Key Solution

CHEN 490 – Fundamentals of Petroleum Engineering
HW # 2 – Due Thursday, 10l10/2013

1. Converting from a weight percent analysis to mole percent for a hydrocarbon gas.

Component	Wt., %	M
C1	30	16.04
C2	40	30.07
C3	30	44.09

2. A gas well is producing gas with a sp. gravity of 0.65 at a rate of 1.1 MM scf /day. The average reservoir pressure and temperature are 1500 psi and 150 F. Calculate:
   a) Apparent molecular weight of the gas
   b) Gas density at reservoir conditions
   c) Flow rate in lb/day

3. (a) Compute the initial tank oil in place for the following field.
   Area = 1000 acres
   Average porosity, ϕ = 18%
   Average connate water saturation, Sw = 25%
   FVF for oil, Bo = 1.15
   Average sand thickness = 15 ft

   0.5×10000 ft $\times \frac{psi}{ft}$
   P = 5000 psi
   T = 150 °F
   = 610 °R

   (b) Compute the standard quantity of 0.70 gravity gas which could be contained in the same field.
   Reservoir depth = 10000 ft
   Static pressure gradient for area = 0.50 psi/ft
   Temperature gradient = 1.5/100 ft
   Average surface temperature = 75 F

   $\frac{1.5}{100 \text{ ft}} \times 10000$

4. A cylindrical core sample was subjected to the following linear flow test conditions. Compute the sample's permeability in md.
   L = 10 cm
   μ = 1 cp
   Diameter = 2 cm
   Q = 12 cc/min
   P1 = 44.1 psig
   P2 = 14.7 psia

1. Solution

(1) Component	(2) Wt.%	(3) M	(4) (2)÷(3) Moles/100 lb	Mole %
C_1	30	16.04	1.87	48.2
C_2	40	30.07	1.33	34.3
C_3	30	44.09	0.68	17.5
			3.88	100.00

2. Solution

Given: Gas with $\gamma_g = 0.65$

$q_g = 1.1$ MM scf/day

Avg. $P = 1500$ psi

$T = 150°$ F

a) Apparent Molecular wt., M_a

$$\gamma_g = \frac{M_a}{28.96}$$

$$M_a = (\gamma_g)(29) = (0.65)(29) = \underline{18.82}$$

b) Gas density

$$\rho_g = \frac{P M_a}{RT} = \frac{(1500)(18.82)}{(10.73)(610)} = \underline{4.31} \text{ lb/ft}^3$$

c) Flow rate in lb/day

Because 1 lb-mole of any gas occupies 379.4 scf at std. conditions, then the daily number of moles that the gas well is producing can be calculated from eqn.

$$n = \frac{(1.1)(10^6)}{379.4} \frac{\text{scf/day}}{\text{scf/lb-mole}} = 2899 \ \frac{\text{lb-mole}}{\text{day}}$$

3. Solution

a) Given: $A = 1000$ acres
$\phi = 18\%$
$S_w = 25\%$
B_o, FVF $= 1.15$
$h = 15$ ft

Compute the initial tank oil in place, N

$$N = \frac{7758\, A h \phi (1 - S_w)}{B_o}$$

$$= \frac{(7758)(1000)(15)(.18)(.75)}{1.15}$$

$$= \underline{13.6 \times 10^6} \text{ bbl tank oil}$$

b) Given:

Reservoir depth = 10000 ft
Static pressure gradient = 0.5 psi/ft

$$P_s = (0.5 \text{ psi/ft})(10000 \text{ ft})$$

$$= 5000 \text{ psi}$$

psi/ft x 10,000 ft

Temp. gradient = 1.5 / 100 ft

$$T = \frac{(1.5)(10000)}{100} = 150^\circ F$$

$$= 610^\circ R$$

Avg. surface temp. = $75^\circ F$ = $535^\circ R$

$V_p = 43560\, \phi (1 - S_w)$ cu ft/acre-ft
$T_s = 460 + 75 = 535^\circ R$
$P_s = 14.7$ psia
$Z \cong 1$

$$G_i = (43560)(.18)(1000)(15)(.75) \times \frac{535}{14.7} \times \frac{5000}{(610)(1.1)}$$

=

26.0×10^9

USE FOR ANSWER

4. Solution:

Given: Cylindrical core..

Linear flow test conditions

$L = 10$ cm
$\mu = 1$ cp
$d = 2$ cm
$q = 12$ cc/min

$P_1 = 44.1$ psig
$P_2 = 14.7$

Find K ?

$$K = \frac{q \mu L}{A \Delta P}$$

$$K = \frac{\frac{(12)}{60}(1)(10)}{(\pi)(1)^2\left(\frac{44.1}{14.7}\right)}$$

$\cong 0.210$ darcy

$\cong 210$ md