DM Plant Sizing (Cation and Anion Resin, Regenerant)

Cation and anion resin volumes and acid and caustic per regeneration for a two-bed demineralisation (DM) plant from flow, run time, ionic load and resin capacities.

Method: Ion-exchange mass balance (ionic load / operating capacity)

Input parameters

Unit system: SI

Parameter	Value	Unit
Treated water flow (net output; regeneration and rinse water not deducted)	20.000	m³/h
Run time between regenerations	20.000	h
Total cations to remove, as $CaCO_3$	300.00	mg/L
Total anions to remove (with CO_2 and silica if no degasser), as $CaCO_3$	280.00	mg/L
Cation resin operating capacity, as $CaCO_3$ From the resin maker's data at your regenerant dose.	50.000	g/L
Anion resin operating capacity, as $CaCO_3$	35.000	g/L
Acid dose per litre of cation resin (as 100 % HCl)	80.000	g/L
Caustic dose per litre of anion resin (as 100 % NaOH)	70.000	g/L

Calculated results

Parameter	Value	Unit
Cation resin volume	2,400.0	L
Anion resin volume	3,200.0	L
Acid per regeneration (100 % HCl)	192.00	kg
Caustic per regeneration (100 % NaOH)	224.00	kg
Water treated per run	400.00	m³

Formula and method

$$V_w = \dot{V} t_r \qquad V_c = \frac{V_w C_c}{Q_c} \qquad V_a = \frac{V_w C_a}{Q_a} \qquad m_{HCl} = V_c \, d_{HCl} \qquad m_{NaOH} = V_a \, d_{NaOH}$$

Variables

$\dot{V}$	treated water flow (net output)	m³/s
t_r	run time	s
C_c	total cations as $CaCO_3$	kg/m³
C_a	total anions as $CaCO_3$	kg/m³
Q_c	cation resin operating capacity	kg/m³
Q_a	anion resin operating capacity	kg/m³
d_{HCl}	acid dose per volume of cation resin	kg/m³
d_{NaOH}	caustic dose per volume of anion resin	kg/m³
V_c	cation resin volume	m³
V_a	anion resin volume	m³
m_{HCl}	acid per regeneration (100 %)	kg
m_{NaOH}	caustic per regeneration (100 %)	kg
V_w	water treated per run	m³

Method and standards

Mass balance of each ion-exchange bed; capacities and regenerant doses are the resin maker's data for your water and regeneration level.

Assumptions and limits

- Steady flow and water quality; capacities at your regeneration level; no degasser unless you have removed CO_2 from the anion load.
- The flow is the net treated water; regeneration and rinse water are not deducted, so add them to the raw water demand.
- No design margin, minimum bed depth or freeboard is applied. A note appears when the regenerant dose is below the stoichiometric need for the load (equivalents as $CaCO_3$); practical ratios are well above that, as the resin maker states.

References

- Ion-exchange mass balance (ionic load / operating capacity)

Report details

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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/boilers-power-plant/water-treatment/dm-plant-sizing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.