SURFACE SEPARATION PROCESSING

Note Title 2013-09-20

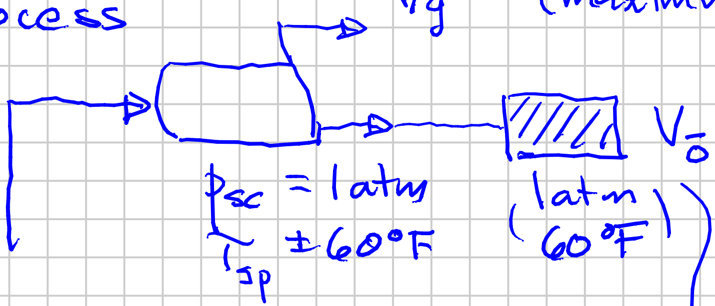
Maximize the resulting Stock Tank Oil Volume from a produced stream (well, manifold, pipeline)

Reason: Any component mole in STO has more value than that component mole being sold as part of the gas.

$\{C_3 - C_7\}$ ↑ Sales Gas (low \$)

STO (high \$)

Single Stage Process



(maximum)

(minimum)

minimum API

"Quality" STO: (API Gravity)

$\rho_{\bar{o}} \Rightarrow \gamma_o = \frac{\rho_{\bar{o}}}{\rho_{\bar{w}}}$

Liquid Specific Gravity ~ Relative Density

$$\gamma_{API} = \frac{141.5}{\gamma_{\bar{o}}} - 131.5$$

Lowest STO Density:

~650 kg/m³

$\gamma_o = 0.65$

$$\gamma_{API} = \frac{141.5}{0.65} - 131.5$$

= 86 °API (Upper Limit)

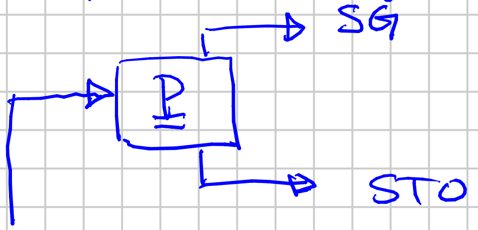
60 - 70

STOs:

10 (\$/STB →) 70

i-Butane i-C_4

$n_{iC_4} = 1234$ kg-moles/D



35.31 scf/Sm^3 gas
6.28 STB/Sm^3 STO

Prices:

\$2 – 10 / Mscf   \$3.50/Mscf

\$100/STB

$$n \rightarrow V_{\bar{g}} = 23.68 \frac{Sm^3}{\text{kg-mole}} \times n \qquad Sm^3\ SG$$

$$n \rightarrow V_{\bar{o}} = n \times M_{i\text{-}C_4} \frac{\text{kg}}{\text{kg-mole}} \times \frac{1}{(\rho_{i\text{-}C_4})_{\text{surface}}} \qquad Sm^3\ STO$$

Liquid @ STC

App. A
560.7 kg/m^3

Value as SG: $1234 \times 23.68 \times 35.31 \times \frac{1}{1000} \times 3.50 = \$3610$

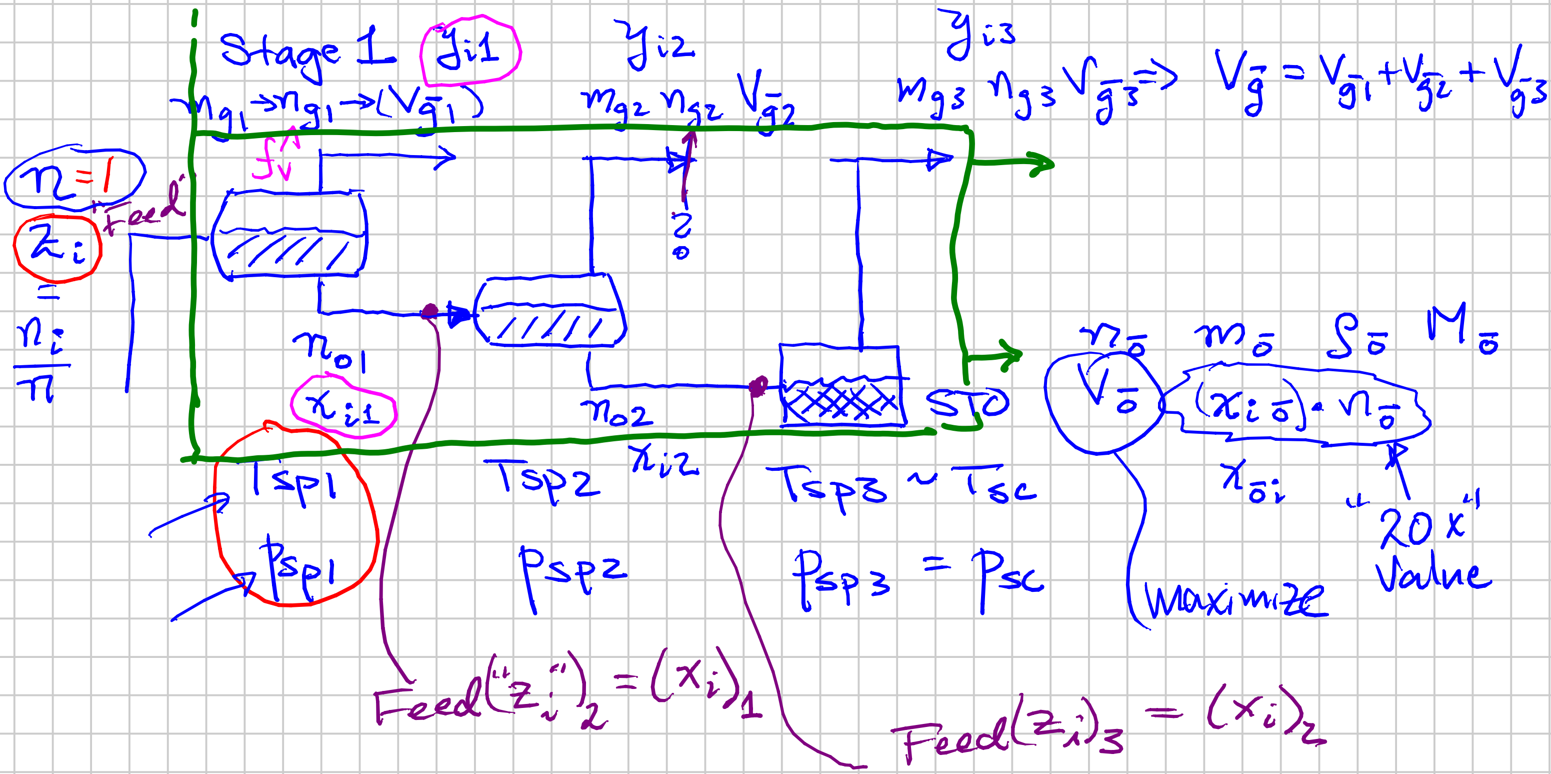
$\text{kg-moles} \quad \frac{Sm^3}{\text{kg-mole}} \quad \frac{scf}{Sm^3} \quad \frac{Mscf}{scf} \quad \frac{USD}{Mscf}$

Value of STO: $1234 \times 58.12 \times \frac{1}{560.7} \times 6.28 \times 100 = \$80,300$

$\text{kg-moles} \quad \frac{kg}{\text{kg-mole}} \quad \frac{m^3}{kg} \quad \frac{bbl}{m^3} \quad \frac{\$}{bbl}$

22 x

Traditional Multi-Stage Separator Process



Rachford-Rice (Muskat-McDowel) : FLASH Calculation

$$z_i \; (p, T) \Rightarrow K_i$$

$$f_v = \frac{n_g}{n} \quad y_i \quad x_i$$

$$n_{g2} = n_{o1} \times (f_v)_2$$

Feed moles into Stage 2

$$n_{g3} = n_{o2} \times (f_v)_3$$

Assuming $n = 1$

Book-keeping of moles

$$n_{g1} = f_{v1}$$

$$n_{g2} = (1 - f_{v1}) \cdot (f_{v2}) =$$

$$n_{g3} = (1 - f_{v1})(1 - f_{v2})(f_{v3})$$

$$n_{o1} = (1 - f_{v1})$$

$$n_{o2} = (1 - f_{v1})(1 - f_{v2})$$

$$\to n_{o3} = (1 - f_{v1})(1 - f_{v2})(1 - f_{v3})$$

Component "STO" Recovery Factor $RF_{\bar{o}i}$

$$RF_{\bar{o}i} = \frac{n_{\bar{o}i}}{n_i} = \frac{n_{\bar{o}} \, x_{i3}}{n_i} \quad \%$$