# COORDINATION COMPOUNDS IMPORTANCE AND APPLICATIONS OF COORDINATION COMPOUNDS

## ✤ APPLICATION OF COMPLEXES

The complexes are of immense importance on account of their applications in various fields. During complex formation there are drastic changes in the properties of metal atom/ion these changes in properties are made use of in the application of metal complexes.

(i) The detection and estimation of Ni<sup>2+</sup> is based on the formation of a scarlet red complex with dimethyl glyoxime.



(a)  $Fe^{3+}$  is detected by formation of a blood red coloured complex with KSCN.

$$Fe^{3^{+}} + 3KSCN \longrightarrow Fe(SCN)_{3} + 3K^{+}$$
  
blood red colour  
or  
$$[Fe(H_{2}O)_{5}(SCN)]^{2^{+}}$$

**(b)** Many ligands (organic reagents) are used for the gravimetric estimation of number of metal ions.

Metal ion to	Cu <sup>2+</sup>	Ni <sup>2+</sup>	Fe <sup>3+</sup>	Al <sup>3+</sup>	Co <sup>2+</sup>
be estimated					
Organic	Benzoin	Dimethyl	1,20-	8-	α- nitroso
reagents	oxime	glyoxime	phena-	hydroxy	$\beta$ -naphthol
used			nthroline	quinoline	

Class-12<sup>th</sup>

- (c) EDTA is used as a complexing agent in volumeter analysis of metal ions like  $Ca^{2+}$ ,  $Mg^{2+}$  and  $Zn^{2+}$ .
- (d) The co-ordination compounds of the transition metals exhibit a variety of colours.This property is utilized in colorimetric analysis for the estimation of many metals.
- (ii)
- (a) Metallurgical process: Silver and gold are extracted by the use of complex formation. Silver ore is treated with sodium cyanide solution with continuous passing of air through the solution. Silver dissolves as a cyanide complex and silver is precipitated by the addition of scrap zinc.

 $Ag_2S + 4NaCN \stackrel{Air}{\approx} 2N[Ag(CN)_2] + NaS \stackrel{O_2(Air)}{\rightarrow} Na_2SO_4 + S$ Argentinesodium argent cyanide $2Na[Ag(CN)_2] + Zn \stackrel{Air}{\approx} Na_2[Zn(CN)_4] + 2Ag$ sodium tetracyano zincate (II)

(b) Native Gold and Silver also dissolve in NaCN solution in presence of the oxygen (air).

 $4 \text{ Ag} + 8 \text{ NaCN} + 0_2 + 2\text{H}_2\text{O} \rightarrow 3\text{Na}[\text{Ag}(\text{CN})_2] + 3\text{NaOH}$ 

Silver and Gold are precipitated by addition of scrap zinc. Nickel is extracted by converting it into a volatile complex, nickel carbonyl, by use of carbon monoxide (Mond's process). The complex decomposes on heating again into pure nickel and carbon monoxide.

$$Ni + 4CO \rightarrow Ni(CO)_4 \xrightarrow{heating} Ni + 4CO$$

(iii) **Photography** In photography, the image on the negative is fixed by dissolving all the remaining silver bromide with hypo solution in the form of a soluble complex.

 $AgBr + 2Na_2S_2O_3 \rightarrow Na_3[Ag(S_2O_3)_2] + NaBr$ 

(soluble) (soluble)

(iv) Electroplating Metal complexes release metal slowly and give a uniform coating of the metal on the desired object Cyano complexes of silver, gold copper and other metals are used for the electrodeposition of these metals, (v) Biological processes Metal complexes are of immense importance in biological processes. Hemoglobin, the red blood pigment, which acts as oxygen carrier to different parts of the body is a complex of iron (II). Vitamin  $B_{12}$  is a complex of cobalt metal. The green colouring matter of plants, called chlorophyll, is a complex of magnesium. It acts as a catalyst in photosynthesis.

### APPLICATIONS OF CO-ORDINATION & ORGANOMETALLIC COMPOUNDS

- (i) Coordination compounds are of great importance in biological systems. Example being chlorophyll (the green pigment in plants); hemoglobin (the red pigment of blood, which acts as oxygen carrier) along with myoglobin (which stores oxygen and is a regulator of respiration); Vitamin B<sub>12</sub>, cyanocobalamin, the anti-pernicious anemia factor. All of these, respectively, are the coordination compounds of magnesium, iron and cobalt with the macrocyclic porphyrin and corrin ligands.
- (ii) There are many examples of the use of coordination compounds in qualitative and quantitative chemical analysis. The familiar colour reactions given by metal ions with a number of ligands (especially the chelating ligands), as a result of formation of coordination entities, form the basis for their detection and estimation by classical and instrumental methods of analysis. Familiar examples of such reagents are : ethylenediaminetetraacetic acid (EDTA), dimethylglyoxime,  $\alpha$ -nitroso  $\beta$ -naphthol, cupron, etc.
- (iii) Some important extraction processes of metals, like those of extraction of silver and gold, make use of complex formation. Gold, for example, combines with cyanide in the presence of oxygen and water to form the coordination entity [Au(CN)<sub>2</sub>]<sup>-</sup> in aqueous solution. Gold can be precipitated from this solution by the addition of Zinc.
- (iv) Purification of metals can be achieved through formation and subsequent decomposition of their coordination compounds. For example, impure nickel is converted to [Ni(CO)<sub>4</sub>], which is decomposed to yield pure nickel.
- (v) EDTA is used in the treatment of lead poisoning. Some coordination compounds of platinum effectively inhibit the growth of tumors. Examples are: cis-platin (cis-[Pt(NH<sub>3</sub>)<sub>2</sub>Cl<sub>2</sub>] and related compounds.

#### Class-12<sup>th</sup>

### Chemistry

- (vi) Organometallic compounds are used as catalysts. These catalysts are either of the homogeneous type (soluble in the reaction medium) or of the heterogeneous type (insoluble in the reaction medium). The catalyzed polymerisation of alkenes at atmospheric pressure and ambient temperature using Ziegler-Natta catalyst (titanium tetrachloride plus triethylaluminium) is one of the important discoveries of organometallic chemistry. The first effective homogeneous catalyst chloridoids(triphenylphosphine) rhodium(I), [RhCl(PPh<sub>3</sub>)<sub>3</sub>] for hydrogenation was given by Wilkinson.
- (vii) Tetra ethyl lead (TEL) is used as antiknock compound in gasoline.