Two Phase Flows

(28-082)

Section 17, HEAT TRANSFER IN CRITICAL HEAT FLUX

By: Professor M.H. Saidi

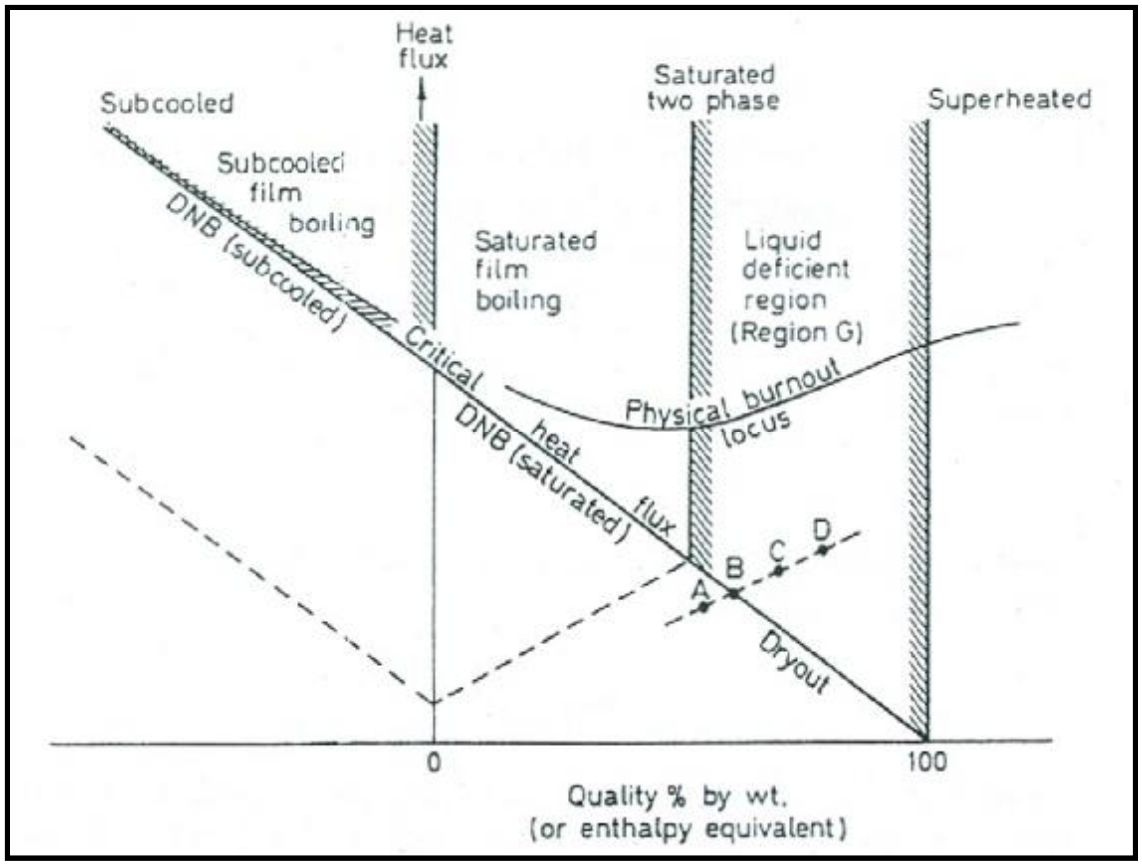
Multiphase Flow Research Group

Center of Excellence in Energy Conversion

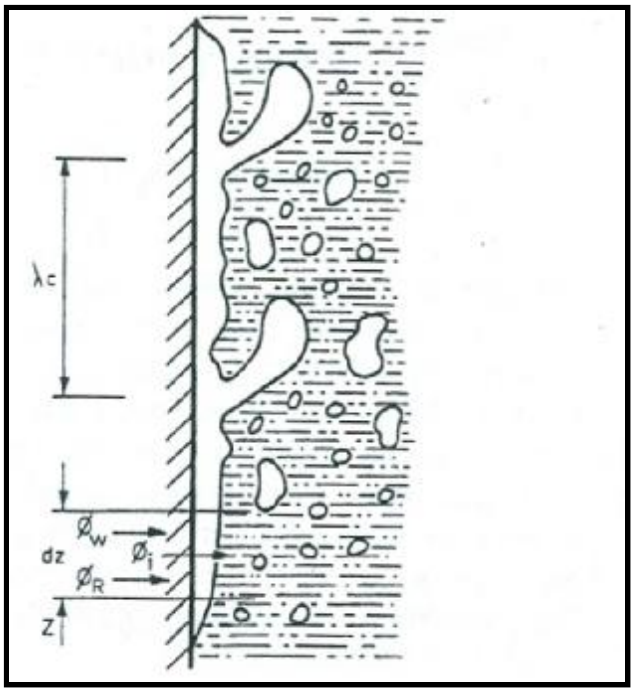
School of Mechanical Engineering

Sharif University of Technology

Regions of heat transfer



Low Quality Post CHF Condition



$$h(z) = C\left[\frac{k_g^3 r_g \left(r_f - r_g\right) gi'_{fg}}{z m_g \Delta T}\right]^{1/4}$$

$$\left[\frac{h(z)\,z}{k_g}\right] = 0.056\,\mathrm{Re}_g^{0.2}\left[\mathrm{Pr}\,Gr^*\right]^{1/3}$$

$$Gr^* = \left[\frac{z^3 g r_g \left(r_f - r_g\right)}{m_g^2}\right]$$

$$h = \left[\frac{k_g^3 r_g \left(r_f - r_g\right) gi'_{fg}}{m_g \Delta T r}\right]^{1/4}$$

Film Boiling Heat Transfer

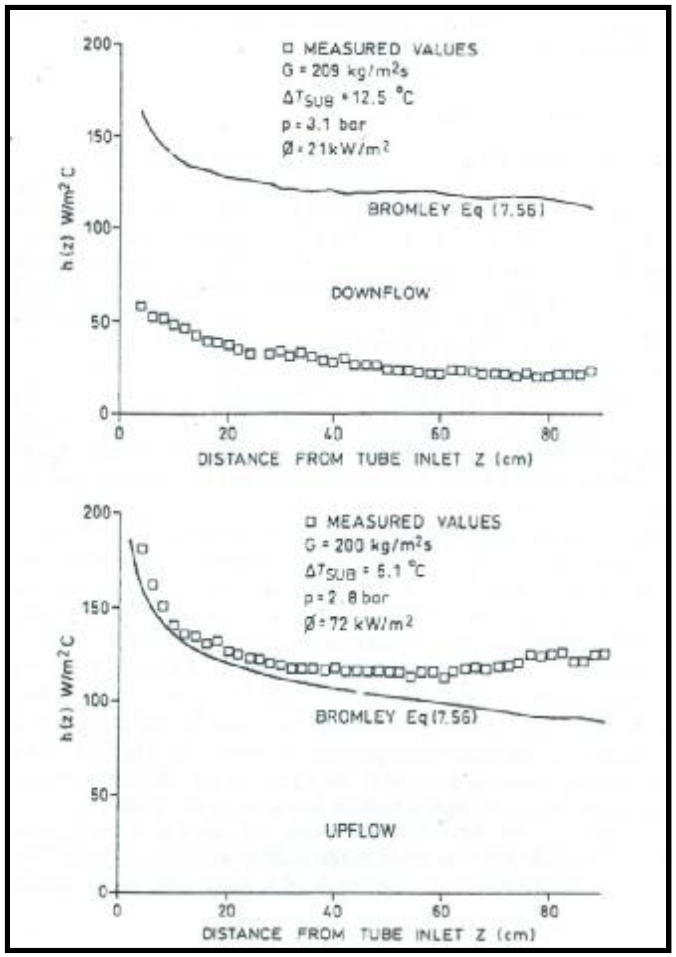
$$h = 0.62\left[\frac{k_g^3 r_g \left(r_f - r_g\right) g i_{fg}^{'}}{m_g \Delta T D}\right]^{1/4}$$

$$\frac{d\Gamma_g}{dz} = \left(f_W + f_r - f_i\right) \Big/ i_{fg}^{'}$$

$$f_W = \frac{k_g \Delta T}{d}$$

$$f_r = \frac{s\left(T_W^4 - T_f^4(z)\right)}{1/e_f + \left(1/e_W - 1\right)}$$

$$f_i = -k_f \left(\frac{\partial T}{\partial r}\right)_i$$

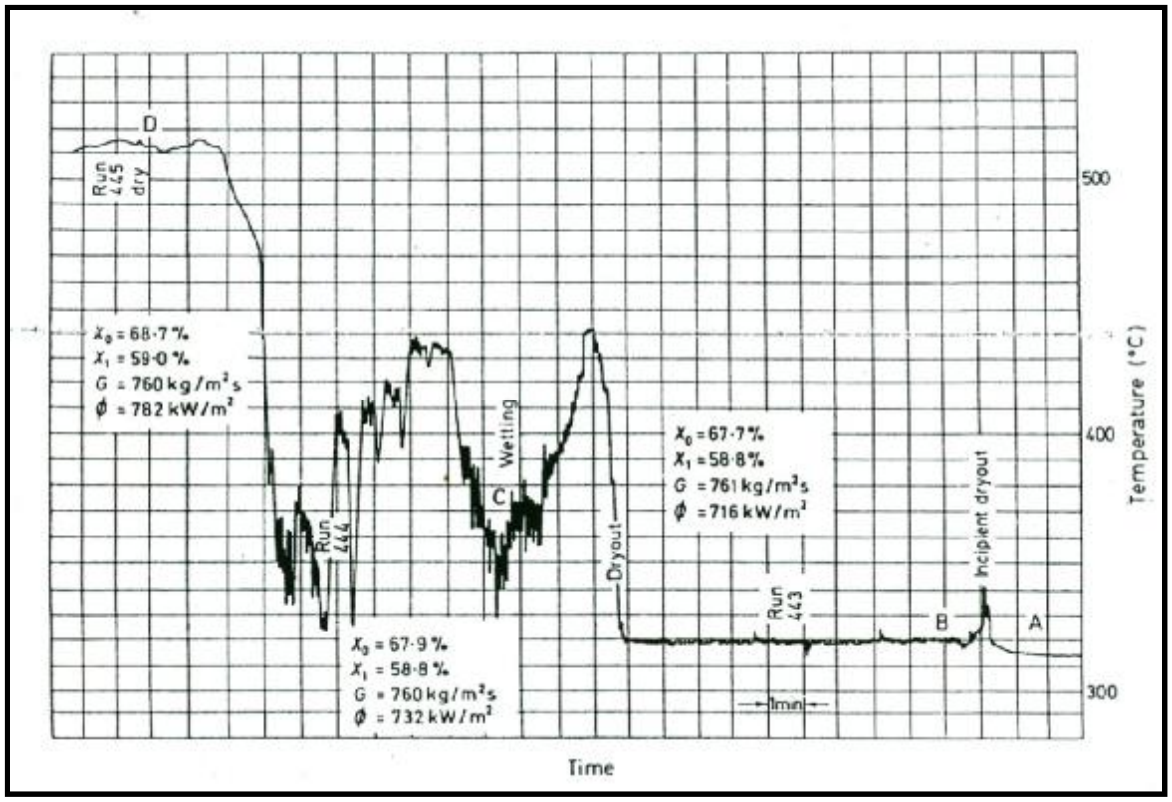


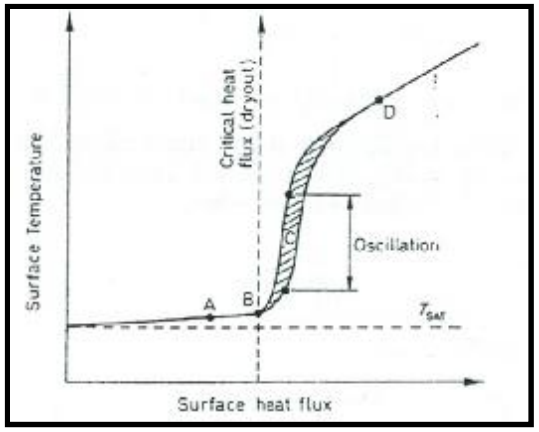
Heating Surface Temperature, During Dry Out Test

$$d = \left[\frac{4\Gamma_g m_g}{r_g \left(r_f - r_g \right) g} \right]^{1/3}$$

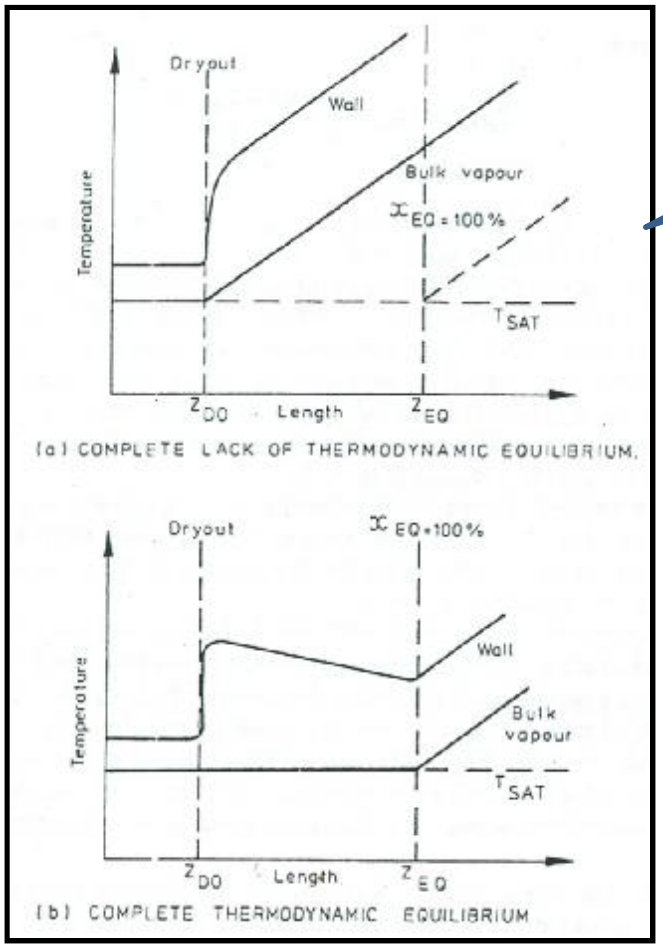
$$h = h_c + 0.875 h_r$$

$$h_c = 2.7 \left[\frac{u k_g r_g i'_{fg}}{D \Delta T_{SAT}} \right]^{1/2}$$



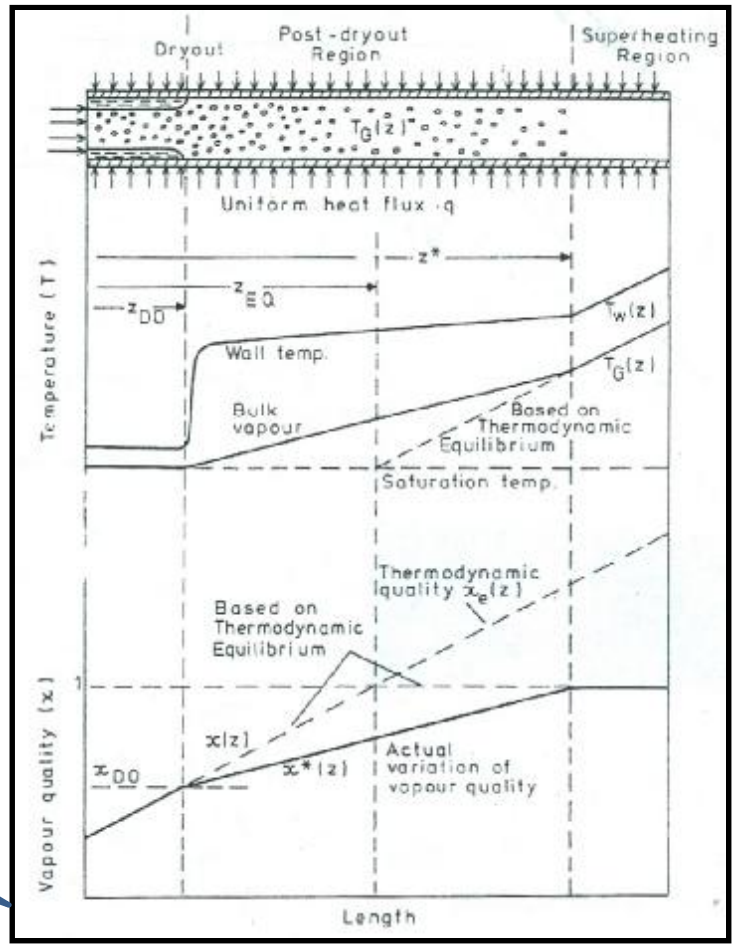


Dry out



Limiting conditions for post dry out heat transfer

Departure from thermodynamic equilibrium in post dry out



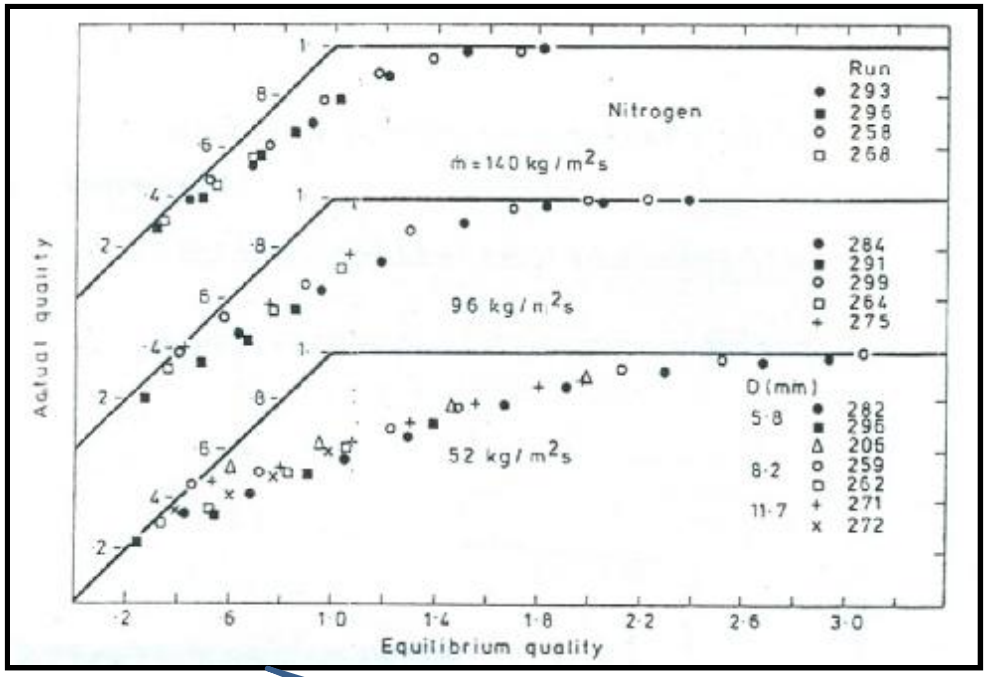
. . .

$$x(z) - x_{DO} = \frac{4}{DGi_{fg}}(z - z_{DO})$$

$$x^*(z) - x_{DO} = \frac{4f}{DGi_{fg}}(z - z_{DO})$$

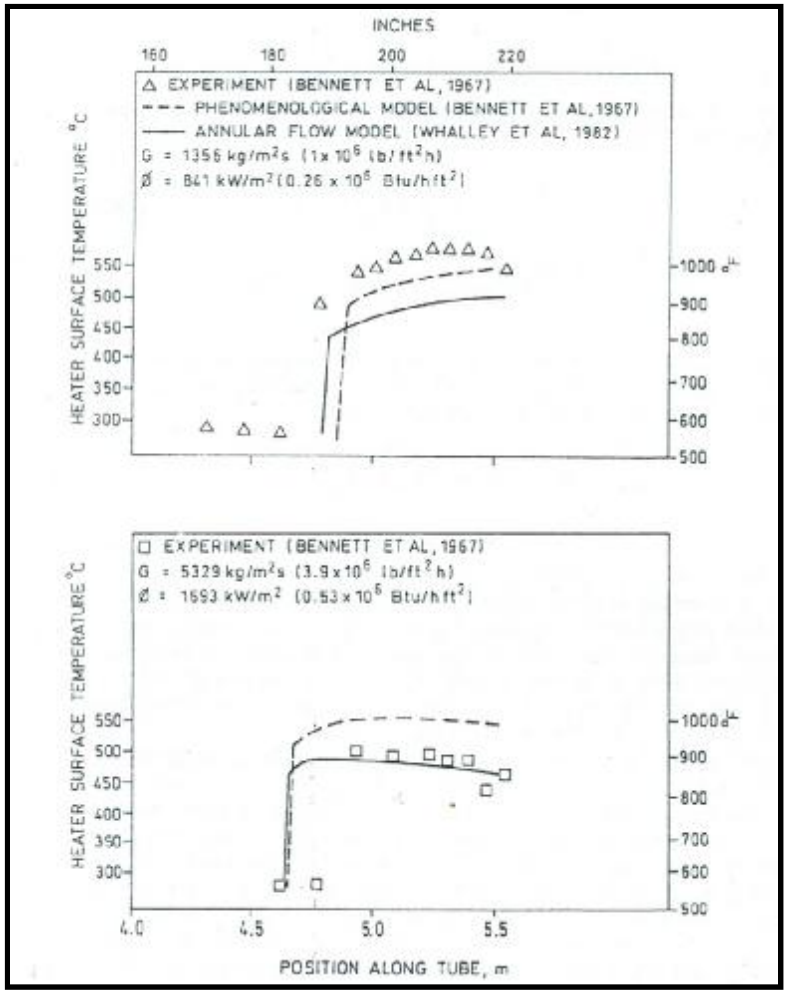
$$z^* = \left[\frac{DGi_{fg}}{4ef}(1 - x_{DO})\right] + z_{DO}$$

$$T_g(z) = T_{SAT} + \left[\frac{4(1-e)f(z - z_{DO})}{Gc_{pg}D}\right]$$

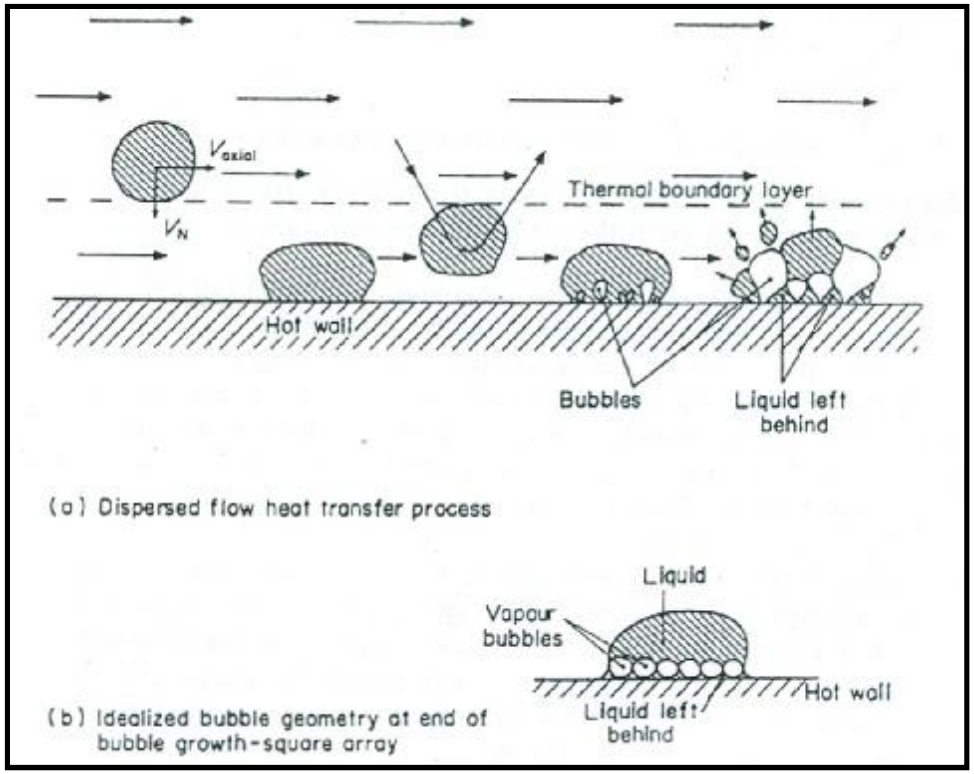


Actual quality v.s. equilibrium quality

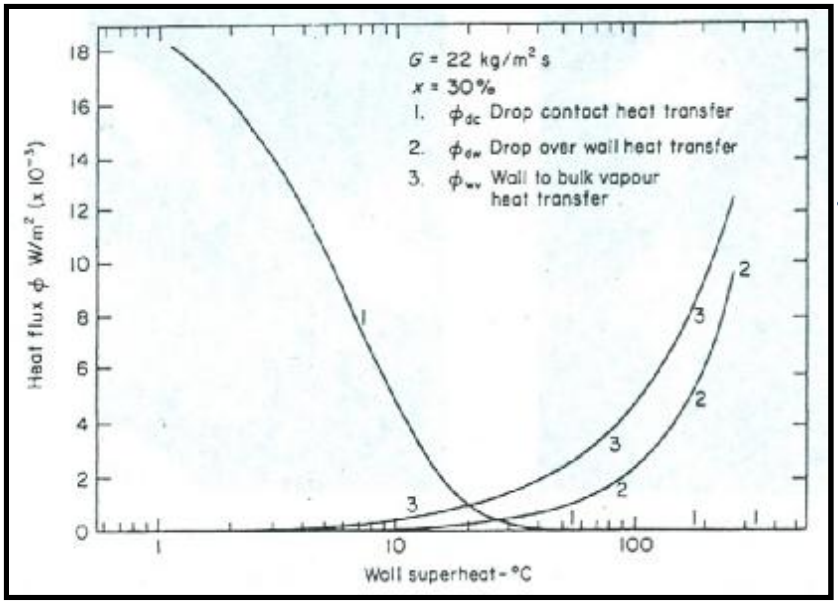
Wall Temp. For Post Dry Out Heat Transfer



Dispersed Flow Heat Transfer Model

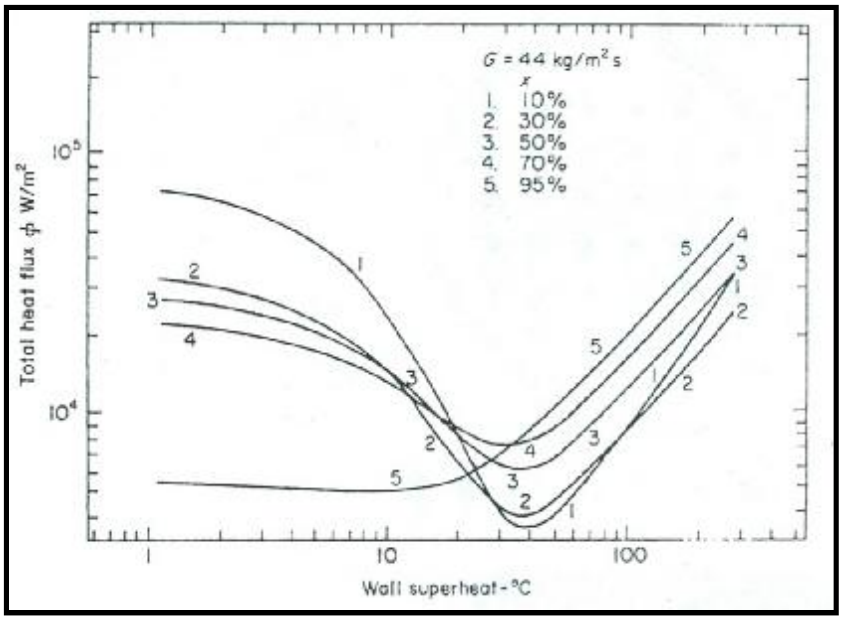


. . .



Behavior of components of total heat flux

Theoretical boiling curves



THE END