Corrosion Current from Tafel Extrapolation

Corrosion current density by extrapolating a measured current at an overpotential back along a Tafel line, and the corrosion rate by Faraday's law.

Method: Tafel equation η = β log(i/i_corr); Faraday's law per ASTM G102; Jones; Principles and Prevention of Corrosion; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Measured current density on the Tafel line (µA/cm²)	500.00	
Overpotential from E_corr (mV)	150.00	
Tafel slope of that branch (mV/decade)	120.00	
Equivalent weight (g per equivalent)	27.920	kg/kmol
Metal density	7,870.0	kg/m³

Calculated results

Parameter	Value	Unit
Corrosion current density (µA/cm²)	28.117	
Corrosion rate (mm/year)	0.32625	

Notes for this case

• Valid only on the linear (Tafel) part of the E–log i curve, usually more than 50 mV from E_corr. Concentration polarisation on the cathodic branch makes the extrapolation unreliable.

Formula and method

$$i_{corr} = \frac{i}{10^{|\eta|/\beta}}, \quad CR = \frac{i_{corr} EW}{F\rho}$$

Variables

i	Measured current density on the Tafel line (µA/cm²)	-
	\eta	$
β	Tafel slope of that branch (mV/decade)	-
EW	Equivalent weight (g per equivalent)	kg/kmol
ρ	Metal density	kg/m³
i_{corr}	Corrosion current density (µA/cm²)	-
CR	Corrosion rate (mm/year)	-

Method and standards

Tafel equation.

Assumptions and limits

- Activation-controlled branch.
- Current densities are plain numbers in µA/cm², the overpotential in mV and the Tafel slope in mV/decade, in every unit system; the corrosion rate is in mm/year (1 mm/year = 39.4 mpy).

References

• Tafel equation η = β log(i/i_corr); Faraday's law per ASTM G102; Jones
• Principles and Prevention of Corrosion
• 2nd ed. (Prentice Hall, 1996)

Report details

Report reference	FCC-B6WX-JFCB (the same inputs always give the same reference)
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Release checks	2 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/materials/corrosion/tafel-corrosion-current

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.