APPLICATION OF COORDINATION COMPOUNDS

Application of formation in Qualitative analysis :-

a) In detecting metal ions:

Formation of Complexes is for detecting metal ions in solutions. E.g.

i). If an ammoniacal solution of the substance gives a scarlet red precipitate with DMG it indicates the presence of Ni^{2+}.

ii). If a solution of the substance gives a blood red colour with potassium thio cyanate (KCNS) it indicates, the presence of Fe^{3+}. The blood colour is due to the formation of the complex $[Fe(CNS)_6]^{3-}$.

iii). If a solution of the substance gives a deep blue colour with ammonia it indicates the presence of Cu^{2+}. The deep blue colour is due to the formation of the complex $[Cu(NH_3)_4]^{2+}$.

iv). oxine (8-hydroxy quinoline) is used for the detection of Mg, Al, Zn etc.

b) In separating metal ions:

i). Separation of Ag^{+} and Hg_2^{2+} in first group analysis is done by adding aqueous ammonia. AgCl dissolves forming a complex $[Ag(NH_3)_2]Cl$. HgCl does not dissolve. It can be separated by filtering it.

ii). Separation of Cu^{2+} and Cd^{2+} in second group analysis is done by adding KCN solution. The sulphides of both metals forms complexes and go into solution. Now H_2S is passed $K_2[Cu(CN)_4]$ is more stable than $K_3[Cd(CN)_4]$. So Cd^{3+} ion is precipitated on passing H_2S. It can be separated by filtration.

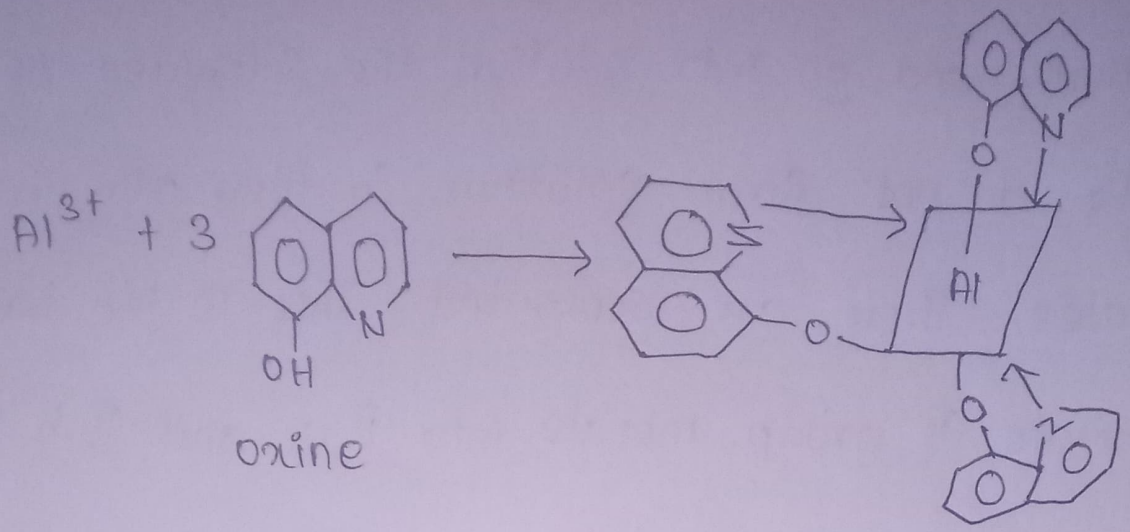
iii). In second group Hg^{2+}, Cu^{2+}, Cd^{2+}, Bi^{2+}, arsenic, antimony and tin are precipitated as their sulphides. To the precipitate yellow ammonium sulphide solution is added. Arsenic, antimony and tin alone form complex sulphide $[AsS_4]^{3+}$, $[SbS_4]^{4+}$ and $[SnS_4]$

respectively. and go into solution the sulphides of elements do not form solution. So they remain as precipitates. They are separated. This is the basis of separate II group metals into II a and II b sub groups.

Quantitative Analysis:-

i). Ni^{2+} forms a complex with dimethyl glyoxime. The complex is bis (dimethyl glyoximato) nickel (II). It is scarlet red in colour. The formation of this complex is used for the gravimetric estimation of Ni^{2+} in solutions.

ii). Al^{3+} forms a complex with oxine (8-hydroxy quinoline C_9H_7ON). The complex is tris oxynato aluminium (III) - $Al(C_9H_7ON)_3$. The formation of this complex is used for the gravimetric estimation of Al^{3+} in solutions. The N and O^- are the donar sites.



oxine

iii). K^+ forms a complex with sodium hexanitrito cobaltate (III). The complex is potassium hexanitrito cobaltate (III) $K_3[Co(NO)_2)_6]$. The formation of this complex is used for the gravimetric estimation of K^+ in solutions.

iv). Hardness of water is estimated by complexo metric titration with standard EDTA using EBT (eriochrome black T) or murexide as indicator. The indicator metal complex and the EDTA metal complex have different colours. So the end point in such titrations are indicated by a colour change.

v). Metal ions like Fe^{2+}, Ni^{2+}, Cu^{2+} etc. which are present in traces are estimated spectro metrically

using suitable complexing agents.

vi). Iodine can be estimated by titrating it against Hg^{2+} in solutions. The formation of a red precipitate of HgI_2, indicates the end point.

$$Hg^{2+} + 4I^- \longrightarrow [HgI_4]^{2-}$$

$$[HgI_4]^{2-} + Hg^{2+} \longrightarrow 2HgI_2 \downarrow$$

(At the end point) (Red precipitate)

Complexometric titration:

In these titrations ions (other H^+ and OH^- ions) are converted into a soluble, slightly dissociated ions or compounds.

Description / Explanation with example:

When $AgNO_3$ is titrated against KCN, Ag^+ is converted into the soluble complex $Ag[(CN)_2]^-$ ion which dissociates slightly.

$$2CN^- + Ag^+ \rightleftharpoons [Ag(CN)_2]^-$$

Principle:

* Metal ions can be determined by titrating them with a reagent that complexes them in solution. The solution to be titrated is buffered at a suitable pH an indicator is added and the metal ion is titrated with a standard solution of the complexing agent. A sharp colour change marks the end point of the titration.

* Complexometric titrations are convenient and accurate They have replaced time consuming gravimetric procedures. Except for the alkali metals most metal cations can be determined by titration with a suitable complexing agent.

* A suitable complexing agent is EDTA. It forms stable chelates with a large number of metal ions. It is used as a primary standard in complexometric titrations.