Kettle Boiler Worksheet

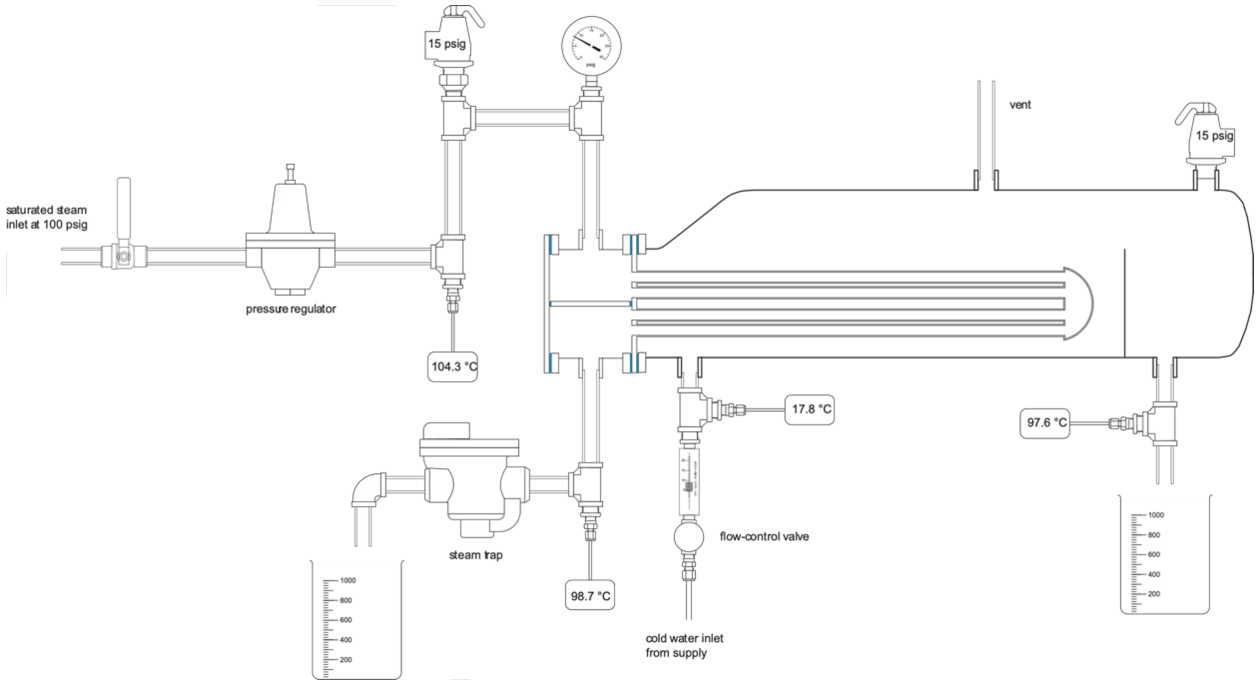

Figure 1. Kettle boiler process.

Experimental Procedure

1. Open the control valve on the cold-water supply and adjust until the rotameter is set to the desired cold-water flow rate in gallons per hour (GPH). Record the water inlet temperature from the thermocouple in the inlet line. Note that the boiler shell will begin to fill with water.
2. Assure that the steam pressure regulator bolt is loose.
3. Open the steam shutoff valve.
4. Slowly tighten the bolt on the steam pressure regulator and watch the pressure gauge downstream of the regulator. Adjust to the desired pressure, but do not exceed 15 psig, as the pressure relief valve opens at this pressure.
5. Visually monitor the liquid level in the boiler shell and wait for this level to become steady.
6. Measure the flow rate of the hot water that overflows the weir and drains from the shell of the boiler through the lower exit pipe. Measure the time required to collect 1000 mL of water. Also, record the temperature of this stream from the outlet pipe thermocouple.

7. Measure the temperature and flow rate of the condensed steam leaving the steam trap following the same procedure used for the shell-side exit stream.
8. Record all data in the tables below for three trials. For the first trial, use a steam pressure of 3 psig and a cold-water rate of 6 GPH. For trial 2, keep the cold-water flow rate the same (6 GPH) and increase the steam pressure significantly, but below the maximum of 15 psig. For trial 3, keep the steam pressure at 3 psig and increase the cold-water rate to a significantly larger value within the rotameter range (up to 22 GPH).

Trial 1

Tube side		Shell side	
Steam inlet pressure (psig)	3	Water inlet flow rate (GPH)	6
Temperature of inlet steam (°C)		Water inlet temperature (°C)	
Mass of steam condensate collected		Mass of outlet stream collected	
Time of collection		Time of collection	
Mass flow rate of steam		Mass flow rate for liquid water outlet	
Temperature of steam condensate		Temperature of liquid water outlet	

Trial 2

Tube side		Shell side	
Steam inlet pressure (psig)		Water inlet flow rate (GPH)	6
Temperature of inlet steam (°C)		Water inlet temperature (°C)	
Mass of steam condensate collected		Mass of outlet stream collected	
Time of collection		Time of collection	
Mass flow rate of steam		Mass flow rate for liquid water outlet	
Temperature of steam condensate		Temperature of liquid water outlet	

Trial 3

Tube side		Shell side	
Steam inlet pressure (psig)	3	Water inlet flow rate (GPH)	
Temperature of inlet steam (°C)		Water inlet temperature (°C)	
Mass of steam condensate collected		Mass of outlet stream collected	
Time of collection		Time of collection	
Mass flow rate of steam		Mass flow rate for liquid water outlet	
Temperature of steam condensate		Temperature of liquid water outlet	

Kettle Boiler Specifications

Tube outside diameter = 5/8 inch

Tube inside diameter = ½ inch

Tube length = 21.6 inch

Tube material: copper

Geometry: 4 tubes per pass, 2 tube passes, 8 tubes total