Electrodialysis: Current, Power and Membrane Area

Current from Faraday's law for a TDS removal, stack power from its resistance, energy per cubic metre and membrane area per cell pair from the CD/N ratio.

Input parameters

Unit system: SI

Parameter	Value	Unit
Product water flow	1,000.0	m³/d
Feed normality (g-eq/L)	0.030000	
Salt removal efficiency	60.000	%
Cell pairs in the stack	300.00	
Current efficiency	92.000	%
Stack resistance	2.5000	Ω
Current density to normality ratio (mA/cm² per g-eq/L)	600.00	
Product water as a fraction of feed	85.000	%

Calculated results

Parameter	Value	Unit
Current	72.830	A
Power	13.261	kW
Energy per m³	0.37442	kWh/m³
Current density	180.00	A/m²
Membrane area per cell pair	0.40461	m²

Notes for this case

- Energy follows: power divided by y × Q_p. CD/N of 500-800 (mA/cm² per g-eq/L) avoids polarisation; the stack resistance comes from tests. Pumping energy is extra.

Formula and method

$$i = \frac{FQ_pNE_r}{nE_c}, \quad P = Ri^2, \quad CD = (CD/N)\,N, \quad A = \frac{i}{CD}$$

Variables

Q_p	Product water flow	m³/s
N	Feed normality (g-eq/L)	-
E_r	Salt removal efficiency	-
n	Cell pairs in the stack	-
E_c	Current efficiency	-
R	Stack resistance	Ω
CD/N	Current density to normality ratio (mA/cm² per g-eq/L)	-
y	Product water as a fraction of feed	-
i	Current	A
P	Power	W
e	Energy per m³	J/m³
CD	Current density	A/m²

A	Membrane area per cell pair	m²

Method and standards

Faraday's law and Ohm's law for an ED stack.

Assumptions and limits

- Constant resistance; one stack.

Report details

Report reference	FCC-4BYW-K456 (the same inputs always give the same reference)
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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/wastewater/electrodialysis-power-area

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.