Average Permeability of Layers: Arithmetic, Harmonic, Geometric

Average permeability of up to five beds: thickness-weighted arithmetic for parallel flow, harmonic for beds in series, and geometric for random heterogeneity.

Input parameters

Unit system: SI

Parameter	Value	Unit
Layer 1 thickness (0 if unused)	4.0000	ft
Layer 1 permeability	150.00	mD
Layer 2 thickness (0 if unused)	6.0000	ft
Layer 2 permeability	60.000	mD
Layer 3 thickness (0 if unused)	2.0000	ft
Layer 3 permeability	400.00	mD
Layer 4 thickness (0 if unused)	5.0000	ft
Layer 4 permeability	25.000	mD
Layer 5 thickness (0 if unused)	0	ft
Layer 5 permeability	100.00	mD

Calculated results

Parameter	Value	Unit
Arithmetic (parallel beds, flow along the layers)	110.88	mD
Harmonic (beds in series, flow across them)	51.256	mD
Geometric (random heterogeneity)	71.926	mD
Total thickness	17.000	ft
Flow capacity Σkh	1,885.0	

Notes for this case

• Arithmetic: horizontal flow through stacked layers (the usual reservoir case). Harmonic: flow across the layers, for example vertical flow or beds in series along the flow path. Geometric: random, uncorrelated heterogeneity. Σkh is in mD·ft.

Formula and method

$$k_{arith} = \frac{\sum k_i h_i}{\sum h_i}, \quad k_{harm} = \frac{\sum h_i}{\sum h_i / k_i}, \quad k_{geom} = \exp\left(\frac{\sum h_i \ln k_i}{\sum h_i}\right)$$

Variables

h_1	Layer 1 thickness (0 if unused)	m
k_1	Layer 1 permeability	m²
h_2	Layer 2 thickness (0 if unused)	m
k_2	Layer 2 permeability	m²
h_3	Layer 3 thickness (0 if unused)	m
k_3	Layer 3 permeability	m²
h_4	Layer 4 thickness (0 if unused)	m
k_4	Layer 4 permeability	m²

h_5	Layer 5 thickness (0 if unused)	m
k_5	Layer 5 permeability	m²
k_{arith}	Arithmetic (parallel beds, flow along the layers)	m²
k_{harm}	Harmonic (beds in series, flow across them)	m²
k_{geom}	Geometric (random heterogeneity)	m²
h_t	Total thickness	m
Σkh	Flow capacity Σkh	-

Method and standards

Permeability averaging.

Assumptions and limits

- Uniform properties within each layer.

Report details

Report reference	FCC-S937-23ZH (the same inputs always give the same reference)
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Calculator	Average Permeability of Layers: Arithmetic, Harmonic, Geometric
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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/chemical/reservoir-engineering/permeability-averaging-layers

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.