Group 2 Elements :- Alkaline Earth Metals

Alkaline earth metals :- The group 2 elements comprise beryllium, magnesium, calcium, strontium, barium and radium. These (except beryllium) are called as alkaline earth metals.

1) Electronic configuration :-

It is Represented as [noble gas] ns^2.

$_4Be$	$[He]2s^2$
$_{12}Mg$	$[Ne]3s^2$
$_{20}Ca$	$[Ar]4s^2$
$_{38}Sr$	$[Kr]5s^2$
$_{56}Ba$	$[Xe]6s^2$
$_{88}Ra$	$[Rn]7s^2$

2) Atomic Radii and Ionic Radii

The atomic and ionic radii increase with increase in atomic number in the group 2 elements.

* The atomic and ionic radii of alkaline earth metals are smaller than those of alkali metals due to increased nuclear charge.

3) Ionization Enthalpies:

The alkaline earth metals have low ionization enthalpies due to fairly large size of the atoms.

So, the atomic size increases down the group, their ionization enthalpy decreases.

4) Hydration Enthalpies

The hydration enthalpies of alkaline earth metals ions decrease with increase in ionic size down the group.

$Be^{2+} > Mg^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+}$

$MgCl_2$ exist as $MgCl_2 \cdot 6H_2O$

$CaCl_2 \longrightarrow CaCl_2 \cdot 6H_2O$, forming as hydrates

But NaCl and KCl do not form hydrates.

5) Physical Properties:-

~~In flame Test;~~

- Be and Mg appear → greyish in colour.
- Melting point and boiling point of alkaline earth metals are higher than that of alkali metals due to smaller size.
- In flame test; a) Calcium imparts → brick red
  b) Strontium imparts → Crimson
  c) Barium imparts → Apple green

Note * But Be and Mg do not impart any colour to flame test because they are strongly bounded atoms.

6) Chemical Properties

i) Reactivity towards O_2 and H_2O :-

* Be and Mg are kinetically inert to O_2 and H_2O because of the formation of an oxide film on their surface.

* Calcium, strontium and Ba are readily attacked by air to form the oxide and Nitride.

ii) Reactivity towards the halogens:-

$$M + \underset{(\text{halogen})}{X_2} \longrightarrow MX_2 \ (X = F, Cl, Br, I)$$

It combines with halogen at elevated temperature forming metal halides.

iii) Reactivity towards H_2 :-

All the elements except beryllium combine with H_2 upon heating to form metal hydrides.

$$M + H_2 \longrightarrow MH_2$$

iv) Reactivity towards acids:-

$$M + 2HCl \longrightarrow MCl_2 + H_2$$

v) Reducing nature:-

* Alkaline earth metals are strong reducing agents because by large negative values of reduction potentials.

* Be has less -ve value of reduction potential compared to other alkaline earth metals.

vi) Solutions in liquid NH_3 :-

The alkaline earth metals dissolve in liq. NH_3 to give deep blue black solutions, forming ammoniated ions.

$$M + (x+y)NH_3 \longrightarrow [M(NH_3)x]^{2+} + 2[e(NH_3)y]^-$$

7.) General characteristics of compounds of the Alkaline Earth Metals

i) Oxides and Hydroxides :-

• Alkaline earth metals + O_2 ⟶ Monoxide (MO).

Exception case :- BeO .it have rock-salt structure

Note *. BeO is amphoteric in nature while oxides of other elements are ionic.

$$MO + H_2O \longrightarrow M(OH)_2.$$

All these oxides except BeO are basic in nature and react with H_2O to form soluble hydroxide.

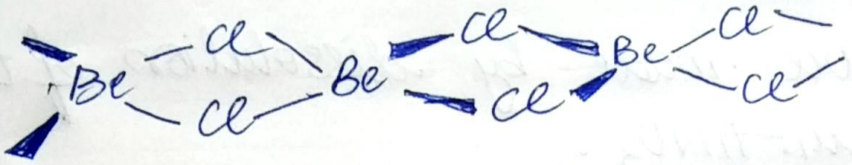
* Be(OH)$_2$
* Beryllium hydroxide is amphoteric in nature as it reacts with acid and alkali both.

ii) Halides :-

All alkaline earth metals halides are ionic in nature, except for Beryllium halides.

Beryllium halides are covalent and soluble in organic solvents.

* $BeCl_2$ has a chain structure in solid state.



iii) Salts of Oxoacids :-

* Carbonates :- Carbonates of alkaline earth metals are insoluble in water.

The solubility of carbonates in H_2O decreases as the atomic number of the metal ion increases

ex, $CaCO_3$ (~~quick lime~~)

↳ used in ~~formation~~ building material in form of marble and manufacture of quick lime.

* Sulphates :- The sulphates of alkaline earth metals are all white solids and stable to heat.

- $BeSO_4$ and $MgSO_4$ are readily soluble in H_2O. ~~The solu~~
- But solubility decreases from $CaSO_4$ to $BaSO_4$.

Ex, $CaSO_4 \cdot \frac{1}{2} H_2O$ (Plaster of Paris) [also known as "dead burnt plaster"]

↳ used in making plasters and also employed in dentistry.

* Nitrates :-

The nitrates are made by dissolution of the carbonates in dil. HNO_3.

* ~~$Mg(NO_3)_2$~~ * $Mg(NO_3)_2$ crystallises with 6 molecules of H_2O, whereas $Ba(NO_3)_2$ crystallises as anhydrous salt.