Cooling Tower Experiment Supplement

August 31, 2011

Follow the same procedures outlined in the “Cooling Tower Performance Experiment (1)” except in our case we will be using the cooling tower in the University Power Plant.

Think of this experiment as the following: Your Company wants to know if the existing cooling tower is performing properly, as expected. They want to know from you if the tower is adequate for the load, could it be oversized or undersized? How can you do this? You will report to them what the performance is; compare the tower to others in industry. This experiment is one similar to those you may have in the real world.

Read the “Assignment” section in the experiment. This will be followed with the following exceptions:

- You need to collect data in the field (power plant), report the performance and describe how to obtain the performance. This is also the same mantra throughout the entire lab.
- Read the experiment and supporting material including the chapter in Perry’s Handbook. You can access Perry online provided you are on the University network.
- Note the date and time the data is taken, also weather conditions.
- In our experiment you will not be making any measurements from the top of the tower. You will be making air flow measurements through or across the tower as described in the write up except you will only measure air flow through one side. The total air flow is 2X one side provided there isn’t a strong wind blowing. You will also have to measure the air intake area. Once you obtain the air flow measurement, compare this value with the fan curve which is on the class web site.
- You will also measure the ambient and wet bulb temperatures as well as the humidity on the roof of the power house. How can you convert the humidity and ambient temperature to a wet bulb temperature? Compare the two methods for
obtaining the wet bulb temperature, discuss accuracy of each method. You will also measure the water temperature in the basin. Compare this reading to those around the pump.

- Take data on the chilled water flows, temperatures delivered to the load.
- Take data on the water flows in the tower system. Note and sketch the tower pumps, piping as well as the condenser/compressor/evaporator piping and pumps. See Figure 124 in the experiment description as a “typical” chilled water system diagram. You will be expected to provide a drawing of the power plant cooling system. Label the equipment on the drawing.
- Take readings of water temperatures, flows and suction, discharge pressures on the cooling tower pump.
- Take information from the cooling tower motor nameplate. The cooling tower circulation pump does not have a flow meter. You will have to calculate it based on the motor nameplate and the voltage, current and power factor data as well as the suction and discharge pressures. This electrical data is recorded for us through the University SCADA system. (Check the definition of SCADA on the web.) This data will be available in a .csv file which can be imported to EXCEL. This data will be emailed to you. Through this time stamped data you will calculate the electrical power to the motor.
- With the performance data on the motor, calculate the power delivered to the pump. Formulas are available in the write up,

The pump and fan curves are available on the class web site:
http://classes.engineering.wustl.edu/che473/files/reference/

The 8G Bell & Gossett 1510 “1500 GPM”, with a 11 inch impeller, pump curve is used to calculate the tower water flow. Compare the water flow rates calculated from both the pressure gauge method as well as horse power delivered method.

- Calculate the Number of Transfer Units (NTU) using the Merkel enthalpy balance method. I recommend you follow the method described in Perry’s under the section “Evaporative Cooling”. The integration method uses the Chebyshev integration method. Compare this method with the nomograph [Woods and Betts]
also in Perry’s. If you choose to use another method, that is satisfactory, but document where you located the method.

- Since you will not be able to access the top of the tower, you will omit the NTU calculation based on adiabatic humidification (McCabe et. al. 1993).
- Calculate the heat load of the tower and the refrigeration system.
- Calculate the rate of water loss, and therefore make up. See Perry’s for the equation based on tower water temperature difference.
- Calculate the heat load based on tons of refrigeration. What is the efficiency of the cooling system?

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