# Aluminium Hydroxide Solubility and Al(III) Species versus pH

Total dissolved Al(III) in equilibrium with amorphous $Al(OH)_3$ at a pH, its species, and the pH of minimum solubility, from the hydrolysis constants.

**Method:** Mass balance on Al(III) with the solubility and hydrolysis equilibria of amorphous $Al(OH)_3$

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| pH | 6.8000 | |
| log K for $Al(OH)_3(s) + 3H^+ \rightleftharpoons Al^{3+}$ | 10.800 | |
| log K for $AlOH^{2+}$ | 5.8000 | |
| log K for $Al(OH)_2^+$ | 1.5000 | |
| log K for $Al(OH)_3^0$ | -4.2000 | |
| log K for $Al(OH)_4^-$ (+ $H^+$) | -12.200 | |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| $Al^{3+}$ | 2.5119e-07 | mol/m³ |
| $AlOH^{2+}$ | 1.5849e-05 | mol/m³ |
| $Al(OH)_2^+$ | 0.005012 | mol/m³ |
| $Al(OH)_3^0$ | 0.063096 | mol/m³ |
| $Al(OH)_4^-$ | 0.003981 | mol/m³ |
| Total dissolved Al(III) | 0.072105 | mol/m³ |
| Total dissolved aluminium as Al | 1.9455 | mg/L |
| pH of minimum solubility | 6.8510 | |
| Minimum dissolved aluminium as Al | 1.9438 | mg/L |

**Notes for this case**

- Ideal solution (activities equal to concentrations) at 25 °C in equilibrium with amorphous $Al(OH)_3(s)$. Enter other constants for other temperatures or for ferric hydroxide (the same five-species form).

## Formula and method

$$Al(III) = K_{s0}[H^+]^3 + K_{s1}[H^+]^2 + K_{s2}[H^+] + K_{s3} + \frac{K_{s4}}{[H^+]}$$

### Variables

| | | |
|---|---|---|
| $pH$ | pH | - |
| $\log K_{s0}$ | log K for $Al(OH)_3(s) + 3H^+ \rightleftharpoons Al^{3+}$ | - |
| $\log K_{s1}$ | log K for $AlOH^{2+}$ | - |
| $\log K_{s2}$ | log K for $Al(OH)_2^+$ | - |
| $\log K_{s3}$ | log K for $Al(OH)_3^0$ | - |
| $\log K_{s4}$ | log K for $Al(OH)_4^-$ (+ $H^+$) | - |
| $[Al^{3+}]$ | $Al^{3+}$ | mol/m³ |
| $[AlOH^{2+}]$ | $AlOH^{2+}$ | mol/m³ |

| | | |
|---|---|---|
| $[Al(OH)_2^+]$ | $Al(OH)_2^+$ | mol/m³ |
| $[Al(OH)_3^0]$ | $Al(OH)_3^0$ | mol/m³ |
| $[Al(OH)_4^-]$ | $Al(OH)_4^-$ | mol/m³ |
| $Al(III)$ | Total dissolved Al(III) | mol/m³ |
| $Al$ | Total dissolved aluminium as Al | kg/m³ |
| $pH_{min}$ | pH of minimum solubility | - |
| $Al_{min}$ | Minimum dissolved aluminium as Al | kg/m³ |

### Method and standards

Equilibrium solubility of a metal hydroxide with its hydrolysis species.

### Assumptions and limits

- Equilibrium, 25 °C constants, no complexing ligands such as fluoride or NOM.

### References

Mass balance on Al(III) with the solubility and hydrolysis equilibria of amorphous $Al(OH)_3$

## Report details

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|---|---|
| Report reference | FCC-5QTW-ZMK3 (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/aluminium-hydroxide-solubility

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.