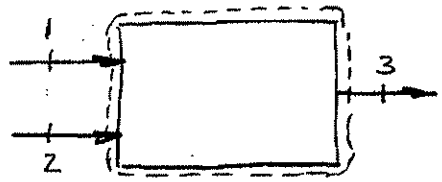
Given: Steam flowing through a SS, adiabatic, aerogenic feedwater heater.

$P_1 = 80$ psia
$T_1 = 500°F$
$\dot{m}_1 = 10$ lbm/s

$P_2 = 80$ psia
$X_2 = 0$



$P_3 = 80$ psia
$X_3 = 0.10$ (10%)

Find: $\dot{m}_2$

Solution: The First Law for the system above,

$$\dot{m}_1 h_1 + \dot{m}_2 h_2 - \dot{m}_3 h_3 = 0$$

Continuity:

$$\dot{m}_1 + \dot{m}_2 - \dot{m}_3 = 0$$

$$\therefore \quad \dot{m}_3 = \dot{m}_1 + \dot{m}_2$$

Substituting:

$$\dot{m}_1 h_1 + \dot{m}_2 h_2 - (\dot{m}_1 + \dot{m}_2) h_3 = 0$$

$$\dot{m}_1 (h_1 - h_3) + \dot{m}_2 (h_2 - h_3) = 0$$

$$\dot{m}_2 = \dot{m}_1 \frac{(h_1 - h_3)}{(h_3 - h_2)}$$

State 1: $P_1 = 80$ psia, $T_1 = 500°F$ $\quad h_1 = 1281.1$ Btu/lbm $\quad$ C.3a

State 2 $\quad P_2 = 80$ psia, $X_2 = 0$ $\quad h_2 = 282.2$ Btu/lbm $\quad$ C.2a

State 3 $\quad P_3 = 80$ psia, $X_3 = 0.1$ $\quad h_f = 282.2$ Btu/lbm, $h_g = 1183.6$ Btu/lbm $\quad$ C.2a

$$\therefore \quad h_3 = (1 - X_3) h_f + X_3 h_g = (1 - 0.1)\left(282.2 \tfrac{\text{Btu}}{\text{lbm}}\right) + (0.1)\left(1183.6 \tfrac{\text{Btu}}{\text{lbm}}\right)$$

$$h_3 = 372.34 \ \frac{\text{Btu}}{\text{lbm}}$$

Then,

$$\dot{m}_2 = \left(10 \frac{lbm}{s}\right) \frac{(1281.1 - 372.34) \frac{Btu}{lbm}}{(372.34 - 282.2) \frac{Btu}{lbm}}$$

$$\dot{m}_2 = \underline{\underline{100.8}} \frac{lbm}{s} \leftarrow$$