

Preparation of Cobalt(II) Complexes with Tetradentate Schiff Base Containing Nitrogen and Oxygen Atoms As Donor Sites

Rakesh Kumar Ranjan

P.G. Centre, Department of Chemistry,
D.A.V. College, Siwan,
J.P. University, Chapra-841301 (BIHAR)

ABSTRACT : I have prepared the complexes of Cobalt(II) metals with tetradentate Schiff base 1,3-bis(*o*-hydroxy anilino) propane in presence of bases containing nitrogen and oxygen atoms as donor sites. After that, all the complexes were characterised by usual physico-chemical methods and found to be non-electrolyte, monomeric, paramagnetic and octahedral in geometry with general molecular formula $[Co(L)(B)_2]$ where L = ligand and B = bases.

Keywords : Complex, ligand, characterisation, geometry, octahedral, analysis, paramagnetic, non-electrolyte, monomeric, paramagnetic, solution, filtrate and filtration.

I. Introduction

Large number of complexes of divalent transition metals have been prepared with the Schiff bases containing oxygen and nitrogen atoms as their donor sites. But least work has been carried out with such Schiff bases which has been obtained by the condensation of 1,3-dibromo propane and *o*-hydroxy aniline. Therefore, in this paper, I report the formation of Cobalt(II) complexes with the Schiff base obtained by the condensation of *o*-hydroxy aniline and 1,3-dibromo propane in presence of bases.

PREPARATION OF SCHIFF BASE LIGAND:-

The Schiff base ligand 1,3-bis(*o*-hydroxy anilino) propane has been prepared by the condensation of 1,3-dibromo propane and 2-amino phenol under suitable conditions.

Procedure:

An ethanolic solution of 1.12g (0.01 mole) of 1,3-dibromo propane was gradually added to an alcoholic solution of 1.1g (0.01 mole) of 2-amino phenol with regular shaking. The resulting solution was heated on water-bath for 3 hours with regular shaking. A yellow solid separated out on cooling under ice-bath. The solid was separated by filtration and washed with acetone and dried over $CaCl_2$ placed in a desiccator. The melting point of the compound was recorded and found to be $\pm 2, 132^\circ C$. The yellow solid was further analysed and found to contain C=68.70%, H=8.79% and N=10.68% respectively which corresponds to the molecular formula $C_{15}H_{18}N_2O_2$.

The identification of the compound was confirmed by spectroscopy.

PREPARATION OF COBALT(II) COMPLEXES:-

Procedure:

2.6g (0.001 mole) of the ligand was dissolved in minimum volume of ethyl alcohol (20ml) and 0.23g (0.001 mole) of Cobalt(II) chloride hexahydrate was dissolved in dry acetone separately. Both solutions were gradually mixed together and allowed to react on water-bath for two and half an hour with regular shaking. Pinkish brown solid separated out on cooling the solution under tap-water. The solid was separated by filtration and washed with ether. The complexes were prepared separately in presence of different bases keeping the molar ratio of the metal and ligand 1:1 respectively. The crude product was recrystallized with methyl alcohol and dried over KOH pellets placed in a desiccator. On the basis of the elemental analysis, the complexes was found to possess the general molecular formula $[Co(L)(B)_2]$ where L = ligand and B = bases.

Analytical Data of Cobalt(II) Complexes

S.N.	Complexes	Metal	Carbon	Hydrogen	Nitrogen
1.	[Co(C ₁₅ H ₁₆ N ₂ O ₂)(H ₂ O) ₂]	16.34 (16.78)	51.18 (51.59)	5.70 (5.69)	8.00 (7.97)
2.	[Co(C ₁₅ H ₁₆ N ₂ O ₂)(NH ₃) ₂]	16.46 (16.88)	68.80 (69.12)	6.32 (6.30)	16.10 (16.05)
3.	[Co(C ₁₅ H ₁₆ N ₂ O ₂)(C ₉ H ₇ N) ₂]	10.10 (10.28)	66.46 (66.80)	5.24 (5.23)	9.90 (9.77)
4.	[Co(C ₁₅ H ₁₆ N ₂ O ₂)(C ₆ H ₅ NC) ₂]	11.10 (11.30)	63.10 (63.43)	5.04 (4.99)	10.82 (10.75)
5.	[Co(C ₁₅ H ₁₆ N ₂ O ₂)(C ₆ H ₅ N) ₂]	12.21 (12.45)	64.30 (64.68)	5.48 (5.49)	11.90 (11.84)
6.	[Co(C ₁₅ H ₁₆ N ₂ O ₂)(C ₅ H ₄ NCH ₃) ₂] α -picoline	11.58 (11.75)	64.22 (64.68)	6.00 (5.98)	11.20 (11.17)
7.	[Co(C ₁₅ H ₁₆ N ₂ O ₂)(C ₅ H ₄ NCH ₃) ₂] β -picoline	11.50 (11.75)	64.28 (64.68)	5.96 (5.98)	11.18 (11.17)
8.	[Co(C ₁₅ H ₁₆ N ₂ O ₂)(C ₅ H ₄ NCH ₃) ₂] γ -picoline	11.46 (11.75)	64.10 (64.68)	5.94 (5.94)	11.22 (11.17)

By the comparison of IR bands of the ligand and the complexes, it has been obtained that there are appreciable change in the band position obtained due to phenolic –OH, aromatic >(C-N), and aliphatic (N-H) groups.

In almost all the complexes, a strong and sharp band obtained at 3420cm⁻¹ in the ligand molecule remains intact in the complexes indicating that anilino (N-H) is not deprotonated. A medium and sharp band obtained around 1340cm⁻¹ in the ligand molecule due to the vibration of aromatic (C-N) group has shifted to 1360cm⁻¹ in the complexes indicating that anilino (C-N) nitrogen atom is taking part in the bond formation with the metal cation. A sharp and medium band obtained in the ligand around 1120cm⁻¹ due to aliphatic (C-N) group has been shifted to 1140cm⁻¹ in the complexes indicating the participation of aliphatic anilino (C-N) nitrogen atom in the complex formation.

A strong and sharp band obtained in the ligand molecule around 3580cm⁻¹ disappears in all the complexes. The deprotonation of phenolic –OH group has been suggested due to the presence of a medium and sharp band obtained in the range of 1510-1530cm⁻¹ in the ligand molecule has been shifted to 1540-1550cm⁻¹. This increase in the bond length of phenolic (C-O) group indicates the deprotonation of phenolic –OH groups.

Thus two oxygen atoms of phenolic –OH groups and two nitrogen atoms attached to benzene ring as well as propane are the bonding sites of the ligand molecule. Thus ligand molecule behaves as bi-anionic tetradentate donor molecule.

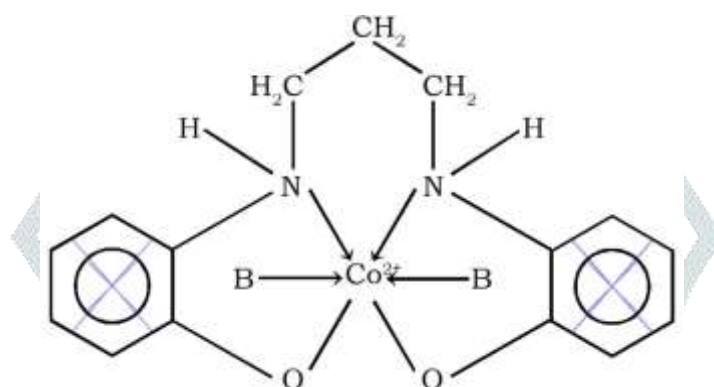
In the complexes, a broad and unsymmetrical band was obtained at about 3360cm⁻¹ due to the vibration of combined (NH+OH) group indicating the participation of water and ammonia molecule in the bond formation. In case of phenyl isocyanide, a sharp and medium obtained in free phenyl isocyanide (2180cm⁻¹) has been shifted to 12230cm⁻¹ in the complexes indicating the participation of N-atom of isocyanide group in the bond formation with the metal cation.

In quinoline complexes, a sharp and medium band obtained at 1420cm⁻¹ in the complex indicates the participation of N-atom of quinoline in the complex formation.

Pyridine and picoline display bands in finger print and far infra-red region. The bands obtained in the range of $920-940\text{cm}^{-1}$ and $630-660\text{cm}^{-1}$ in the complexes are the special bands to indicate the presence of pyridine and picoline in the complexes.

Two new bands obtained in the range of $430-450\text{cm}^{-1}$ and $540-560\text{cm}^{-1}$ in the complexes due to the vibrations of (M-N) and (M-O) bonds respectively further confirms the participation of oxygen and nitrogen atoms in the bond formation with the metal cations.

Thus on the basis of elemental analysis, measurement of electrical conductance, magnetic moment, electronic and IR spectral, the geometry of Cobalt(II) complexes with the ligand 1,3-bis(o-hydroxy anilino) propane in presence of bases has been suggested to be octahedral with the general molecular formula $[\text{Co}(\text{L})(\text{B})_2]$ where L = ligand and B = bases such as water, ammonia, phenyl isocyanide, quinoline, pyridine and α -picoline, β -picoline and γ -picoline.



VI. Acknowledge

I am highly thankful to the then Principal, P.G. Centre, D.A.V. College, Siwan, J.P. University, Chapra for providing me available library and laboratory facilities. I am also thankful to Dr. Shamshad Ahmad Khan, Head, Department of Chemistry, for providing me cordial help during the course of experimental work. I am highly grateful to faculty members and non-teaching staffs for keeping village relation with me during the course of whole research work.

References

- [1] H. Schiff: *Annal Phys.*, 150(1869)193.
- [2] R.B. Singh, B.S. Garg & R.P. Singh: *Talanta*, 25(1978)619.
- [3] F.M. Collins et.al.: 128(1982)1349.
- [4] Mann & Saunders: *Organic Practical Chemistry*, 4th Ed., 1976.
- [5] K. Nakamoto: *Infrared Spectra of Inorganic and Coordination Compounds*, Willey, New York (1970).
- [6] A.B.P. Lever: *Inorganic Electronic Spectroscopy*, Elsevier, Amesterdom (1968)275.
- [7] L.J. Bellamy: *The Infra-red Spectra of Complex Molecule*, Willey, New York (1959).
- [8] D.G. Palke, S.D. Salunke & B.K. Ray: *Asian J. Chem.*, 29(2017)2707-2710.
- [9] S. Kumari, R.K. Jha and C.M. Jha: *J. Chemtracks*, 20(2018)5762.
- [10] Ramjee Sah et.al.: *J. Chemtracks*, 14(2012)29-34.
- [11] B.K. Ray et.al.: *Asian J. Chem.*, 21(2009)3708-3712.
- [12] Sanjay Kumar Rai: *J. Chemtracks*, 19(2017)69-70.