Double Pipe Heat Exchanger – Standard Operating Procedure  7-2016

R.Cox

- Use safety glasses when operating this equipment
- Wear leather gloves when working with the steam and condensate valves.
- If valves are not labeled, do not operate them.
- Do not adjust the air regulators located by the “I” beam behind the computer.
- The white control valves are a pinch hazard – do not place your hands near the valve mechanism.
- The computer is not connected to the network.
- Do not open the data file while the system is running, doing so will stop the data log.
- Pay close attention to the water level in the main tank, it is very easy to overfill.

Never leave this equipment operating unattended!

Startup:
1. Open the main water supply valve (green pipe – blue handle globe valve).
2. Using gloves open the main steam valve located adjacent to the water valve.
3. Using gloves open the condensate drain valve located next to the steam trap to drain the condensate through the hose to the floor drain.
4. Once the condensate has been drained from the system and steam is flowing out of the hose and into the floor drain, close the condensate drain valve.
5. Verify that the small red globe valve in line with the steam trap is open; this is the valve with the metal tag labeled Do Not Close Valve, this will allow the condensate from the steam trap to drain to the collection area in the basement.

Setting the tank valves:
6. The tank drain/fill line includes three ball valves, V1, V2 and V3. V1 is mounted vertically directly under the tank, this valve will normally be open, the other two valves, mounted horizontally – one yellow, V3 and one green V2 - are located on either side of the cooling water system output line. The cooling water system output line takes the water flowing out of the cooling circuit to drain or, by adjusting the drain valves, (V1, 2, 3) the cooling water may be fed into the mixing vessel, filling it from the bottom of the vessel.
Fill the feed tank.

7. In the feed tank drain line, close the horizontal yellow ball valve V3 and open the green horizontal ball valve V2. Verify that valve V1 is open.
8. Log onto the computer: user = administrator, password = password.
10. Close the Event Log Viewer window and select Start Opto Control.

11. **About the Software:**

   The Opto control software is configured so that the system may be operated as a heat exchange experiment or as a control experiment. When operating the system as a heat exchange experiment the system is controlled using the Manual Mode Controls in the lower right-hand corner of the main window. Temperature data is displayed on the left side of the main window. The controls listed under Process Fluid Valve Control and Coolant Valve Control are for PID control when running a control experiment. When the software starts the system is in Manual mode, indicated by the capitol M to the right of the **PID Mode text**. Clicking on the PID mode text will activate the PID mode control. Do not activate the PID mode unless you are running a control experiment. When running a heat-exchange experiment the PID Mode display must read M.

12. Using the Opto Control program, open the coolant water valve 100%. The Manual Mode valve controls are located in the lower right-hand section of the window.
13. Now, using the software, open the steam flow valve 100 %.
14. Monitor the level of the mixing tank as it fills. Do not fill the tank above the fill line.
15. As the mixing tank approaches the fill line close the coolant water valve using Opto control. The coolant flow may also be stopped by closing the main water line valve (blue handle globe valve).
16. Once the mixing tank is filled to the fill line close the green horizontal ball valve in the drain line V2.

**Heating / pumping the process fluid:**

17. Open the recycle valve on the yellow pump output recycle pipe. This valve MUST be open before the pump is started.
18. Verify that the green ball valve located just above the pump output flow meter is open. This valve should remain open at all times.
19. Open the process fluid valve 100% using Opto control.
20. Switch the pump on using the pump control breaker- the one labeled Double Pipe - located on the west wall next to the double pipe.
21. You should see flow indicated on the analog process water flow meter, this flow reading should also be displayed on the Opto display. The process fluid will flow from the pump, through the yellow pipe / heat exchanger and empty back into the mixing vessel.
Regulating the flow of process fluid:

22. Process fluid flow is controlled by regulating the amount of process fluid that is recycled back to the mixing tank. By closing the green ball valve, (Recycle Valve) in the yellow pump output recycle piping, 100% of the pump output will flow through the process fluid valve and heat exchanger. **Before closing the recycle ball valve verify that the process fluid valve, in Opto, is open 100% to avoid burning out the pump motor.**

Running the cooling water:

23. Verify that the Green horizontal ball valve V2, in the mixing drain line is closed. This will prevent the tank from draining.
24. Open the yellow horizontal ball valve V3.
25. Verify that the coolant water main water supply (green pipe – blue handle globe valve) is open.
26. Open the coolant valve from Opto control.
27. Verify that the coolant flow is reading on the analog cooling water flow meter and on the Opto display.
28. Coolant flow may be regulated by adjusting the coolant flow valve. The coolant flow path is into the lower blue pipe and out the upper blue pipe to drain. Note, the blue pipe is the outer jacket on the process fluid (yellow) pipe.

Shutdown:

29. Stop the pump.
30. Close the main water supply valve, (green pipe – blue handle globe valve).
31. Drain the tank: Open all the ball valves in the drain line: V1, V2, V3.
32. Using gloves, close the main steam valve.
33. Close all valve on the Opto control system.
34. Verify that the condensate drain valve is closed.
35. Exit the Opto control software.
36. Save your data to a flash drive after each run.
37. Data is stored at C:\Data Double Pipe HeatExchanger

Viewing and saving the data

1. Once you have exited the Opto program, open Excel
2. In Excel go to: Open, then navigate to the data folder, C:\Data Double Pipe HeatExchanger. In the bottom right hand corner of the Excel window click on the drop-down window and select All Files, the data files should now be displayed. The data files are organized by date.
3. Double-click on the file you wish to open. The Text Import Wizard will open. Select delimited then click Next, then select Comma delimited, select Next, select the General data format option and then select Finish. The data should now be displayed in Excel.
4. Save this data to a flash drive after each lab.