Homework – Steady and Unsteady State Heat Transfer

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1. An uninsulated retort is made of 1 cm steel. The steam temperature inside the retort is 125°C and the outside air temperature is 35°C. Compute the heat flow per unit area through the retort wall. For simplicity, treat the wall as a flat surface for this analysis.
2. A single pass heat exchanger is used to cool milk from 65°C to 20°C using water initially at 10°C. The exit water is at 24°C.
   a. Is this a parallel- or counter-flow unit?
   b. If U = 2500 $W/m^2.K$, what is the heat transferred per square meter of heat exchanger area?
3. A swept surface heat exchanger cools 3500 kg of tomato paste per hour from 93°C to 32°C. If the overall heat transfer coefficient based on the inside surface area is 855 $W/m^2 \cdot K$, calculate the heating surface area required for concurrent flow and countercurrent flow. Cooling water enters at 21°C and leaves at 27°C. The specific heat of tomato paste is about 3560 J/(kg·K).
4. A 'can' dimension is about 150 m high and 400 m in diameter. It has the thermal properties as follows:
   a. ρ = 980 kg/m3
   b. c_p = 3.77 kJ/(kg K)
   c. k = 0.64 W/(m K)

   The initial temperature of the can is about 30°C. What is the can center temperature after exposure to an ambient temperature of 110°C for half hour? Assume a surface heat transfer coefficient of 500 W/(m2 K).

Note:

1. **Make necessary assumptions if needed.**
2. **Due date: 24th March 2017 in my locker at DFST Secretariat!**