Design Problem 3 – Introduction to Process Control

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Objectives

1. Use CHEMCAD to design a temperature controller on a heat exchanger.
2. Use CHEMCAD control valve, temperature sensor, and ramp programmer.
3. Run a dynamic simulation in CHEMCAD.

Problem Background and Statement

You were previously introduced to piping elements in CHEMCAD. In lab 1, we examined the piping unit and pumps with a fixed pressure increment. In lab 2, we examined hydraulic calculations in CHEMCAD using nodes and pumps with characteristic curves. In this lab, we will introduce three more elements, namely control valves, control sensors, and ramps for programming changes in streams. We also began our discussions of heat exchangers in lesson 7, so a natural place to go is to learn how to perform a dynamic simulation of a heat exchanger under temperature control.

Your instructor will provide you with a PowerPoint presentation that contains the detailed instructions for building and running the simulation. The file is located in Canvas. Carefully follow the procedure in the PowerPoint and run the simulations. When finished, proceed to the questions and submission requirements below.

Questions:

1. Explain what is being shown in the dynamic plots of streams 11, 13, and 16 dynamic plots. Explain each feature in the plot.

2. Go to this web site (https://www.swagelok.com/en/toolbox/cv-calculator) and use the tool to calculate Cv. Use the new value of Cv in the second heat exchanger, run in steady-state mode, and explain the change in the water flow rate.

3. After adding the controller as described in the gray slides, compare the flow rate of stream 33 to the flow rate of stream 16 between 20 and 60 minutes. How do the calculations differ?

Submission Requirements

1. Print of completed slide 12 in pdf format.
2. Print of completed slides 30-34 (plots) in pdf format.
3. Print of completed slides 36-37 (questions 1 and 2) in pdf format
2. Single pdf bundle of or requirements 1-3 with cover page to Canvas.
5. Final CHEMCAD file to Canvas.
6. All work is due NLT 1445 hours (End of lab hour).