

## GROUP 17 ELEMENTS(HALOGENS)

**Group 17 elements: F,Cl,Br,I,At**

**General electronic configuration:ns<sup>2</sup>np<sup>5</sup>**

### ATOMIC & PHYSICAL PROPERTIES

- i. Atomic & ionic radii increase from fluorine to iodine.
- ii. Ionization enthalpy gradually decreases from fluorine to iodine due to increase in atomic size.
- iii. Electron gain enthalpy of fluorine is less than that of chlorine. It is due to small size of fluorine & repulsion between newly added electron & electrons already present in its small 2p orbital.
- iv. Electronegativity decreases from fluorine to iodine. Fluorine is the most electronegative element in the periodic table.
- v. The colour of halogens is due to absorption of radiations in visible region which results in the excitation of outer electrons to higher energy level.
- vi. Bond dissociation enthalpy of fluorine is smaller than that of chlorine is due to electron-electron repulsion among the lone pair in fluorine molecules where they are much closer to each other than in case of chlorine. The trend: Cl-Cl>Br-Br>F-F>I-I.

### CHEMICAL PROPERTIES

OXIDATION STATES:-1.However, chlorine, bromine & iodine exhibit +1, +3, +5, +7 oxidation states also.

Fluorine forms two oxides OF<sub>2</sub> and O<sub>2</sub>F<sub>2</sub>. These are essentially oxygen fluorides because of the higher electronegativity of fluorine than oxygen.

**Anomalous behavior of fluorine-** due to its small size, highest electronegativity, low F-F bond dissociation enthalpy and absence of d-orbitals.

### TRENDS IN PROPERTIES

Bond dissociation Enthalpy(Increasing order): I<sub>2</sub> < F<sub>2</sub> < Br<sub>2</sub> < Cl<sub>2</sub>

Oxidizing property – F<sub>2</sub>>Cl<sub>2</sub>>Br<sub>2</sub>>I<sub>2</sub>

Acidic strength- HF<HCl<HBr<HI

Stability & bond dissociation enthalpy- HF>HCl>HBr>HI

Stability of oxides of halogens- I>Cl>Br

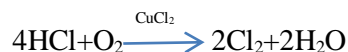
Ionic character of halides –MF>MCl>MBr>MI

### CHLORINE

#### PREPARATION

1.  $\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + \text{Cl}_2 + 2\text{H}_2\text{O}$
2.  $4\text{NaCl} + \text{MnO}_2 + 4\text{H}_2\text{SO}_4 \rightarrow \text{MnCl}_2 + 4\text{NaHSO}_4 + 2\text{H}_2\text{O} + \text{Cl}_2$
3.  $2\text{KMnO}_4 + 16\text{HCl} \rightarrow 2\text{KCl} + 2\text{MnCl}_2 + 8\text{H}_2\text{O} + 5\text{Cl}_2$

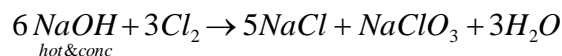
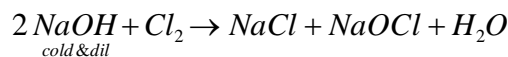
#### 4. **DEACON'S PROCESS**



5. By electrolysis of brine solution.  $\text{Cl}_2$  is obtained at anode.

#### **PROPERTIES**

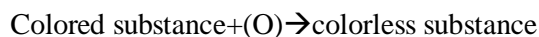
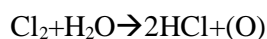
- i. With cold and dilute  $\text{Cl}_2$  produces a mixture of chloride and hypochlorite but with hot and concentrated alkalis it gives chloride and chlorate.



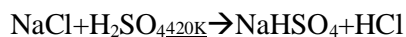
- ii. With dry slaked lime it gives bleaching powder.



- iii. It is a powerful bleaching agent; bleaching action is due to oxidation



- iv. Action of concentrated  $\text{H}_2\text{SO}_4$  on  $\text{NaCl}$  give  $\text{HCl}$  gas.



3:1 ratio of conc.  $\text{HCl}$  &  $\text{HNO}_3$  is known as aquaregia & it is used for dissolving noble metals like  $\text{Au}$  and  $\text{Pt}$ .

#### **OXOACIDS OF HALOGENS** (SEE TABLE 7.10 & FIG.7.8)

##### Interhalogen compounds

They are prepared by direct combination of halogens.

Ex:  $\text{ClF}$ ,  $\text{ClF}_3$ ,  $\text{BrF}_5$ ,  $\text{IF}_7$

They are more reactive than halogens because  $\text{X-X}'$  is weaker than  $\text{X-X}$  bonds in halogens (except  $\text{F-F}$ ).

TYPE	STRUCTURE
$\text{XX}'_3$	Bent T-shaped
$\text{XX}'_5$	Square pyramidal
$\text{XX}'_7$	Pentagonal bipyramidal