Powdered Activated Carbon Dose from a Freundlich Isotherm

Powdered activated carbon dose to lower an organic concentration to a target from the Freundlich constants, with daily carbon use and annual cost.

Input parameters

Unit system: SI

Parameter	Value	Unit
Flow	20,000	L/min
Initial concentration	0.050000	mg/L
Target concentration	0.010000	mg/L
Freundlich capacity (mg/g)(L/mg)^1/n	40.000	
Freundlich intensity 1/n	0.40000	
Carbon price per kg	1.2000	

Calculated results

Parameter	Value	Unit
Carbon loading at C_e	6.3396	g/kg
Carbon dose	6.3096	mg/L
Carbon used	181.72	kg/d
Annual carbon cost	79,591	

Notes for this case

- Single-stage batch contact reaching equilibrium with the effluent concentration, which is why PAC needs more carbon than a column: the carbon is loaded only to the capacity at the final concentration. Isotherm constants come from bench tests on the actual water; the cost is in the currency of the price entered.

Formula and method

$$q_e = K_f C_e^{1/n}, \quad \frac{m}{V} = \frac{C_o - C_e}{q_e}$$

Variables

Q	Flow	m³/s
C_o	Initial concentration	kg/m³
C_e	Target concentration	kg/m³
K_f	Freundlich capacity (mg/g)(L/mg)^1/n	-
$1/n$	Freundlich intensity 1/n	-
c_{PAC}	Carbon price per kg	-
q_e	Carbon loading at C_e	kg/kg
m/V	Carbon dose	kg/m³
$\dot{m}$	Carbon used	kg/s
C_a	Annual carbon cost	-

Method and standards

Freundlich isotherm with a batch mass balance.

Assumptions and limits

- Equilibrium reached; isotherm valid at C_e.

Report details

Report reference	FCC-XVNX-1F5K (the same inputs always give the same reference)
Generated	23 November 2026, 17:42 UTC
Calculator	Powdered Activated Carbon Dose from a Freundlich Isotherm
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/wastewater/pac-dose-freundlich

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.