Initial Oil in Place from the Material Balance Equation

Initial oil in place from production, PVT data, gas-cap size, water influx and rock and water expansion by the general material balance equation.

Input parameters

Unit system: SI

Parameter	Value	Unit
Cumulative oil produced	0.80000	MMbbl
Cumulative produced gas-oil ratio	520.00	scf/STB
Oil formation volume factor now	1.3750	
Initial oil formation volume factor	1.3600	
Solution gas-oil ratio now	520.00	scf/STB
Initial solution gas-oil ratio	520.00	scf/STB
Gas formation volume factor now	8.0000e-04	bbl/scf
Initial gas formation volume factor	8.0000e-04	bbl/scf
Gas-cap to oil volume ratio	0	
Cumulative water influx	0	MMbbl
Cumulative water produced	0.010000	MMbbl
Water formation volume factor	1.0200	
Initial water saturation	24.000	%
Water compressibility	3.2000e-06	1/psi
Pore compressibility	5.0000e-06	1/psi
Pressure drop	1,100.0	psi

Calculated results

Parameter	Value	Unit
Initial oil in place (stock tank)	42.127	MMbbl
Underground withdrawal	1.1000	MMbbl
Oil and dissolved-gas expansion per stock-tank barrel	0.015000	
Gas-cap expansion per stock-tank barrel	0	
Rock and water expansion per stock-tank barrel	0.011354	

Notes for this case

- The material balance needs a measurable pressure drop; early in the life of a reservoir small errors in pressure or PVT give large errors in N. Plot F against the expansion terms over several surveys (Havlena–Odeh) to test the result.

Formula and method

$$N = \frac{N_p[B_o + (R_p - R_s)B_g] - (W_e - W_p B_w)}{(B_o - B_{oi}) + (R_{si} - R_s)B_g + mB_{oi}\left(\frac{B_g}{B_{gi}} - 1\right) + B_{oi}(1+m)\frac{S_{wi}c_w + c_f}{1 - S_{wi}}\Delta p}$$

Variables

N_p	Cumulative oil produced	m³
R_p	Cumulative produced gas-oil ratio	m³/m³

B_o	Oil formation volume factor now	-
B_{oi}	Initial oil formation volume factor	-
R_s	Solution gas-oil ratio now	m³/m³
R_{si}	Initial solution gas-oil ratio	m³/m³
B_g	Gas formation volume factor now	m³/m³
B_{gi}	Initial gas formation volume factor	m³/m³
m	Gas-cap to oil volume ratio	-
W_e	Cumulative water influx	m³
W_p	Cumulative water produced	m³
B_w	Water formation volume factor	-
S_{wi}	Initial water saturation	-
c_w	Water compressibility	1/Pa
c_f	Pore compressibility	1/Pa
$p_i - p$	Pressure drop	Pa
N	Initial oil in place (stock tank)	m³
F	Underground withdrawal	m³
E_o	Oil and dissolved-gas expansion per stock-tank barrel	-
$mB_{oi}E_g$	Gas-cap expansion per stock-tank barrel	-
$E_{f,w}$	Rock and water expansion per stock-tank barrel	-

Method and standards

General (Schilthuis) material balance.

Assumptions and limits

- Tank model; PVT at average pressure.

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/chemical/reservoir-engineering/oil-material-balance-ooip

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Reopens the calculator with the inputs of this report.