Theis Well Drawdown (Non-Equilibrium) and Cooper–Jacob

Drawdown at a distance and time from a well pumping a confined aquifer, by the Theis well function and the Cooper–Jacob straight-line approximation.

Method: Theis non-equilibrium equation with the exponential integral; Cooper–Jacob approximation

Input parameters

Unit system: SI

Parameter	Value	Unit
Pumping rate	104.17	m³/h
Transmissivity	600.00	m²/d
Storativity (storage coefficient)	2.0000e-04	
Distance from the well	50.000	m
Time since pumping started	48.000	h

Calculated results

Parameter	Value	Unit
Well function argument r²S/(4Tt)	1.0417e-04	
Theis well function	8.5924	
Drawdown (Theis)	2.8490	m
Drawdown (Cooper–Jacob)	2.8490	m
Cooper–Jacob drawdown per log cycle of time	0.76347	m

Notes for this case

- Theis: confined, homogeneous, infinite aquifer, fully penetrating well, constant rate, water released instantly from storage.

Formula and method

$$s = \frac{Q}{4\pi T} W(u), \quad W(u) = \int_u^\infty \frac{e^{-x}}{x}\,dx = E_1(u), \quad u = \frac{r^2 S}{4Tt}$$

$$s_{CJ} = \frac{Q}{4\pi T}(-0.5772 - \ln u)$$

Variables

Q	Pumping rate	m³/s
T	Transmissivity	m²/s
S	Storativity (storage coefficient)	-
r	Distance from the well	m
t	Time since pumping started	s
u	Well function argument r²S/(4Tt)	-
$W(u)$	Theis well function	-
s	Drawdown (Theis)	m
s_{CJ}	Drawdown (Cooper–Jacob)	m
Δs	Cooper–Jacob drawdown per log cycle of time	m

Method and standards

Non-equilibrium radial flow to a well.

Assumptions and limits

- Confined aquifer, Theis assumptions.

References

Theis non-equilibrium equation with the exponential integral; Cooper–Jacob approximation

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

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

This calculator online

https://calc.firecad.com/civil/hydraulics/theis-well-drawdown

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Reopens the calculator with the inputs of this report.