Gazi University
Department of Chemical Engineering
CHE321 Heat Transfer
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Homework 1 25.10.2021

Problem 1. A refrigeration room has a cork boared wall that is 2 m long, 1.8 m high and 0.18 m thick. The outside wall temperature is 35 °C and the inside wall temperature is 3 °C. The rate of heat flow through the wall is 100 W. Find the thermal conductivity.

Problem 2. a) Obtain the equation below for the heat loss from the surface through a series of concentric cylinders as:

Total heat transferred (W) $$Q = \frac{2\Pi L(T_i - T_a)}{\frac{1}{h_i r_i} + \frac{\ln \frac{r_1}{ri}}{k_1} + \frac{\ln \frac{r_2}{r_1}}{k_2} + \frac{\ln \frac{r_0}{r_2}}{k_3} + \frac{1}{h_0 r_0}}$$

b) A steel pipeline 1 in Sch40 pipe (Di = 0.026, D_0 = 0.0334 m) contains saturated steam at 149 °C. Neglect convective heat transfer in the inside and outside.

$k_{asbestos}$: 0.208 W/m °C and k_{steel} = 45 W/m °C, latent heat of steam= λ =2120 J/g

i) If there is no insulation and the outer surface temperature of the metal wall is at 146 °C, find the heat loss and the amount of steam condensed per hour due to heat loss per 1 m of length. (Note: Heat removed by steam Q=m λ)

ii) If this pipeline is insulated with 0.0167 m of asbestos, the outer surface temperature of the insulation becomes 49 °C. Calculate the heat loss per 1 m of length. Discuss whether this insulation is economical or not?

iii) Obtain the relation of critical radius for this pipe.

If convective heat transfer coefficient of air h_0 = 8 W/m^2 K , compare the insulation thickness with critical insulation thickness.

Note: For part (b), use the equation given in part (a).

Due date: 1.11.2021