Preface

In recent years an increasing variety of research techniques are being employed to get an insight into the molecular behaviour of liquids. In the present stage of development, ultrasonic techniques are yielding fruitful results comparable with those of other methods in the elucidation of molecular mechanisms. Measurement of sound velocity has been used for many years in connection with the determination of elastic and thermodynamic properties of gases, liquids and solids. Intimate relations between the values of sound velocity and chemical or structural characteristics of molecules of liquids or liquid mixtures have been found. This gives sound velocity the primary quantity in the molecular theory of liquids.

It is well known that small amplitude ultrasonic wave velocity in a medium is a physical property of the medium and a study of the velocity under varying conditions provides valuable informations about the physical properties of the medium under such conditions. The nature of molecular interactions in liquid mixtures can be studied from the measurement of ultrasonic velocity in conjunction with thermoacoustical parameters and excess thermodynamical functions. Similarly, a study of the absorption of ultrasonic waves provides valuable information about various inter- and intramolecular processes like relaxation of the medium, existence of isomeric states or the exchange of degrees of freedom. Hence the study of absorption of ultrasonic waves in liquids or liquid mixtures
leads to an understanding of the different loss mechanisms existing in the medium.

Wave propagation of ultrasound through condensed media is fundamentally non-linear in nature. The extent of nonlinearity is related to the ratio of the third to the second virial coefficients (B/A) in the equation of state of the medium. The acoustic nonlinearity parameter B/A plays a significant role in nonlinear acoustics and its determination is very important in underwater acoustics and also in molecular physics. Hence the study of ultrasonic velocity, absorption and nonlinearity parameter might give a complete insight into the intermolecular interactions, energy exchange and loss mechanisms existing in liquids and liquid mixtures.

This thesis entitled “Ultrasonic absorption and non-linearity parameter B/A of binary liquid mixtures” is a detailed account of experimental studies of ultrasonic velocity in and absorption of five different binary liquid mixtures at different temperatures. Also, ultrasonic absorption and the acoustic non-linearity parameter B/A of these liquid mixtures were evaluated theoretically and the results are included in this thesis. In addition, B/A values of seven other liquid mixtures have been determined making use of the high pressure ultrasonic velocity values reported in the literature.

The thesis is divided into six chapters. Chapter 1 provides a brief review of ultrasonic studies in binary liquid mixtures reported in the literature. Also, the details of the binary liquid mixtures chosen for the present study are included.

Chapter 2 gives a description of the pulse echo overlap method for measuring ultrasonic velocity and the pulse method for measuring ultrasonic
absorption in liquids. The precautions to be taken to minimize errors in these measurements are also discussed.

The details of the experimental study of ultrasonic velocity in five different binary liquid mixtures at different temperatures are given in chapter 3. A brief description of the theoretical aspects of different thermo-acoustical parameters and the computational procedure used in the evaluation of these parameters are given. The evaluation of the excess thermodynamic functions is also included in this chapter. The intermolecular interactions existing in the binary liquid mixtures are discussed making use of the excess isentropic compressibility and other excess thermodynamical functions.

Chapter 4 gives an account of the experimental study of ultrasonic absorption in five binary liquid mixtures at different temperatures. The values of ultrasonic absorption were theoretically calculated using three different methods and these values were compared with the experimental results of the present study. The validity of these theoretical methods for estimating ultrasonic absorption in the present study is discussed.

Chapter 5 deals with the theoretical evaluation of acoustic non-linearity parameter B/A in the five binary liquid mixtures at two different temperatures using Tong and Dong theory. Basically, Tong and Dong theory was developed for pure liquids and this theory was extended to binary mixtures in the present study. Molecular interactions present in the binary liquid mixtures are discussed making use of the parameters excess B/A and excess isentropic compressibility.

Chapter 6 contains the details of the determination by two different methods of acoustic nonlinearity parameter B/A in seven binary mixtures making use of the high-
pressure ultrasonic velocities reported in the literature. Also, the B/A values of these liquid mixtures were determined theoretically by two methods without using high pressure ultrasonic velocities. A comparative study of the results obtained using these four methods was done. Molecular interaction existing in these liquid mixtures were also studied with the help of the computed excess thermodynamic parameters.

A part of the work included in this thesis has been published / communicated and presented in seminars.

**Research paper published/ communicated**


2. Acoustic non-linearity parameter B/A and related molecular properties in binary organic liquid mixtures. (Communicated).

**Research papers presented/accepted for presentation in symposium**


Papers published on Topics not included in the thesis


7. Ultrasonic study of (1-x-y) B_2O_3-X (Li_2O)-y (MCl_2), (M=Cd,Zn), glasses P. S. Vijoy, J. Jugan and M. Abdul Khader, Material Research Bulletin 36 (2001) 867.