**ECHE 362**

**HEAT EXCHANGER EXPERIMENT**

**Guidelines for Foreman’s Reports**

**(for TA only – do not give to students)**

**Safety**

Water and medium pressure steam are used in this experiment. Exposed temperatures can be in the range of 100 to 150°C, so reasonable precautions should be used around the equipment. Although some water and steam leakage is unavoidable, major leaks should be reported and the system shut down. The house steam is sent to the steam exchanger to heat cold water to produce the hot water stream that is used in the experiment. The hot steam should never be directly connected to the (un-insulated) exchangers the students use.

Foreman’s report must include the following:

1. Emergency shut down procedures (close steam valve)
2. Appropriate first aid for burns from steam
3. Proper procedure for connecting hoses, including having a 2nd person double check system before steam and water are turned on. In particular check to see that all streams end up going down the drain!
4. Use of gloves appropriate for high temperatures and goggles.

For the determination of U (overall heat transfer coeff)– the foreman’s report must include:

1. Listing of flow rates (values between 2 and 5 l/min) to be used. Four trials with different shell side and tube side flows for each exchanger is reasonable. Avoid trials with identical shell and tube side flow rates. If the group wishes – they should try co and counter flow on the plate and frame exchangers. On the shell and tube exchangers they should try reversing the direction of flow as well. They might also wish to try having the hot fluid on the shell side vs having the hot on the tube side. For the S&T, they should find that the direction of flow and which side is hot or cold should have no effect. ***Also – be sure that the students watch for a pinch – for the plate and frame, this is when the hot in temperature equals the cold out, for the shell and tube this is when T cold out equals T hot out.*** Any trials resulting in a pinch must be discarded and different flow rates tried.

Use the manual valves for the cold water flow when running the S&T exchangers. You can get more flow from them than the electronic valves. They will need the greater flow rates in order to avoid a pinch on the S&T exchangers.

1. Excel spreadsheet to enter data – two flow rates and four temperatures. From this the spreadsheet must calculate Q = mCpΔT for both the hot and cold streams so that the two Q’s can be compared – they should be within 10%. U should also be calculated – check to see that the log mean temperature difference is correctly calculated and that the correction factor, F, is calculated for the shell and tube exchangers. A useful value of the heat capacity is given in the lab handout in units of W min / liter °C. Use this to avoid errors in unit conversions. The S&T exchangers are four pass on the tube side – and the foreman’s report should state this.

NOTE from JSW – IT IS ABSOLUTELY VITAL THAT YOU CHECK THEIR CALCULATION OF DELTA T LOG MEAN TO SEE IF IT IS CORRECT

– this is a source of confusion and delay every year!

Delta T log mean is always defined for counter current flow. It does not change for the S&T exchanger. ∆T1 = hot in – cold out, ∆T2 = hot out – cold in

For the heat exchange network construction – the foreman’s report must include:

1. At least one simulated network design. Simulation to be done in ASPEN. Check to see that simulation includes S&T as four tube side pass exchangers and reasonable values for U for both exchangers (S&T around 1000 W/m2 K and P&F around 2500 W/m2 K). If more than one cooling water stream is used – check to see that the flow rate of each stream is at least 1.0 l/min – we can’t control lower flow rates than that. When streams are split, check to see that a flow meter/valve is included on each stream after the split.
2. Calculation of the theoretical minimum amount of cooling water. The minimum flow rate of cooling water is 3.0 l/min assuming all cooling water goes from 20 C to 80C – the inlet temperature of the hot stream. In the lab the cooling water inlet temperature may be colder – closer to 15C, so the minimum needed would be lower, closer to 2.75 l/min.

**Task 2, 3 and 4 are for the final report – nothing required for foreman’s report**

**Data Acquisition via the PC and Lab View Software**

TA should be fully familiar with the software – see Craig V. Known bug in 2010 – never swap thermocouples while the VI is running. When you need to swap out thermocouples – stop the VI first. *Check w/ Craig – this may no longer be an issue.*

**Known Hardware Issues/Things to watch our for**

Make sure the pneumatic valve is connected to the air supply.

Occasionally a flow meter will stop working, generally due to an accumulation of dirt inside the meter. Have Craig show you how to take the meter apart, remove the paddle-wheel and clean dirt out of the housing. Alternatively, connect the flow in reverse – water in at the top, out through the bottom. Often running water backwards like this will clear the dirt preventing the paddle wheel from spinning.

When connecting hoses to the flow meters – always support the connection – put your hand behind the female coupling when inserting the hose.

Flow path through the plate and frame exchangers is top left to top right, bottom left to bottom right. For counter flow, have one inlet on the right and the other on the left.

To get sufficient cold water flow – you may need to adjust the pressure regulators – loosen the lock nut and turn the screw on the top of the regulators.

To prevent the hot water stream from boiling in the steam exchanger – throttle the amount of steam entering the exchanger by partially closing the steam valve. They’ll need to do this if the hot water flow is lower than 5 l/min.

**TA Pre-lab Responsibilities (at the beginning of the semester)**

Check all hoses for leaks, replace worn hoses and fittings

Check the flow meter calibration, use a stopwatch and a 5 gallon bucket. Also, connect all the meters in series (same water flow through each meter) – see if the meters are in agreement with each other.

Check the Labview VI, make sure you can control each valve, get steady temperature readings from each thermocouple.

Check the connections to the steam line and the fittings at the steam exchanger.