Coagulant Feed Rate, Alkalinity Consumed and Precipitate (Alum, FeCl3)

Stock strength, chemical feed rate, alkalinity consumed, hydroxide precipitate and caustic to restore alkalinity for an alum or ferric chloride coagulant dose.

Input parameters

Unit system: SI

Parameter	Value	Unit
Coagulant	Ferric chloride, FeCl3 (stock strength as % FeCl3)	
Stock strength (mass fraction, as stated)	40.000	%
Stock specific gravity	1.4200	
Dose (as Al2(SO4)3·14H2O or FeCl3)	25.000	mg/L
Plant flow	20,000	m³/d

Calculated results

Parameter	Value	Unit
Metal ion in the stock	3.5020	mol/L
Stock concentration as the dosed product	568.00	g/L
Stock feed rate	0.61131	L/min
Alkalinity consumed (as CaCO3)	23.140	mg/L
Hydroxide precipitate	16.472	mg/L
Precipitate per day	329.44	kg/d
Caustic to restore the alkalinity	18.495	mg/L
Caustic per day	369.90	kg/d

Notes for this case

- Stoichiometric: each Al^{3+} or Fe^{3+} consumes 3 equivalents of alkalinity and precipitates as the hydroxide. Real sludge is more (bound water, organics, turbidity solids); use the sludge calculator for the total.

Formula and method

$$Al_2(SO_4)_3 \cdot 14H_2O + 6HCO_3^- \rightarrow 2Al(OH)_3 + 3SO_4^{2-} + 6CO_2 + 14H_2O$$

$$FeCl_3 + 3HCO_3^- \rightarrow Fe(OH)_3 + 3Cl^- + 3CO_2, \quad Q_{feed} = \frac{DQ}{C_{stock}}$$

Variables

$\mathrm{coagulant}$	Coagulant	-
w	Stock strength (mass fraction, as stated)	-
SG	Stock specific gravity	-
D	Dose (as Al2(SO4)3·14H2O or FeCl3)	kg/m³
Q	Plant flow	m³/s
$[M^{3+}]$	Metal ion in the stock	mol/m³
C_{stock}	Stock concentration as the dosed product	kg/m³
Q_{feed}	Stock feed rate	m³/s

ΔAlk	Alkalinity consumed (as CaCO3)	kg/m³
$M(OH)_3$	Hydroxide precipitate	kg/m³
$\dot{m}_{ppt}$	Precipitate per day	kg/s
$NaOH$	Caustic to restore the alkalinity	kg/m³
$\dot{m}_{NaOH}$	Caustic per day	kg/s

Method and standards

Stoichiometry of metal-salt coagulation with IUPAC atomic masses.

Assumptions and limits

- Stoichiometric alkalinity and precipitate; no allowance for hydrolysis species or NOM.

Report details

Report reference	FCC-9554-E202 (the same inputs always give the same reference)
Generated	23 November 2026, 17:34 UTC
Calculator	Coagulant Feed Rate, Alkalinity Consumed and Precipitate (Alum, FeCl3)
Method last reviewed	17 November 2026
Software release	FireCAD Calc, release of 22 November 2026
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/coagulant-dose-alkalinity-precipitate

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.