Note Title 3/6/2017

GOR ⟶

	OILS			GAS CONDENSATES		
	Black	Volatile	(Near Critical)	Rich	Lean	Dry
CCE	✓ (Blind Cell)	✓	✓	✓	✓	(✓)
		Windowed Cell (Volatile through Lean)				
SEP	✓	✓	✓	✓	× × (GOR ≳ 15000 scf/STB, 3,000 Sm^3/Sm^3)	× ×
DLE						
CVD						

✓ All sample types (BHS, "MDT", SEP)

DLE test ~ SEP test procedurally, except:

- $T_{SPK} = T_R$
- 6–8 stages
- Final "residual" oil @ 1 atm, cooled to 60°F is NOT an oil we sell!

$$h(F_v) = \sum_{i=1}^{N} \left(\frac{z_i}{c_i + F_v} \right) = 0$$

N − 1 solutions

Right solution : $F_{min} < F_v < F_{max}$

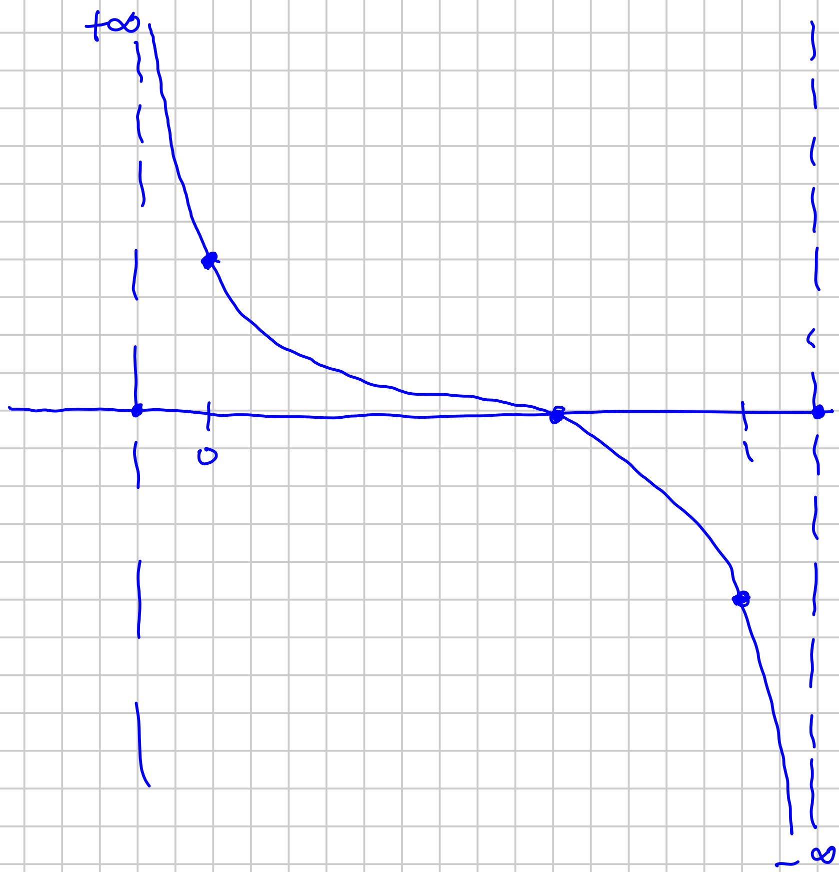
$$F_{min} = \frac{1}{1 - K_{max}} < 0$$

$$F_{max} = \frac{1}{1 - K_{min}} > 1$$

NR : $$F_v^{n+1} = F_v^{n} - \frac{h(F_v^n)}{\frac{dh}{dF_v}(F_v^n)}$$

n = iteration

Bisection fallback



Solve $\frac{d^2 h}{dF_v^2} = 0$ to get a better initial guess

Flash @ STC

$$\frac{n_{\bar{g}}}{n_{\bar{g}}+n_{\bar{o}}} = F_v \rightarrow GOR = \frac{V_{\bar{g}}}{V_{\bar{o}}}$$

$$V_{\bar{g}} = n_{\bar{g}} \cdot \left(\frac{R\,T_{sc}}{p_{sc}}\right)$$

$23.68\ Sm^3/\text{Kg-mole}$

$$V_{\bar{o}} = n_{\bar{o}} \cdot \frac{M_{\bar{o}}}{\rho_{\bar{o}}}$$

Let $n = 1$ $\quad n_{\bar{g}} = F_v \cdot 1$ $\quad n_{\bar{o}} = (1-F_v)\cdot 1$

$$GOR = \frac{F_v \cdot 23.68}{(1-F_v)\left(\frac{M}{\rho}\right)_{\bar{o}}}$$

Flash @ STC: F_v

$y_{\bar{g}i}$ $\quad x_{\bar{o}i}$

✓ $x_{\bar{o}i}$

$$\bar{M}_{\bar{o}} = \frac{m_{\bar{o}}}{n_{\bar{o}}} = \frac{(\sum x_{\bar{o}i} M_i)\,\cancel{(1-F_v)}}{(\sum x_{\bar{o}i})\,\cancel{(1-F_v)}}$$

$$\rho_{\bar{o}} = \frac{m_{\bar{o}}}{V_{\bar{o}}} = \frac{\sum(\sum x_{\bar{o}i} M_i)\,\cancel{(1-F_v)}}{\sum_{i=1}^{N} \frac{x_{\bar{o}i} M_i}{\rho_i}\,\cancel{(1-F_v)}}$$

$\gamma_{\bar{o}}$

γ_{API}

ST Liquid density (of ρ_i)
App. A

$$\bar{H} = \frac{\sum y_i H_i}{\sum y_i}$$

DLE: Only for OILS (i.e. p_s: a bubblepoint)

Designed to get phase & volumetric properties at reservoir conditions (T_R; $p_R = p_b \rightarrow$ 10 bar, 1 atm)

$p \leq p_b$: ρ_o μ_o V_o (Shrinkage) Gas Released from Solution $\} = R_{sb} - R_s(p)$

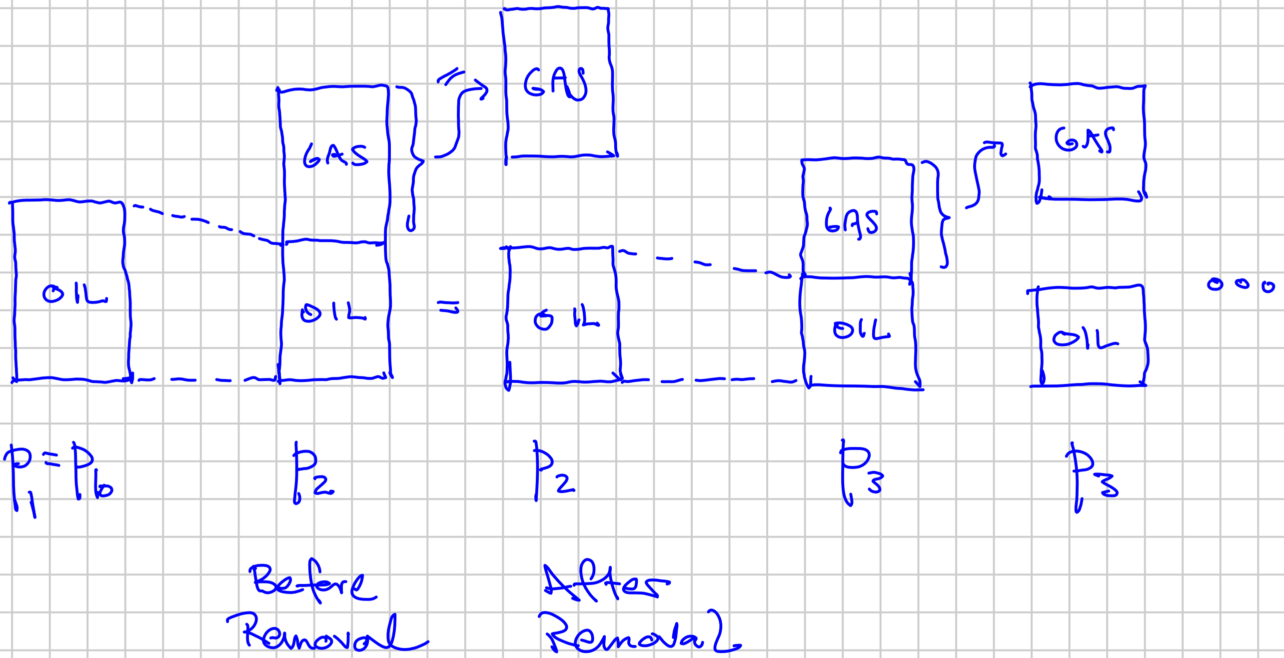
$p_b \rightarrow p$

Strongly related

Calc. by Lee, Gonzalez,

$p < p_b$ ρ_g (Z_g^*) γ_g^* (M_g) $\mu_g(\rho_g, T)$ y_i ($\pm$ for C_{s+})

$$\rho_g = \frac{p M_g}{R T Z_g}$$



Does the DLE process mimic the actual depletion process in a reservoir?

No

Does it matter ?

No, or good enough (95%)

What is reported in DLE test

OIL PHASE

Stage	P	$B_{od} = \frac{V_o(P)}{V^*_{oresidual}}$	Calc ρ_o	DLE test #1 ΔR_{sd}	R_{sd}	DLE test #2 μ_o
1	p_b	Shrinkage		0		
	⋮					
2						
3						
4						
5						
6						
N-1	~10 bar					
N	1 atm					

$$\Delta R_{sd} = \frac{\Delta V_{\bar{g}\,removed,k}}{V^*_{oresidual}}$$

$$R_{sd} = R_{sd,b} - \sum_{k}^{1} \Delta R_{sd}$$

R_{sd}: Left in Solution; $\sum \Delta R_{sd}$: Current Cum. Released

$$\overline{(\sum \Delta R_{sd})} = R_{sd,b}$$

Total Released Gas = Initial Solution Gas } "$R_{sd,b}$"

"R": GOR

* At 1 atm, 60°F