Ion Exchange Resin Capacity from a Column Test and Resin Required

Resin exchange capacity from the throughput between two breakthrough curves, then the mass and volume of resin to remove an ion from a water volume.

Input parameters

Unit system: SI

Parameter	Value	Unit
Throughput at C/C₀ = 0.5 for the first ion (e.g. Cl^-)	7.5000	L
Throughput at C/C₀ = 0.5 for the exchanged ion (e.g. Ca^{2+})	22.100	L
Feed concentration of the exchanged ion (meq/L)	2.0000	
Resin mass in the test	0.10000	kg
Water to treat	4,000.0	m³
Ion to remove (meq/L)	1.0000	
Resin bulk density	700.00	kg/m³
Design factor for leakage (1.1-1.4)	1.2500	

Calculated results

Parameter	Value	Unit
Exchange capacity (meq/kg)	292.00	
Equivalents to remove (eq)	4,000.0	
Resin mass	17,123	kg
Resin volume	24.462	m³
Capacity as g $CaCO_3$ per m³ of resin	10,220	g/m³

Notes for this case

• The throughput between the half-breakthrough points of the displaced ion and the exchanged ion measures the sites filled. Typical synthetic resins hold 2-10 eq/kg; leakage and partial use make real beds 1.1-1.4 times the theoretical size. 1 eq/m³ = 50 g $CaCO_3$/m³.

Formula and method

$$EC = \frac{(V_2 - V_1)C_o}{R}, \quad R_{mass} = f\frac{C_t V_t}{EC}, \quad R_{vol} = \frac{R_{mass}}{\rho_r}$$

Variables

V_1	Throughput at C/C₀ = 0.5 for the first ion (e.g. Cl^-)	m³
V_2	Throughput at C/C₀ = 0.5 for the exchanged ion (e.g. Ca^{2+})	m³
C_o	Feed concentration of the exchanged ion (meq/L)	-
R	Resin mass in the test	kg
V_t	Water to treat	m³
C_t	Ion to remove (meq/L)	-
ρ_r	Resin bulk density	kg/m³
f	Design factor for leakage (1.1-1.4)	-
EC	Exchange capacity (meq/kg)	-
N	Equivalents to remove (eq)	-

R_{mass}	Resin mass	kg
R_{vol}	Resin volume	m^3
EC_v	Capacity as g $CaCO_3$ per m^3 of resin	kg/m^3

Method and standards

Column test exchange capacity and bed sizing.

Assumptions and limits

- Full use of capacity at the half-breakthrough points.

Report details

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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/ion-exchange-resin-capacity

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Reopens the calculator with the inputs of this report.