PST Exercise 2

Problem 1

a) $\frac{d\phi}{dt} = J_{in} - J_{out} + R_{gen} - R_{cons} = J_{in} - J_{out} + q$

$\downarrow$

$\frac{dE}{dt} = F_{in}\hat{E}_{in} - F_{out}\hat{E}_{out} + Q + W$

where $W = W_S + W_{IE} + W_P$

and $E = U + K_{IE} + P_E$

$W_F = [FP\hat{v}]_{in} - [FP\hat{v}]_{out}$

$\Rightarrow \frac{dE}{dt} = [F(U + K_E + P_E)]_{in} - [F(U + K_E + P_E)]_{out} + Q + W_S + W_{IE}$

$+ [FP\hat{v}]_{in} - [FPv]_{out}$

$\Rightarrow \frac{dE}{dt} = [F(U + K_E + P_E + Pv)]_{in} - [F(U + K_E + P_E + P\hat{v})]_{out} + Q + W_S + E_e$

use $H = U + Pv$

$\Rightarrow \frac{dE}{dt} = [F(\hat{H} + \hat{K_E} + \hat{P_E})]_{in} - [F(\hat{H} + \hat{K_E} + \hat{P_E})]_{out} + Q + W_S + W_e$

b)

can be 0 for isobaric & isothermal are isochoric processes where the pressure volume work is constant

c)

systems with incompressible liquids. the volume change will give negligible PV change

steady state. the change over time will be negligible

d)

systems that have zero or close to zero change in composition & work over small temperature ranges or at low temperatures

Problem 2

$T = T_{out}$ $P = P_{out}$

c)

Control volume around gas and liquid phase

$$F z_A = V y_A + L x_A$$
$$F z_B = V y_B + L x_B$$

$$\frac{dQ}{dt} = J_{in} - J_{out} + q$$

$$\frac{dn}{dt} = F - (V + L)$$

$$\frac{dn_A}{dt} = F x_F - (V y_A + L x_A) \quad \dots \; n$$

$$\frac{dH}{dt} = [F\hat{H}]_{in} - [F\hat{H}]_{out} + Q + W_s + \frac{dVv}{dt}$$

$$= [F\hat{H}]_{in} - [F\hat{H}]_{out} + Q$$

$x_A + x_B = 1$ $\quad y_A = P^A_{sat}(T) \cdot \frac{x_A}{P}$

$z_A + z_B = 1$ $\quad y_B = P^B_{sat}(T) \cdot \frac{x_B}{P}$

$y_A + y_B = 1$

$n = n_V + n_L$ $\quad n_A = n_L \cdot x_A + n_V y_A$

$H = n_V H_V + n_L H_L$ $\quad n_B = n_L \cdot x_B + n_V y_B$

b) 10 equation

DOF : 18 - 10 = 8

c) hold up likningene som ikke gir noe ny informasjon

d) if F, y_A, T, P, x_B are specified

there are still 3 (8-5) variables un specified

and the system is under specified

and not well posed

e) the incident matrix can be used

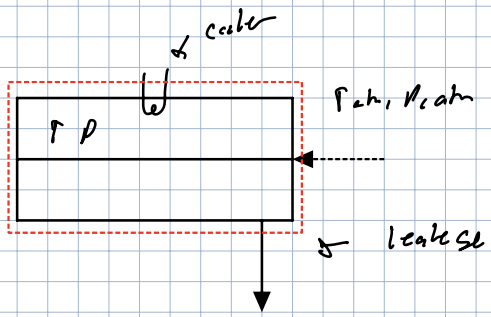
to specify the degrees of freedom in

such a way that shows how the model

can be solved and by wich equations

Problem 3

i)



modeling goal: level and temperature in tank

ii)

short time scale, rapid pressure equalization with atm system which will affect the temperature

and a initial small spurt once evaporation of the solvent

Long time scale.

a equilibrium will occur and it is reasonable to assume the solvent is all vaporized

iii)

the out flow, depressurization and evaporation dynamics

assume isothermal ie, so short that the outside temperature does not affect inside

iii) assuming that the cube is set at a constant temp.

Temperature dynamics, constant pressure and flow dynamics