Chlorine Residual Decay and Temperature (Arrhenius)

First-order chlorine residual decay constant at another temperature by the Arrhenius equation, residual after a storage time at both temperatures and half-lives.

Input parameters

Unit system: SI

Parameter	Value	Unit
Initial residual	1.5000	mg/L
Decay constant at the test temperature	0.020000	1/h
Test temperature	20.000	°C
Activation energy	70.000	kJ/mol
Other temperature	30.000	°C
Storage or travel time	48.000	h

Calculated results

Parameter	Value	Unit
Decay constant at the other temperature	0.051578	1/h
Residual after the time at T_1	0.57434	mg/L
Residual after the time at T_2	0.12615	mg/L
Half-life at T_1	34.657	h
Half-life at T_2	13.439	h

Notes for this case

- Bulk-water first-order decay; pipe-wall demand adds to it in distribution systems. Fit k_d from a bottle test as the slope of ln(C/C₀) against time.

Formula and method

$$C = C_0 e^{-k_d t}, \quad k_{d,2} = k_{d,1} \exp\left[\frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)\right], \quad t_{1/2} = \frac{\ln 2}{k_d}$$

Variables

C_0	Initial residual	kg/m³
$k_{d,1}$	Decay constant at the test temperature	1/s
T_1	Test temperature	K
E_a	Activation energy	J/mol
T_2	Other temperature	K
t	Storage or travel time	s
$k_{d,2}$	Decay constant at the other temperature	1/s
$C_1(t)$	Residual after the time at T_1	kg/m³
$C_2(t)$	Residual after the time at T_2	kg/m³
$t_{1/2,1}$	Half-life at T_1	s
$t_{1/2,2}$	Half-life at T_2	s

Method and standards

First-order decay with Arrhenius temperature dependence.

Assumptions and limits

- First-order bulk decay; constant temperature during the time.

Report details

Report reference	FCC-99CQ-92B3 (the same inputs always give the same reference)
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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/environmental/drinking-water/chlorine-residual-decay-temperature

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.