

Salt + Alkali → Metal hydroxide + Salt formed in solution

1. Calcium salts (Ca²⁺ ion)
 Ca(NO₃)₂ + 2NaOH → Ca(OH)₂ + 2NaNO₃
 Calcium nitrate Caustic soda Calcium hydroxide (White ppt) Sodium nitrate (Colourless)

2. Iron:
 a) Ferrous Salts (Fe²⁺ ion)
 FeSO₄ + 2NaOH → Fe(OH)₂ + Na₂SO₄
 Ferrous sulphate Caustic soda Ferrous hydroxide (Dirty green gelatinous ppt) Sodium sulphate (Colourless)

b) Ferric Salts (Fe³⁺ ion)
 FeCl₃ + 3NaOH → Fe(OH)₃ + 3NaCl
 Ferric chloride Caustic soda Ferric hydroxide (Reddish Brown ppt) Sodium chloride (Colourless)

3. Copper Salts (Cu²⁺ ion)
 CuSO₄ + 2NaOH → Cu(OH)₂ + Na₂SO₄
 Copper sulphate Caustic soda Copper hydroxide (Pale blue ppt) Sodium sulphate (Colourless)

4. Copper (II) Salts (Cu²⁺ ion)
 CuSO₄ + 2NH₄OH → Cu(OH)₂ + (NH₄)₂SO₄
 (Blue) (Colourless) (Pale blue ppt) (Colourless in sol.)
 With excess of NH₄OH ppt dissolves.

• Cu(OH)₂ + (NH₄)₂SO₄ + 2NH₄OH → (Cu(NH₄)₂)SO₄ + 4H₂O

• Cu(OH)₂ + 4NH₄OH(excess) → (Cu(NH₄)₄)(OH)₂ + 4H₂O
 Tetraammine copper hydroxide Soluble in excess of NH₄OH and forms blue solution

- This reaction is a characteristic property of Cu²⁺ ion and is used for its detection in qualitative analysis.
- Potassium hydroxide (Caustic potash) solution also shows similar behaviour.

Zinc Salts (Zn²⁺ ion) Gelatinous white, soluble.
 ZnSO₄ + 2NaOH → Zn(OH)₂ + Na₂SO₄
 (Colourless) (Colourless) (White, gelatinous ppt) (Colourless)
 (with excess of NaOH ppt dissolves)

Zn(OH)₂ + 2NaOH → Na₂ZnO₂ + 2H₂O
 (excess) (Sodium zincate, colourless)

Lead Salts (Pb²⁺ ion) Chalky white, soluble.
 Pb(NO₃)₂ + 2NaOH → Pb(OH)₂ + 2NaNO₃
 (Colourless) (Colourless) (White ppt) (Colourless)

(with excess of NaOH ppt dissolves)
 Pb(OH)₂ + 2NaOH → Na₂PbO₂ + 2H₂O
 (excess) (Sodium plumbite, colourless)

Salt + Ammonium hydroxide → Metal + salt formed in solution

1. Calcium salts:

No precipitation even on addition of excess of NH₄OH. This is because, the concentration of OH⁻ ions from ionisation of NH₄OH is low such that it cannot precipitate the hydroxide of calcium.

2. Zinc Salts (Zn²⁺ ion):

ZnSO₄ + 2NH₄OH → Zn(OH)₂ + (NH₄)₂SO₄
 (colourless solution) (White) (gelatinous) (colour in solution)

With excess of NH₄OH ppt dissolves
 Zn(OH)₂ + (NH₄)₂SO₄ + 2NH₄OH → Zn(NH₄)₂SO₄ + 4H₂O
 Zinc hydroxide (excess) tetraamminezinc sulphate (colourless sol.)
 Zn(OH)₂ + NH₄OH → Zn(NH₄)₂(OH)₂ + 4H₂O
 Tetrammine zinc hydroxide

Analytical Chemistry

Determination of chemical components in a given sample.

It is done by carrying out chemical tests with the help of reagents.

It involves the identification of the unknown substances.

It involves the determination of composition of a mixture.

Qualitative
Quantitative

Colour of the salts & their solution

The process of formation of an insoluble solid when solutions are mixed. The solid formed is called precipitate.

Cation	Symbol	Colour	Anion	Symbol	Colour
Copper ion	Cu ²⁺	Blue	Permanganate ion	MnO ₄ ⁻	Pink/purple
Ferrous ion	Fe ²⁺	Light green	Dichromate ion	Cr ₂ O ₇ ²⁻	Orange
Ferric ion	Fe ³⁺	Brown	Chromate ion	CrO ₄ ²⁻	Yellow
Nickel ion	Ni ²⁺	Green			

Salts of Group 3 to 12 are generally coloured.

Salts of Group 1, 2 and 13 to 17 are generally colourless.

Cation	Symbol	Anion	Symbol
Ammonium ion	NH ₄ ⁺	Chloride ion	Cl ⁻
Sodium ion	Na ⁺	Sulphate ion	SO ₄ ²⁻
Potassium ion	K ⁺	Carbonate ion	CO ₃ ²⁻
Calcium ion	Ca ²⁺	Hydrogen carbonate ion	HCO ₃ ⁻

Oxide/hydroxide + acid → salt + water
 Oxide/hydroxide + alkali → salt + water

Some metal oxides and hydroxides exhibit dual character, i.e., they show acidic as well as basic character, they are said to be amphoteric in nature. Examples:

(1) ZnO + 2NaOH → Na₂ZnO₂ + H₂O
 Sodium zincate

Zn(OH)₂ + 2NaOH → Na₂ZnO₂ + 2H₂O

(2) Al₂O₃ + 2NaOH → 2NaAlO₂ + H₂O
 sodium aluminate

Al(OH)₃ + NaOH → NaAlO₂ + 2H₂O

Trace the Mind Map

► First Level ► Second Level ► Third Level

(1) Zinc:

Zn + 2NaOH → Na₂ZnO₂ + H₂
 (Hot & conc.) Sodium zincate (Colourless)

Zn + 2KOH → K₂ZnO₂ + H₂
 (Hot & conc.) Potassium zincate (Colourless)

(2) Aluminium:

Aluminium reacts with boiling caustic alkali sol.

2Al + 2NaOH + 2H₂O → 2NaAlO₂ + 3H₂
 Sodium aluminate (Colourless)

Aluminium reacts with faded alkali to produce sodium aluminate.
 2Al + 6NaOH → 2Na₃AlO₃ + 3H₂

(3) Lead:

Pb + 2NaOH → Na₂PbO₂ + H₂
 Sodium plumbite (Colourless)

Pb + 2KOH → K₂PbO₂ + H₂
 Potassium plumbite (Colourless)