Arps Decline Curve: Rate and Cumulative Production

Production rate and cumulative production after a time by Arps' exponential, hyperbolic or harmonic decline, from initial rate, decline rate and exponent b.

Input parameters

Unit system: SI

Parameter	Value	Unit
Initial rate	1,000.0	bbl/d
Initial decline rate (nominal)	0.40000	1/a
Decline exponent (0 exponential, 1 harmonic)	0.50000	
Time	3.0000	a

Calculated results

Parameter	Value	Unit
Rate at time t	390.62	bbl/d
Cumulative production to time t	684,844	bbl
Effective annual decline in the first year	30.556	%

Notes for this case

- D_i is the nominal (instantaneous) decline rate; the effective first-year decline is shown for comparison. Arps' relations hold for boundary-dominated flow at constant bottom-hole pressure.

Formula and method

$$q = \frac{q_i}{(1 + b D_i t)^{1/b}}, \quad N_p = \frac{q_i^b}{(1-b) D_i}\left(q_i^{1-b} - q^{1-b}\right)$$

$$q = q_i e^{-D_i t}, \; N_p = \frac{q_i - q}{D_i} \; (b = 0); \quad N_p = \frac{q_i}{D_i} \ln \frac{q_i}{q} \; (b = 1)$$

Variables

q_i	Initial rate	m³/s
D_i	Initial decline rate (nominal)	1/s
b	Decline exponent (0 exponential, 1 harmonic)	-
t	Time	s
$q(t)$	Rate at time t	m³/s
N_p	Cumulative production to time t	m³
D_e	Effective annual decline in the first year	-

Method and standards

Arps' decline relations.

Assumptions and limits

- Boundary-dominated flow; constant operating conditions.

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/arps-decline-curve

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.