CHEG 3128 – Chemical Engineering Junior Laboratory
Spring 2017 – CSTR 1 Prelab

In Chemical Engineering classes, we often talk about the continuously stirred tank reactors (CSTRs), which are cornerstone unit operations for mixing and reactions in industry. One of the core assumptions in the CSTR model is instantaneous homogeneous mixing. Intuition tells us that it is impossible to achieve this type of perfect mixing. Mass transport issues (laminar flow regimes, vortexing, back mixing, dead zones, short circuiting, etc.) all influence the degree of mixing in the reactor. In this laboratory, we will explore the various factors that influence mixing through:

1. In class lecture and discussion; and
2. Hand-on experimentation with pre-designed and assembled CSTR stations

However, before you arrive to class to perform the lab, there are a few tasks that should be completed in order to be adequately prepared to take part in our discussion.

1. Purchase at least 16oz of 5% white distilled vinegar
2. Download and install the NeuLog software that controls the pH sensor
3. Familiarize yourself with the NeuLog software and user guide
4. Read about steady state mass balances in "Elementary Principles of Chemical Processes", either the 3rd or 4th Ed, Section 4.2.
5. Read about non steady-state mass balances in "Elementary Principles of Chemical Processes", 3rd Edition Sections 11.1-11.2 or 4th Edition Sections 10.1-10.2.
6. Review Acid-Base equilibrium and pK_a's from your chemistry textbook and/or: https://www.av8n.com/physics/ph-versus-concentration.htm

In this portion of the lab, we will investigate the mixing properties of a pre-assembled CSTR with a given impeller at a constant speed. The tracer species in this study will be protons that come from the dissociation of acetic acid in water. The proton concentration in the CSTR exit will be continuously monitored using a NeuLog pH sensor. Below is an abbreviated procedure:

1. Adjust the inlet flowrate of tap water until a steady state CSTR volume between 3.5 and 4.0 gallons is achieved
2. Introduce a known volume of 5% acetic acid into the reactor as a pulse input
3. Monitor the pH change over time
4. Perform steps 2-3 at least 3 times, introducing fresh acetic acid only after the concentration (pH) levels off near the initial value (this will take 10-20 minutes per addition)
5. Remove all of the water from the system and rinse thoroughly
6. Disconnect experimental setup and return it to its storage location
7. Clean your laboratory station before leaving

There will be a laboratory assignment posted to Husky CT that provides detail regarding how to prepare the lab report, including discussion and data analysis, as well as the other tasks that will need to be completed before the group's assigned time for the second part of this lab (shown as CSTR 2 in the Course Schedule).