**metal carbonyls and its classifications**

Metal carbonyls of transition elements constitute another important class of organometallic compounds. All d-block elements which contain only carbonyl ligands are called homoleptic carbonyls.

Amond in 1890 prepared the first homoleptic carbonyl, Ni(CO)4. Later on a large number of neutral binary carbonyl like, Fe(CO)5, Cr(CO)6, Mo(CO)6, W(CO)6 were prepared. In addition to mononuclear metal carbonyls mentioned above, transition metals from many polynuclear metal carbonyls such as Fe3(CO)12, Mn2(CO)10. The metal carbon bonds in metal carbonyls possess both σ and π character.

**Classification of metal carbonyls**

Metal carbonyls are classified into two types:

(i) Mononuclear (or monomeric) carbonyls: these are such compounds which contain only one metallic atom per molecule. For example, V(CO)6, Cr(CO)6, etc.

(ii) Polynuclear carbonyls: these contain two or more metallic atoms per molecule and are of the type Mx(CO)y. These carbonyls are also sometimes called as bridged carbonyls. Polynuclear carbonyls may be homonuclear e.g., Fe3(CO)12 or heteronuclear e.g.,MnCo(CO)9, MnRe(CO)10.

**Nomenclature of metal carbonyls**

(i) In metal carbonyls the metal atom is in zero oxidation sate therefore it may not be mentioned.

(ii) If the metal atom appears two or more times than the word di, tri, tetra etc is added before the name of metal atom.

(iii) If the CO groups act as bridge between the two metals atoms then the Greek letter mu (is written before their names.

(iv) When the metal-metal bond is present between similar atoms than the multiple prefixes, bis, tris, etc. are taken.

(CO)3-Co-(CO)2-Co(CO)3 Di- -carbonyl bis (tricarbonyl cobalt)

(v) While writing the names of π bonded organometallic compounds the symbol prefixes, hapto (η) is used before the name of molecule indicating the number of carbon atoms in the carbon bonded ligand.

e.g Fe(CO3) (C4H6) (η4-butadiene) tricarbonyl iron.

Some examples are given below to illustrate the above points.

 Ni(CO)4 Tetracarbonylnickel

Mn2(CO)10 decacarbonyl dimanganese

Co2(CO)8 Octacarbonyl dicobalt

Fe2(CO)9 Enneacarbonyldiiron

(CO)3-Co-(CO)2-Co(CO)3 Di- - carbonyl bis (tricarbonyl cobal

(CO)4Co-Co-(CO)4 Bis (tetracarbonyl cobalt)

(CO)3Fe(CO)3Fe(CO)3 Tri- -Carbonyl bis (tricarbonyl iron)

(C6H6) Cr(CO)3 (η6-benzene) tricarbonyl chromium

 Fe(CO3) (C4H6) (η4-butadiene) tricarbonyl iron.

**Bonding in metal carbonyl**

As already mentioned, the M-C bond in metal carbonyls has σ as well as π character. The metal-carbon σ bond is formed by the donation of lone pair of electrons on the carbonyl carbon into a vacant orbital of the metal. The metal-carbon π bond is formed by the donation of a pair of electrons from a filled d-orbital of metal into the vacant antibonding pi-molecular orbital (π) of carbon monoxide.

The metal to ligand bonding generates a synergic effect that reinforces the bond between CO and the metal.

**Preparation of metal carbonyls**

Finely divided nickel reacts with CO at room temperature to form Ni(CO)4.

 Ni + 4CO →Ni(CO)4

Iron reacts with CO at higher temperature and pressure.

 Fe + 5CO → Fe (CO)5

Nickel can be purified by first converting it into volatile Ni(CO)4 and subsequent thermal decomposition of Ni(CO)4. This process is known as Mond process.

**Properties of metal carbonyls**

1. Metal carbonyls are generally solids at room temperature and pressure. However Nickel carbonyls are liquids.

2. The mononuclear carbonyls are unstable and noxious.

3. Mononuclear carbonyls are either colourless or light coloured whereas polynuclear carbonyls are more deeply coloured. For example, Fe(CO)5 is light straw coloured liquid while Fe3(CO)12 is a deep green solid.

4. With exception of Fe2(CO)9, carbonyls are soluble in hydrocarbon solvents.