$$Temp = \mathbf{T}(\text{'R717'}, P=P, x=1) - 0.001$$

$$P_{atm} = 83.5$$

$$P = 260 + 83.5$$

$$H = 0.009$$

$$W = 0.035$$

$$L = 3.5$$

$$d = 0.012$$

$$RelRough = 0.005 \quad [-]$$

$$A_{plate} = 1.27 \cdot 3.5$$

$$2 \cdot L_{c,s} = 0.0015$$

$$k_{s,E} = \mathbf{k}(\text{'Stainless}_{AISI304}\text{'}, T_{r,E.har})$$

$$c_s = \mathbf{c}(\text{'Stainless}_{AISI304}\text{'}, T_{r,E.har}) \cdot 1000$$

$$c_{ice} = \mathbf{c}(\text{'Ice'}, 0)$$

$$\rho_f = \rho(\text{'R717'}, T=T_{r,E.har}, x=0)$$

$$\rho_s = \mathbf{rho}(\text{'Stainless}_{AISI304}\text{'}, T_{r,E.har})$$

$$k_{water} = \mathbf{k}(\text{'Water'}, T=T_{Im.har}, P=P_{atm})$$

$$k_{ice} = \mathbf{k}(\text{'Ice'}, T_{ave,I,sc})$$

$$c_w = \mathbf{Cp}(\text{'Water'}, T=0, P=P_{atm}) \cdot 1000$$

$$\rho_w = \rho(\text{'Water'}, T=0, P=P_{atm})$$

$$P_{r,E.har} = 510 + 83.5$$

$$T_{r,E.har} = \mathbf{T}(\text{'R717'}, P=P_{r,E.har}, x=1)$$

$$P_{evap} = 260 + 83.5$$

$$T_{r,E,build} = \mathbf{T}(\text{'R717'}, P=P_{evap}, x=0)$$

$$\rho_{ice} = \mathbf{rho}(\text{'Ice'}, 0)$$

$$\mu_l = \mathbf{Visc}(\text{'R717'}, T=T_{r,E.har}, x=0)$$

$$Bi = h_{r.har} \cdot 2 \cdot \frac{L_{c,s}}{k_{s,E}}$$

$$\alpha_s = \frac{k_{s,E}}{\rho_s \cdot c_s}$$

$$Fo_s = \alpha_s \cdot \frac{t_{im}}{(2 \cdot L_{c,s})^2}$$

$$\sigma_s \cdot \mathbf{tan}(\sigma_s) = Bi$$

$$C = 4 \cdot \left[\frac{\mathbf{sin}(\sigma_s)}{2 \cdot \sigma_s + \mathbf{sin}(2 \cdot \sigma_s)}\right]$$

$$THETA2 = C \cdot \mathbf{exp}(-\sigma_s^2 \cdot Fo_s)$$

$$\frac{T_w - T_{r,E.har}}{T_{r,E,build} - T_{r,E.har}} = THETA2 \cdot \mathbf{cos}(\sigma_s \cdot \bar{x})$$

$$T_{w.i} = \Theta_{inner} \cdot (T_{r,E,build} - T_{r,E.har}) + T_{r,E.har}$$

$$\Theta_{inner} = \mathbf{planewall}_{T,ND}(\bar{x}_{inner}, Bi, Fo_s)$$

$$T_{w.o} = \Theta \cdot (T_{r,E,build} - T_{r,E.har}) + T_{r,E.har}$$

$$\bar{x} = 0$$

$$\bar{x}_{inner} = 1$$

$$x_{bar3} = 1$$

$$\Theta = \mathbf{planewall}_{T,ND}(\bar{x}, Bi, Fo_s)$$

$$t_{im} = time_{harvesting.wall}$$

$$channels = 30$$

$$Q_s = 24713$$

$$V_{pd} = 0.8232$$

$$\rho_i = \rho(\text{'Ice'}, T=-2, P=P_{atm})$$

$m_{condensed} = 106.6$

$m_{transfer} = 161.3$

$h_{rftransfer} = \mathbf{h}(\text{'R717'}, x=0, T=T_{r,E,build} + zz)$

$$zz = \frac{4.5 + 5 + 4}{3 \cdot 2}$$

$$\dot{m}_{r,E.har} = \frac{Q_s + 0.05 \cdot V_{pd} \cdot \rho_l \cdot \mathbf{u}(\text{'R717'}, P=P_{r,E.har}, x=0) - 0.3 \cdot V_{pd} \cdot \rho_{l,IB} \cdot \mathbf{u}(\text{'R717'}, P=P_{evap}, x=0) + 0.95 \cdot V_{pd} \cdot \rho_v \cdot \mathbf{u}(\text{'R717'}, P=P_{r,E.har}, x=1) - 0.7 \cdot V_{pd} \cdot \rho_{v,IB} \cdot \mathbf{u}(\text{'R717'}, P=P_{evap}, x=1) + \rho_i \cdot 35 \cdot A_{plate} \cdot 2 \cdot y_{im} \cdot \left[h_{sf} - c_{ice} \cdot \frac{T_{r,E,build}}{2}\right] + m_{condensed} \cdot \mathbf{h}(\text{'R717'}, P=P_{r,E.har}, x=0) + m_{transfer} \cdot h_{rftransfer}}{\mathbf{h}(\text{'R717'}, P=P_{r,E.har}, x=1)}$$

$t_h = 90$

$h_{sf} = 335$

$$\dot{m}_{r,E.har,per,channel} = \frac{\dot{m}_{r,E.har}}{t_{im} \cdot 35 \cdot 30 \cdot 2}$$

$h_{fg,h} = \mathbf{h}(\text{'R717'}, P=P_{r,E.har}, x=1) - \mathbf{h}(\text{'R717'}, P=P_{r,E.har}, x=0)$

$y_{im,final} = 0.001105$

$g = 9.81$

$Fluid\$ = \text{'R717'}$

$Wi = \pi \cdot d$

$T_{sat} = \mathbf{T}(\text{'R717'}, P=P_{r,E.har}, x=1) + 0.001$

$\dot{m}_t = \dot{m}_{r,E.har,per,channel}$

Call $\mathbf{Cond}_{HorizontalTube,avg}(Fluid\$, \dot{m}_t, T_{sat}, T_{w,ave}, d, 1, 0 : h_{tp,EES,hor})$

$x = 0.5$

Call $\mathbf{Cond}_{HorizontalTube}(Fluid\$, \dot{m}_t, x, T_{sat}, T_{w,ave}, d : h_{tp,EES,hor}, F\$)$

$\mu_{rl} = \mathbf{Visc}(\text{'R717'}, T=T_{r,E.har}, x=0)$

$\mu_{rv} = \mathbf{Visc}(\text{'R717'}, T=T_{r,E.har}, x=1)$

$\rho_l = \rho(\text{'R717'}, P=P_{r,E.har}, x=0)$

$\rho_{l,IB} = \rho(\text{'R717'}, P=P_{evap}, x=0)$

$\rho_v = \rho(\text{'R717'}, P=P_{r,E.har}, x=1)$

$\rho_{v,IB} = \rho(\text{'R717'}, P=P_{evap}, x=1)$

$c_{pl} = \mathbf{Cp}(\text{'R717'}, x=0, P=P_{r,E.har})$

$k_l = \mathbf{k}(\text{'R717'}, x=0, P=P_{r,E.har})$

$$Pr = c_{pl} \cdot \frac{\mu_{rl}}{k_l} \cdot 1000$$

$$X_{tt} = \left[\frac{\rho_v}{\rho_l}\right]^{0.5} \cdot \left[\frac{\mu_{rl}}{\mu_{rv}}\right]^{0.1}$$

$$h_{tp,D,C,1} = 0.023 \cdot Re^{0.8} \cdot Pr^{0.4} \cdot \left[1 + \frac{2.22}{X_{tt}^{0.89}}\right]$$

$$Vel = \frac{\dot{m}_{r,E.har,per,channel}}{\rho_l \cdot \pi \cdot \frac{d^2}{4}}$$

$$Re = \rho_l \cdot Vel \cdot \frac{d}{\mu_{rl}}$$

$grav = 9.81$

$k = \mathbf{k}(\text{'R717'}, x=0, P=P_{r,E.har})$

$$h_{tp,v} = 0.943 \cdot \left[h_{fg,h} \cdot 1000 \cdot grav \cdot (\rho_l - \rho_v) \cdot \frac{k^3}{L \cdot (T_{r,E.har} - T_{w,ave}) \cdot \frac{\mu_{rl}}{\rho_l}}\right]^{(1/4)}$$

$$h_{tp,J,K,hor} = 0.728 \cdot \left[\left(1 + \left[\frac{\rho_v}{\rho_l} \right]^{(2/3)} \right)^{-1} \right]^{(3/4)} \cdot \left[\rho_l \cdot (\rho_l - \rho_v) \cdot h_{fg,h} \cdot 1000 \cdot grav \cdot \frac{k^3}{d \cdot \mu_{rl} \cdot (T_{sat} - T_{w,ave})} \right]^{(1/4)}$$

$$h_{tp,D,C,hor} = h_{tp,D,C,1} \cdot \frac{k_l}{d}$$

$$\dot{m}_{condense} = h_{tp,v} \cdot (T_{r,E.har} - T_{w.o}) \cdot \pi \cdot d \cdot \frac{L}{h_{fg,h} \cdot 1000}$$

$$\lambda = \left[3 \cdot \frac{\mu_{rl}}{\rho_l} \cdot \frac{\dot{m}_{condense}}{\pi \cdot d \cdot \rho_l \cdot grav} \right]^{(1/3)}$$

$$h_3 = \frac{k}{\lambda}$$

$$T_{Im.harlayer,i} = 0$$

$$T_{ave,I,sc} = \frac{T_{r,E,build}}{2}$$

$$T_{I.o} = 0$$

$$y_{im,ave} = y_{im}$$

$$t_{im} = 90$$

$$T_{w,ave} = \frac{T_{w.i} + T_{w.o}}{2}$$

$$\rho_w \cdot y_{imu} \cdot c_w \cdot T_{Im.har`} = k_{s,E} \cdot (T_{w,ave} - T_{Im.har}) - k_{ice} \cdot (T_{Im.har} - T_{ave,I,sc})$$

$$T_{Im.har} = T_{Im.har,i} + \int_0^{90} (T_{Im.har`}) \, dt$$

$$y_{imu} = 0.001105$$

$$T_{Im.har,i} = 0$$

$$\rho_{ce} \cdot h_{sf} \cdot 1000 \cdot y_{im`} = \frac{T_{r,E.har} - T_{ave.waterheat}}{\frac{1}{h_{r.har}} + 2 \cdot \frac{L_{c,s}}{k_{s,E}} + \frac{y_{im}}{k_{water}}} - \left[\frac{T_{Im.har} - T_{ave,I,sc}}{\frac{2 \cdot L_{ice} - y_{im}}{k_{ice}}} \right]$$

$$2 \cdot L_{ice} = 0.00631 - y_{im}$$

$$T_{ave.waterheat} = T_{Im.har}$$

$$y_{im} = y_{im,i} + \int_0^{90} (y_{im`}) \, dt$$

$$y_{im,i} = 1.0 \times 10^{-9}$$

$$h_{l,shah} = 0.023 \cdot Re^{0.8} \cdot Pr^{0.4} \cdot \frac{k}{d}$$

$$Co = \left[\frac{1}{x} - 1 \right]^{0.8} \cdot \left[\frac{\rho_v}{\rho_l} \right]^{0.5}$$

$$h_{1,shah} = h_{l,shah} \cdot (1 - x)^{0.8}$$

$$\sigma_{shah} = \frac{1.8}{Co^{0.8}}$$

$$h_{tp,Sh} = \sigma_{shah} \cdot h_{1,shah}$$

$$Z = \left[\frac{1}{x} - 1 \right]^{0.8} \cdot Pr^{0.4}$$

$$\sigma_{shah2} = 1 + \frac{3.8}{Z^{0.95}}$$

$$h_{tp,Sh2} = h_{l,shah} \cdot \left[(1 - x)^{0.8} + 3.8 \cdot x^{0.76} \cdot \frac{(1 - x)^{0.04}}{Pr^{0.38}} \right]$$

$$h_{tp,Sh,ave} = h_{l,shah} \cdot \left[0.55 + \frac{2.09}{Pr^{0.38}} \right]$$

$$h_{r.har} = h_{tp,v}$$

$$q_{dash} = \frac{T_{r,E.har} - T_{ave.waterheat}}{\frac{1}{h_{tp,Sh}} + 2 \cdot \frac{L_{c,s}}{k_{s,E}} + \frac{y_{im}}{k_{water}}}$$

$$h_{new2} = 0.925 \cdot \left[k_l^{3} \cdot \rho_l^{2} \cdot g \cdot \pi \cdot \frac{0.009}{\textbf{Visc}\,(\text{'R717'}\,, T = T_{r,E.har}\,, x = 0) \cdot \dot{m}_{r,E.har,per,channel}} \right]^{(1/3)}$$