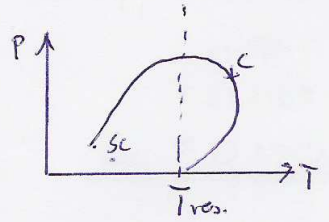
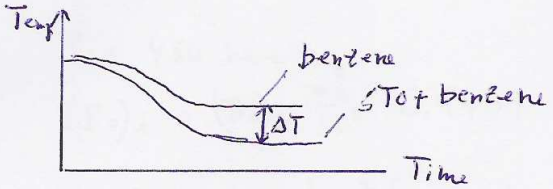
MPE-690 PVT-analysis and Res. modelling.

Problem 1.

(1) - Oil reservoir.



(2) Principle: Freezing point depression



$$\Delta T = K_f \frac{\frac{m_{STO}}{M_{STO}}}{\frac{m_b}{1000}}$$

$\Rightarrow M_{STO} = \dots$

(3) GC-analysis of STO:

- FID: peak area proportional to the mass ($A_i \propto m_i$)
- Internal standard i-C8 (iso-octane)
- Responsfactor: $R_s = \frac{m_s}{A_s}$
- Given m_{STO}, m_s (about 1%)
- $m_i = R_s \cdot A_i$
- $\underline{\left(\text{Weight \%}\right)_i = \frac{100\% \cdot m_i}{m_{STO}}}$

$$\underline{(wt\%)_{C_{10+}} = 100 - \sum (w\%)_i}$$

(4) Based on 100g STO: (mole conservation)

$$\frac{100}{M_{STO}} = \sum_{i=1}^{C_9} \frac{(w\%)_i}{M_i} + \frac{(w\%)_{C_{10+}}}{M_{C_{10+}}}$$

$$M_{C_{10+}} = \frac{(wt\%)_{C_{10+}}}{\frac{100}{187} + \sum_{i=1}^{C_9} \frac{(wt\%)_i}{M_i}}$$

⑤ Molefraction of C_1 in the reservoir fluid. (Based on 1 mole res. fluid)

$Z_{C_1} = n_{STO} \cdot x_{C_1} + n_g \cdot y_{C_1}$ $\quad n_{STO}$ and n_g : molefractions.

$= 0.34$) : $n_{STO} + n_g = 1$

$= 0.2162 \cdot 0.343 + 0.7838 \cdot 0.7079$

$\underline{Z_{C_1} = 0.6290}$

⑥

$(B_o)_b = 2.29 \ \frac{m_b^3}{Sm^3}$

$P_i = 450$ bara

$(B_o)_i = (B_o)_b \frac{m_b^3}{Sm^3} \cdot 0.9439 \ \frac{m_i^3}{m_b^3} = \underline{2.16 \ \frac{m^3}{Sm^3}}$

$HCPV = 10^6 m^3 \cdot \Phi(1 - S_{wi}) = 10^6 \cdot 0.25(1 - 0.25)$

$\underline{HCPV = 1.875 \times 10^5 \ m^3}$

$IOIP = \frac{HCPV}{(B_o)_i} = \frac{1.875 \times 10^5}{2.16} = \underline{8.6806 \times 10^4 \ Sm^3}$

$IGIP = GOR \cdot IOIP = 382 \cdot 8.6806 \times 10^4 =$

$\underline{IGIP = 33.159 \times 10^6 \ Sm^3}$

⑦ Production $P_i \rightarrow P_b$

$V_{STO} = HCPV \left(\frac{1}{(B_o)_i} - \frac{1}{(B_o)_b} \right) = 1.875 \times 10^5 \left(\frac{1}{2.16} - \frac{1}{2.29} \right)$

$\underline{V_{STO} = 4.928 \times 10^3 \ Sm^3}$

$V_g = GOR \cdot V_{STO} = 382 \cdot 4.928 \times 10^3 = \underline{1.882 \times 10^6 \ Sm^3}$

% recovery at P_b : $\frac{100\% \cdot V_{STO}}{IOIP} = \frac{100 \cdot 0.4928 \times 10^4}{8.6806 \times 10^4}$

$= \underline{5.68\%}$

(8) Diff. gas liberation:

- Fluid in PVT-cell at T_{res} and P_b
- Only gas is produced from the cell in pressure steps.
- Volume of the gas at actual P_{res} and P_{sc} is measured.
- Comp. of produced gas is determined.
- Residual oil at sc: P_{sc}, T_{sc}

(9)

$$(B_o)_d = \frac{(V_o)_{res}}{(V_o)_{residual}}$$

$(V_o)_{residual}$: at 1 atm and 15°C.

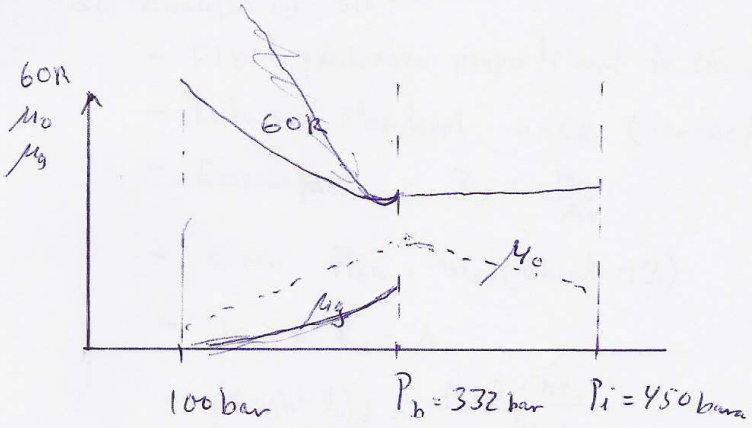
$$R_{sd} = \frac{(V_g)_{sc}}{(V_o)_{residual}}$$

$(V_g)_{sc}$: Volum of gas i the oil at P_{res} measured at sc.

$$B_g = \frac{(V_g)_{res.}}{(V_g)_{sc}}$$

ordinary B_g-factor.

(10)



μ_g: decreases due to decrease in P from P_b

μ_o: goes through a maximum at P_b

GOR: Constant at $P_{res} > P_b$, at $P < P_b$ GOR increases.