Note Title 2/24/2017

PROBLEM 3 SOLUTION (strategy)

* Study Problem text
  - key words/phrases
  - search book for words/phrases
  - Snippit copy key sections into Excel

$$K_i = \left(\frac{p_{ci}}{p_K}\right)^{A_1 - 1} \frac{\exp\left[5.37\, A_1 (1 + \omega_i)\left(1 - T_{ri}^{-1}\right)\right]}{p_{ri}}, \qquad (3.159)$$

$$A_1 = 1 - (p/p_K)^{A_2}, \qquad (3.160)$$

where A_2 ranges from 0.5 to 0.8 and pressures p and p_K are given in psig. Canfield[105] also suggests a simple K-value correlation

psia

Problem 3: $A_2 = 1.6$

So that Modified Wilson Eq. gives $T_c \sim 169°F$

How to solve p_K given p_s @ T w/ z_i

Problem 17

Problem. Tables B-23 and B-24 show the composition of a reservoir oil in the Kabob field, Canada. Bubblepoint pressure is 3,100 psia at 236°F reservoir temperature.

a. Calculate the convergence pressure, p_K, that matches the measured bubblepoint pressure. Use the modified Wilson K-value equation (Eq. 3.159) with $\cancel{A_0}$ = 0.7.

A_2

For reservoir calculations where convergence pressure can be assumed constant (e.g., pressure depletion), a more direct approach to determining convergence pressure is suggested. With a K-value correlation of the form $K_i = K(p_K, p, T)$ as in Eq. 3.159, the convergence pressure can be estimated from a single experimental saturation pressure. For a bubblepoint and a dewpoint, Eqs. 3.165 and 3.166, respectively, must be satisfied.

$$F(p_K) = 1 - \sum_{i=1}^{N} z_i K_i(p_K, p_b, T) = 0 \quad \ldots\ldots\ldots\ldots\ldots \quad (3.165)$$

and
$$F(p_K) = 1 - \sum_{i=1}^{N} \frac{z_i}{K_i(p_K, p_d, T)} = 0, \quad \ldots\ldots\ldots\ldots \quad (3.166)$$

where z_i, p_b, or p_d and T are specified and p_K is determined.

$K_i = \frac{y_i}{x_i}$ $\qquad K_i(p, T; z_i)$ or p_K

G(V)	y_i
O(L)	x_i

$K_i(p, T; p_K)$

Bubblepoint: $z_i = x_i$ $\qquad \underbrace{K_i = \frac{y_i}{x_i} = \frac{y_i}{z_i}}$

↳ Find y_i

$\sum y_i = 1$ $\qquad y_i = z_i K_i$

$1 - \sum y_i = 0$

$$F(p_K) = 1 - \sum z_i K_i(p_s, T, p_K) = 0 \quad (1)$$

?

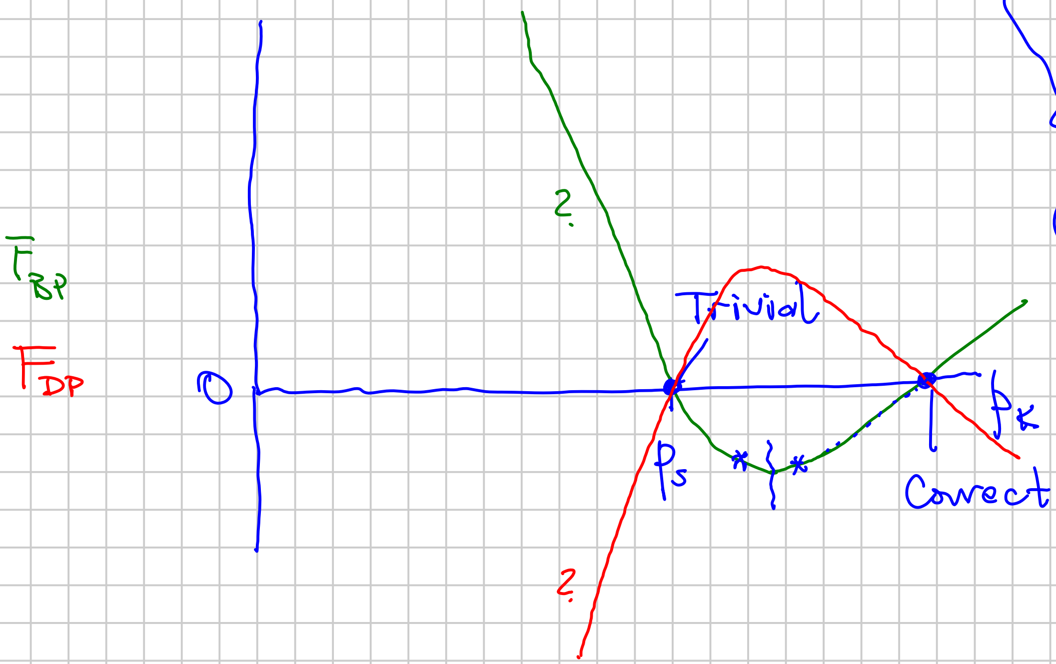
Lower Limit $p_K \geq p_s$

$\boxed{T}$ $\boxed{p_s}$ $\quad \boxed{p_K}$

BP $\qquad$ DP

i	z_i ✓	K_i	$y_i = z_i K_i$	$x_i = z_i / K_i$

$\boxed{\Sigma}$ $F_{BP}(p_K)$ $\boxed{\Sigma}$ $F_{DP}(p_K)$



At $T = T_c$
Correct = Trivial
$p_K = p_s = p_o$

$F(p_K)$ has two solutions:

(1) $p_K = p_s$ $K_i(p = p_K, T, p_K) = 1$

TRIVIAL SOLUTION

(2) Correct solution @ $p_K > p_s$

The function to be minimized (driven to zero) at the saturation pressure is given by $F_s=(1-f_{gi})f_{bp} + f_{gi} \cdot f_{dp}$, where f_{gi} is the incipient-phase gas mole fraction (BP: $f_{gi}=0$ and DP: $f_{gi}=1$), with $f_{bp}=1-\Sigma y_i=1-\Sigma z_i K_i$ and $f_{dp}=1-\Sigma x_i=1-\Sigma z_i/K_i$. K-value dependence is $K_i(p_K, A_2 \mid T_{ci}, p_{ci}, \omega_i \mid p,T)$, where you will solve for p_K given known values of z_i, T_{ci}, p_{ci}, ω_i, A_2, f_{gi} (BP or DP), and $p=p_s$ at T.

$F_{BP} = 1 - \Sigma z_i K_i$ $F_{DP} = 1 - \Sigma z_i / K_i$

Drive $F \to 0$
F^2 minimize

$$F_s = (1 - f_{gi}) F_{BP} + f_{gi} F_{DP} = 0$$

BP: $f_{gi\,(\text{incipient})} = 0$ | DP: $f_{gi} = 1$

* At p_k $K_i = 1$ ✓ $z_i = \underline{\underline{f_g}}\, \underline{\underline{y_i}} + (1-f_g)\, \underline{\underline{x_i}}$ ✓

$$f_g = \frac{n_g}{n_g + n_o} \rightarrow \frac{n_g}{n}$$

Q: Is $z_i = y_i = x_i$ at p_k

NO
((Usually not)) } $f_g = +\infty \mid -\infty$

$y_i = x_i \neq z_i$

(Only if $p_k = p_c$ of z_i)

$-\infty$ $f_{g\,min} = \dfrac{1}{1 - K_{max}}$ $K_{max} = 1$

@ p_k

$+\infty$ $f_{g\,max} = \dfrac{1}{1 - K_{min}}$ $K_{min} = 1$

NEGATIVE FLASH Physically $\underbrace{\text{Single Phase } p > p_s}$

Flash can still find

$f_g < 0$ $f_g > 1$