Table : Recorded values from Tubular Heat Exchanger Lab.

|  |  |  |  |
| --- | --- | --- | --- |
| **Data Type** | **100%** | **75%** | **50%** |
| Qe [W] | 0.997 | 0.990 | 0.829 |
| Qa [W] | 1.008 | 1.030 | 0.856 |
| Mdot Hot [kg/s] | 0.041 | 0.041 | 0.041 |
| Mdot Cold [kg/s] | 0.043 | 0.039 | 0.027 |
| Qf [W] | -0.024 | -0.040 | -0.028 |
| U [W/m2.K] | 2.050 | 1.973 | 1.702 |
| Mean Temp Efficiency [%] | -31.058 | -31.513 | -34.435 |
| Vdot Hot [m3/min] | 4.161E-05 | 4.165E-05 | 4.177E-05 |
| Vdot Cold [m3/min] | 4.277E-05 | 3.942E-05 | 2.674E-05 |
| System Efficiency [%] | 102.521 | 104.077 | 103.381 |

**1. Did the heat exchanger remove more or less heat from the hot stream as the flow rate of the cold water decreased?**

To determine if the heat exchanger removed more or less heat from the hot stream as the flow rate of the cold water decreased, we refer to the heat absorption equation from Dr. Kassegne’s Lab 4 document [1].

$$Q= \dot{m\_{c}}c\_{p}∆T= \dot{m\_{c}}c\_{p}(T\_{6}-T\_{4})$$

The heat loss, *Q*, is a function of the mass flow rate of the cold water, $\dot{m\_{c}}$. Thus if the flow rate of the cold water decreases, the heat loss through the system will decrease resulting in a higher temperature of the hot water. If the cold water moves at a slower rate, the hot water will be able to increase the temperature of the cold water making the difference in temperature, *ΔT*, smaller which will also reduce the heat loss through the system.

**2. Did the system efficiency increase or decrease as the cold water flow rate decreased?**

The efficiency of the system is described as the heat absorbed by the system divided, $Q\_{absorbed},$ by the heat emitted from the system, $Q\_{emitted}$.

$$η= \frac{Q\_{absorbed}}{Q\_{emitted}}\*100\%$$

The values for the heat absorbed and the heat emitted move linearly with each other so the efficiency will stay around the same value. As the mass flow rate decreases, the heat absorbed decreases and the heat emitted decreases. Thus the ratio between the two values stayed fairly constant. The efficiencies for the 100%, 75%, and 50% flow of the cold water were recorded as 102.52%, 104.08%, and 103.38% respectively. The values can be seen in Tab. 1.

**3. Why is it necessary to find the heat transfer co-efficient for the heat exchanger?**

The heat transfer coefficient, *h*, needs to be calculated for any apparatus where heat loss is important because the heat transfer coefficient directly affects the systems’ ability to transfer heat. For heat exchangers, the heat transfer coefficient measures how well the heat exchange between two fluids or gases or different temperatures is. If the value of the heat transfer coefficient is low, the heat transfer will be low and if the value is high then a better heat transfer is obtained in the system.

**4. Were there any systematic or random errors that affected your measurements? Discuss in detail and suggest innovative ways to minimize such errors.**

During the experiment, we noticed the filter at the inlet of the cold water flow was filled with algae which may have infiltrated the system or impeded the flow of the cold water which may have made the pump do more work. It is recommended the filter be removed and cleaned, or if damaged then replaced. Another parameter that should be noted is that our system efficiencies for various flow rates exceeded 100% which may reflect an error in the thermocouples of the system. Due to the constant replacing of the tubular and plate heat exchangers, some thermocouples may have been damaged in transport or may need to be recalibrated. Fixing the thermocouples would result in more accurate temperature readings and a more realistic system efficiency.

**[1]** Kassegne, S. "ME495 Lab - Tubular Heat Exchanger - Expt Number 4." Mechanical Engineering Department. San Diego State University. Fall 2011.