



INFRARED (FTIR) SPECTROSCOPY STUDY OF METAL IONS CU⁺², FE⁺³, MN⁺², CO⁺² AND ZN⁺² METAL IONS OF NOVEL POLYMERIC METAL CHELATES OF PATHQ

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Abstract

The novel polymeric ligands were prepared by reaction of 5-amino-8-quinolinol with polyamines containing cyanuric chloride moieties. These were characterized by preliminary characterization. Aim of recent study was to determined function group of polymeric metal chelates of PATHQ with Cu⁺², Fe⁺³, Mn⁺², Co⁺² and Zn⁺² metal ions by using FTIR spectroscopy method. All FTIR analysis was done in FTIR high efficiency instrument. The study results found variation of function group in ligand sample at wave length peak 3355 to 843 cm⁻¹. Highest peak of FTIR results are found in 3066.42 (C-H of PL-1 and Cu²⁺), 3348.51 (O-H, PL-2 and Fe³⁺), 3194.03 (C-H, PL-3 and Zn²⁺), 3160.45 (N-H, PL-4 and Mn²⁺), 3355.22 (O-H, PL-5 and Co²⁺) and 3361.94 (O-H, PL-6 and Mn²⁺). Metal-oxygen new band is seen in the IR spectra.

Keyword: FTIR, polymeric metal chelates of PATHQ with metal ions

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INTRODUCTION

The first chelating compounds with two donor atoms were found by Morgan and Drew in 1920 [1]. Polymers that create chelates have traditionally been put to use in the selective removal of multivalent metal ions from wastewater discharges. Ion-selective electrodes and ion-exchange membranes benefit from the special properties of polymer chelates of monovalent metal particles (utilizing crown and cryptand) and monomeric buildings of multivalent metal particles, the two of which have been examined in recent years [2]. N, O, and S are the most common nonmetal elements that serve as chelation donors, despite the abundance of chelating and complexing agents. The ligands that comprise these components in functional groups, such as B.: carboxylic acid (-COOH), sulfonic acid (-SO₃H), hydroxyl (-OH), nitroso (-N=O), and thiol (-SH) [3,4], can be classified as cationic, neutral, or anionic. Recent reviews of various methodologies [5,6].

MATERIAL and METHOD

2.1 Synthesis of Ligands:

The purified polymeric ligand PL-1 to PL-6 was utilized to make polymeric metal chelates. We separated each polymeric ligand using the conventional method. The refined procedure was completed by producing metal chelates from a desiccated ligand sample. The combination of all the chemicals was used to create a sodium salt solution.

2.1.1 Production of the sodium salt solution:

Polymeric metal chelates were created using polymeric ligands [PL-1 to PL-6]. According to the standard procedure, every polymeric ligand was purified. After the purification process was finished, a powdered ligand sample was used to create metal chelates. The entire complement of ligands was put to use in the making of the salt solution.

a) Production of Cu⁺² chelates:

A product was purified using a 100 ml solution of cupric nitrate hexahydrate and sodium salt solutions of each ligand, resulting in a chelate precipitate of 4.5 pH and yield of 73%.

b) Production of Fe⁺³ chelates:

A mixture of sodium salt solutions of each ligand and ferric nitrate hexahydrate in 100 ml of water was used to purify the result, resulting in a chelate precipitate of 6.0 pH and a yield of 67%.

c) Production of Co⁺² chelates:

100 ml of water were mixed with cobalt nitrate hexahydrate and sodium-salt of the ligand to create a dazzling white precipitate. The total chelate output was 75% and the pH was 6.0.

d) Production of Mn⁺² chelates:

Each ligand's sodium salt solution was combined with a 100 ml solution of manganese chloride hexahydrate., resulting in a pH of 5.6 and a yield of 72%.

e) Production of Zn⁺² chelates:

The sodium salt arrangement of every ligand was combined with a 100 ml solution of zinc nitrate hexahydrate, resulting in a pH of 5.6 and a 70% yield

2.2 Sample preparation:

By turning the screw counterclockwise and holding it in place in the instrument's sample holder, you can fix an empty NaCl or KBr plate between plate holders. Consider the ambient spectrum. Place a standard or sample between two NaCl or KBr plates, screw the plates into the plate holders by turning the screw counterclockwise until a consistent film form between the plates (remove any air bubbles if they are visible in the film), and then place the plate assembly in the sample holder. Consider the standard/sample IR spectrum. Following analysis, the cell is first cleaned with dry tissue paper before being treated with carbon tetrachloride.

Install the NaCl cell device with fixed thickness as needed. Place the cell in a cassette and choose an appropriate background (such as the air background).

Insert the plug into both holes after injecting the liquid diluent or sample via one hole in the cell until the liquid emerges from the other hole and forms a thin layer. Use tissue paper to wipe the cell. Consider the IR range.

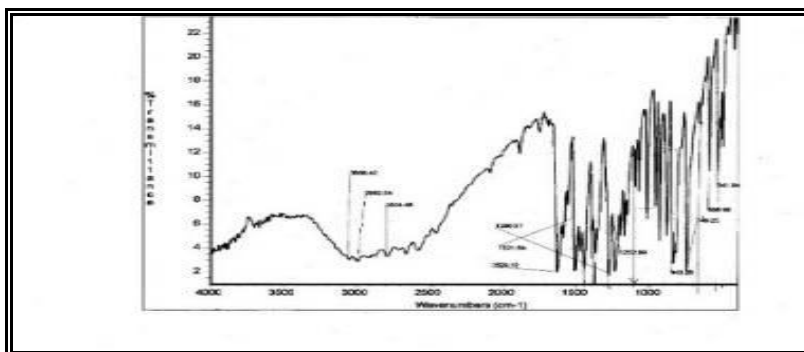
After analysis, or with the solvent suggested in the monograph, clean the cell by first wiping it with tissue paper and then with carbon tetrachloride.

RESULTS AND CONCLUSION

1. IR Spectrum of [PL-1] Cu²⁺ Chelate:

According to the study's findings, the function group varied from wavelength peak 3066.42 to 1252.99 cm⁻¹. The highest peak is observed at (Bond-C-H, FG- Alkane and Frequency 3066.54 cm⁻¹) and lowermost peak is observed at (Bond-C-O, FG- Alcohol, Ether, Ester, Carboxylic Acid, Anhydride and Frequency 1252.99 cm⁻¹) (Bond-

C-O, FG- Alcohol, Ether, Ester, Carboxylic Acid, Anhydride and Frequency 1252.99 cm^{-1}).



Graph No.01 IR Spectrum of [PL-1] Cu^{2+} Chelate

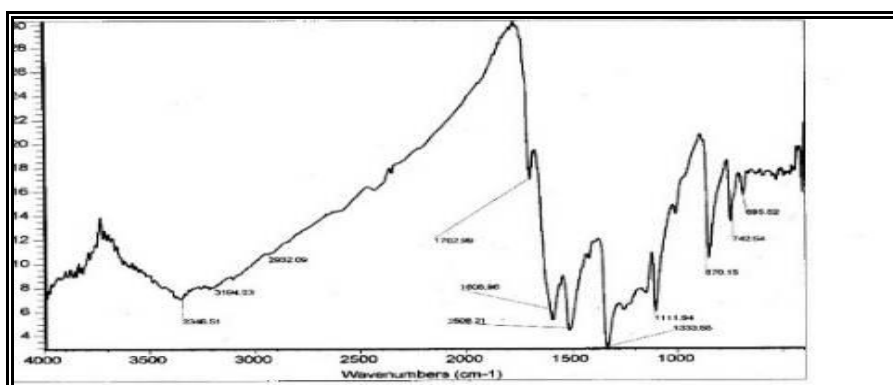
Table No.01. IR Spectrum of [PL-1] Cu^{2+} Chelate

Functional-Group		Wave length
C-H	Alkane	3066.42
C-H	Alkane	2992.54
C-H	Aldehyde	2804.48
C=C	Alkene	1629.1
N=O	Nitro (R-NO ₂)	1521.64
C-O	Alcohol, Ether, Ester, Carboxylic Acid, Anhydride	1288.57
C-O	Alcohol, Ether, Ester, Carboxylic Acid, Anhydride	1252.99

2. IR Spectrum of [PL-2] Fe^{3+} Chelate:

According to the study's findings, the function group's peak wave length ranged from 3348.51 to 695.52 cm^{-1} . The peak at (Bond. O-H, FG-

Hydrogen-bonded, and Frequency 3348.51 cm^{-1} is the highest, and the peak at (Bond (Bond-C-CL, FG- Chloride and Frequency 695.52 cm^{-1}).



Graph No.02 IR Spectrum of [PL-2] Fe^{3+} Chelate

Table No 02. IR Spectrum of [PL-2] Fe^{3+} Chelate

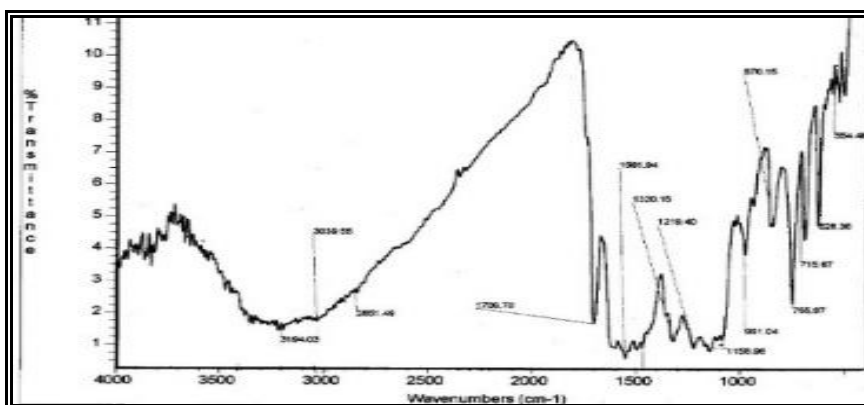
Functional- Group		Wave Length
O-H	Hydrogen-bonded	3348.51
N-H	Primary and Secondary Amine and Amide	3194.03
O-H	Carboxylic Acids	2932.09
N=O	Nitro (R-NO ₂)	1508.21
N=O	Nitro (R-NO ₂)	1333.58
C-O	Alcohol, Ether, Ester, Carboxylic Acid, Anhydride	1111.94
C-Cl	Chloride	742.54
C-Cl	Chloride	695.52

3. IR Spectrum of [PL-3] Zn^{2+} Chelate:

According to the study's findings, the function group varied from wave length peak 3194.03 to

1219.4 cm^{-1} . The highest peak is detected at (Bond-C-H, FG- Alkyne (terminal) and Frequency 3194.03 cm^{-1}) and lowermost peak is observed at

(Bond N=O, FG- Nitro (R-NO₂) and Frequency 1219.4 cm⁻¹).



Graph No.03 IR Spectrum of [PL-3] Zn²⁺Chelate

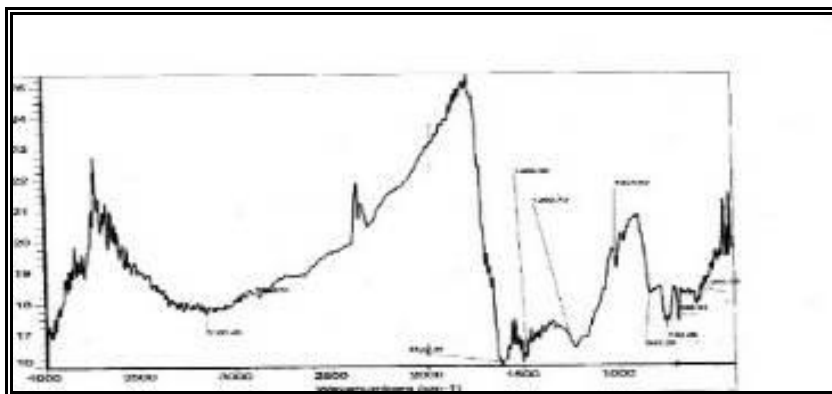
Table No. 03 IR Spectrum of [PL-3] Zn²⁺Chelate

Functional-Group		Wave Length
C-H	Alkyne (terminal)	3194.03
C-H	Alkane	3039.55
C-H	Alkane	2851.49
C=O	Carboxylic Acid	1709.7
C-O	Alcohol, Ether, Ester, Carboxylic Acid, Anhydride	1320.15
N=O	Nitro (R-NO ₂)	1219.4

4. IR Spectrum of [PL-4] Mn²⁺ Chelate:

According to the study's findings, the function group varied between the wave length peaks of 3160.45 and 843.28 cm⁻¹. The greatest peak is detected at (Bond-N-H, FG- Primary and

Secondary Amine and Amide and Frequency 3160.45 cm⁻¹) and lowermost peak is observed at (Bond C-Cl, FG-Chloride and Frequency 843.28 cm⁻¹) (Bond C-Cl, FG-Chloride and Frequency 843.28 cm⁻¹).



Graph No. 04 IR Spectrum of [PL-4] Mn²⁺ Chelate

Table No.04 IR Spectrum of [PL-4] Mn²⁺Chelate

Functional-Group		Wave Length
N-H	Primary and Secondary Amine and Amide	3160.45
C-H	Alkane	2886.51
C=N	Imine and Oxime	1622.39
N=O	Nitro (R-NO ₂)	1259.7
C-N	Amine	1024.63
C-Cl	Chloride	843.28

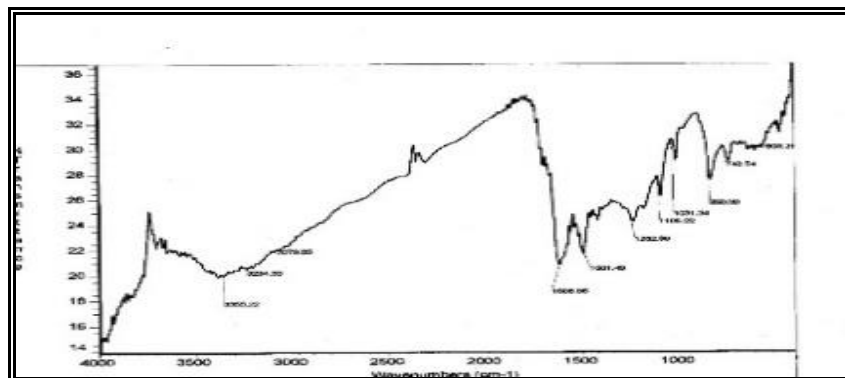
5. IR Spectrum of [PL-5] Co²⁺ Chelate:

According to the study's findings, the function group varied from wave length peak 3355.22 to

1031.34 cm⁻¹. Bond-O-H, FG-Hydrogen bound, and Frequency 3355.22 cm⁻¹ are the frequencies

where the largest and lowest peaks, respectively, are detected (Bond

C-N, FG-Amine and Frequency 1031.34 cm^{-1}).



Graph No. 05 IR Spectrum of [PL-5] Co^{2+} Chelate

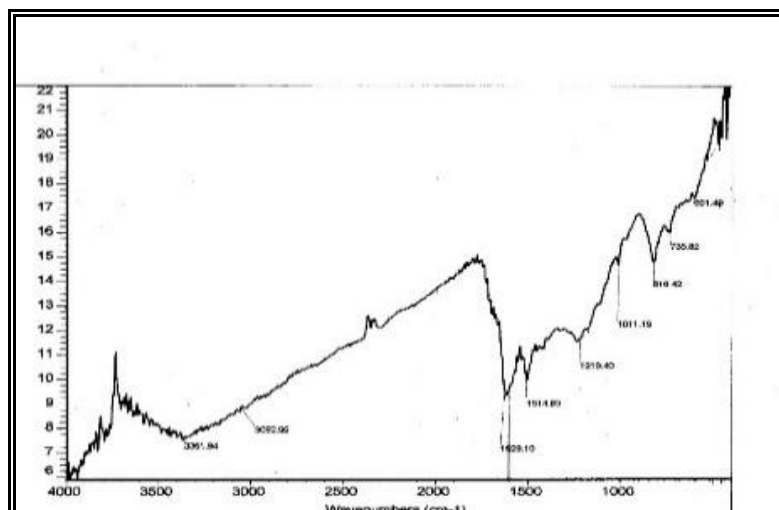
Table No. 05 IR Spectrum of [PL-5] Co^{2+} Chelate

Functional-Group		Wave Length
O-H	Hydrogen-bonded	3355.22
O-H	Hydrogen-bonded	3233.34
N-H	Primary and Secondary Amine and Amide	3079.85
C=N	Imine and Oxime	1606.06
C-O	Alcohol, Ether, Ester, Carboxylic Acid, Anhydride	1252.99
C-N	Amine	1106.22
C-N	Amine	1031.34

6. IR Spectrum of [PL-6] Mn^{2+} Chelate:

The study results indicated variation of function group at wave length peak 3361.94 to 1011.19 cm^{-1} . The frequency at which the highest peak and

lowest peak are observed is (Bond-O-H, FG-Hydrogen bound, and Frequency 3361.94 cm^{-1}) (Bond C-N, FG-Amine and Frequency 1011.19 cm^{-1}).



Graph No. 06 IR Spectrum of [PL-6] Mn^{2+} Chelate

Table No.06 IR Spectrum of [PL-6] Mn^{2+} Chelate

Functional-Group		Wave Length
O-H	Hydrogen-bonded	3361.94
N-H	Primary and Secondary Amine and Amide	3052.99
C=N	Imine and Oxime	1629.1
N=O	Nitro (R-NO ₂)	1514.93
C-O	Alcohol, Ether, Ester, Carboxylic Acid, Anhydride	1219.4
C-N	Amine	1011.19

CONCUSION

The tables and graphs #01, 02, 03, 04, 05, and 06 show the identified IR spectra of polymeric metal chelates from a recent study. Chelates are substances that resemble the appropriate polymeric ligands. Each set of polymeric chelates has a characteristic Infrared spectrum that can be differentiated from the spectrum of its related ligand. All the chelates in each row exhibit a new band in their IR spectra, which is probably the result of a metal-oxygen bond forming as a result of complex formation. A novel band, at 1095 cm⁻¹, was observed in the spectra of the metal chelates. It's all thanks to the discovery of γ_{c-o} of C-O-Metal bond.

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