



## Study of Coordination compound and their applications

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**Abstract** : Coordination compound, any of a class of substances with chemical structures in which a central metal atom is surrounded by nonmetal atoms or groups of atoms, called ligands, joined to it by chemical bonds. Coordination compounds include such substances as vitamin B12, hemoglobin, and chlorophyll, dyes and pigments, and catalysts used in preparing organic substances.

**Key Words** : Coordination compound, Organometallic

### **Application :**

A major application of coordination compounds is their use as catalysts, which serve to alter the rate of chemical reactions. Certain complex metal catalysts, for example, play a key role in the production of polyethylene and polypropylene. In addition, a very stable class of organometallic coordination compounds has provided impetus to the development of organometallic chemistry. Organometallic coordination compounds are sometimes characterized by “sandwich” structures, in which two molecules of an unsaturated cyclic hydrocarbon, which lacks one or more hydrogen atoms, bond on either side of a metal atom. This results in a highly stable aromatic system.

### **Coordination Compounds In Industry**

The applications of coordination compounds in chemistry and technology are many and varied. The brilliant and intense colours of many coordination compounds, such as Prussian blue, render them of great value as dyes and pigments. Phthalocyanine complexes (e.g., copper phthalocyanine), containing large-ring ligands closely related to the porphyrins, constitute an important class of dyes for fabrics.

Several important hydrometallurgical processes utilize metal complexes. Nickel, cobalt, and copper can be extracted from their ores as ammine complexes using aqueous ammonia. Differences in the stabilities and solubilities of the ammine complexes can be utilized in selective precipitation procedures that bring about separation of the metals. The purification of nickel can be effected by reaction with carbon monoxide to form the volatile tetracarbonylnickel complex, which can be distilled and thermally decomposed to deposit the pure metal. Aqueous cyanide solutions usually are employed to separate gold from its ores in the form of the extremely stable dicyanoaurate(-1) complex. Cyanide complexes also find application in electroplating.

There are a number of ways in which coordination compounds are used in the analysis of various substances. These include

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(1) the selective precipitation of metal ions as complexes—for example, nickel(2+) ion as the dimethylglyoxime complex (shown below),

(2) the formation of coloured complexes, such as the tetrachlorocobaltate(2-) ion, which can be determined spectrophotometrically—that is, by means of their light absorption properties, and (3) the preparation of complexes, such as metal acetylacetonates, which can be separated from aqueous solution by extraction with organic solvents.

In certain circumstances, the presence of metal ions is undesirable, as, for example, in water, in which calcium ( $\text{Ca}^{2+}$ ) and magnesium ( $\text{Mg}^{2+}$ ) ions cause hardness. In such cases the undesirable effects of the metal ions frequently can be eliminated by “sequestering” the ions as harmless complexes through the addition of an appropriate complexing reagent. Ethylenediaminetetraacetic acid (EDTA) forms very stable complexes, and it is widely used for this purpose. Its applications include water softening (by tying up  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$ ) and the preservation of organic substances, such as vegetable oils and rubber, in which case it combines with traces of transition metal ions that would catalyze oxidation of the organic substances.

A technological and scientific development of major significance was the discovery in 1954 that certain complex metal catalysts—namely, a combination of titanium trichloride, or  $\text{TiCl}_3$ , and triethylaluminum, or  $\text{Al}(\text{C}_2\text{H}_5)_3$ —bring about the polymerizations of organic compounds with carbon-carbon double bonds under mild conditions to form polymers of high molecular weight and highly ordered (stereoregular) structures. Certain of these polymers are of great commercial importance because they are used to make many kinds of fibres, films, and plastics. Other technologically important processes based on metal complex catalysts include the catalysis by metal carbonyls, such as hydridotetracarbonylcobalt, of the so-called hydroformylation of olefins—i.e., of their reactions with hydrogen and carbon monoxide to form aldehydes—and the catalysis by tetrachloropalladate(2-) ions of the oxidation of ethylene in aqueous solution to acetaldehyde (*see* chemical reaction and catalysis).

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