BASES AND ALKALIS

The term base was originally used to describe substances that turn red litmus paper blue and neutralizes and acid in aqueous solutions.

Most oxides and hydroxides of metals are bases. Common examples of basic oxides are Na_2O, K_2O and MgO. They are formed when these metals burn in air or oxygen, e.g.

$$4Na(s) + O_2(g) \rightarrow 2Na_2O(s)$$

Most of these metallic oxides are insoluble in water. Some, however, dissolve in water to form hydroxides. For example

$$Na_2O(s) + H_2O(l) \rightarrow 2NaOH(aq)$$

A basic soluble hydroxide is known as alkali. Many basic hydroxides like $Cu(OH)_2$, and $Al(OH)_3$ are insoluble in water. The few soluble hydroxides of Na, K and Ca are economically important.

Like acids, alkalis may be strong or weak. Sodium (Na) and Potassium (K) hydroxides are strong alkalis that ionize completely in aqueous solutions to produce negatively charged hydroxide ions, OH^-, and positively charged metallic ions. CaO reacts with water to give a hydroxide which is only slightly soluble in water. A calcium hydroxide solution produces relatively few ions. It is a weak alkali.

$$\mathrm{CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(aq)}$$

$$\mathrm{Ca(OH)_2(aq) \rightleftharpoons Ca^{2+} + 2OH^-}$$

Another common alkali is aqueous ammonia formed when ammonia is bubbled through water. It ionizes to limited extent in solution to liberate NH_4^+ and OH^-. Thus, aqueous ammonia is a weak alkali.

$$\mathrm{NH_3(g) + H_2O(l) \longrightarrow NH_3.H_2O(aq)}$$

$$\mathrm{NH_3.H_2O \rightleftharpoons NH4^+ + OH^-}$$

Physical Properties of Alkali

1. Alkalis have bitter taste.
2. Alkalis are soapy to touch.
3. Alkalis turn red litmus to blue.
4. Concentrated forms of the two caustic alkalis, KOH and NaOH are corrosive.

Chemical Properties of Alkali/Bases

1. All bases react with acids to form salt and water only.

$$NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

$$MgO(s) + 2HNO_3(aq) \longrightarrow Mg(NO_3)_2(aq) + H_2O(l)$$

2. Alkalis react with ammonia salts, in the presence of heat, to generate ammonia gas.

$$Ca(OH)_2(aq) + 2NH_4Cl(aq) \longrightarrow CaCl_2(aq) + 2H_2O(l) + 2NH_3(g)$$

$$NaOH(aq) + NH_4NO_3(aq) \longrightarrow NaNo_3(aq) + H_2O(l) + NH_3(g)$$

Uses of Alkalis

Alkali	Use
Sodium hydroxide	Used in the manufacture of soap, sodium salts and plastics; used in petrol refining.
Potassium hydroxide	Used in the manufacture of liquid soap; Used in dyeing and electroplating.
Calcium hydroxide	Used in the manufacture of mortar, cement and plaster; Used in neutralizing acidic soils.
Magnesium hydroxide	Used in the manufacture of toothpastes; Used as a laxative.
Aqueous ammonia	Used for bleaching cloth; Used as a detergent.