PREFACE

The investigations presented in this thesis were carried out by the author in the Materials Science Laboratory, Department of Physics, Alagappa University, Karaikudi during 2002-2005. A part of the work has also been carried out at the Microwave Research Laboratory, Department of Physics, Dr.B.A.M.University, Aurangabad, Maharastra.

The dielectric properties of liquids are useful to some extent to understand their structures and molecular interactions therein. The thesis deals with the dielectric studies of corrosion inhibitors in diluted state. The thesis is divided into two parts. The first part deals with the introduction of corrosion inhibitors, an overview of dielectric studies and the various theories on dielectrics, review of literature and the scope of the work. The second part deals with the experimental details for the dielectric constant measurement of corrosion inhibitors with polar liquids, dipolar increment studies of alcohol – amine mixtures and relaxation studies of corrosion inhibitors using time domain reflectometry technique.

Chapter I gives a brief introduction of corrosion inhibitors. Inhibitors are substances which when added to a corrosive medium, lowers the corrosion rate by retarding the anodic process and/or the cathodic process. Number of organic compounds have been studied in detail as the corrosion
inhibitors of Iron compounds such as amines, aldehydes, alcohols, alkaloids etc. have been studied and tried as corrosion inhibitors. The amines studied in this work come under organic inhibitors.

The second chapter explains the applications of Dielectric studies in the area of agriculture, electronics, ceramic industry, polymer industry and medicine. These areas are described briefly.

In the chapter III, the various theories of dielectrics are briefly described. The theories of dielectric relaxation can be broadly divided into two parts as theories of static permittivity and theories of dynamic permittivity. The polar dielectric materials having a permanent dipole moment, when placed in a steady electric field so that all types of polarization can maintain equilibrium with it. The permittivity of the material under these conditions is called as static permittivity (\(\varepsilon_0\)). The Clausius Mossotti equation, Debye’s theory, Onsager theory, Kirkwood theory and Frohlich theory are described briefly. In dynamic permittivity, an alternating electric field of appropriate frequency gives rise to dielectric dispersion; the characteristic orientation motions of the dipole result in a frequency variation of the dielectric constant, and the appearance of ‘dielectric loss’ over a broad band of frequencies. Under this section, Debye model, Cole – Cole model, Davidson – Cole relaxation model and Havriliak – Negami model are
described. A brief review of literature has been given. Scope of the work is also reported.

Chapter IV discusses the study of fluid structure of corrosion inhibitors with polar liquids having low dielectric constant. The dielectric parameters were determined using VLCR meter. Measurement of density, refractive index and dipole moment are also discussed.

Chapter V is an introduction of our studies of H-bonded complexes of corrosion inhibitors. It deals with different quantum mechanical theories of H-bonding. This chapter also discusses our investigations on the H-bonding ability of the lone pair of electrons of the carbonyl group of the amines with proton donors of alcohols by measurement of dipole moments of the complexes.

Chapter VI gives the brief outline of the time domain technique. The experimental setup, the operating principle, working and data analysis are discussed. The investigation of permittivity and relaxation time of corrosion inhibitors - polar liquid mixtures for different concentrations for a wide range of frequency from 10 MHz to 20 GHz using time domain reflectometry is the effective way to study the molecular interactions of Corrosion inhibitors - polar liquid mixtures.
Chapter VII deals with the results and discussion for the experimental studies discussed in chapter IV, V and VI. All the tables and figures are presented in Appendix I and II respectively. A brief conclusion is given in chapter VIII.

The theoretical background related to the material has also been presented briefly. The unit of dipole moment is given as Debye (D) as convention. The S.I. units are given in the glossary. The thesis is mainly a report of the experimental investigation, great care was taken in the matter of purity of chemicals used. The errors involved in the measurements and computations are minimized and a statistical analysis of the data was done.

A part of the work presented in the thesis was published as follows:

1. Study of fluid structure and dielectric behaviour of Diethylamine in polar liquids

A part of the work presented in the thesis was presented in the conferences as follows.

1. Dielectric studies and fluid structure of some esters diluted in benzene.
   *National Seminar on Chemical Physics (NSCP-2003), Mar. 10-11, 2003, Department of Physics, Annamalai University, Annamalai Nagar.*
2. Dielectric studies on binary mixtures of polar liquids and molecular interactions.

**National Seminar on Emerging Trends in Molecular Physics (NASETEMP-2004),**
Mar.8-9, 2004. *Department of Physics, Annamalai University, Annamalai Nagar.*

3. Study of fluid structure and dielectric behaviour of Morpholine in polar liquids

**National Seminar on Emerging Trends in Molecular Physics (NASETEMP-2004),**
Mar.8-9, 2004. *Department of Physics, Annamalai University, Annamalai Nagar.*

4. Study of fluid structure and dielectric behaviour of Cyclohexylamine in polar liquids.


5. Study of fluid structure and dielectric behaviour of Diethylamine in polar Liquids.

**National Seminar in Ferroelectrics and Dielectrics (NSFD-XIII),**
Nov.23-25, 2004, *Department of Physics and Astrophysics, University of Delhi, New Delhi.*

6. Dielectric relaxation study of THF with Cyclohexylamine and Diethylamine at microwave frequency using time domain technique.

**National Seminar in Ferroelectrics and Dielectrics (NSFD-XIII),**
Nov.23-25, 2004, *Department of Physics and Astrophysics, University of Delhi, New Delhi.*
7. Dielectric relaxation study of Cyclohexylamine in Methanol at microwave frequency using time domain technique.

National Seminar in Ferroelectrics and Dielectrics (NSFD-XIII),
Nov.23-25, 2004, Department of Physics and Astrophysics,
University of Delhi, Delhi

8. Study of fluid structure and dielectric behaviour of Morpholine in Diethylamine.

National symposium on advances in Material Science (NSAMS-2005)
March 17-19, 2005, Department of Physics D.D.U. Gorakhpur University,
Gorakhpur.


National symposium on advances in Material Science (NSAMS-2005)
March 17-19, 2005, Department of Physics D.D.U. Gorakhpur University,
Gorakhpur.

10. Dielectric studies of cyclohexylamine-2 ethyl hexanol binary polar liquid mixtures.

'National Conference on Recent Advances in Materials Science'.
(NCMS – 2006)
February 16-17, 2006, Department of Physics. Periyar University. Salem

11. Dipole Moment Studies and Molecular Interactions of Corrosion Inhibitors.

Materials Performance (Communicated)

12. Dielectric studies of Corrosion Inhibitor in Polar liquid

Materials Performance (Communicated)
13. Dielectric study of Triethylamine and 1-Dodecanol mixture at different temperatures using LCR meter

*Journal of the Chinese Chemical Society* (Communicated)

14. Dielectric studies of H-bonded complexes of Benzamide and Nicotinamide with alcohols

*Indian Journal of Pure & Applied Physics* (Communicated)

15. Dielectric studies of m-Toluidine-Dibutyl phthalate and Di- isopropylamine-1-Dodecanol binary mixtures.

*Journal of Molecular Liquids* (Communicated)