller in class? What was considered when designing the new impeller? Show the now impeller in solidworks and an image of the new impeller. Why will this one work where the other failed? Show the new data. Discuss the results, both vs. CSTR 1 and theory (2 pages)
h. Baffles – Discuss when/why baffles are employed in existing reactors. Discuss the design considerations for your teams baffle design, including size/shape/etc. Show the new data. Discuss the results, both vs. CSTR 1 and theory (1.75 pages)
i. Extension to Chemical Engineering Practice – Invent an example problem relevant to your kinetics class. Quantitatively estimate what effect the deviation from non-instantaneous, non-homogenous mixing (i.e. CSTR 1) has on important parameters like rate and conversion. How did your designed physical changes to the CSTR system influence this (be quantitative)? This is purposely open ended – be creative! (2 pages)
j. References (Does not count against page limit).

d. Your team must have at least 15 literature references that are used throughout the document. Acceptable references are textbooks and peer-reviewed articles. The references section does not count towards the 10 page limit.