I.E., EN.

Be (1)	Size,
Mg (2)	Metallic Character,
Ca (3)	Ionic nature,
Sr (4)	Softness
Ba (5)	

Decreases ↓ Increases →

Exception :-

M.P. :- (1) > (3) > (4) > (5) > (2)

B.P. :- (1) > (5) > (3) > (4) > (2)

Density :- (5) > (4) > (1) > (2) > (3)

Chemical Prop.

(1) Rxn. with O_2 :-

$Be \xrightarrow{O_2} BeO$ } amphoteric, Great covalent character

$Mg \xrightarrow{//} MgO$

$Ca \xrightarrow{//} CaO$

$Sr \xrightarrow{//} SrO$

$Ba \xrightarrow{//} BaO$

} Basic & Ionic

Oxide + H_2O ⟶ Hydroxide

$CaO + H_2O \longrightarrow Ca(OH)_2$

Oxides

BeO
MgO
CaO
SrO
BaO

Basicity & Solubility (Increases)

Ionic Radii :-

$Be^{2+}_{(g)} < Mg^{2+}_{(g)} < Ca^{2+}_{(g)} < Sr^{2+}_{(g)} < Ba^{2+}_{(g)}$

Hydrated Radii :-

$Be^{2+}_{(aq.)} > Mg^{2+}_{(aq.)} > Ca^{2+}_{(aq.)} > Sr^{2+}_{(aq.)} > Ba^{2+}_{(aq.)}$

(2.) Rxn. with H_2O :-

$Be \xrightarrow{\text{Steam}} BeO + H_2$

$Mg \xrightarrow{\text{''}} MgO + H_2$

$M + H_2O \longrightarrow M(OH)_2 + H_2 + Energy$

M = All alkaline except Be

Amphoteric ← $Be(OH)_2$

Basic: $Mg(OH)_2$, $Ca(OH)_2$, $Sr(OH)_2$, $Ba(OH)_2$

Basicity ↑
Solubility ↑
Thermal stability ↑
(Increases ↓)

- $Be(OH)_2 \xrightarrow[2H_2O]{2HCl} [Be(H_2O)_4]Cl_2$

  $[BeCl_2 \cdot 4H_2O]$

- $Be(OH)_2 \xrightarrow{2NaOH} Na_2^{+}[Be(OH)_4]^{2-}$

  Beryllate ion

(3) Rxn. with N_2 :-

$M + N_2 \longrightarrow M_3N_2$

(M = All alkaline)

(4) Rxn. with N_2 :-

$$M + N_2 \longrightarrow MN_2$$

[M = All Except Be]

$$BeCl_2 + LiAlH_4 \longrightarrow BeH_2 + LiCl + AlCl_3$$

$(BeH_2)_n$ and $(MgH_2)_n$ are polymeric (covalent also)

rest all are ionic.

BeH_2
MgH_2
CaH_2
SrH_2
BaH_2

∵ size diff ↑ Stability ↓

{Stability decreases}

(5) Rxn. with aqu. NH_3

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

Reducing Agent
Paramagnetic
Conducting
Blue

When conc^{n} increases;

Para ⟶ dia

Blue ⟶ bronze

(6.) Rxn. with dry NH_3 :-

$M + dry\ NH_3 \longrightarrow M_3N_2 + H_2$

$M_3N_2 + H_2O \longrightarrow M(OH)_2 + NH_3$

(7.) Sulphates (M_2SO_4)

{Solubility decreases} | $BeSO_4$, $MgSO_4$, $CaSO_4$, $SrSO_4$, $BaSO_4$ | {Thermal Stability increases}

∵ Lattice energy dominates here

Lattice energy ∝ charge (M^{2+})

$MSO_4 \xrightarrow{\Delta} MO + SO_2 + O_2$

(M = All)

(8.) Nitrates (MNO_3)

Solubility decreases ↓

$Be(NO_3)_2$
$Mg(NO_3)_2$
$Ca(NO_3)_2$
$Sr(NO_3)_2$
$Ba(NO_3)_2$

Thermal Stability increases ↓

$M(NO_3)_2 \xrightarrow{\Delta} MO + NO_2 + O_2$

(NO_2: Brown paramagnetic gas; O_2: Colourless Paramagnetic gas)

(9.) Carbonates (MCO_3)

Solubility (decreases) ↓

$BeCO_3$
$MgCO_3$
$CaCO_3$
$SrCO_3$
$BaCO_3$

Thermal Stability (Increases) ↓

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

(10.) Bicarbonates ($M(HCO_3)_2$)

All bicarbonates exist in Soln.

$$M(HCO_3)_2 \xrightarrow{\Delta} MCO_3 + CO_2 + H_2O$$

M.I.P :- 5 Bicarbonates exist in solid

$NaHCO_3$
$KHCO_3$
$RbHCO_3$
$CsHCO_3$
NH_4HCO_3

} from alkali

(11) Halides (MX)

$$M + X_2 \longrightarrow MX_2$$

- Best method for BeF_2 :-

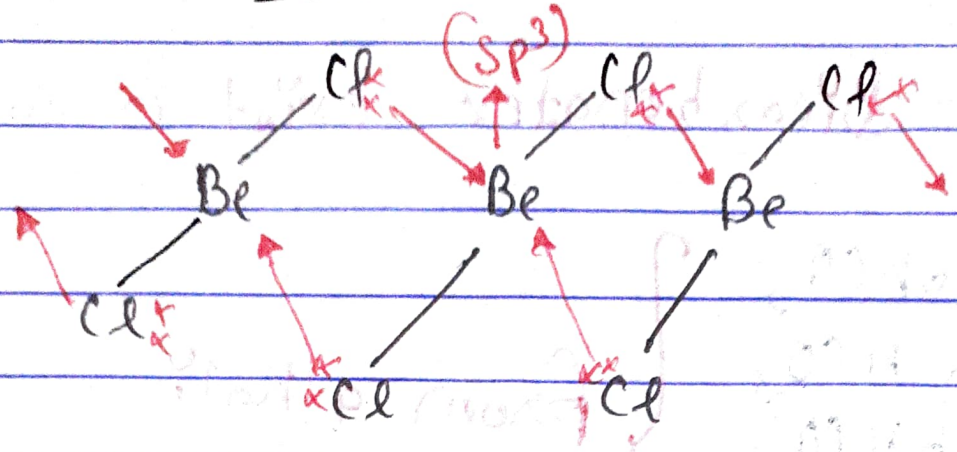
$$(NH_4)_2BeF_4 \xrightarrow{\Delta} BeF_2 + NH_4F$$

- Best method for $BeCl_2$:-

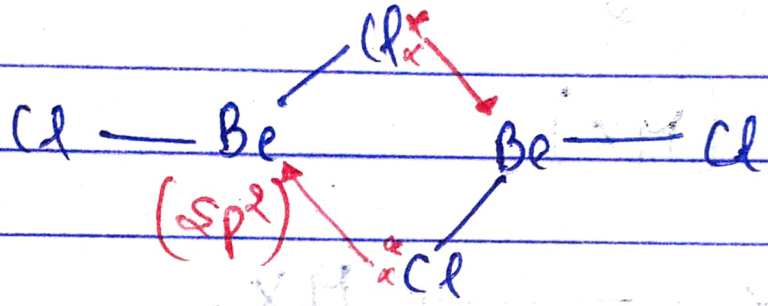
$$BeO + C + Cl_2 \xrightarrow{600-800\ K} BeCl_2 + CO$$

Structure of $BeCl_2$:-

1.) In Solid Phase $(BeCl_2)_n$ (Polymer)



2.) In Vapour Phase $(BeCl_2)_2$ (Dimer)



3.) When T ≈ 1200 K $(BeCl_2)$ (Monomer)

Cl — Be — Cl

sp

Covalent Charac. (Increases)

BeF_2
$BeCl_2$
$BeBr_2$
BeI_2

Solubility (Decreases)

Covalent Charac. (Increases)

AgF → Soluble

AgCl
AgBr → ppt.
AgI

Solubility (Decreases)

Hydrates :- 1) $BeCl_2 \cdot 4H_2O$

2) $MgCl_2 \cdot xH_2O$ $(x = 6, 8)$

3) $CaCl_2 \cdot 6H_2O$

4) $SrCl_2 \cdot 6H_2O$

5) $BaCl_2 \cdot 2H_2O$

M.I^{+} 1) Heating of $BeCl_2 \cdot 4H_2O$:

a) $BeCl_2 \cdot 4H_2O \xrightarrow{\Delta} BeCl_2 \cdot H_2O + 3H_2O$

$BeCl_2 \cdot H_2O \xrightarrow{\Delta} Be(OH)Cl$ (Hydroxy Chloride)

b) $MgCl_2 \cdot 6H_2O \xrightarrow{\Delta} MgCl_2 \cdot 2H_2O + 4H_2O$

$MgCl_2 \cdot 2H_2O \xrightarrow{\Delta} Mg(OH)Cl + HCl + H_2O$

$Mg(OH)Cl \xrightarrow{\Delta} MgO + HCl$

c) $MgCl_2 \cdot 6H_2O \xrightarrow[HCl]{dry} MgCl_2 + 6H_2O$

Some imp. comp. of Ca

(1) Quick Lime (CaO)

M.O.P i) From Limestone ($CaCO_3$)

$CaCO_3 \xrightarrow{1070 - 1270\,K} CaO + CO_2$

Prop :- 1.) White amorphous solid
2.) High M.P.
3.) It absorbs moisture & CO_2 from atmosphere.

$$CaO + H_2O \longrightarrow Ca(OH)_2$$

(Lump of Lime)

$$CaO + CO_2 \longrightarrow CaCO_3$$

4.) It is basic in nature

$$CaO + SiO_2 \longrightarrow CaSiO_3$$ (calcium silicate)

$$CaO + P_4O_{10} \longrightarrow Ca_3(PO_4)_2$$ (Thomas slag)

(2.) Slaked Lime ($Ca(OH)_2$)

M.O.P :- $CaO + H_2O \longrightarrow Ca(OH)_2$

Prop :- 1.) White amorphous powder
2.) aqu. soln. is called Lime water.
3.) Suspension of Slaked Lime is called Milk of Lime.
4.) When CO_2 is passed Milkyness appears.

$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3$ (Milk)

(Milkiness Gaya b) $Ca(HCO_3)_2$ ← ($CO_2 + H_2O$ (excess))

soluble

5.) $Ca(OH)_2 + Cl_2 \longrightarrow$ Bleaching powder ($CaOCl_2$)

$[Ca(OCl)_2 \cdot CaCl_2 \cdot Ca(OH)_2 \cdot 2H_2O]$

(3.) Lime stone ($CaCO_3$)

Prep. 1) $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3$

Excess ($CO_2 + H_2O$) should be avoided

2.) $CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2NaCl$

Prop. :- 1) White fluffy powder

2) Heating effect :-

$CaCO_3 \xrightarrow{1200\ K} CaO + CO_2$

3) Rxn. with HCl & H_2SO_4 :-

$CaCO_3 \xrightarrow{HCl} CaCl_2 + H_2O + CO_2$

$\xrightarrow{H_2SO_4} CaSO_4 + H_2O + CO_2$

(4.) POP (Plaster of Paris) $[CaSO_4 \cdot \frac{1}{2} H_2O]$

(Calcium sulphate hemi hydrate)

M.O.P. :-

$CaSO_4 \cdot 2H_2O \xrightarrow{100^\circ C} CaSO_4 \cdot \frac{1}{2} H_2O + \frac{3}{2} H_2O$

(Gypsum)

$T > 100^\circ C$

$CaO + SO_2 + O_2 \xleftarrow[\Delta]{\text{Strong}} CaSO_4$

(Dead burnt plaster)

Flame Test :-

Be & Mg do not impart colour in flame test due to high ionisation energy.

Ca	Sr	Ba
Brick Red / ~~Crimson Red~~	~~Brick Red~~ (Crimson Red)	Apple Green

Name	Formula
1) Indian Salt Petre	KNO_3
2) Chile Salt Petre	$NaNO_3$
3) Milk of Magnesia	$Mg(OH)_2$
4) Caustic Soda	$NaOH$

	Name	Formula
5)	Caustic Potash	KOH
6)	Plaster of Paris	$CaSO_4 \cdot \frac{1}{2} H_2O$
7)	Gypsum	$CaSO_4 \cdot 2H_2O$
8)	Dead Burnt Plaster	$CaSO_4$
9)	Caliche	$NaNO_3 + NaIO_3$
10)	epsom's salt	$MgSO_4 \cdot 7H_2O$
11)	Glauber's Salt	$Na_2SO_4 \cdot 10H_2O$
12)	Slaked Lime	$Ca(OH)_2$
13)	Limestone (Marble)	$CaCO_3$
14)	Quicklime	CaO
15)	Soda ash	Na_2CO_3
16)	Bleaching powder	$CaOCl_2$
17)	Washing soda	$Na_2CO_3 \cdot 10H_2O$
18)	Brine	aqu. $NaCl$
19)	Nitrolium	$CaC_2 + N_2$
20)	Baking Soda	$NaHCO_3$
21)	Kainelite	$KCl \cdot MgCl_2 \cdot 6H_2O$