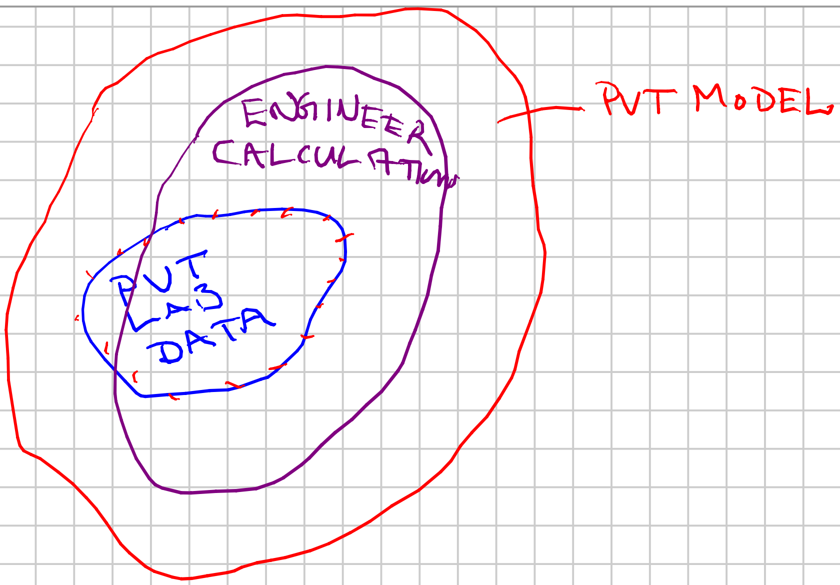
SAMPLING & PVT LABORATORY TESTS (CH. 6)

Note Title 2013-09-26



SAMPLING

* Have a well

SAMPLE TYPES:

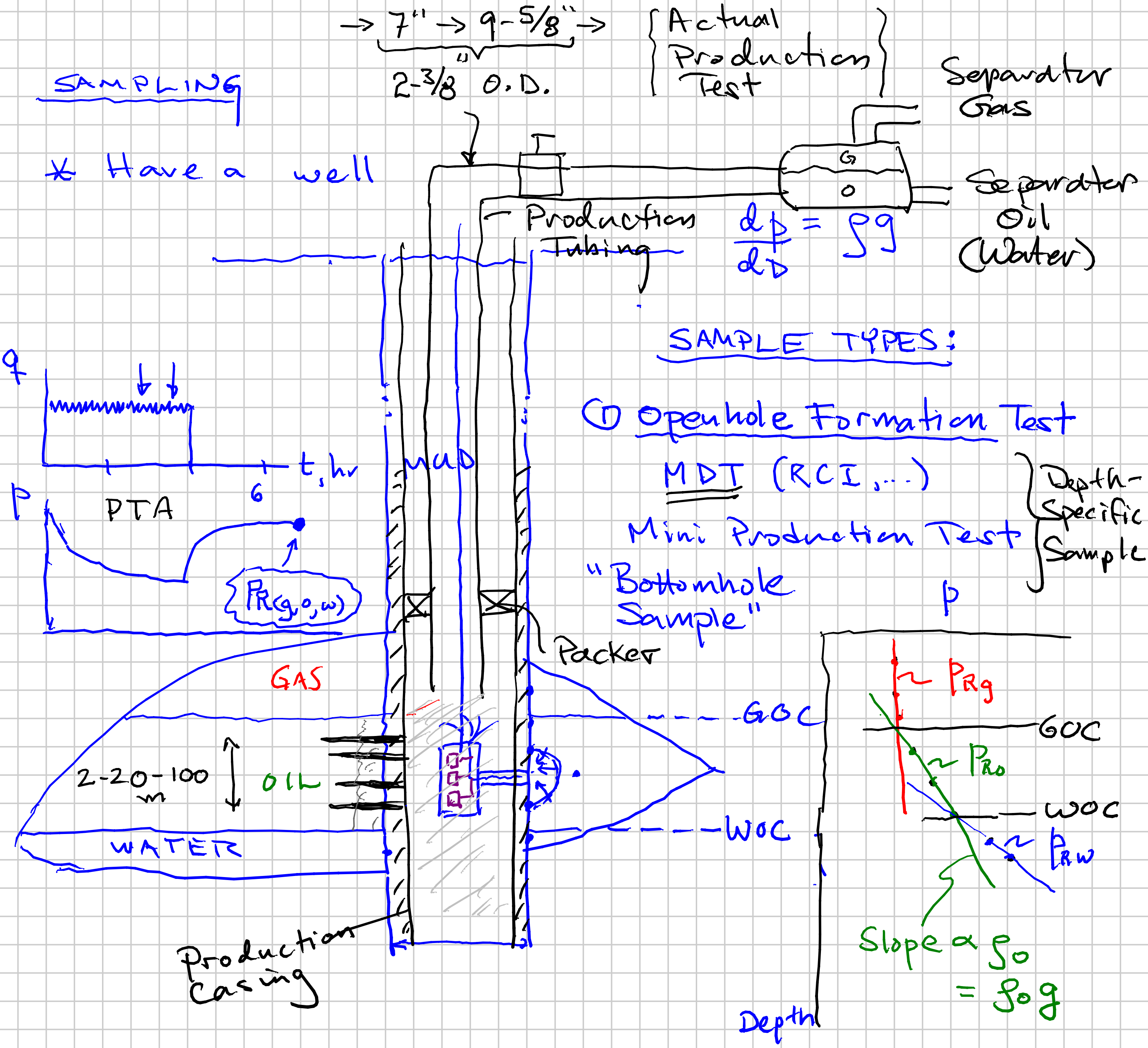
① Openhole Formation Test

MDT (RCI, ...)

Mini Production Test

"Bottomhole Sample"

} Depth-Specific Sample



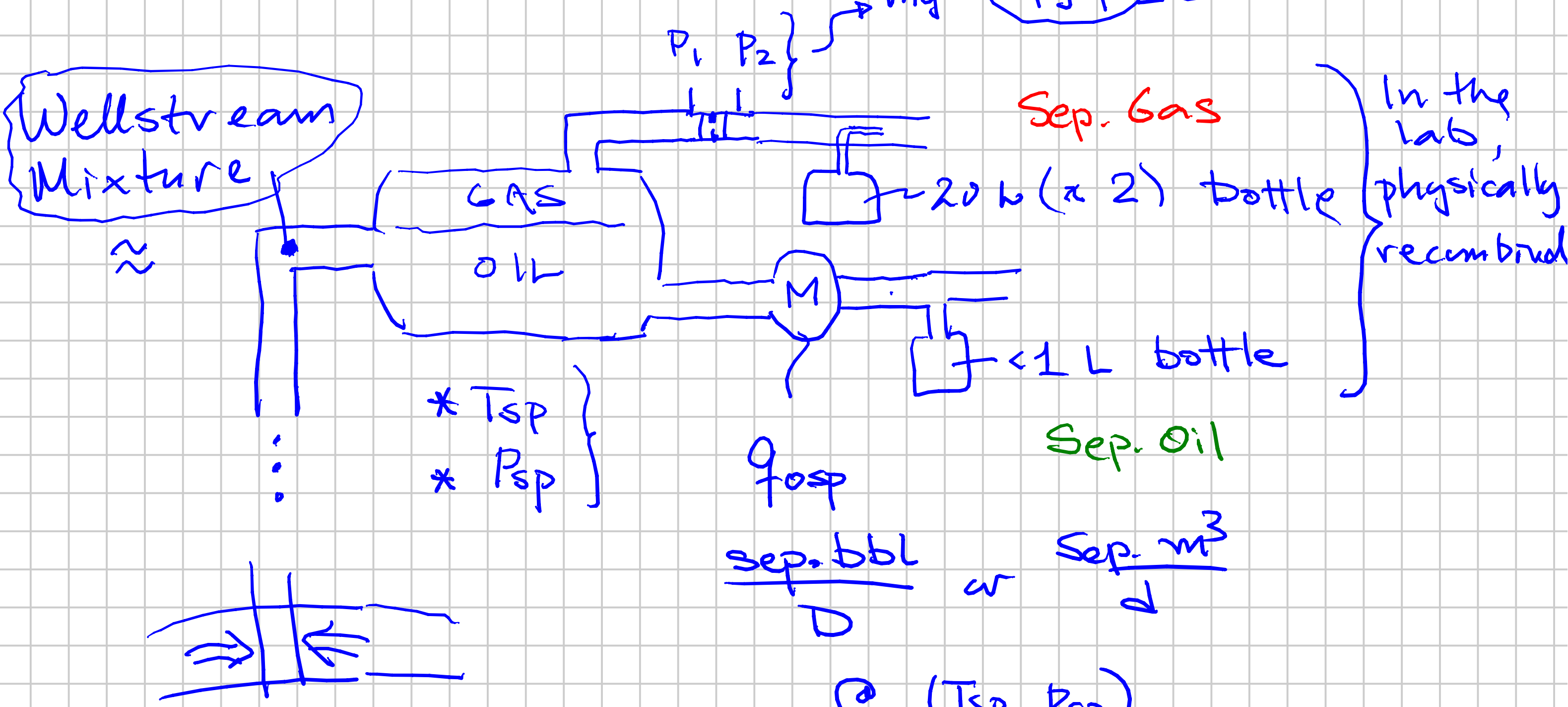
DURING CASED HOLE PRODUCTION TEST (Flowing/Shut-In)

(2) Wireline Bottomhole Sampler
(usually located ~ at/above perforations)

(a) During Flow
(b) During Shut-In
} "Average" Sample over the perf'd interval

ONLY Recommended for "Oil" reservoirs
whereas Openhole Formation BHS can be any kind of reservoir fluid (oil or gas/gas condensate)

(3) (Well Must be flowing)
SEPARATOR SAMPLE



@ (Tsp, Psp)

$$\text{Separator Test GOR} = \frac{q_{gsp}}{q_{osp}} \left[\frac{scf}{sep.bbl}, \frac{Sm^3}{sep\ m^3}\right]$$

Beware: Test Company Report (xls) often convert the physically measured q_{osp} [sep-bbl/D] into a "Stock-Tank Oil" Rate $(q_{\bar{o}})_T$

How?
⇒ Is it made? q_{osp} or $q_{\bar{o}}$

2% → 30%

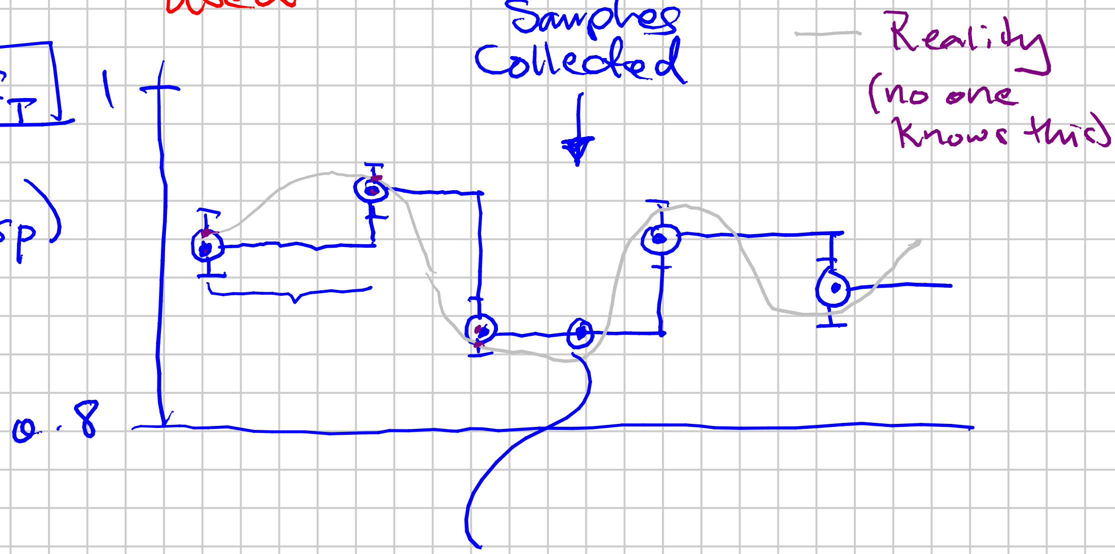
ASK Testing Company

If $q_{\bar{o}}$ reported ⇒ Ask for the Test Shrinkage Factor

$$SF_T \equiv \frac{q_{\bar{o}}}{q_{osp}}$$

used

$SF_T = f(T_{sp}, p_{sp})$



$$q_{osp} = \frac{q_{\bar{o}T}}{SF_T}$$

PVT Lab needs

Lab will (slightly 1%-5%) q^T_{gsp} [scf/D]

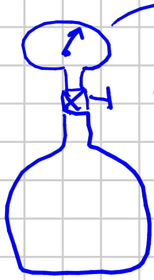
Gas Meter Eq.: (Z^T_g, M^T_g) approx.

Lab $\{ Z_g^{Lab} \quad M_g^{Lab} \} \Rightarrow q_{gsp}^{Corr}$

Lab will <u>Recombine</u> using $\left(\frac{q_{gsp}^{Correct}}{q_{osp}^{Correct}} \right) = R_{sp}$

Lab makes two QC tests of the sample bottles:

① Sep. Gas



Check $p_{opening} \doteq p_{sp}$ >10% ?

Open Valve

Heat Gas Bottle to T_{sp}

Identify possible Leakage during transport

② Sep. Oil

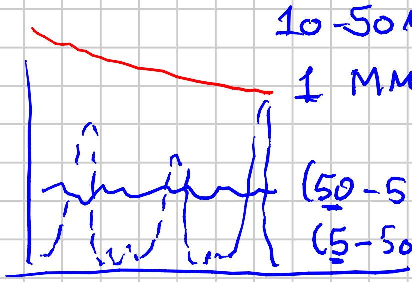
@ T_{sp}

$(p_b) = p_{sp}$

Sep. Samples OK ✓ for reservoir oils & gas condensates

q_g

q_o ↗ ~ Stabilized



10-50 Mscf/D (off)

1 MMscf/D (on)

(50-5000+ STB/D)

(5-5000 STB/D)

DETERMINING COMPOSITION OF THE SAMPLE(S)

M_i ↓ weight (mass)-% / molar-% } of N_2 CO_2 H_2S / C_1 C_2 ... C_6 .. C_7 C_8 ...

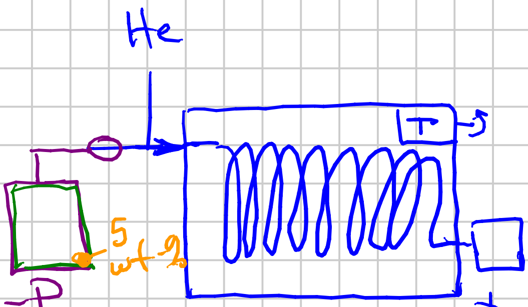
C_{N+}

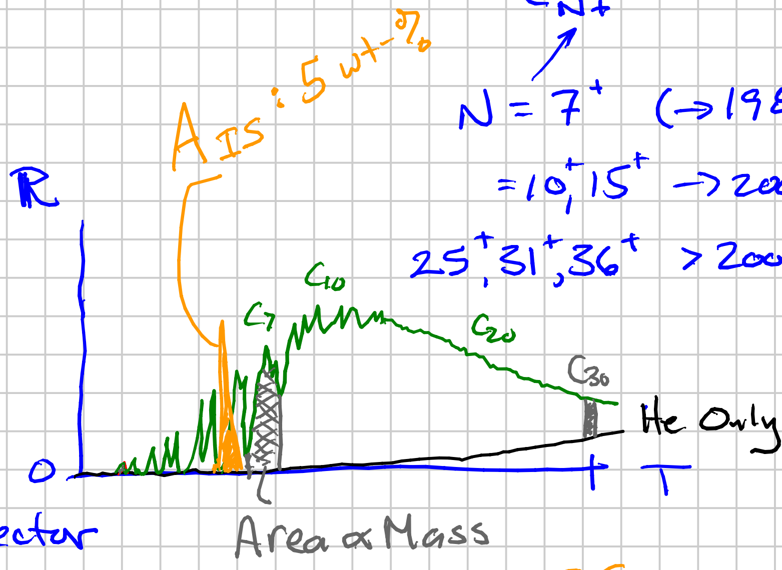
$N = 7^+$ (→1980)

$= 10^+, 15^+$ → 2000

$25^+, 31^+, 36^+$ > 2000

① GAS CHROMATOGRAPH





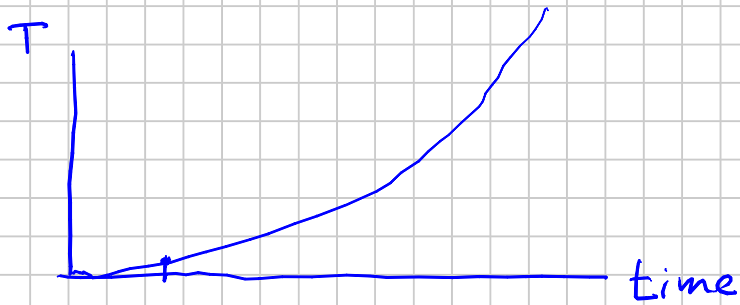
Low-P Sample:

(1) atmospheric oil

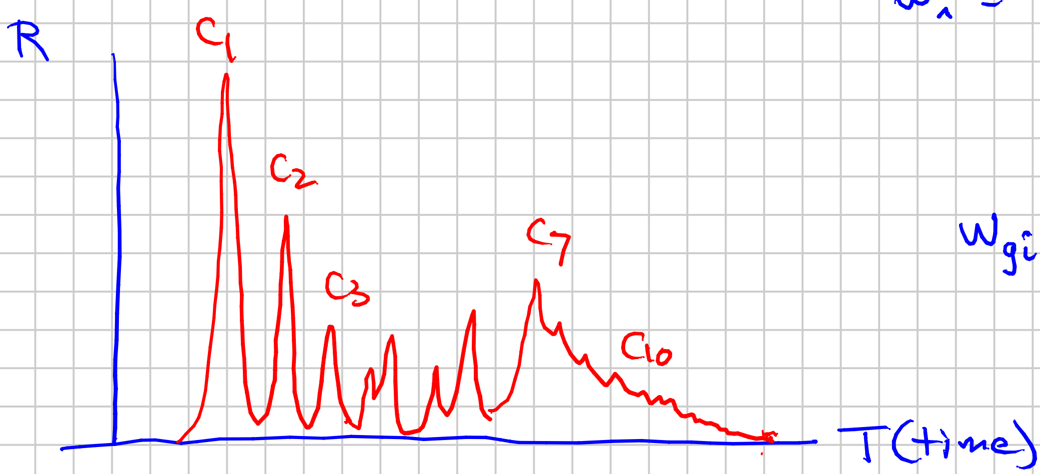
(2) separator gas
atmospheric gas

I.S.

i	A_i →	W_{oi}%
C_1		$\sum_{i=1}^{N-1}$
C_2		
⋮		
C_{N+}	?	$100 - \Sigma$



$$w_i \equiv \frac{m_i}{m}$$

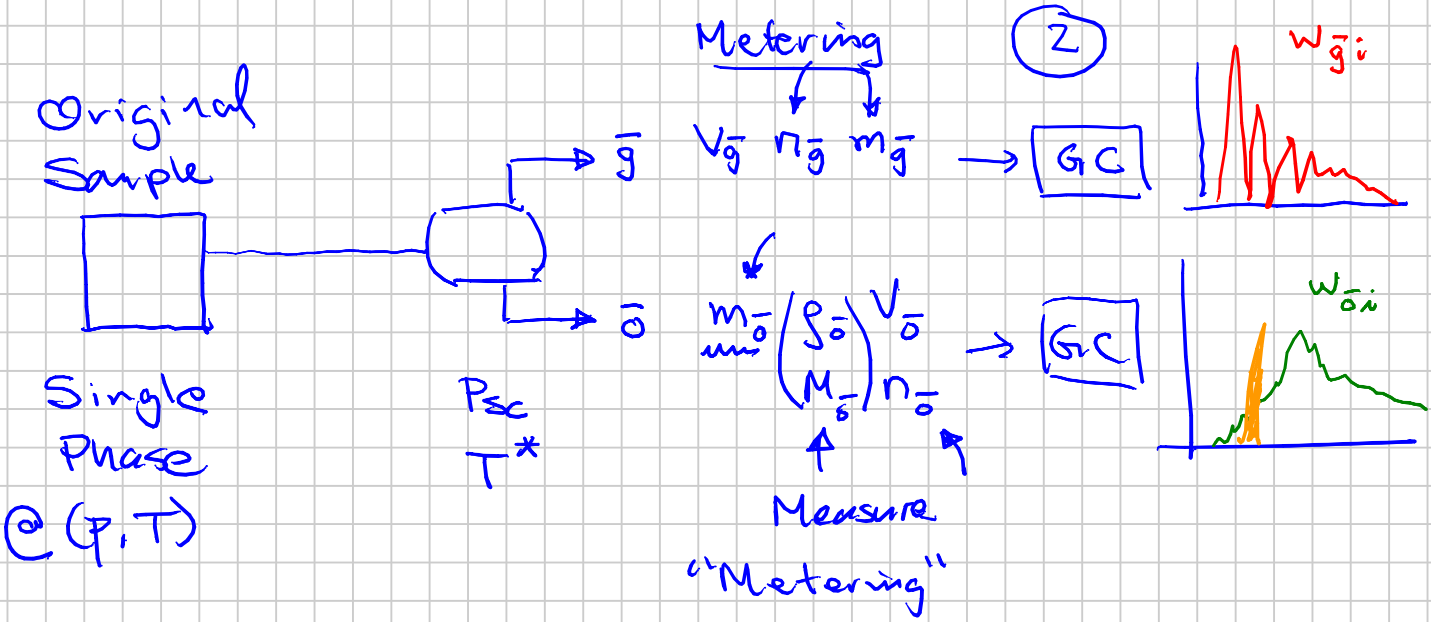


w_{gi}

"Pressurized" Samples

- Bottomhole Samples (all types)
- Separator oil

① Flash Equilibrium @ 1 atm T^* (~60°F)



③ Recombination $\bar{g}$ & $\bar{o}$ ⇒ Original Sample

$$m_i = m_{\bar{g}} \cdot w_{\bar{g}i} + m_{\bar{o}} w_{\bar{o}i}$$

$$w_i = \frac{m_i}{\sum_{j=1}^{N_t} m_j}$$

④ Mole Fractions

$$n_i = w_i / M_i \qquad M_i \, ?$$

$i = H_2S\ CO_2\ N_2$
$C_1 - C_5$ ✓

C_6
C_7
$\vdots$
C_{N_t}
} Differ somewhat field to field

$$(x_i,\ z_i) = \frac{n_i}{\sum_{i}^{N_t} n_j} \quad ✓$$

$\{M_{N+}\}$ ↕ Large Variations Field to Field

Lab has "internal average"

M_i^{Lab} SCN $i = 7, \ldots, N-1$

(Ch. 5 Table 5.2 Katz & Firoozabadi)

Lab measured $\boxed{M_{\bar{o}}}$ 232

$\pm 2\text{-}10^{+}\%$

Cryoscopic Benzene (Freezing Point Depression)

↓

M

$$\overset{\checkmark}{M_{\bar{o}}} = \frac{\sum \overset{\checkmark}{w_i}}{\left(\sum_{i=1}^{N-1} \frac{w_i}{M_i} \right) + \frac{w_{N+}}{M_{N+}}}$$

→ Back-Calculate M_{N+}

Lab