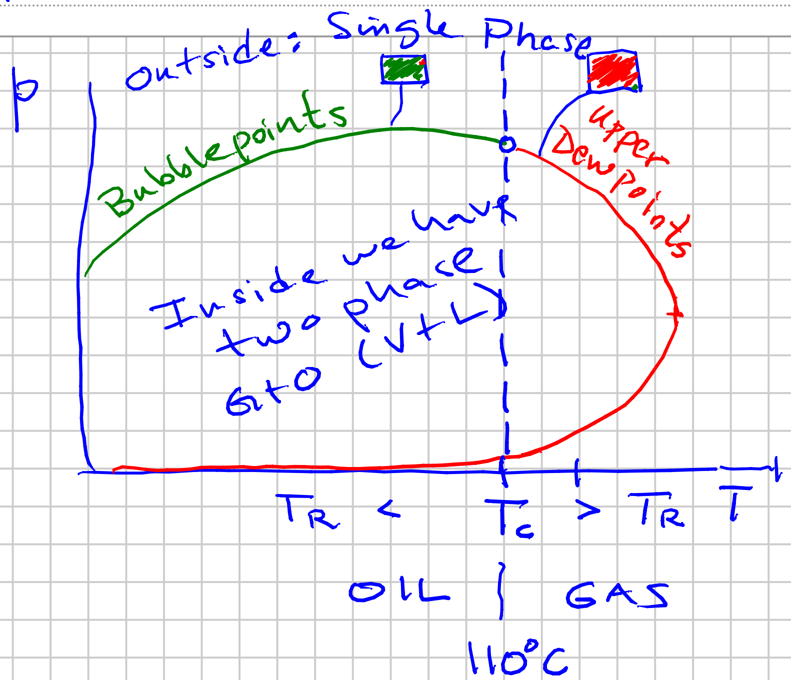
FLASH & SATURATION PRESSURE CALCULATIONS

Note Title 2012-09-25



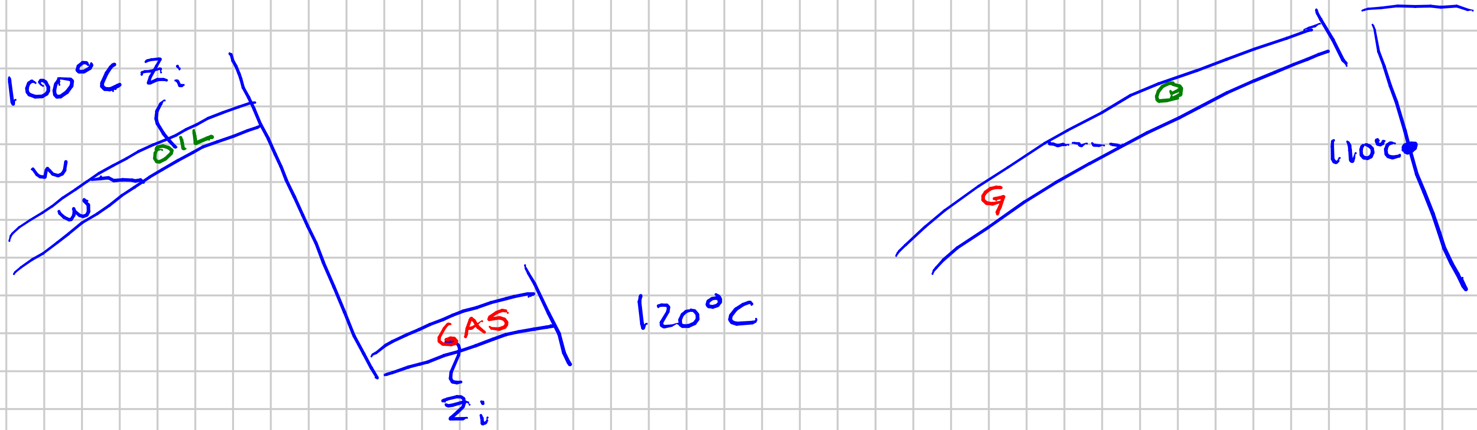
Given z_i

Flash (p, T)

⇒ # phases (1 or 2)

⇒ amount of each phase $f_v = \frac{n_v}{n}$

⇒ phase compositions y_i & x_i



Ch. 6 Lab PVT Tests

* – Oil Example $\quad p_b$ 2620 psig = 2635 psia

– Gas Condensate Example

K-values Estimation : Modified Wilson Eq. (Ch. 3)

$T_{ri} = T/T_{ci}$

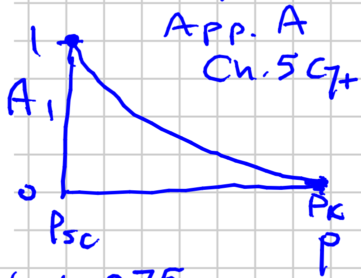
$$K_i = \left(\frac{p_{ci}}{p_K}\right)^{A_1 - 1} \frac{\exp\left[5.37\,A_1\,(1+\omega_i)\left(1 - T_{ri}^{-1}\right)\right]}{p_{ri}}, \qquad (3.159)$$

Guess ? $\quad p_{ri} = p/p_{ci}$

$p_K \sim 5000$ psia

where A_1 = a function of pressure, with $A_1 = 1$ at $p = p_{sc}$ and $A_1 = 0$ at $p = p_K$. The key characteristics of K values vs. pressure

$i \quad p_{ci} \quad T_{ci} \quad \omega_i$ — App. A, Ch. 5 C_{7+}



$A_1 \simeq 1 - \left(p/p_K\right)^{0.75}$

TABLE 6.4—WELLSTREAM (RESERVOIR-FLUID) COMPOSITION FOR GOOD OIL CO. WELL 4 BOTTOMHOLE OIL SAMPLE

Component	mol% ($z_i = z_{Ri}$)	wt%	Density* (g/cm³)	°API*	Molecular Weight
H_2S	Nil	Nil			
CO_2	0.91	0.43			
N_2	0.16	0.05			
Methane	36.47	6.24			
Ethane	9.67	3.10			
Propane	6.95	3.27			
i-butane	1.44	0.89			
n-butane	3.93	2.44			
i-pentane	1.44	1.11			
n-pentane	1.41	1.09			
Hexanes	4.33	3.97			
Heptanes plus	33.29	77.41	0.8515	34.5	218
Total	100.00	100.00			

*At 60°F.

Troll oil:

	z_i	
C_1	36	mol-%
C_2–C_4	20	
C_{5+}	40	

RR Equation: 195x

$$h(f_v) = \sum_{i=1}^{N} \frac{z_i(K_i - 1)}{1 + f_v(K_i - 1)} = 0$$

MM (1949)

or

$$h(f_v) = \sum_i \frac{z_i}{c_i + f_v} = 0$$

$$c_i = \frac{1}{K_i - 1} \quad ; \; c_i = 0 \text{ if } K_i = 1$$

$$\frac{1}{1 - K_{max}} = f_{v_{min}} < f_v < f_{v_{max}} = \frac{1}{1 - K_{min}}$$

x : integer > 1

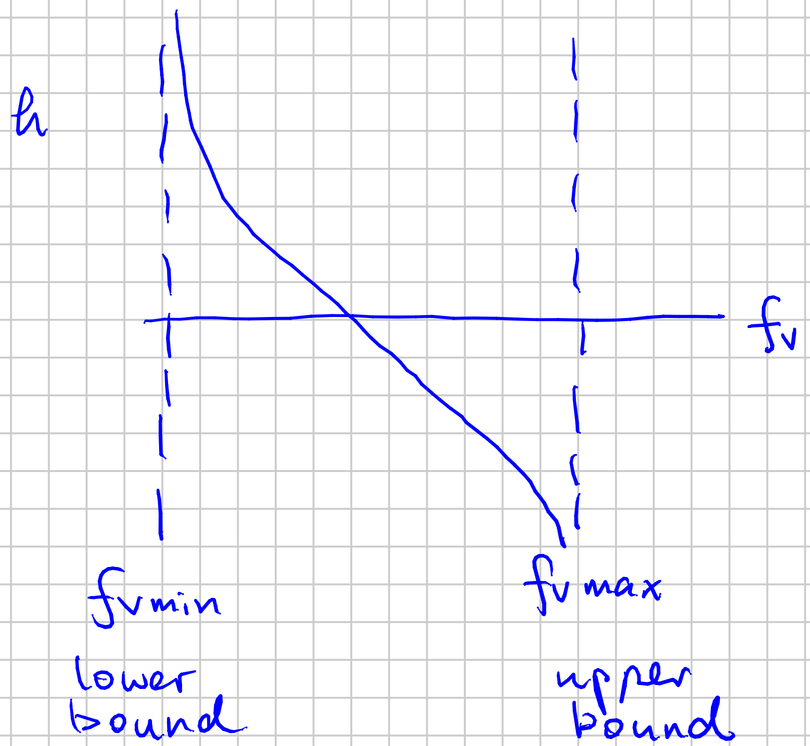
$(x-1) \times (x+1)$ divide by 6

SOLVER:

1. A cell "target" to
   - Minimize
   - Maximize
   - To = value

2. Define "Variables"
   i.e. the cells you want to change to achieve (1)

3. Optionally, you can limit "bound" the variables (2) we are changing



$$x_i = \frac{z_i}{fv \cdot (K_i - 1) + 1}$$

Bubblepoint Calculation

$$\sum y_i = 1$$

$$y_i = K_i \cdot x_i$$

$x_i = z_i$ for an oil @ p_b

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

$$g = 1 - \sum y_i = 0$$

$$g = 1 - \sum z_i K_i(T, p_b, p_K) = 0$$

(T, p_b): Known from Lab data

(p_K): Solve for p_K

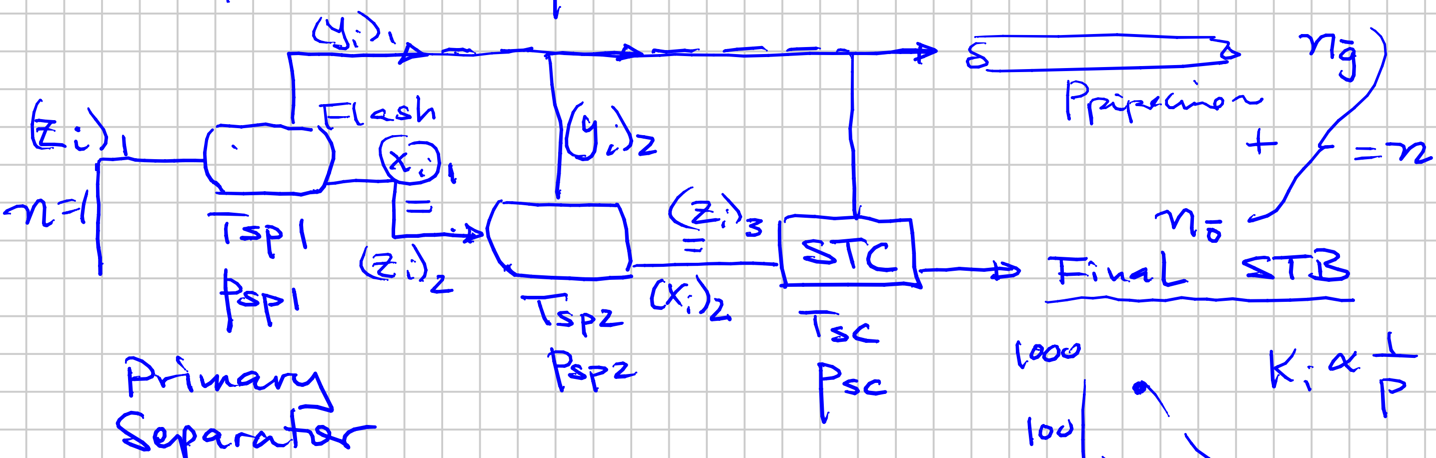
Equivalent to solving RR flash for $f_v = 0$.

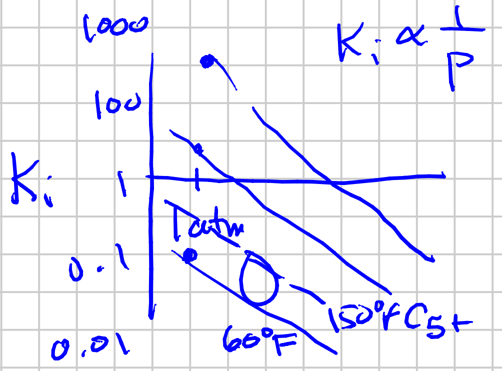
But much easier numerically to solve.

This will be part of Problem 2

Flash calculation is the basis for estimate amount of "stock tank oil" \$105/STB and surface sales gas \$3.50/Mscf

MULTI-STAGE SURFACE SEPARATOR





$$n_{\bar{o}} = \Big[\big[n \cdot (1-f_{v1})\big](1-f_{v2})\Big](1-f_{v3})$$

$$n_{\bar{g}} = n - n_{\bar{o}}$$

$$\frac{V_{\bar{g}} = 23.68 \cdot n_{\bar{g}}}{V_{\bar{o}} = n_{\bar{o}} \cdot (M_{\bar{o}} / \rho_{\bar{o}})} = \frac{Sm^3}{Sm^3} = GOR$$

$$M_{\bar{o}} = \sum (x_i)_3 M_i$$

$$\rho_{\bar{o}} = \frac{\sum (x_i)_3 M_i}{\sum \frac{(x_i)_3 M_i}{\rho_{Lsc\,i}}} \qquad \frac{\text{mass}}{\text{volume}}$$

$\rho_{Lsc\,i}$ ← App. A ; C_{7+} lab