

me263 – Fluids and Heat Transfer

Heat Exchanger: Tutorial Questions

Question 1

EXAMPLE 23-4 Heating Water in a Counter-Flow Heat Exchanger

A counter-flow double-pipe heat exchanger is to heat water from 20°C to 80°C at a rate of 1.2 kg/s. The heating is to be accomplished by geothermal water available at 160°C at a mass flow rate of 2 kg/s. The inner tube is thin-walled and has a diameter of 1.5 cm. If the overall heat transfer coefficient of the heat exchanger is $640 \text{ W/m}^2 \cdot ^\circ\text{C}$, determine the length of the heat exchanger required to achieve the desired heating.

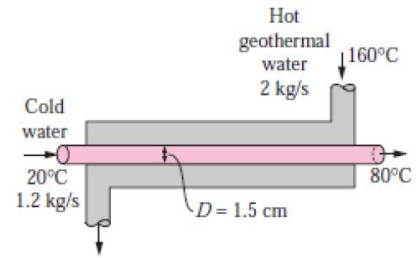


FIGURE 23-20
Schematic for Example 23-4.

Question 2

EXAMPLE 23-5 Heating of Glycerin in a Multipass Heat Exchanger

A 2-shell passes and 4-tube passes heat exchanger is used to heat glycerin from 20°C to 50°C by hot water, which enters the thin-walled 2-cm-diameter tubes at 80°C and leaves at 40°C (Fig. 23-21). The total length of the tubes in the heat exchanger is 60 m. The convection heat transfer coefficient is $25 \text{ W/m}^2 \cdot ^\circ\text{C}$ on the glycerin (shell) side and $160 \text{ W/m}^2 \cdot ^\circ\text{C}$ on the water (tube) side. Determine the rate of heat transfer in the heat exchanger (a) before any fouling occurs and (b) after fouling with a fouling factor of $0.0006 \text{ m}^2 \cdot ^\circ\text{C/W}$ occurs on the outer surfaces of the tubes.

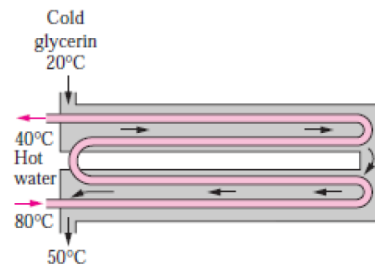


FIGURE 23-21
Schematic for Example 23-5.

Question 3

EXAMPLE 23-6 Cooling of an Automotive Radiator

A test is conducted to determine the overall heat transfer coefficient in an automotive radiator that is a compact cross-flow water-to-air heat exchanger with both fluids (air and water) unmixed (Fig. 23-22). The radiator has 40 tubes of internal diameter 0.5 cm and length 65 cm in a closely spaced plate-finned matrix. Hot water enters the tubes at 90°C at a rate of 0.6 kg/s and leaves at 65°C. Air flows across the radiator through the interfin spaces and is heated from 20°C to 40°C. Determine the overall heat transfer coefficient U_i of this radiator based on the inner surface area of the tubes.

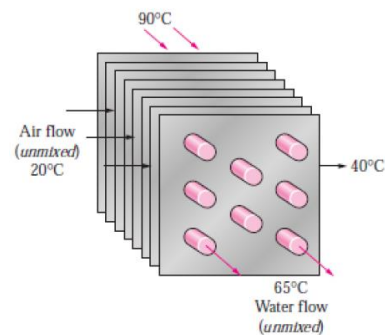


FIGURE 23-22
Schematic for Example 23-6.