

Project 2:

Assumptions:

No phase change
Friction losses are negligible
No losses from pot
Inflowing river water temp is constant
Properties are constant and evaluated at 325K
Assume no fouling in coil
Velocity in coil is equal to velocity in heat exchanger
Neglect kill chamber

Essay Question 1:

When designing the size of the heat exchanger tubing, there are multiple things to consider to optimize the performance of the heat exchanger. To be specific, we know that heat exchanger performance is affected by the diameter and length of the tubing, the flow rates of the fluid, and the material of the tubing. The diameter or length of the heat exchanger could be increased to optimize performance, because of the increased surface area experiencing heat transfer in the heat exchanger. This is an important factor in optimizing the performance, and is usually done to accommodate for fouling. However, this is a design trade-off that is important to consider when compact size is a design requirement. Alternatively, the mass flow rate of the fluid could be reduced to achieve the desired heat transfer without increasing the length of the heat exchanger. This is a great option to optimize performance because it would reduce the required size and cost of the heat exchanger tubing, however the trade off to this is that the desired heat transfer process will take longer. This is important to consider, because in this situation, the heat exchanger is being used to generate a clean water source for many people and a longer time to generate this water would not be ideal for the overall design. Another change that could be made to optimize performance is the material used for the tubing. A material with a better thermal conductivity could reduce the size of tubing required to achieve the desired heat transfer, although the trade-off to this is that the material cost would be affected.

Essay Question 2:

With the design of this heat exchanger, there should be a safety factor incorporated due to the variation of conditions in a real-life situation. These conditions were neglected for a simplified baseline analysis, however many variables could change based on the setting they are in. For example, based on the region, or a variation of seasonal ambient temperature, the temperature of the inflowing untreated water could be lower which would result in a longer time necessary for the water to be safely pasteurized. To incorporate a factor of safety to prevent this from happening, the required length of the coil should be made longer than necessary to ensure

the required temperature is reached. Another factor that could affect safety of the water is the nominal flow rate. Unless the water is supplied to the system by a pump, there is no way to guarantee a constant flow of water through the heat exchanger, because it's not specifically stated how the water is cycled through this system. One last factor would be increasing the $T_{\text{coil,out}}$ temperature, this would ensure that the water is pasteurized, thus making the water safe for consumption.

Graphs:

