Pseudo-Steady-State Well Rate with Dietz Shape Factor

Oil well rate and productivity index at pseudo-steady state in a bounded drainage area of any shape (Dietz shape factor), and the pressure decline rate.

Input parameters

Unit system: SI

Parameter	Value	Unit
Permeability	25.000	mD
Net pay thickness	40.000	ft
Oil viscosity	1.2000	cP
Oil formation volume factor	1.3000	
Porosity	20.000	%
Total compressibility	1.5000e-05	1/psi
Drainage area	80.000	acre
Dietz shape factor (circle 31.62, square 30.88)	21.837	
Wellbore radius	0.30000	ft
Skin factor	3.0000	
Average reservoir pressure	2,800.0	psi
Flowing bottom-hole pressure	1,800.0	psi

Calculated results

Parameter	Value	Unit
Oil rate (stock tank)	428.32	bbl/d
Productivity index	0.42832	bbl/(d·psi)
Rate of decline of the average pressure	0.31150	psi/h
Time to reach pseudo-steady state (t_DA = 0.1)	190.31	h

Notes for this case

• Valid after the boundaries are felt (pseudo-steady state); for a circle C_A = 31.62 reduces it to the ln(r_e/r_w) − 0.75 form. Elongated or off-centre drainage areas have small C_A and lower productivity.

Formula and method

$$Q_o = \frac{2\pi k h(\bar{p} - p_{wf})}{\mu B_o \left[\frac{1}{2}\ln\frac{4A}{\gamma C_A r_w^2} + s\right]}, \quad \frac{d\bar{p}}{dt} = \frac{Q_o B_o}{Ah\phi c_t}, \quad \gamma = 1.781$$

Variables

k	Permeability	m²
h	Net pay thickness	m
μ_o	Oil viscosity	Pa·s
B_o	Oil formation volume factor	-
ϕ	Porosity	-
c_t	Total compressibility	1/Pa
A	Drainage area	m²
C_A	Dietz shape factor (circle 31.62, square 30.88)	-

r_w	Wellbore radius	m
s	Skin factor	-
$\bar{p}$	Average reservoir pressure	Pa
p_{wf}	Flowing bottom-hole pressure	Pa
Q_o	Oil rate (stock tank)	m³/s
J	Productivity index	m³/(s·Pa)
$d\bar{p}/dt$	Rate of decline of the average pressure	Pa/s
t_{pss}	Time to reach pseudo-steady state (t_DA = 0.1)	s

Method and standards

Pseudo-steady-state flow in bounded drainage areas.

Assumptions and limits

- Single-phase, slightly compressible oil; constant rate.

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/pseudo-steady-state-shape-factor

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Reopens the calculator with the inputs of this report.