Iron and Manganese Oxidation: Oxidant, Alkalinity and Sludge

Stoichiometric oxidant dose (oxygen, chlorine, chlorine dioxide or permanganate), alkalinity consumed and sludge produced when oxidising ferrous iron and manganese.

Input parameters

Unit system: SI

Parameter	Value	Unit
Ferrous iron	2.0000	mg/L
Manganese	0.50000	mg/L
Oxidant	Chlorine	
Flow	8,000.0	m³/d

Calculated results

Parameter	Value	Unit
Oxidant per mg of iron	0.63479	
Oxidant per mg of manganese	1.2905	
Oxidant dose	1.9149	mg/L
Oxidant feed	15.319	kg/d
Alkalinity consumed (as CaCO3)	7.1984	mg/L
Alkalinity consumed per day	57.587	kg/d
Sludge (Fe(OH)3 + MnO2)	4.6185	mg/L
Sludge per day	36.948	kg/d

Notes for this case

- Stoichiometric from the bicarbonate reactions of ASCE/AWWA in common practice. Organic matter, ammonia and sulphide also consume oxidant; permanganate is usually dosed slightly below stoichiometric to avoid pink water.

Formula and method

$$4\mathrm{Fe(HCO_3)_2} + \mathrm{O_2} + 2\mathrm{H_2O} \rightarrow 4\mathrm{Fe(OH)_3} + 8\mathrm{CO_2}, \quad 3\mathrm{Fe(HCO_3)_2} + \mathrm{KMnO_4} + 2\mathrm{H_2O} \rightarrow 3\mathrm{Fe(OH)_3} + \mathrm{MnO_2} + \mathrm{KHCO_3} + 5\mathrm{CO_2}$$

$$3\mathrm{Mn(HCO_3)_2} + 2\mathrm{KMnO_4} \rightarrow 5\mathrm{MnO_2} + 2\mathrm{KHCO_3} + 2\mathrm{H_2O} + 4\mathrm{CO_2}$$

Variables

Fe^{2+}	Ferrous iron	kg/m³
Mn^{2+}	Manganese	kg/m³
$\mathrm{oxidant}$	Oxidant	-
Q	Flow	m³/s
R_{Fe}	Oxidant per mg of iron	-
R_{Mn}	Oxidant per mg of manganese	-
D	Oxidant dose	kg/m³
$\dot{m}_{ox}$	Oxidant feed	kg/s
ΔAlk	Alkalinity consumed (as CaCO3)	kg/m³
$\dot{m}_{alk}$	Alkalinity consumed per day	kg/s
X	Sludge (Fe(OH)3 + MnO2)	kg/m³
$\dot{m}_X$	Sludge per day	kg/s

Method and standards

Stoichiometry of iron and manganese oxidation in bicarbonate water.

Assumptions and limits

- Stoichiometric; complete oxidation; precipitates as $Fe(OH)_3$ and MnO_2.

Report details

Report reference	FCC-P82Q-YKS1 (the same inputs always give the same reference)
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Release checks	4 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/iron-manganese-oxidant-demand

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.