

## GROUP 17 ELEMENTS(HALOGENS)

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

General electronic configuration: $ns^2np^5$

### 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  $OF_2$  and  $O_2F_2$ . 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):  $I_2 < F_2 < Br_2 < Cl_2$

Oxidizing property –  $F_2 > Cl_2 > Br_2 > I_2$

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.  $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$
2.  $4NaCl + MnO_2 + 4H_2SO_4 \rightarrow MnCl_2 + 4 NaHSO_4 + 2H_2O + Cl_2$
3.  $2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$

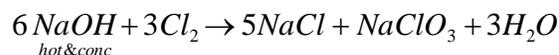
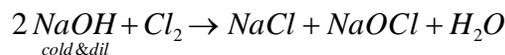
#### 4. **DEACON'S PROCESS**



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

#### **PROPERTIES**

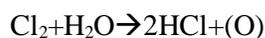
- i. With cold and dilute  $\text{Cl}_2$  produces a mixture of chloride and hypochlorite but with hot and concentrated alkalis it gives chloride and chlorate.



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

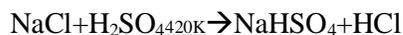


- iii. It is a powerful bleaching agent; bleaching action is due to oxidation



Colored substance + (O)  $\rightarrow$  colorless substance

- 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 Au and 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 F-F).

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