

Tikrit University
The College of Petroleum Processes
Engineering
Petroleum and Gas Refining Engineering
Department

An Introduction to Petroleum Technology

First Class

Lecture (9)

By

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Initial oil in place (OIIP)

Oil initially in place (OIIP) is the amount of crude oil first estimated to be in a reservoir. Oil initially in place differs from oil reserves, as OIIP refers to the total amount of oil that is potentially in a reservoir and not the amount of oil that can be recovered. Calculating OIIP requires engineers to determine how porous the rock surrounding the oil is, how high water saturation might be and the net rock volume of the reservoir. The numbers for the aforementioned factors are established by conducting a series of test drills around the reservoir.

Determination of initial oil in place

There are commonly two approaches:

- 1- Volumetric method.
- 2- Material Balance method.
- 3- Decline curve.

Derivation and access to the final equation:

$$\text{Bulk volume} = 43560 \text{ Ah, ft}^3 \quad 9-1$$

or

$$\text{Bulk volume} = 7758 \text{ Ah, bbl} \quad 9-2$$

$$P_v = 43560 \text{ Ah}\Phi, \text{ ft}^3. \quad 9-3$$

Or

$$P_v = 7758 \text{ Ah}\Phi, \text{ bbl} \quad 9-4$$

$$\text{Where: } 1 \text{ acres} = 43560 \text{ ft}^3$$

$$1 \text{ bbl} = 5.6148 \text{ ft}^3$$

$$N \text{ (OIIP)} = 7758 \text{ V}_b \Phi (S_{oi}) / B_{oi} \quad 9-5$$

Or

$$N = 7758 V_b \Phi (1 - S_{wi}) / B_{oi} \quad 9-6$$

Where:

N is initial oil in place, STB

Oil Reserves (N_p) = initial oil in place(N) – Remaining oil in place (N_r)

$$N_p = [7758 V_b \Phi (1 - S_{wi} - S_{or}) / B_{oi}] \quad 9-7$$

Where , B_{oi} : initial oil formation volume factor, 1bb/STB.

S_{or} : Residual oil saturation, fraction.

$$B_o = \frac{(V_o)_{p,T}}{(V_o)_{sc}} \quad 9-8$$

$$B_{oi} = \frac{(V_o)_{p_i, T_i}}{(V_o)_{sc}} \quad 9-9$$

Where :

B_o = oil formation volume factor, bbl/STB

$(V_o)_{p,T}$ = volume of oil under reservoir pressure p and temperature T.

B_{oi} = initial oil formation volume factor in reservoir barrels per stock tank barrel (bbl/STB)

$(V_o)_{p_i, T_i}$ = volume of oil in reservoir before production.

$(V_o)_{sc}$ = volume of oil is measured under standard conditions, STB (1 atm and 60 f°) 1 atm= 14.7 psi .

Recovery Factor (Rf):

It is the ratio between the volume of oil produced or capable of production and the volume of the original oil.

$$R_f = \frac{(\text{recoverable oil})}{(\text{initial Oil in place})} = \frac{NP}{N} = \frac{1-S_{wi}-S_{or}}{1-S_{wi}} \quad 9-10$$

Example1:

Calculate the initial oil-in-place (N) of an oil reservoir if A=1,600 acres, h=32 ft, $\phi=22\%$, $S_{wi}=20\%$, and $B_{oi}=1.23$ bb1/STB.

Solution

Using Eq. (9-6), we have:

$$N = 7758 (1600) (32) (0.22) (1-0.20) / (1.23) = 56.8 \times 10^6 \text{ STB}$$

Example2:

Calculate the initial oil-in-place (N) & Oil Reserves (Np) of an oil reservoir if A=1,600 acres, h=32 ft, $\phi=22\%$, $S_{wi}=20\%$, $S_{or}=15\%$ and $B_{oi}=1.23$ bb1/STB, $B_o=1.104$ bb1/STB

Solution

Using Eq. (9-6), we have:

$$N = 7758 (1600) (32) (0.22) (1-0.20) / (1.23) = 56836495.61 \text{ STB}$$

$$N_p = [7758 V_b \phi (1-S_{wi}-S_{or}) / B_{oi}]$$

$$N_p = 46179652.68 \text{ STB}$$

Or

$$R_f = \frac{1-S_{wi}-S_{or}}{1-S_{wi}} = \frac{1-0.2-0.15}{1-0.2} = 0.8125$$

$$R_f = \frac{NP}{N}$$

So that :

$$N_p = R_f \times N = 0.8125 \times 56836495.61 = 46179652.68 \text{ STB}$$