

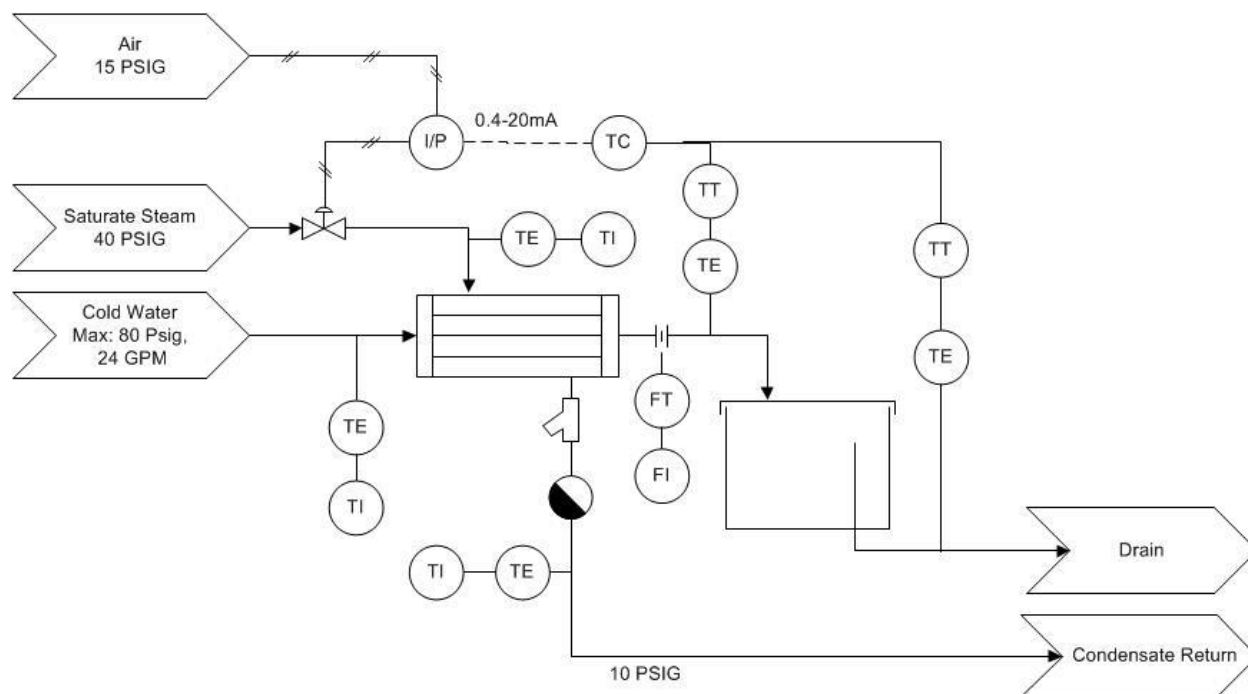
Chemical Engineering MEng Project

Field of Interest: Process Design
Title: Process Control Experiment for UO Lab
Supervisor: A.B. Anton
Duration: 9/17-5/18
#Participants: 1 (Matt Schofield)

Project Description:

The Olin Hall UO Lab includes a process control apparatus that was constructed in summer 2011 and rendered briefly operational by Elbert Chang MEng in summer 2012, but never brought into service as a teaching experiment in CHEME 4320. The goal of this project is to prepare the experiment for use in CHEME 4320 next year and thereafter.

The apparatus, shown schematically below, includes a shell-and-tube heat exchanger for heating water with steam, a $\frac{3}{4}$ " air-to-open control valve for throttling the steam flow rate, a globe valve for manually throttling the water flow rate, a venturi tube with differential pressure transmitter for measuring the water flow rate, a 20 gal mixing tank, a commercial PLC (= programmable logic controller), and RTDs for measuring water temperatures entering the heat exchanger, leaving the heat exchanger, and leaving the mixing tank.



The Rockwell PLC reads water temperatures and uses a PID algorithm to hold the outlet temperature constant when the water flow rate is varied by manually adjusting the globe valve. The mixing tank adds a ~ 1 min lag to the open-loop system response. The PID controller can be tuned with or without the mixing tank in play, allowing one to investigate and appreciate the relationship between process dynamics and controller performance.

This MEng project will involve the following:

- Rewire the RTDs and troubleshoot all the control hardware.
- Program the PLC to collect data from the RTDs and the flow meter.
- Calibrate the flow meter (venturi tube + differential pressure transmitter for recording water flow rates (gpm).
- Generate a “friendly” user interface that will allow undergraduate students to change PID control constants and collect data, including temperatures, water flow rate, and control valve position vs time.
- Demonstrate open-loop/feedforward and closed-loop/feedback control of the process.
- Investigate the dynamics of the water heating and mixing processes, and interpret the results via comparison to analytical models for the relevant transfer functions.
- Investigate and document the relationship between PID control constants and controller performance.
- Write an MEng Project Report that details all the progress made in such way that it can be repeated by others who follow.
- Write a User’s Manual for students and TAs who will use the apparatus to do experiments in CHEME 4320.