Electrical Double Layer Thickness (Debye Length)

Ionic strength and the Debye length (thickness of the electrical double layer) around particles for a symmetric electrolyte at a given concentration and temperature.

Input parameters

Unit system: SI

Parameter	Value	Unit
Electrolyte molarity, mol/L	0.50000	
Ion charge (symmetric electrolyte)	1.0000	
Temperature	25.000	°C
Relative permittivity of water	78.540	

Calculated results

Parameter	Value	Unit
Ionic strength, mol/L	0.50000	
Debye length	0.43032	nm

Notes for this case

- The double layer shrinks as ionic strength rises; compressing it lets particles approach and flocculate (the mechanism of double-layer compression in coagulation).

Formula and method

$$\frac{1}{\kappa} = \left(\frac{\varepsilon_r \varepsilon_0 k T}{2 \times 1000\, e^2 N_A I} \right)^{1/2}, \quad I = \frac{1}{2} \sum M_i z_i^2$$

Variables

M	Electrolyte molarity, mol/L	-
z	Ion charge (symmetric electrolyte)	-
T	Temperature	K
ε_r	Relative permittivity of water	-
I	Ionic strength, mol/L	-
$1/\kappa$	Debye length	m

Method and standards

Gouy–Chapman double-layer thickness.

Assumptions and limits

- Symmetric electrolyte; dilute solution.

Report details

Report reference	FCC-VZ4X-WZQS (the same inputs always give the same reference)
Generated	23 November 2026, 17:34 UTC
Calculator	Electrical Double Layer Thickness (Debye Length)
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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/environmental/drinking-water/debye-length-double-layer

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.