Valence bond theory نظرية اصرة التكافؤ

This theory is applied to the coordination compounds, which are closely related to the hybridization and geometrical shape of the central atom. This theory represents the metal orbitals in squares (or circles) to show the distribution electron of the outer shell of the metal (Lewis acid), which has the ability to accept a pair of electrons, (Lewis base) have the ability to give a pair of electrons and formation coordination bond between the ligand and the metal.

Example 1: The complex ion of the copper diamin $[Cu(NH_3)_2]^+$ the electronic structure of the outer shell of the copper and the electronic structure of the complex shall be as follows:

- Four electrons came from two ligands.

-The hybridization type sp formation from orbital type s with orbital type p .

-Linear complex ion shape.

-The complex ion is a diamagnetic because of absence of a single electron in it.

Example 2: The complex ion of the triiodo zinc (II) $[ZnI_3]^-$ the electronic structure of the outer shell of zinc metal and the electronic structure of the complex shall be as follows:

- Six electrons came from three ligands.

-The hybridization type sp^2 formation from orbital type s with two orbitals type p .

-Trigonal planner complex ion shape.

-The complex ion is a diamagnetic because of absence of a single electron in it.

Example 3: The complex ion of the nickel(II) tetrachloro $[NiCl_4]^{2-}$ the electronic structure of the outer shell of nickel and the electronic structure of the complex shall be as follows:

- 8 electrons came from four ligands.

-The hybridization type sp^3 formation from orbital type s with three orbitals type p .

-Tetrahedral complex ion shape.

-The complex ion is a paramagnetic because of presence pair electrons non paired .

Example 4: The complex ion of the nickel(II) tetracyanid $[NiCN_4]^{2-}$ the electronic structure of the outer shell of nickel and the electronic structure of the complex shall be as follows:

- 8 electrons came from four ligands.

-The hybridization type dsp^2 formation from orbital type d and one orbital from s with two orbitals type p .

-Square planer complex ion shape.

-The complex ion is a diamagnetic because of absence of a single electron in it .

Note:

The single electrons of d remained as they were in the complex $[NiCl_4]^{2-}$ while they became double in the complex $[NiCN_4]^{2-}$ that is, the type of ligand has an important effect in this case where CN is a strong ligand because it makes single electrons In the complex that is formed paired. While the ion chlorine ligand is weak because it cannot make single electrons paired.

Weak ligands	**Strong ligands**
Iodide (I^{-})	Cyanide (CN^{-})
Bromide (Br^{-})	Ammonia (NH_3)
Chloride (Cl^{-})	Nitrite (NO_2^{-})
Fluoride (F^{-})	Carbonyl (CO)
Hydroxide (OH^{-})	
Water (H_2O)	

Example:

Write the type of complex hybridization that contains cobalt where it represents $[CoL_4]^{2-}$ (The ligand hybridization is defined as L):

1 - The first case: The electronic structure of the outer shell of cobalt metal and electronic structure in the complex.

Note that according to this structure, single electrons are equal to 3 and hybrids of the type sp^3.

2 - The second case: The electronic structure in the complex:

The number of single electrons equals one and the hybridization of a type dsp^2