

PROBLEM 4.6

Figure P4.6 shows a mixing tank initially containing 3000 lb of liquid water. The tank is fitted with two inlet pipes, one delivering hot water at a mass flow rate of 0.8 lb/s and the other delivering cold water at a mass flow rate of 1.3 lb/s. Water exits through a single exit pipe at a mass flow rate of 2.6 lb/s. Determine the amount of water, in lb, in the tank after one hour.

SCHEMATIC & GIVEN DATA:

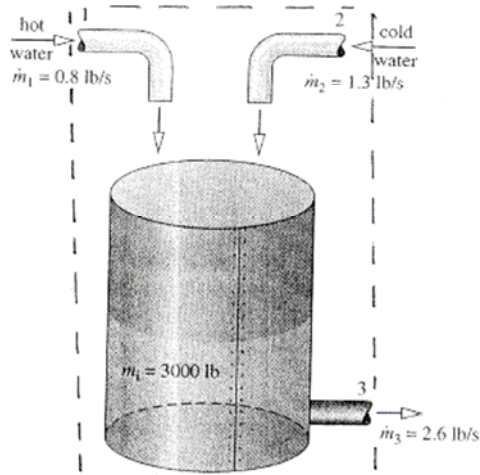


Fig. P4.6

ENGR. MODEL:

1. The control volume has two inlets and one exit, as shown in the sketch.
2. The mass flow rates are constant.

ANALYSIS:

The mass rate balance, Eq. 4.2, reads

$$\begin{aligned} \frac{dm_{cv}}{dt} &= \dot{m}_1 + \dot{m}_2 - \dot{m}_3 \\ &= (0.8 + 1.3 - 2.6) \text{ lb/s} \\ &= -0.5 \text{ lb/s} \end{aligned}$$

Integrating from $t = 0$ to $t = 1 \text{ h} (3600 \text{ s})$,

$$\begin{aligned} m_{cv}(1 \text{ h}) - m_{cv}(0) &= (0.5 \frac{\text{lb}}{\text{s}})(3600 \text{ s}) \\ &= -1800 \text{ lb} \end{aligned}$$

$$\begin{aligned} \therefore m_{cv}(1 \text{ h}) &= m_{cv}(0) - 1800 \text{ lb} \\ &= 3000 \text{ lb} - 1800 \text{ lb} = 1200 \text{ lb} \leftarrow \end{aligned}$$