Key Solution

CHEN 490 –Fundamentals of Petroleum Engineering
HW # 3 – Due Tuesday, 22/10/2013

1. How much tank oil exists in the following field?
   Area of field = 640 acres
   Average sand thickness = 29 ft
   Average porosity = 20%
   Average connate water saturation = 30 %
   FVF = 1.20

2. Given the following data, compute the porosity of a cylindrical sample. The grain volume was measured in a two-cell Boyle's law porosimeter.
   Sample dimension: length = 6 cm
   Diameter = 2.5 cm
   Porosimeter data:
   V_1 = 25 cc
   V_2 = 50 cc
   P_1 = 100 psig
   P_2 = 50 psig

3. The bulk volume of a core sample was measured in mercury displacement as 25.0 cc. Pore volume was obtained by saturating the sample with a hydrocarbon solvent as shown by the following data:
   W_d = 50.25 gm
   W_g = 54.50 gm
   ρ = 0.701 gm/cc
   a) What is the sample's porosity
   b) What is the grain density of this rock

4. Compute the ideal production rate of the following well which was completed in the sand of the following data:
   Well spacing = 1 well per 40 acres
   Sand thickness = 10 ft
   Static reservoir pressure, P_e = 2000 psia
   Bottom hole producing pressure, Pw = 1500 psia
   Reservoir oil viscosity = 3 cp
   Well diameter = 8 in.

1. Given: 640 acres = A

Thickness, $h = 29$ ft

$\phi = 20\%$

$S_{wc} = 30\%$

$B_o = 1.20$

Find: How much tank oil in the field?

Solution:

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

$$= \frac{7758\,(0.20)\,(1-0.30) \times 640 \times 29}{1.20}$$

$$= 16.8 \times 10^6 \text{ bbl}$$

2. Given : Cylindrical core sample

Sample length = 4 cm
diameter = 2.5 cm
porosimeter data :
$V_1 = 25 cc$
$V_2 = 50 cc$
$P_1 = 100 psig$
$P_2 = 50 psig$

Compute the porosity

Solution :

$$V_b = \frac{\pi (2.5)^2}{4} \times 4 = 19.6 cc$$

$$V_s = V_1 + V_2 - \frac{P_1}{P_2} V_1$$

$$= 25 + 50 - \frac{100}{50} \times 25$$

$$= 25 cc$$

$$\phi = \frac{25.0 - 19.6}{25.0} \simeq 0.216 = 21.6\%$$

$P_1 V_1 = P_2 V_2$

$\frac{P_1}{P_2} V_1 =$

$P_1 V_1 = P_2 V_2 = K$

3. Given: Dry core sample, weight, $W_d = 50.25$ gm
Sample saturated weight, $W_s = 54.50$ gm
density of saturating liquid, $\rho = 0.701$ gm/cc

a) What is the sample porosity?
b) What is the grain density of this rock?

Solution:

a) Sample ϕ ?

$$V_p = \frac{W_s - W_d}{\rho} = \frac{54.5 - 50.25}{0.701}$$

$$= 6.06 \text{ cc}$$

$$\phi = \frac{6.06}{25} = 0.242 \text{ or } 24.2\%$$

b) Grain density, ρ_g

$$\rho_g = \frac{W_d}{V_g} = \frac{W_d}{V_b(1-\phi)}$$

$$= \frac{50.25}{25(1-.242)}$$

$$= 2.65 \text{ gm/cc}$$

4. Given: Well spacing = 1 well / 40 acres

Sand thickness = 10 ft

P_w = 1500 psia

P_e = 2000 psia

μ_o = 3 cp, K = 117 ~~darcy~~ md

d_w = 8 in, r_w = 0.33 ft

r_e = 700 ft

Find: Ideal production rate

Solution:

$$q_o = \frac{7.07 K h (P_e - P_w)}{\mu_o \ln(700/0.33)}$$

$$= \frac{7.07(117)(10)(500)}{(3)\ln(700/.33)}$$

$\ln(700/.33) = 6.06$

$$\cong 180{,}000 \text{ bbl/day}$$