S-block group - 2 Pragati Education

Chemical properties

★ Reactivity increases down the group

★ Less reactive than AM.

Hydrides (Except - Be) [$BeCl_2 + LiAlH_4 \rightarrow 2BeH_2 + LiCl + AlCl_3$]

a] $M + H_2 \rightarrow MH_2$

★ MgH_2 is covalent in nature.

★ CaH_2, SrH_2 & BaH_2 ionic.

(Hydrolith)

$MH_2(s) + 2H_2O(l) \rightarrow M^{2+}(aq) + 2OH^-(aq) + 2H_2(g)$

★ $CaH_2(s) + 2H_2O(l) \rightarrow Ca^{+2}(aq) + 2OH^- + 2H_2(g)$.

(High reactivity with water)

Oxides

$2M + O_2 \rightarrow 2MO$ (Mono-oxide)

→ M = Be, Mg or Ca

→ $M + O_2 \rightarrow MO_2$ [M = Ba or Sr]

Peroxide.

→ $MCO_3 \rightarrow MO + CO_2$. [M - Be, Mg, Ca, Sr or Ba].

→ Down the gp reactivity with O_2 ↑.

$2Mg + O_2 \rightarrow 2MgO$

$3Mg + N_2 \rightarrow Mg_3N_2$

Characteristics of oxides Pragati Education

a] Very stable due to large enthalpies of formation.

b] BeO → Amphoteric

Rest are basic in nature.

Amphoteric → $BeO + 2HCl \rightarrow BeCl_2 + H_2O$

Amphoteric → $BeO + 2NaOH + H_2O \rightarrow Na_2[Be(OH)_4]$ Sodium Beryllate

c] $MO(s) + H_2O(l) \rightarrow M^{2+}(aq) + 2OH^-(aq) + Heat$

except BeO.

Hydroxides

$Be(OH)_2$
$Mg(OH)_2$
$Ca(OH)_2$ ★ Basic.
$Sr(OH)_2$ ★ Down the group basic
$Ba(OH)_2$ strength increases.

$Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$

Trick
★ If a metal reacts with cold water, metal hydroxide is formed.

★ If a metal reacts with steam, metal oxide is formed.
∵ metal hydroxide thermally decompose to give oxide & H_2O

★ Because of decrease in ionization enthalpy, strength of M-O bond in MOH decreases.

★ $M(OH)_2 + 2HCl \rightarrow MCl_2 + 2H_2O$
[M = Mg, Ca, Sr, Ba]

Solubility

$Be(OH)_2$
$Mg(OH)_2$
$Ca(OH)_2$
$Sr(OH)_2$
$Ba(OH)_2$

★ increases down the group.
★ Due to increase in size, magnitude of lattice enthalpy decreases.
★ Hydration enthalpy doesn't change much.
★ $\Delta H_{solution} = \Delta H_{lattice} - \Delta H_{hydration}$.
★ Down the group ΔH solution becomes more negative.

★ Solubility increases & hence basic str. increases.

So, Solubility ∝ basic str.

* $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$
white ppt.

* $Ba(OH)_2 + CO_2 \longrightarrow BaCO_3 + H_2O$
white ppt

* If excess of CO_2 is passed, precipitates dissolve due to soluble Bicarbonates.

$$CaCO_3 + H_2O \underset{-CO_2}{\overset{+CO_2}{\underset{\Delta}{\rightleftharpoons}}} Ca(HCO_3)_2 .$$

Reaction with H_2O

* Be $\longrightarrow$ No reaction with water at room temp.

* Mg $\longrightarrow$ only boiling water.

* Ca, Sr, Ba $\longrightarrow$ Reacts vigorously at room temp.

$$M(s) + 2H_2O(l) \longrightarrow M^{2+}(aq) + 2OH^-(aq) + H_2(g)$$

Carbonates

* Insoluble in water

* $CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2NaCl$

* $MCO_3 \xrightarrow{\Delta} MO + CO_2$

* Atomic no. ↑ down the group, Thermal stability ↑.

* $BeCO_3$ is unstable & kept only in CO_2 environment.

* Stability of metal carbonates is dependent on stability of metal oxide.

$$MCO_3 \rightleftharpoons MO + CO_2 .$$

* If MO is stable, more MCO_3 will decompose to take reaction in forward direction, so less is MCO_3 is stable.

* If MO is less stable, MCO_3 will not decompose, So, reaction will favour reactant side, So MCO_3 is stable.

* Down the group lattice enthalpy of MO decrease, due to increase in size, so, MCO_3 will not break.

Sulphates :- $Ca + H_2SO_4 \rightarrow CaSO_4 + H_2$

$CaO + H_2SO_4 \rightarrow CaSO_4 + H_2O$

$Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$

$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + CO_2 + H_2O$.

* Less soluble.
* Down the group stability of sulphates decreases.
∵ Hydration enthalpy decreases significantly, due to increase in atomic size of alkaline earth metals bringing about a decrease in solubility of their sulphates.
* Stable towards Heat.

Halides $M + X_2 \rightarrow MX_2$ [X = F, Cl, Br, I]

$M + 2HX \rightarrow MX_2 + H_2$

$MO + 2HX \rightarrow MX_2 + H_2O$

$MCO_3 + 2HX \rightarrow MX_2 + H_2O + CO_2$

$M(OH)_2 + 2HX \rightarrow MX_2 + 2H_2O$

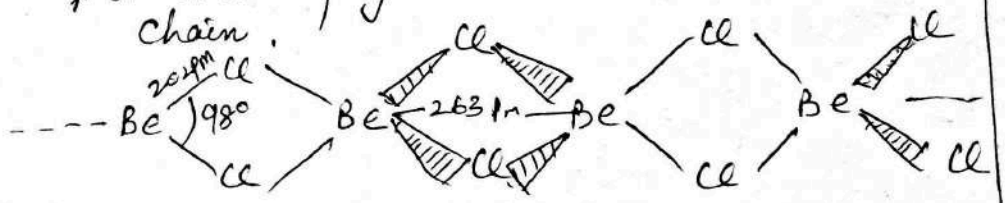
BeF_2 can be prepared by

$(NH_4)_2BeF_4 \rightarrow BeF_2 + 2NH_4F$

$BeO + C + Cl_2 \xrightarrow{600-800K} BeCl_2 + CO$.

In solid state

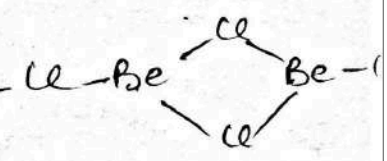
* It exist as polymeric chain.



In vapour state

Cl-Be-Cl

Monomer,



* Be-halides covalent in nature & Rest are ionic.
* Down the group ionic character ↑ as atomic size ↑.
* Be-halide → covalent → soluble in organic solvents
* Metal-flourides insoluble in water due to.
(i) High magnitude of lattice enthalpy
but, bromides, chlorides & iodides are soluble in water.
* Hygroscopic (a) Down the gp. tendency to hydrate ↓.
(b) anhy. $CaCl_2$ → dehydrating agent.
(c) $BeCl_2$ fumes in air due to hydrolysis
$BeCl_2 + 2H_2O \rightarrow Be(OH)_2 + 2HCl$.

Nitrides Pragati Education S-block Gp 2

$3Ca + N_2 \longrightarrow Ca_3N_2$
$3Mg + N_2 \longrightarrow Mg_3N_2$ } ionic nitride

$Ca_3N_2 + 6H_2O \longrightarrow 3Ca(OH)_2 + 2NH_3\uparrow$

Solubility in liq. NH_3

$M + (x+y)NH_3 \longrightarrow [M(NH_3)_x]^{2+} + 2[e(NH_3)_y]^-$
deep blue black soln.

* Mg is found in chlorophyll in form of complex compounds.

Thermal stabilities

Group 2

* Sulphates thermally stable
* Hydroxides
  $Mg(OH)_2(s) \xrightarrow{\Delta} MgO(s) + H_2O(g)$
  $2LiOH(s) \xrightarrow{\Delta} Li_2O(s) + H_2O(g)$
  Stabilities of hydroxides of group 2 ↑ down the gp.

Nitrates
$Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$
Down the gp. stability ↑.

Carbonates & Hydrogencarbonates
Down the gp. stability ↑.

Group 1

* Sulphates thermally stable.
* Hydroxides of alkali metals except LiOH are thermally stable.

Nitrates Except $LiNO_3$
All decompose.
$2KNO_3 \longrightarrow 2KNO_2 + O_2$
$2LiNO_3 \rightarrow Li_2O + 2NO_2 + O_2$
$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$

More is the radius diff. b/w cation & anion, More is the solubility.

⊕ ⊖ Solubility is less

⊕ ⊖ Solubility is more