RO + OBM ⇒ MDT (Contaminated)

x_{ROi} $\quad$ x_{obmi} $\quad$ $x_{MDTi} = x_{ROi} \cdot (1 - f_{obm}) + x_{obmi} \cdot f_{obm}$

n_{RO} $\quad$ n_{obm}

$f_{obm} = \frac{n_{obm}}{n_{RO} + n_{obm}}$ (Reservoir Molar)

↕

f^*_{obm} (Gt|wt)

Collected by OTF test (MDT)

↓ LAB

Flash @ STC

✓ m_{FG} $\quad$ n_{FG}, V_{FG} @ STC $\quad$ FG $\quad$ y_{FGi} (GC) → M_{FG}

Calc n_{FO}

Lab m_{FO} ✓

Calc V_{FO} $\quad$ FO $\quad$ x_{FOi}

Lab M_{FO} ± $\quad$ w_{FOi} ← GC

Lab ρ_{FO} ✓

Mathematical Recombination ⇒ x_{MDTi}

Flash-GC (2) - Recombination

Normally the lab analyzes (estimates) OBM level of contamination from FO

GC ✓

$$w_{FOi} = \underset{(D)}{w_{FOi}}^{?} \cdot \left(1 - f^*_{obm}\right) + w_{obmi} \cdot f^*_{obm}$$

($w_{FOi(D)}$ ↑ Clean; f^*_{obm} ?)

$$f^*_{obm} = \frac{m_{obm}}{m_{obm} + m_{FO(D)}}$$

Decontamination Process:

$\Rightarrow f^*_{obm} \Rightarrow w_{FOi(D)} \quad m_{FO(D)}$

$$m_{FO(D)} = m_{FO} \cdot \left(1 - f^*_{obm}\right)$$

(m_{FO}: Lab)

Clean MDT Sample:

$$\boxed{w_{MDTi(D)}} = \left(w_{FGi} \cdot m_{FG} + w_{FOi(D)} \cdot m_{FO(D)}\right) \frac{1}{m_{FG} + m_{FO(D)}}$$

(w_{FGi} ✓, m_{FG} ✓)

What is Needed (Decontaminated Reservoir Composition)

Get from Decontamination Process

f_{obm} (Rl molar) $\longleftrightarrow$ f^*_{obm} (Fo | wt)

$$\frac{n_{obm}}{n_{RO} + n_{obm}} \qquad \frac{m_{obm}}{m_{Fo\,(D)} + m_{obm}}$$

$$f^*_{obm} = \frac{\left(\sum_{C_{7+}} w_{obmi}\right) M_{obm} \cdot f_{obm}}{\left(\sum_{C_{7+}} w_{obmi}\right) M_{obm} \cdot f_{obm} + \left(\sum_{C_{7+}} w_{ROi\,(D)}\right) M_{RO} \left(1 - f_{obm}\right)}$$

Problem 1 $\Rightarrow$ f_{obm} given f^*_{obm}, w_{obmi}, $w_{ROi\,(D)}$

Decontamination Process ?

Problem 2.

Solution (Oras)

(1) Assumed f_{obm} — Variable

Backcalc $\left\{x_{RGi\,(D)}\right\}_{PhZ} = f\left(f_{obm}, X_{RGi\,MDT}, X_{obmi}\right)$

Plot $X_{RGi\,(D)}$ C_{7+} fractions

min RMS

max R^2 (fobm)

Trend Line of C_{v2t} components

(Exp)

Measure : $w_{MDT\,i}$

$$\hat{w}_{MDT\,i} = \frac{w_{MDT\,i}}{w_{MDT,\,C_{v2t}}} \qquad i \geq n \text{ (start of obm)}$$

(2)

$$\boxed{\hat{w}_{MDT\,i}} = \hat{w}_{R\,i\,(D)}\,(1 - f^{*}_{obm}) + \hat{w}_{obm\,i} \cdot f^{*}_{obm}$$

✓ ? ? ✓

Lab — Model Est

RMS

$$\boxed{\hat{w}_{R\,i\,(D)} : \Gamma(\alpha, \eta, \bar{M})}$$

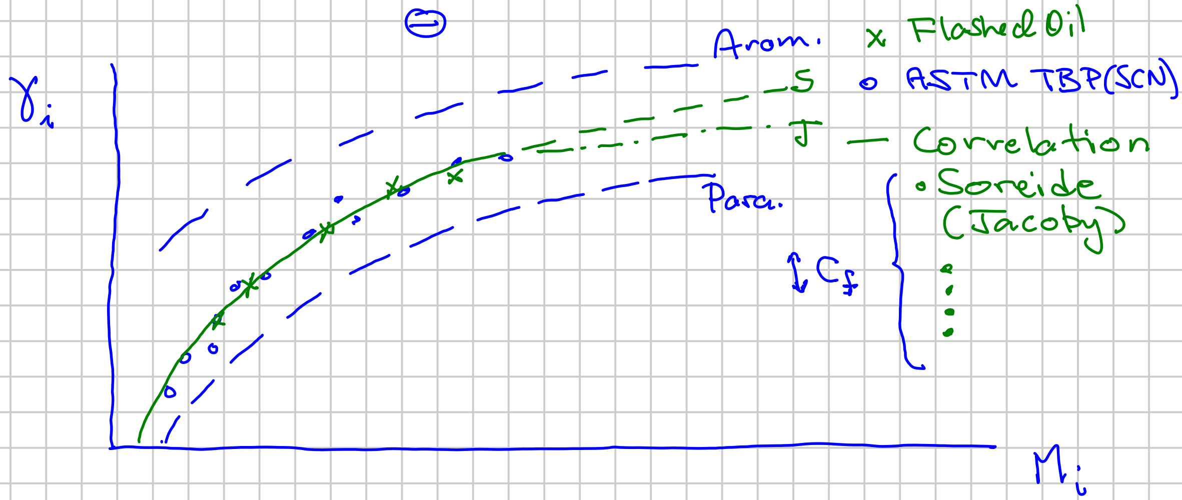
Weighting Factors – ?

Flashed Oil $\gamma_{\bar{o}}$ $M_{\bar{o}}$

Reliable $\gamma - M$ relation for C_{7+} fractions { Define our heavies as P–A

{ Cubic EOS } requires { M T_c p_c ω s } $C_7 \ldots C_{15} \ldots$ ± ↕

Θ



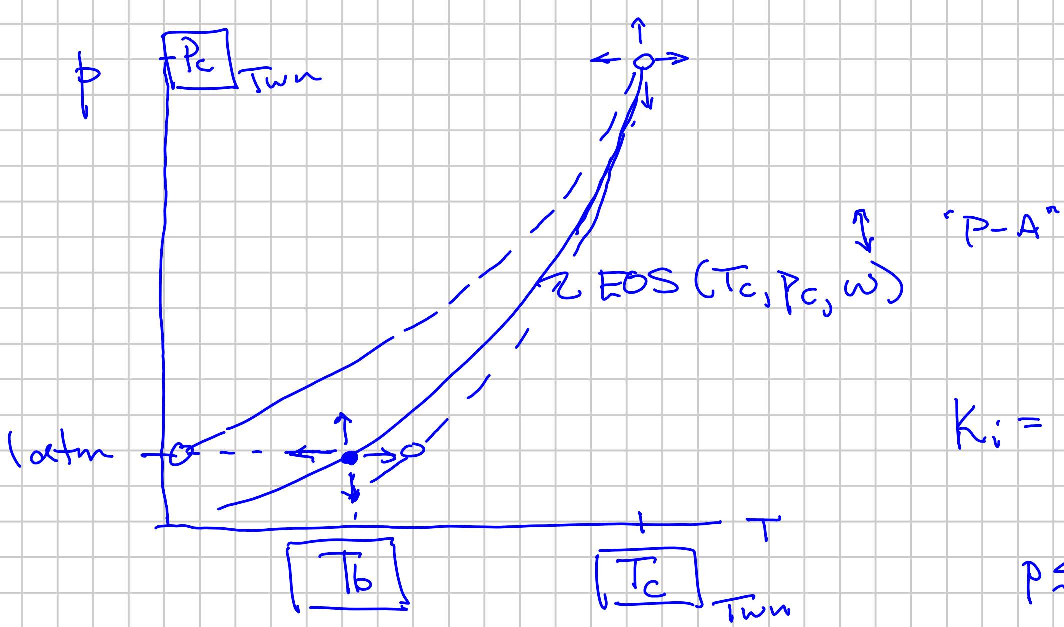
C_7 :

	M	ρ	
Benzene	78	>850	A
n-C_7	100	700	P

Avg.

$\Theta_i(M_i, \gamma_i)$ ⇒ EOS → $K_i(p, T, z)$ | p_s V_{ro} y_i x_i MMP

$\underbrace{\qquad}_{C_{7+}}$ → ρ_o (ρ_g) ←



$$K_i = \frac{p_{vi}(T)}{p}$$

$p \lesssim 50^+$ bar

θ Estimation

- Correlations (1930s →)

  Refinery & Process Distillation Data

$\theta(T_b, \gamma)$ Inspection properties (T_b, γ, M)

$M(T_b, \gamma)$

$T_c(T_b, \gamma)$

$p_c(T_b, \gamma)$

$\omega(T_b, T_c, p_c)$

Today Most Methods (SW)

M_i < KF (lab) / Gamma model } ①

$\gamma_i(M_i ; C_f)$ Correlation } ②

Honor $\begin{Bmatrix} M_5 & \gamma_5 \\ M_{7+} & \gamma_{7+} \end{Bmatrix}_{Lab}$

$$M_{7+} = \frac{\sum_{7+} x_i M_i}{\sum_{7+} x_i}$$

$$\gamma_{7+} = \frac{\sum_{7+} (x_i M_i)}{\sum \left(\frac{x_i M_i}{\gamma_i (M_i; C_f)} \right)}$$

$\gamma_{7+} = (\gamma_{7+})_{Lab}$

Ideal Volume Mixing (Liquids)

Bilal Twu:

Perturbation Theory

Paraffins: $M_p(T_b)$, $T_{cp}(T_b)$, $P_{cp}(T_b)$, $\gamma_p(T_b)$

$\Delta\gamma = \gamma - \gamma_p$

$\gamma(T_b) - \gamma_p(T_b)$

(M, γ)

Twu $\begin{cases} M = f(T_b, \Delta\gamma) & \leftarrow \text{Get } T_b \\ T_c = f(T_b, \Delta\gamma) \\ P_c = f(T_b, \Delta\gamma) \end{cases}$

TWUMW = 1 use Turr religously

(*) 0 ~ use $M \sim M_p(T_b)$ ignores the $\Delta\gamma$ effect for MW

Might use C_7 C_8 C_9 w/ Isomers

$\underbrace{M \quad \gamma}_{\text{TWUMW}} \quad T_b$

$\bar{\gamma}(\bar{M}) \neq \gamma_i(M_i)$ Close but not same

depends on $\underbrace{x_i(M)}_{\text{Gamma Exp ...}}$

C7+
FO

$\bar{\gamma}(\bar{M}) \underset{\checkmark}{=} \gamma_i(M_i)$ if $\boxed{\dfrac{M_i}{\gamma_i} = a_0 + a_1 M_i}$

v_{Li} Not in PhazeComp

$w_{RG_i} =$
- 0.9 C_{9-} MDT
- $\underbrace{0.1(1-f^*_{obm})}$ C_{10+} !

w_{MDT_i}
- $\boxed{C_{9-}}$ $m_{MDT,i} = m_{RG_i}$ 0.9
- C_{10+} RG + OBM 0.1

$$\left(\frac{OBM}{RG + OBM}\right)_{C10+} = 0.974 \quad \text{mass}$$