

DENSITY, VISCOSITY AND THERMO ACOUSTICAL STUDY OF STYRENE-ETHYLENE-BUTYLENE-STYRENE IN POLAR SOLVENT AT VARIOUS CONCENTRATION AT 303K

Submitted in partial fulfillment of the requirements for the award of
Master of Science Degree in Physics

By

J. VENIS MANO

(41590026)



**DEPARTMENT OF PHYSICS
SCHOOL OF SCIENCE AND HUMANITIES**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

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JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119.

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BONAFIDE CERTIFICATE

This is to certify that this project report is the bonafide work of **VENIS MANO.J (REG.NO. 41590026)** who carried out the project entitled "**Density, Viscosity and Thermo acoustical study of styrene-ethylene-butylene-styrene in polar solvent at various concentration at 303k**" under my supervision from **NOVEMBER 2022 TO MAY 2023**.

Internal Guide
DR.S.RAVICHANDRAN

Head of the department
DR.S.RAVICHANDRAN

Submitted for Viva voce Examination held on 9.5.2023 2023

INTERNAL EXAMINER

EXTERNAL EXAMINER

Dr.D. DINESH KUMAR

Associate Professor (Research)

DECLARATION

I **VENIS MANO J** hereby declare that the Project Report entitled **Density, Viscosity and Thermo acoustical study of styrene-ethylene-butylene-styrene in polar solvent at various concentration at 303k** done by me under the guidance of **Dr.S.RAVICHANDRAN** at SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY is submitted in partial fulfillment of the requirements for the award of Master of Science degree in Physics.

DATE: 09-05-2023

PLACE: CHENNAI

A handwritten signature in black ink that reads "Venis Mano". The signature is written in a cursive style with a horizontal line underneath the name.

SIGNATURE OF THE CANDIDATE

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ABSTRACT

Ultrasonic investigation of polymer mixtures consisting polar and non-polar components is of considerable importance in understanding intermolecular interaction between the mixtures and they find applications in several industrial and technological process. Many investigators have been studies in the collecting more data and discussion in terms of the properties of liquid mixtures. In view of growing interest, the results of an ultrasonic velocity, density and viscosity to study the related thermodynamic properties that is molar volume (V_a), available volume (V_m), isentropic compressibility (β_s), inter molecular free length (L_f), compressibility, surface tension, and viscosity. The measurement of ultrasonic velocity of ultrasonic waves in liquids enables determination of some useful acoustic and thermodynamic parameters that are found to be very sensitive to molecular interactions. Hence these measurements are useful to study the strength of molecular interactions in liquid mixtures. The thermodynamic studies of binary liquid mixture have attracted much attention of scientist and experimental data on number systems are available from review and publication.

Nano fluids have extremely large surface to volume ratio and thus have great potential in heat transfer applications. They have enhanced thermal properties, due to the presence of small sized nanoparticles and find wide range of applications like electronics, transportations, medical field. The important goal in Nano fluid research is to develop Nano fluid with stability for industrial applications. Nano fluids are prepared by sonication process which is a usual and simple method. Ultra sonication is an accepted technique for dispersing aggregated nanoparticles for the preparation of aqueous Nano-suspensions. The Nano fluids synthesized using metal or metal oxide nanoparticles have relatively high thermal conductivity than the base fluid.

Ultrasonic velocity and viscosity, density values are measured for different concentrations of Nano fluids. The acoustic parameters like adiabatic compressibility, intermolecular free length, and acoustic impedance are calculated from the experimental data. The variation of ultrasonic velocity and other parameters with particle concentration are discussed on the basis of interaction of ultrasonic wave.

TABLE OF CONTENTS

CHAPTER NO	TITLE	Pg. No
	ABSTRACT	VI
	TABLE OF CONTENTS	VII
	TABLE OF FIGURES	X
	LIST OF TABLES	XII
	ABBREVIATIONS	XIII
	SYMBOL	XIII
1	INTRODUCTION	
1.1.	ULTRASONIC INTERFEROMETER	1
1.2.	THE HIGH FREQUENCY GENERATOR	3
1.3.	THE MEASURING CELL	3
1.4.	ADJUSTMENT OF ULTRASONIC INTERFEROMETER	3
1.5.	WORKING PRINCIPLE OF ULTRASONIC INTERFEROMETER	3
1.6.	ADJUSTMENT OF ULTRASONIC INTERFEROMETER	4
1.7.	PROCEDURE	4
1.8.	MEASUREMENT OF DENSITY	5
1.9.	MEASUREMENT OF VISCOSITY	5
2	LLITERATURE SURVEY	6
3	AIM AND SCOPE	9
4	MATERIALS AND METHODS	
4.1.	THEORY	10
4.1.1.	SOLVENTS	10
4.1.2.	POLAR SOLVENTS	11

	4.1.3. ACETONITRILE	11
	4.1.4. PROPERTIES OF ACETONITRILE C_2H_3N OR CH_3CN	11
	4.1.5. STRUCTURE OF ACETONITRILE C_2H_3N OR CH_3CN	12
	4.1.6. PREPARATION OF ACETONITRILE	12
	4.1.7. USES OF ACETONITRILE	12
	4.1.8. SEBS (Styrene-Ethylene-Butylene-Styrene)	13
	4.1.9. HOW SEBS IS MADE?	13
	4.1.10. APPLICATIONS OF SEBS	15
	4.1.11. ADVANTAGES OF SEBS	15
	4.1.12. DISADVANTAGES OF SEBS	15
	4.2. THE MEASURED VALUES OF DENSITY (P), VISCOSITY (H) AND ULTRASONIC VELOCITY (U) WERE USED TO DETERMINE VARIOUS PHYSICAL PARAMETERS	16
	4.2.1. ADIABATIC COMPRESSIBILITY	16
	4.2.2. ACOUSTIC IMPEDENCE	16
	4.2.3. RELATIVE ASSOCIATION	17
	4.2.4. MOLAR VOLUME	17
	4.2.5. AVAILABLE VOLUME	17
	4.2.6. FREE VOLUME	18
	4.2.7. INTERMOLECULAR FREE LENGTH	18
	4.2.8. INTERNAL PRESSURE	19
	4.2.9. RELAXATION TIME	20
	4.2.10. MOLE FRACTION	20
5	RESULT AND DISCUSSION	
	5.1. VELOCITY	21
	5.2. DENSITY	22

	5.3. VISCOSITY	23
	5.4. ADIABATIC COMPRESSIBILITY	24
	5.5 . ACOUSTIC IMPEDENCE	25
	5.6. RELATIVE ASSOCIATION	26
	5.7. MOLAR VOLUME	27
	5.8. AVAILABLE VOLUME	28
	5.9. FREE VOLUME	29
	5.10. INTERMOLECULAR FREE LENGTH	30
	5.11. INTERNAL PRESSURE	31
	5.12. RELAXATION TIME	32
	5.13. MOLE FRACTION	33
	5.14. TABLE EXPERIMENTAL VALUES OF ACOUSTICAL PARAMETERS FOR SEBS IN ACETONITRILE SOLUTION AT VARIOUS CONCENTRATION AT 303K (CONCENTRATION-1)	34
	5.15. TABLE EXPERIMENTAL VALUES OF ACOUSTICAL PARAMETERS FOR SEBS IN ACETONITRILE SOLUTION AT VARIOUS CONCENTRATION AT 303K (CONCENTRATION-2)	35
6	CONCLUSION	36
7	REFERENCES	37

TABLE OF FIGURES:

Fig.no	TITLE	Pg.no
1.1	ULTRASONIC INTERFEROMETER SETUP	2
5.1	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and velocity.	21
5.2	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and density.	22
5.3	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and viscosity.	23
5.4	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and adiabatic compressibility.	24
5.5	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and acoustic impedance.	25
5.6	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and relative association.	26
5.7	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and surface tension.	27
5.8	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and molar volume.	28
5.9	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and available volume.	29

5.10	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and free volume.	30
5.11	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and intermolecular free length.	31
5.12	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and Internal pressure	32
5.13	(a) And (b) shows the concentration-1 and concentration-2 respectively of mole fraction of SEBS and relaxation time.	33

LIST OF TABLES:

Table no	Title	Pg.no
5.14	TABLE EXPERIMENTAL VALUES OF ACOUSTICAL PARAMETERS FOR SEBS IN ACETONITRILE SOLUTION AT VARIOUS CONCENTRATION AT 303K (CONCENTRATION-1)	34
5.15	TABLE EXPERIMENTAL VALUES OF ACOUSTICAL PARAMETERS FOR SEBS IN ACETONITRILE SOLUTION AT VARIOUS CONCENTRATION AT 303K (CONCENTRATION-2)	35

ABBREVIATIONS:

PEG- Polyethylene Glycol

SEBS- Styrene-Ethylene-Styrene-Butylene

IUPAC- International Union of Pure and Applied Chemistry

TPE- Thermoplastic Elastomers

Pp- Polypropylene

UV- Ultraviolet

SYMBOLS:

λ - Wavelength

β - Compressibility

ρ - Density

η - Viscosity

CHAPTER-1

1. INTRODUCTION:

Ultrasonic technique has been widely used to study the molecular interaction in polymer solutions. Acoustic impedance, molecular free length and adiabatic compressibility, compound from ultrasonic velocity and density of the solutions are given direct information's involve among the various polymers-solvents, complex formation, association dissociation, structural and de-structural nature of solvents. The ultrasonic technique is a powerful tool to investigate the behavior of polymer solutions and character of polymer chain in an ultrasonic field. Ultrasonic studies have found extensive applications in characterizing the aspects of thermodynamic, structural and physicochemical behavior of liquid mixtures. The measurements of ultrasonic velocity and other parameters has been used in understanding the nature of intermolecular interactions in binary liquid mixtures. The measurements of ultrasonic velocity and other calculated parameters has been used in understanding the nature of intermolecular interactions in binary liquid mixtures. Ultrasonic technique together with isometric and density studies offers promising method to characterize the solutions. Joshi et al studied the interactions of polyethylene glycols in aqueous solution at 288.0K: by ultrasonic method and they conducted that the nature of all PEG's in water as structure maker.

Ultrasonic velocity and thermodynamic parameters derived from these measurements are widely used to study of molecular interactions in pure liquid, aqueous solutions and liquid mixtures. Thus the study of these solute-solute interactions is essential due to their important contribution to the energetic of protein denaturation. Ion-solvent interactions have been extensively investigated in a number of mixed solvents using different techniques. Limiting ionic apparent molal isentropic compressibility's are important parameters which not only provide the magnitude but also predict the nature of interactions on the basis of their positive or negative signs. In the present investigation, an attempt has been made to give detailed information on the measurement of velocity, density and viscosity of Styrene-Ethylene-Butylene-Styrene in Acetonitrile liquid mixture.

1.1. ULTRASONIC INTERFEROMETER:

Ultrasonic sound is defined as sound pressure with a frequency higher than that of the human auditory range (20 Hz to 20 KHz). When an ultrasonic wave travels through a medium, the molecules in that medium vibrate in a direction parallel to the longitudinal wave for a very short distance. Momentum is transmitted among molecules during this oscillation. As a result, the wave travels through the medium.

The piezoelectric technique is used to generate ultrasonic waves in an ultrasonic interferometer. The wavelength of sound in an experimental liquid media is monitored in a fixed frequency variable path interferometer, and this allows one to compute its velocity across that medium. The equipment comprises of an ultrasonic cell with a capacity of 10ml that is double walled brass with chromium plated surfaces. The double wall lets water to circulate around the experimental medium, allowing it to remain at a consistent temperature.

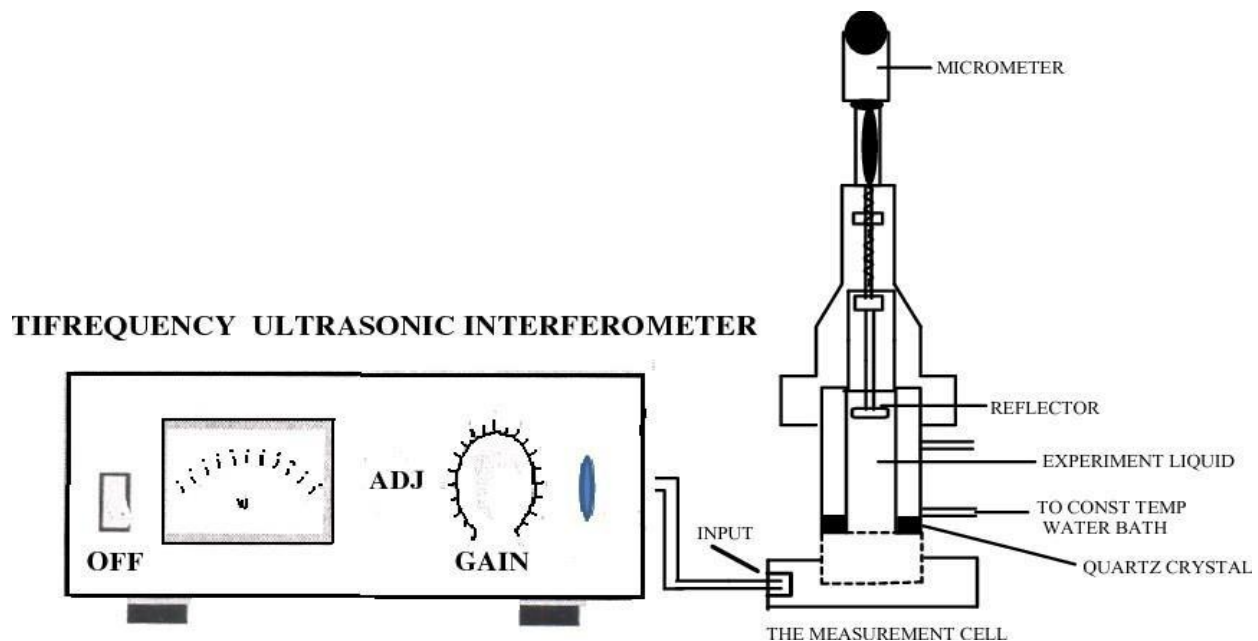


Fig 1.1 ULTRASONIC INTERFEROMETER SETUP

The micrometre scale is 25mm in length and is marked in 0.01mm increments. A quartz crystal installed at the bottom of the cell generates ultrasonic waves of specified frequency. The waves are reflected by a moveable metallic plate parallel to the quartz plate. Standing waves are formed in the liquid medium when the waves interact with their

reflections and the gap between the plates is exactly an integer multiple of half-wavelengths of sound. Acoustic resonance happens under these conditions. The resonant waves have a maximum amplitude, which causes a maximum in the piezoelectric generator's anode.

The anode current returns to its maximum if the distance is increased or decreased by exactly one half of the wavelength ($\lambda / 2$) or an integer multiple of one half wavelength. If d is the distance between successive anode current maxima, then

$$d = \frac{\lambda}{2}$$

We have, the velocity (v) of a wave is related to its wavelength (λ) by the relation,

$$v = \lambda f$$

Where f is the frequency of the wave.

Then,

$$v = \lambda f = 2df$$

The compressibility of the medium's substance mostly determines the velocity of ultrasound. The velocity will be lower in a medium with a high compressibility. The adiabatic compressibility of a fluid is a measure of the fluid's relative volume change in response to pressure change. The Greek word beta (β) is used to represent compressibility, which is the reciprocal of bulk modulus. The equation may be used to calculate the adiabatic compressibility of a sample material.

$$Q = \frac{1}{\rho v^2}$$

Where ρ is the density of the material of the medium and v is the velocity of sound wave through medium.

1.2. THE HIGH FREQUENCY GENERATOR:

The high frequency generator is intended to excite the quartz crystal positioned at the bottom of the measuring cell at its resonant frequency, causing ultrasonic waves to be generated in the experimental liquid contained in the "measuring cell." On the high frequency generator's panel is a micrometer for measuring current changes and two buttons for sensitivity regulation and initial micrometer adjustment.

1.3. THE MEASURING CELL

The measurement cell is carefully built to keep the liquid temperature constant during the experiment. At the top is a tiny digital micrometer screw (LC 0.001 mm) that may lower or raise the reflector plate in the liquid within the cell by a specified distance. It has a quartz crystal attached to the bottom.

1.4. ADJUSTMENT OF ULTRASONIC INTERFEROMETER

For initial adjustment two knobs are provided on high frequency generator, one is marked with "ADJ" to adjust the position of the needle on the ammeter and the knob marked "GAIN" is used to increase the sensitivity of the instrument for greater deflection, if desired. The ammeter is used to notice the number of maximum deflection while micrometer is moved up or down in liquid.

1.5. WORKING PRINCIPLE OF ULTRASONIC INTERFEROMETER

The measurement of velocity (U) is predicated on an exact assessment of the wavelength (λ) in the medium. The quartz crystal installed at the bottom of the cell generates ultrasonic waves of known frequency (f). These waves are reflected by a moveable metallic plate held parallel to the quartz crystal. Standing waves arise in the medium if the gap between these two plates is exactly a full multiple of the sound wavelength. This acoustic resonance causes an electrical reaction on the generator,

pushing the quartz crystal and increasing the generator's anode current. If the distance is now raised or reduced and the variation is precisely one half wavelength ($\lambda/2$) or a multiple of it, the anode current becomes maximal from knowledge of wavelength ($\lambda/2$) the velocity (U) may be determined by the relation:

$$\text{Velocity} = \text{Frequency} \times \text{Wavelength}$$

$$U = \lambda \times f$$

1.6. ADJUSTMENT OF ULTRASONIC INTERFEROMETER

On the high frequency generator, two knobs are provided for initial adjustment: one labelled "ADJ" to modify the position of the needle on the ammeter and one marked "GAIN" to raise the sensitivity of the instrument for more deflection, if required. The ammeter is used to record the greatest deflection of the micrometer as it moves up and down in the liquid.

1.7. PROCEDURE

- ❖ Unscrew the cell's knurled cover and remove it away from the cell's double-walled structure. Fill it halfway with experimental liquid and screw on the knurled cover. Wipe away any surplus liquid that has overflowed from the cell.
- ❖ Insert the cell into the hefty base socket and secure it with the screw on its side.
- ❖ Connect the high frequency generator to the cell using the coaxial connection that came with the instrument. The frequency selector knob of an ultrasonic interferometer should be set to the required frequency (the same frequency as the cell selected).
- ❖ Slowly turn the micrometer clockwise or anticlockwise until the anode current on the ammeter on the high frequency generator reaches a maximum or a minimum.
- ❖ Take note of the micrometer value that corresponds to the maximum or minimum in micro ammeter. Take roughly 25-50 consecutive maximum or minimum readings and tabulate them.

- ❖ Calculate the average of all differences ($\lambda / 2$).
- ❖ Once the wavelength (λ) is determined, the velocity (U) in the liquid may be estimated using the relation.

1.8. MEASUREMENT OF DENSITY

The density measurements were by dilatometer. It was placed in a high precision water bath for temperature control. The dilatometer was calibrated initially using distilled water. The reliability of the dilatometer was checked for liquid like benzene and carbon tetrachloride at known temperatures.

1.9. MEASUREMENT OF VISCOSITY

The viscosity was measured using Ostwald's viscometer. The viscometer is immersed in a water bath and filled with distilled water (reference liquid). The water in the viscometer is given some time to reach the desired temperature. The water is sucked over the prescribed level and then let to flow freely using an appropriate setup. The time it takes for the water to flow is recorded. The water is replaced by a mixture, the viscosity of which is to be determined. The time required for the flow of a liquid combination at the experimental temperature was calculated using the same approach.

Using time taken for distilled water and mixture, the viscosity of unknown liquid mixture is determined:

$$\eta_s/\eta_w = \rho_s/\rho_w \times t_s/t_w$$

Where η_w, ρ_w and t_w velocity, density and time flow of water respectively and η_s, ρ_s and t_s are viscosity, density and time flow of unknown liquid mixture respectively.

CHAPTER-2

2. LITERATURE SURVEY

- 1) In 2018, Indu Saxena, RN Pathak, Vijay Kumar, Rikkam Devi Experimental techniques employed in the present work for the measurement of density, ultrasonic velocity, viscosity and working principle of ultrasonic interferometer have been discussed in this paper. In addition to that, the present paper also includes a brief discussion on experimental setup, different parts, procedure of ultrasonic interferometer, and various thermodynamic parameters which have been evaluated using theoretical equations. Specifically, experimental techniques employed in the present paper are Principle of Interferometry Technique.
- 2) In 2018, Pradip V. Tekadea, Bhagyashri U. Talea, Sonal D. Bajaja, and Nandini Authankar Ultrasonic studies of compounds of dihydropyridine series in polar and non-polar solvents at various concentrations and temperatures 303–318 K. Density and ultrasonic velocity and different thermoacoustical parameters measured. Rao's constant, molar volume, Wada's constant, isothermal compressibility reported with the help of these data using standard formulae. Ethanol and DMF selected as polar and nonpolar solvents respectively. The variation in thermoacoustical parameters with temperature and concentration shows that the solute–solute molecular interaction takes place in solution which is more in DMF.
- 3) In 2016, A. Sherif and S. Chidambara Vinayagam Ultrasonic velocity, viscosity and density of solution containing transition metal acetates with poly (ethylene glycol) were determined at 303K. From the experimental values the acoustical parameters such as adiabatic compressibility (β), acoustic impedance (Z), free path length (L_f), Free Volume (V_f), Internal pressure (π_i), Absorption Coefficient (α/f^2), Available Volume (V_a), Viscous Relaxation Time (τ) and Cohesive Energy (CE) have been computed. The trend in acoustical parameters with concentration identifies the strong interaction between the solute and solvent. The variations of these parameters with composition of the mixture suggest the strength of molecular interactions in these mixtures.
- 4) In 2016, S.P.Steevi Felix and A.Rose Venis The ultrasonic velocities, density, viscosity of binary mixtures such as cyclohexane with Propanol and 1-Butanol at

318.15 K have been measured. From the measure data, some of the acoustical parameters such as adiabatic compressibility (and free volume (V_f) values have been calculated for all the mixtures. These parameters are useful for explaining the molecular interaction between the components of liquid mixtures.

- 5) In 2015, S. Ravichandran and K. Ramanathan The ultrasonic velocity and density of polyacrylamide in water, ethanolamine, diethanolamine, and triethanolamine solutions were measured at 299 K at different concentrations. Variations in ultrasonic velocity, acoustic impedance, adiabatic compressibility, and free length were found to be nonlinear. Other parameters, such as mole fraction, effective molecular weight, molar volume, Rao constant, Wada's constant, available volume, and relaxation strength were also calculated. The nonlinear variation predicts the presence of solute–solvent interactions in PAA solutions, and it is observed that the interactions are very weak in a particular concentration. The molecular interactions present in the solutions are discussed in light of polymer concentrations and solvents.
- 6) In 2015, Shilpa A. Mirika, Pravina P. Pawar and Govind K. Bichile A systematic study using ultrasonic velocity (u), density (ρ) and viscosity (η) measurements as a function of mole fraction has been carried out. The temperature dependence of these quantities has also been investigated at 308.15K using this experimental data, thermodynamic parameters such as the adiabatic compressibility (β_a), intermolecular free length (L_f), acoustic impedance (z) and relative association (RA) of amino acids in aqueous solution of electrolyte at 308.15K temperature and at different concentrations.

CHAPTER-3

3. AIM AND SCOPE:

The low concentrated solution is prepared by dissolving 2grams of SEBS in 100 milliliters of acetonitrile. This solution takes one day to dissolve completely. From this prepared solution, firstly we take 2 ml from this prepared stock solution and add 18 ml of acetonitrile to it and stirred it well. For this prepared solution, the experimental methods to determine ultrasonic velocity U , density ρ and viscosity η were carried out and the measurement values were noted in the table. Next we take another 4 ml from this prepared stock solution and add 16 ml of acetonitrile to it and stir it well. For this prepared solution we carry out the experiments to determine those experimental parameters and the measured values are tabulated. Like that we prepare 6ml (SEBS solution) + 14ml (acetonitrile), 8ml (SEBS solution) + 12ml (acetonitrile) 18ml (SEBS solution) + 2ml (acetonitrile) and the experiments were carried out for each solution and the measured values are tabulated. For these measured values, the acoustic parameters are calculated and the calculated values are also tabulated. Graphs are plotted for those values.

The high concentration solution is prepared by dissolving 2.5grams of SEBS in 100 milliliters of acetonitrile. This solution takes one day to dissolve completely. We follow the same procedure for this prepared stock solution as we follow for the low concentrated solution i.e., we prepare 2ml (SEBS solution) + 18ml (acetonitrile), 4ml (SEBS solution) + 16ml (acetonitrile) 18ml(SEBS solution) + 2ml(acetonitrile). For these solutions we carry out the experiments to determine those experimental parameters and the measured values are tabulated in the separate tabular column. For these measured values, the acoustic parameters are calculated and the calculated values are also tabulated. Graphs are plotted for these values.

CHAPTER-4

4. MATERIALS AND METHODS:

4.1. THEORY

Commercial Styrene-Ethylene-Butylene-Styrene (SEBS) is used in the present study. (Karotan polymers, Mumbai) Styrene-Ethylene-Butylene-Styrene solutions were prepared by dissolving (2gm) in 100 ml of Acetonitrile. The polymer solution was prepared in different concentration like 0:20, 2:18, 4:16... And ultrasonic parameters were studied. The total volume of a solution should be maintained. For density measurements, the liquid mixtures were taken 125ml gravity bottle. In order to obtain a constant temperature, the specific gravity bottle was kept inside the water bath for about 30 minutes. The densities of the pure liquids and liquid mixtures were measured using a gravity bottle. Ultrasonic Interferometer of fixed frequency (2MHz) was used for measuring ultrasonic velocity. (F-81, Mittal Enterprises, New Delhi). Density and Ultrasonic velocity were measured for the different concentration of the mixed solution at 303K.

4.1.1 SOLVENTS

Solvents can be broadly classified into two categories: Polar and Non-polar. A solvent is a chemical substance that dissolves another chemical substance to form a solution of a homogeneous mixture. The solvent is the component in the solution that is present in the largest amount and determines the physicochemical form of the substance as either solid, liquid or gas. Solvents are usually but not necessarily always liquids and can also be gases or solids.

The solvent is the part that normally consists of more than 50 % of a solution, whereas the solute is the part that is blended into the solvent. Typically, this is less than 50 % of the solution.

4.1.2 POLAR SOLVENTS

Polar solvents are the solvents that contain partial positive and partial negative charge. The dipole moment occurs during charge separation. Polar solvents generally dissolve other polar substances as polar solvents generally carry a positive and negative charge and when we add a polar substance negative charge of the polar substance goes to the positive charge of the solvent and the positive charge of the polar substance goes to the negative charge of polar solvents. So that Polar substances can dissolve in polar solvents.

4.1.3 ACETONITRILE

It is an organic chemical with the formula C_2H_3N or CH_3CN , and it is a volatile chemical. Other names for acetonitrile include cyanomethane and methane carbonitrile. Acetonitrile is the IUPAC name for it. It's a nitrile, a type of hydrogen cyanide in which the hydrogen (H) has been swapped out for a methyl group ($-CH_3$). Acetonitrile is an extremely colorless, limpid liquid. It smells strongly of fragrance. It is less dense than water when compared to water. Its vapors are denser than those of air. Acetonitrile has a mildly pleasant flavor and is readily soluble in water. In the lab, it serves as a solvent with a medium polarity. In the year 1847, Jean Baptiste Dumas made the first preparation of acetonitrile. Mostly, it is created as a result of acrylonitrile manufacture. In the European Economic Area since March 2000, acetonitrile has been banned in cosmetic products. It is often preferred as safe for domestic use.

4.1.4 PROPERTIES OF ACETONITRILE

1. Molecular weight: 41.05g/mol
2. Density: 786 kg/m³
3. Melting point: -46°C to -44°C
4. Boiling point: 81.3°C to 82.1°C
5. IUPAC ID: Acetonitrile

6. Colour: Colorless
7. Odor: Aromatic odor
8. Taste: Sweetish taste
9. Solubility: Soluble in water
10. Chemical names: Methyl cyanide, Cyanomethane, Ethanitrile

4.1.5 STRUCTURE OF ACETONITRILE - C_2H_3N or CH_3CN

In terms of its functional group, acetonitrile is categorized as a nitrile. A carbon atom with a triple bond to a nitrogen atom is referred to as a nitrile in organic chemistry. The simplest organic nitrile with a triple bond between carbon and nitrogen is acetonitrile.

4.1.6 PREPARATION OF ACETONITRILE - C_2H_3N or CH_3CN

As a byproduct of acrylonitrile production, it is obtained. It may also be made by dehydrating acetamide and ammonia, or by hydrogenating combinations of carbon monoxide. The invention described a two-step process for producing high purity acetonitrile from acetic acid and ammonia, and the process includes the following two steps: Ammonium acetate is created by:

1. Neutralizing acetic acid and ammonia to produce ammonium acetate;
2. Mixing an aqueous solution of ammonium acetate with gaseous ammonia; heating the mixture; and forcing it into a fixed bed reactor with an aluminum oxide catalyst for reaction to produce acetonitrile, which contains mixed gas; and
3. Continuously refining the gas to produce pure acetonitrile.

4.1.7 USES OF ACETONITRILE

1. Acetonitrile is employed as a solvent in the extraction of hydrocarbons.
2. Chemist utilize it as a solvent in chemical process and chromatography.
3. Acetonitrile is used to extract fatty acids from vegetable oil.

4. Acetonitrile is used for making perfumes.
5. Acetonitrile is commonly utilized in the manufacture of synthetic medicines.
6. Acetonitrile is a chemical that is used in the production of rubber.
7. It is utilized in both copper extraction and refining.
8. It is utilized as a solvent in electrochemical cells.
9. It is commonly utilized in battery applications due to its relatively high dielectric constant and ability to dissolve electrolytes.

4.1.8 SEBS (Styrene-Ethylene-Butylene-Styrene)

SEBS, or styrene-ethylene-butylene-styrene, is a significant thermoplastic elastomer (TPE) that acts like rubber without being vulcanized. SEBS is a robust and flexible material with good heat and UV resistance that is also simple to produce. It is made by partially and selectively hydrogenating styrene-butadiene-styrene copolymer (SBS), which enhances thermal stability, weather ability, and oil resistance while also making SEBS steam sterile. However, hydrogenation decreases the mechanical performance of the polymer and raises its cost.

SEBS elastomers are frequently mixed with other polymers to improve performance. They are employed as impact modifiers in engineering thermoplastics as well as flexibilizers and toughness in transparent polypropylene (PP). Oil and fillers are frequently used to reduce costs and/or adjust the characteristics. Hot-melt pressure sensitive adhesives, toy products, shoe soles, and TPE-modified bitumen items for road paving and roofing applications are all important uses.

4.1.9 HOW SEBS IS MADE?

Styrene Ethylene Butylene Styrene (SEBS) is a thermoplastic elastomer that is typically produced through a polymerization process. Here are the basic steps involved in the production of SEBS

1. **Polymerization:** The first step in SEBS production is the polymerization of styrene and butadiene to produce styrene-butadiene-styrene (SBS) copolymer. This is typically done using a catalytic process, in which a catalyst is used to initiate the reaction between the two monomers.
2. **Hydrogenation:** Once the SBS copolymer has been produced, it is hydrogenated to convert the butadiene component into ethylene. This is typically done using a hydrogenation catalyst, which converts the double bonds in the butadiene into single bonds.
3. **Mixing:** The hydrogenated SBS copolymer is then mixed with additional ethylene and butylene monomers to create the final SEBS polymer. This mixing process typically takes place in a reactor vessel, where the various components are blended together under controlled conditions of temperature and pressure.
4. **Processing:** Once the SEBS polymer has been produced, it can be processed into a variety of different products using standard thermoplastic processing techniques such as injection molding, extrusion, or blow molding.

Overall, the production of SEBS is a complex and highly controlled process that requires specialized equipment, expertise, and attention to detail to ensure consistent quality and performance.

4.1.10 APPLICATIONS OF SEBS

SEBS is a thermoplastic elastomer that has many applications in various industries. Here are some common applications of SEBS:

1. **Adhesive and sealants:** SEBS can be used in the production of pressure-sensitive adhesive and sealants due to its excellent adhesion properties and high tackiness.
2. **Automotive Industry:** SEBS can be used in the production of various automotive components such as interior trim parts, weather stripping, and gaskets due to its excellent weather resistance and durability.
3. **Medical Industry:** SEBS can be used in the production of medical devices such as tubing, stoppers, and seals due to its biocompatibility and low extractable.

4. Construction Industry: SEBS can be used in the production of roofing membranes, waterproofing membranes, and sound barriers due to its excellent weather resistance and durability.
5. Consumer Goods: SEBS can be used in the production of various consumer goods such as toys, sporting goods, and footwear due to its flexibility, durability, and softness.
6. Packaging Industry: SEBS can be used in the production of food packing materials such as films, trays, and containers due to its excellent barrier properties and compatibility with food contact.
7. Electrical and Electronics: SEBS can be used in the production of cable sheathing and insulation due to its excellent electrical properties and resistance to heat and chemicals.

4.1.11 ADAVANTAGES OF SEBS

1. Inherits the soft-touch characteristics of SBS.
2. Thermal stability.
3. Weathering resistance.
4. UV resistance.
5. Ozone resistance.
6. Chemical resistance (oil, detergents, acids, bases, etc.)
7. Good abrasion resistance.
8. Better cost-performance ratio compared to vulcanized rubber processing.
9. SEBS-based compounds can be used for 2K molding.
10. Sterilizable.

4.1.12 DISADVANTAGES OF SEBS

1. Small loss of mechanical performance compared to SBS.
2. Hydrogenating SBS to SEBS increases the cost of the polymer.

4.2. The measured values of density (ρ), viscosity (η) and ultrasonic velocity (U) were used to determine various physical parameters

4.2.1 ADIABATIC COMPRESSIBILITY

When no heat moves in or out, the adiabatic compressibility is the fractional reduction in volume per unit rise in pressure. These changes are connected to the medium's compressibility via a thermodynamic relationship: When no heat moves in or out, the adiabatic compressibility is the fractional reduction in volume per unit rise in pressure. These changes are connected to the medium's compressibility via a thermodynamic relationship:

$$\beta_{ad} = \frac{1}{V} [\partial V / \partial p]$$

It can also be calculated from the speed of sound (U) and the density of the medium (ρ) using the equation of Newton Laplace as;

$$\beta_{ad} = \frac{1}{u^2} \text{Kg}^{-1} \text{ms}^{-2}$$

4.2.2 ACOUSTIC IMPEDENCE

Under the effect of sound pressure, sound passes through materials. Because a solid's molecules or atoms are elastically connected to one another, excess pressure causes wave propagation through the solid. A material's acoustic impedance (Z) is defined as the product of its density (ρ) and ultrasonic velocity (u), which is provided as;

$$Z = U\rho$$

4.2.3 RELATIVE ASSOCIATION

The density of solution divided by the density of the solvent is multiplied by the cube root of ultrasonic velocity in solvent divided by the cube root of ultrasonic velocity in solution. It is determined by the following equation:

$$R_a = [\rho/\rho_0] [U/U_0]^{1/3}$$

Where ρ and ρ_0 densities of solution and solvent respectively and U and U_0 are the velocities of solution and solvent.

4.2.4 MOLAR VOLUME

The molar volume (V_m) at standard temperature and pressure (STP) is the volume filled by one mole of a chemical element or a chemical compound. It is computed by dividing the molar mass (M) by the mass density (ρ). Molar gas volume is the volume of one mole of any gas at a given temperature and pressure.

The Molar volume is directly proportional to molar mass and inversely proportional to density. The formula of the molar volume is expressed as,

$$V_m = \frac{\text{Molar mass}}{\text{Density}}$$

4.2.5 AVAILABLE VOLUME

The direct measure of compactness and strength of binding the molecule of liquid or liquid combination is available volume. The accessible volume is another quantity that can be calculated using ultrasonic velocity and is provided by;

$$V_a = V[1 - U/U_\infty] \text{ m}^3 \text{ mol}^{-1}$$

Where U_∞ is the Schaaf's limiting value taken as 1600 m/s for liquid mixture.

4.2.6 FREE VOLUME

One of the most important elements in understanding changes in the physio-chemical characteristics of liquids and liquid mixtures is free volume. The free space and its dependent qualities are closely related to molecular structure, and they may reveal intriguing characteristics regarding interactions that might occur when two or more liquids are combined together. The structural arrangements, as well as the shape and size of the molecules, impact molecular interactions between like and unlike molecules.

A liquid can be modelled as though it were made up of individual molecules, each of which moves in a volume V_f with an average potential owing to its neighbours. That is, the molecules of a liquid are not completely packed together, and there are some open spaces between the molecules for movement, and the volume V_f is referred to as the free volume. Eyring and Kincaid defined free volume as the effective volume in which a certain liquid molecule can move and follow flawless gas laws. Free volume in terms of ultrasonic velocity (U) and liquid viscosity (η) as;

$$V_f = [M_{\text{eff}}U/K\eta]^{1/2}$$

Where M_{eff} is the effective molecular weight.

$$M_{\text{eff}} = M_i X_i$$

M_i and X_i are the Molecular weight and the mole fraction of the individual constituents respectively. K is a temperature independent, constant which is equal to 4.28×10^9 for all liquids.

4.2.7 INTERMOLECULAR FREE LENGTH (L_f)

The intermolecular free length is the distance between the surfaces of neighboring molecules covered by a sound wave. It is a measure of the intermolecular forces between the components of a binary mixture. The change in free length shows the weakening or strengthening of intermolecular attraction. The interaction free length must decrease when the ultrasonic velocity increases owing to increases in concentration, and vice versa. It is connected to ultrasonic velocity and density in the following ways:

$$L_f = K/(\rho U)^{1/2} m$$

The adiabatic compressibility of a liquid may be stated in terms of the intermolecular free length, which is the distance between neighboring molecules' surfaces and is given by the relation,

$$L_f = K_T Q^{1/2}$$

Where, $K_T = (93.875 + 0.345T) \times 10^{-8}$

4.2.8 INTERNAL PRESSURE (π_i)

Internal pressure measurement is critical in the research of liquid thermodynamic characteristics. Internal pressure is the cohesive force that results from the forces of attraction and repulsion between molecules. Cohesion generates pressure within the liquid ranging from 10^3 to 10^4 atmospheres. Internal pressure also indicates the solubility properties. Dissolved solutes reside under the medium's internal pressure, and their interactions with the solvent occur via hydrogen bonding, charge transfer, and the Columbic (or) Vander Waal's interaction. The quantity a/v^2 in Vander Waal's equation, which is the measure of the molecule's attractive force, is known as the cohesive (or) internal pressure. The measurement of internal pressure is important in the study of the thermodynamic properties of liquids. The internal pressure is the single factor which varies due to all type of solvent-solute, solute-solute and solvent-solvent interactions. The internal pressure, (π_i) can be calculated by using equation;

$$\pi_i = bRT[K\eta/U]^{1/2}[\rho^{1/3}/M^{7/6}]$$

Where K is a constant. T is the absolute temperature. η is the viscosity in Nsm^{-2} . U is the ultrasonic velocity in ms^{-1} and ρ is the density in kgm^{-3} of the liquid.

4.2.9 RELAXATION TIME

The relaxation time is the amount of time it takes for excitation energy to manifest as translational energy, and it is affected by temperature and contaminants. The dispersion of ultrasonic velocity in a binary mixture offers information on the relaxation process that creates dispersion. The relationship may be used to calculate the relaxation time (τ);

$$\beta = \frac{4}{3}\beta\eta$$

4.2.10 MOLE FRACTION

Mole fraction represents the number of molecules of a particular component in a mixture divided by the total number of moles in the given mixture. It's a way of expressing the concentration of a solution.

The molar fraction can be represented by X. If the solution consists of components A and B, then the mole fraction is,

$$\begin{aligned}\text{Mole fraction of solute} &= \frac{\text{Moles of solute}}{\text{Moles of solute} + \text{Moles of solvent}} \\ &= \frac{n_A}{n_A + n_B}\end{aligned}$$

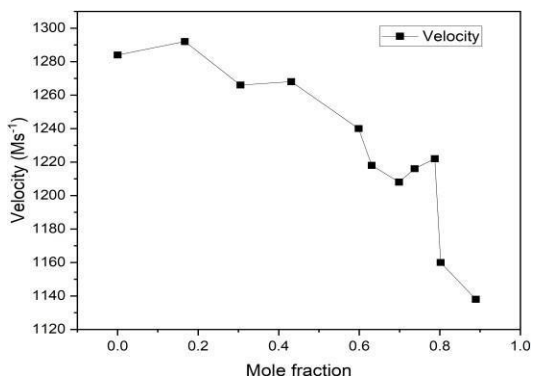
$$\begin{aligned}\text{Mole fraction of solvent} &= \frac{\text{Moles of solvent}}{\text{Moles of solute} + \text{Moles of solvent}} \\ &= \frac{n_B}{n_A + n_B}\end{aligned}$$

Therefore, the sum of mole fraction of all the components is always equal to one.

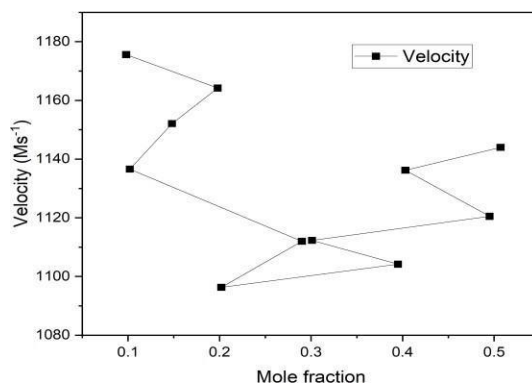
CHAPTER-5

5. RESULT AND DISCUSSION:

5.1. VELOCITY:



(a)



(b)

Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Velocity.

Plots of ultrasonic velocity against mole fraction of Acetonitrile in different concentration. The variation of ultrasonic velocity in a solution depends upon the increase or decrease of intermolecular free length (L_f) after mixing the component. According to Eyring and Kinchaid (1938) velocity increases if the intermolecular free length decreases and vice versa as a result of mixing component. It is seen that the ultrasonic velocity decreases initially with increase of concentration of acetonitrile. From concentration-1, it attains maximum at a concentration of 2:18 with a mole fraction of 0.1668. The increase in the concentration of acetonitrile weakens the molecular forces and hence the abrupt change in velocity with increase in concentration indicates critical characteristics at a particular composition (Muraliji 2002). From concentration-2, it attains maximum at a concentration of 0:20 with mole fraction of 0.507. There a rapid increases and slight decreases in this concentration. Both concentration-1 and concentration-2 shows the non-linear values.

5.2. DENSITY:

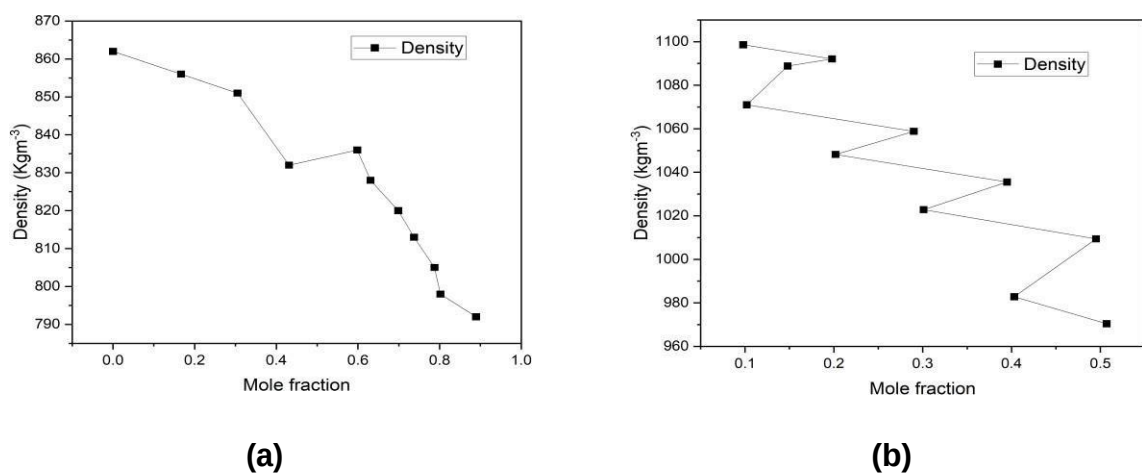


Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Density.

Density of mixed salts solution of binary mixture of acetonitrile is measured in different concentration. As the no. of particle increases, the density is also increases. Density increases with increasing the concentration due to the presence of ions or particles. The density of mixed solution is decrease with increase the composition of acetonitrile. . From concentration-1, It attains maximum at a concentration of 0:20 with the mole fraction of 0.00 and minimum concentration of 20:0 with mole fraction of 0.8895. From concentration-2, it attains maximum concentration of 0:20 with the mole fraction 0.507 and minimum concentration of 20:0 with mole fraction of 0.098. Both concentration-1 and concentration-2 are in non-linear values. The density of mixed salt solution shows a sharp increase which confirms the structural rearrangement of molecules.

5.3. VISCOSITY:

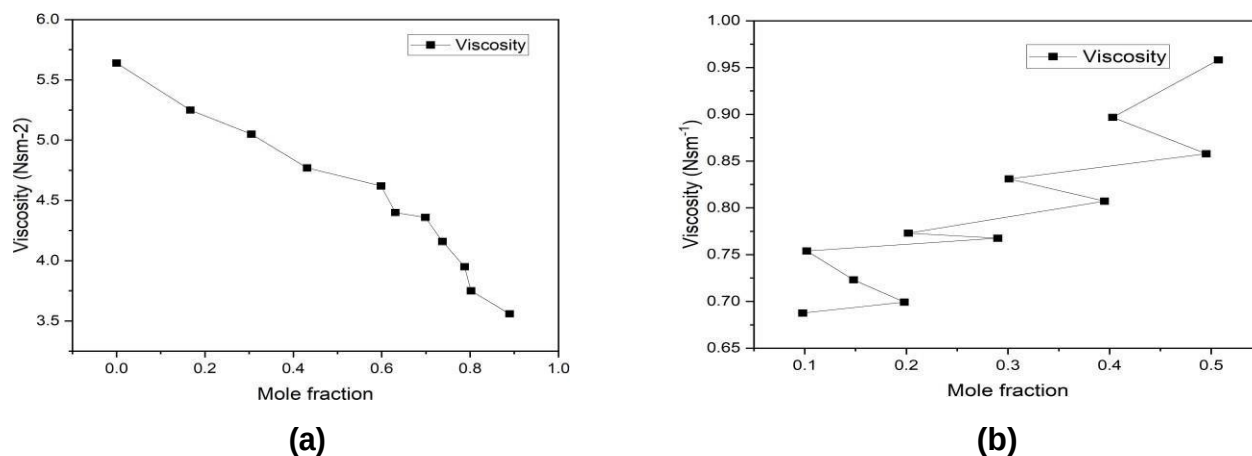
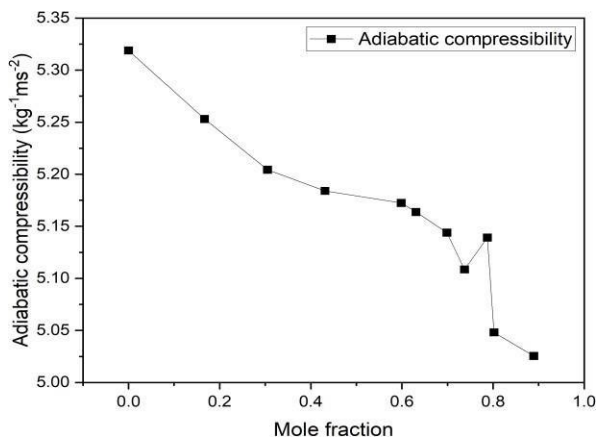


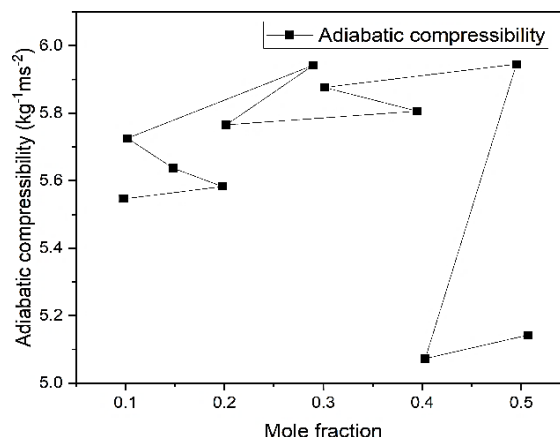
Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Viscosity.

Viscosity depends mainly on the availability of bulky or less mobile entities of salt solution. The viscosity is related to normal forces in the liquids. The variation of viscosity of acetonitrile mixed salt solution. The changes in density and viscosity can be correlated to hydrophilic (Hydrogen bond forming or structure making). The viscosity is decreases with increase the concentration of acetonitrile. From concentration-1, the values of viscosity attains maximum concentration of 0:20 with the mole fraction of 0.00. From observed viscosity values, it is confirmed that the viscosity is more sensitive to structural changes because of solvent-solute interactions. From concentration-2, the values of viscosity attains maximum concentration of 20:0 with mole fraction of 0.098. There is a rapid increase in concentration-2. The viscosity is maximum at lower concentration and it is minimum at higher concentration.

5.4. ADIABATIC COMPRESSIBILITY:



(a)

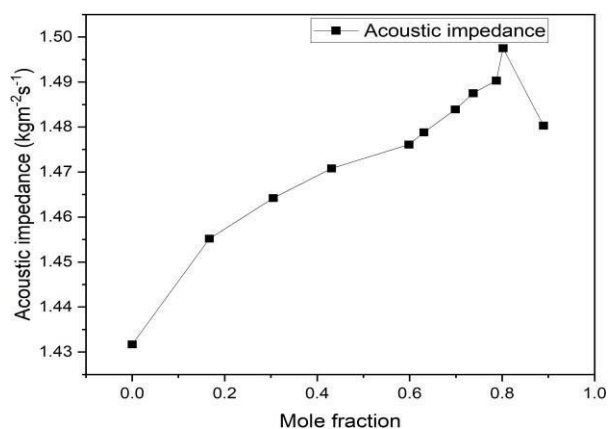


(b)

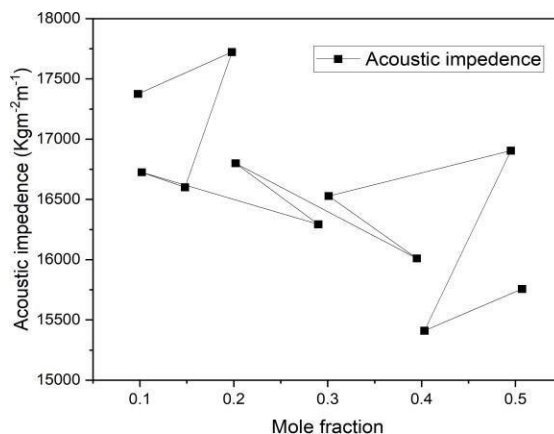
Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Adiabatic compressibility.

Adiabatic compressibility values calculated for acetonitrile mixed salt solution. Adiabatic compressibility is inversely proportional to U^2 and the trend in adiabatic compressibility with concentration reverse of the trend in U with concentration in the system. The adiabatic compressibility decreases with increase in concentration. Adiabatic compressibility is the fractional decrease in volume per unit raise in pressure when no heat flows in or out. Increase in its value indicates weakening of molecular interaction. From concentration-1, it attain maximum concentration at 0:20 with mole fraction of 0.00. There is a rapid decrease in concentration-1 at one point there is a slight increase with concentration of 16:4 with mole fraction of 0.7875. From concentration-2, it attain maximum concentration at 16:4 with mole fraction of 0.148. There is a rapid increase and decrease in this concentration-2. Non-linear values are obtained.

5.5. ACOUSTIC IMPEDANCE:



(a)

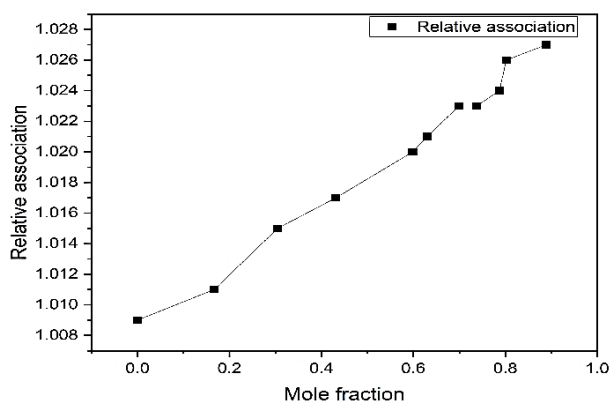


(b)

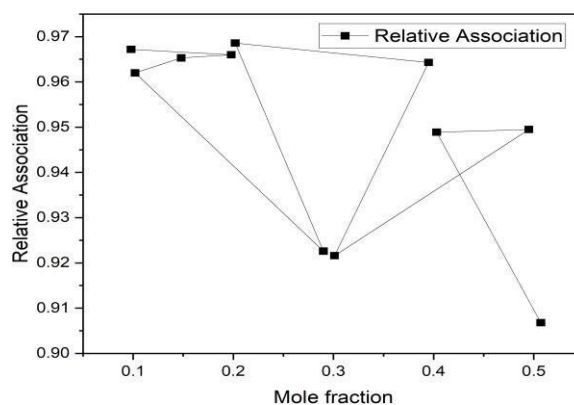
Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Acoustic impedance.

The variation of acoustic impedance and mole fraction of acetonitrile is shown in table. In aqueous solution of SEBS and acetonitrile increase with increase the concentration of acetonitrile suggesting that the ion solvent interaction increases till the mole fraction at 0.8021. But it decrease at mole fraction of 0.8895 (Concentration-1). It attain increase in concentration and a sudden decrease at last value. From concentration-2, it attain maximum concentration 2:18 with mole fraction of 0.403. There a rapid increase and decrease in the values. Non-linear variation obtained.

5.6. RELATIVE ASSOCIATION:



(a)



(b)

Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Relative association.

The relative association of acetonitrile increases with increase the concentration. The relative association is strong at higher concentration. From concentration-1, it attain maximum concentration of 20:0 with mole fraction of 0.8895. There is a random increases in values. From concentration-2, it attain maximum concentration of 20:0 with mole fraction of 0.098. There is a non-linear variations in values. Rapid increase and decrease in this concentration.

5.7. SURFACE TENSION:

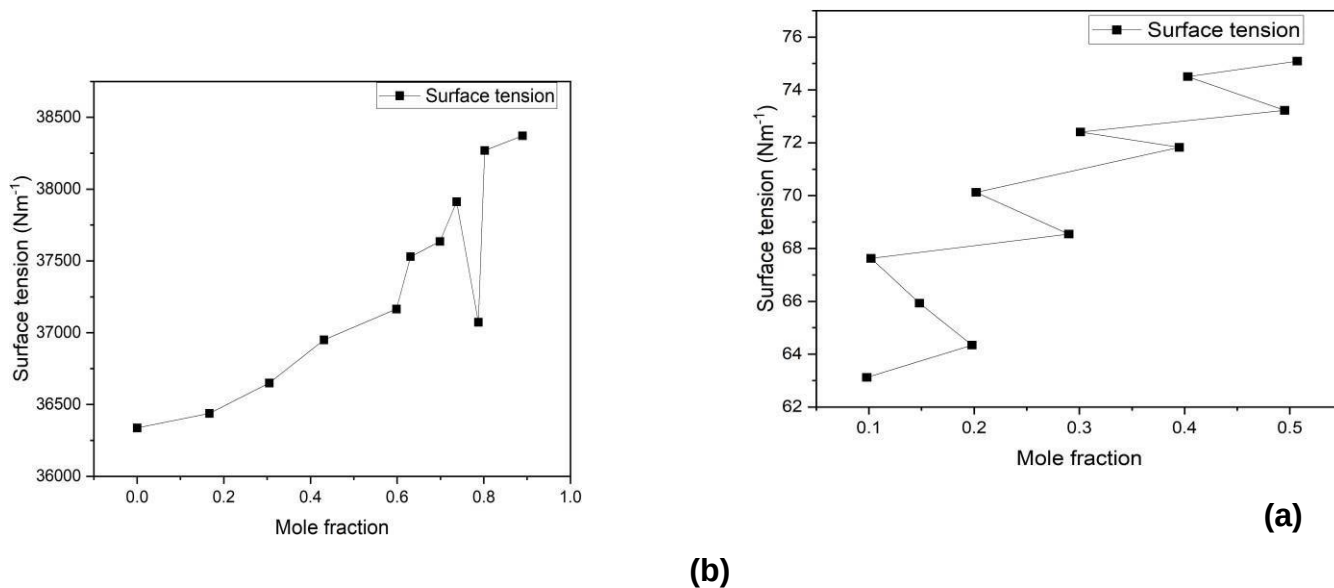


Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Surface tension.

In concentration-1 values get increased and sudden decrease at 16:4 with mole fraction of 0.7875. It attains maximum concentration at 20:0 with mole fraction of 0.8895. In concentration-1 it increase and decrease randomly. It attains maximum concentration at 20:0 with mole fraction of 0.008.

5.8. MOLAR VOLUME:

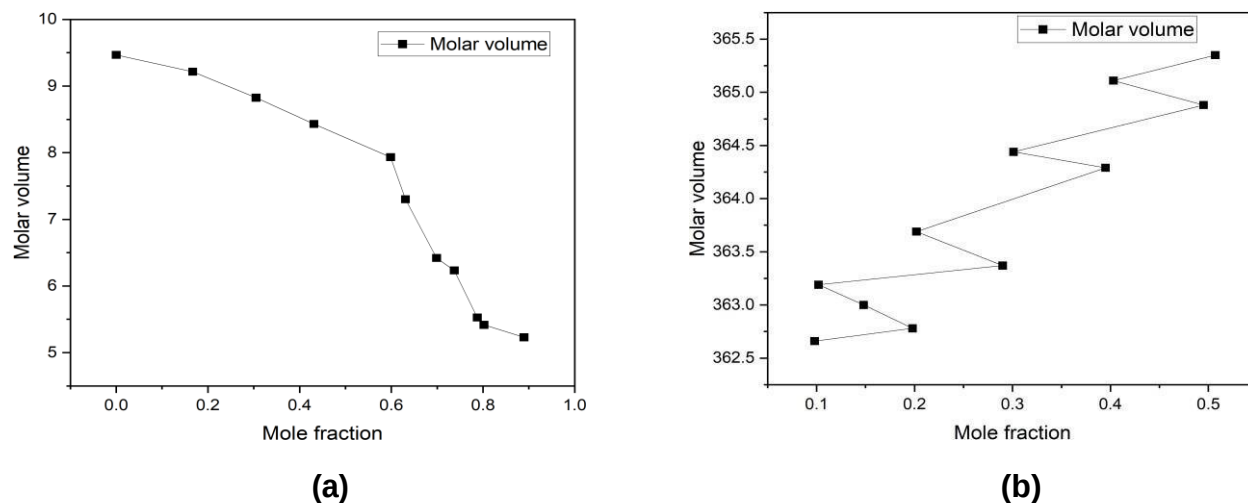
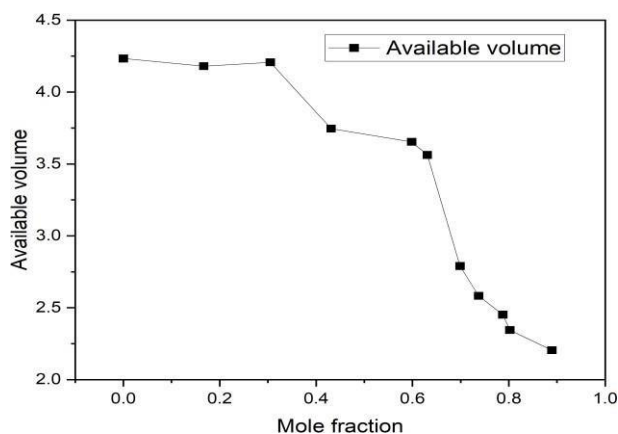


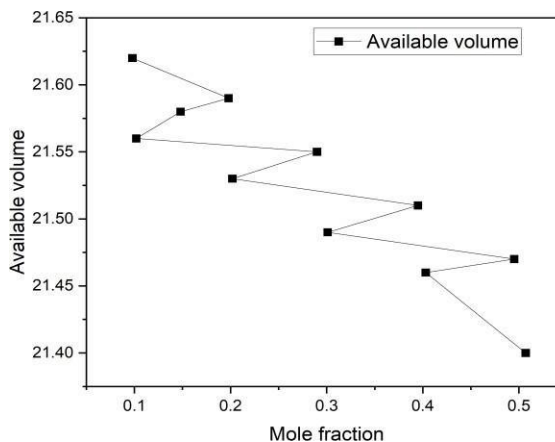
Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Molar volume.

A small quantity of acetonitrile is added to the mixed solution. Ion solvent interaction occurs resulting considerable increase intermolecular space between the molecules. This contributes to increase in molar volume. It is also noted that, a decrease in molar volume increase the intermolecular interactions. This trend shows that bonding length decrease with the increase in concentration and hence the intermolecular interaction decreases. Similar trend occurs in case of acetonitrile mixed salt solution. From concentration-1, the values get decrease and it attain maximum concentration of 0:20 with mole fraction of 0.00. There is decrease in concentration so, the intermolecular interaction increases. From concentration-2, the values are rapidly increase and decrease in concentration, it attain maximum concentration of 20:0 with mole fraction of 0.098. Increase in concentration decrease the intermolecular interaction.

5.9. AVAILABLE VOLUME:



(a)

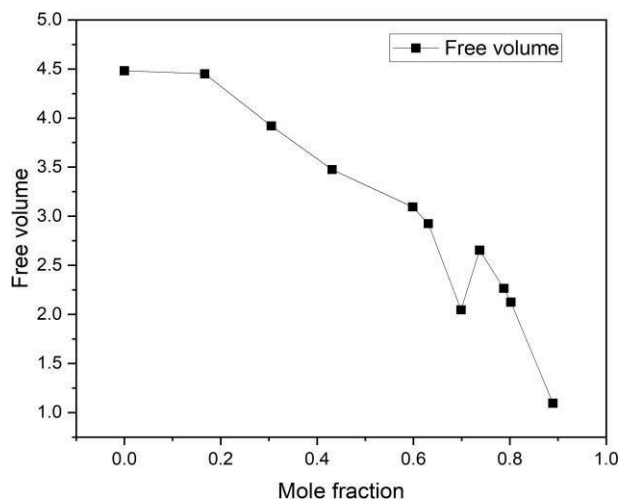


(b)

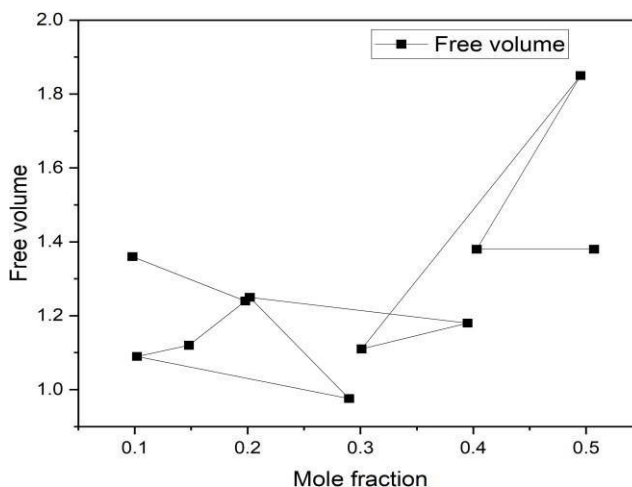
Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Available volume.

The available volume decreases with concentration of acetonitrile and it shows non-linear variation. From the values, it is inferred that the available volume is directly proportional to velocity. From concentration-1, the values shows a sudden decrease at concentration of 0.4312 which confirms that the complex formed has less available volume. Available volume shows that the non-linear values indicating the structural variations at molecular levels inside the liquid system. It attain maximum concentration at 4:16 with mole fraction of 0.3051. From concentration-2, it attain maximum concentration of 0:20 with mole fraction of 0.507. Non-linear values are obtained. Rapid decrease and increase obtained.

5.10. FREE VOLUME:



(a)



(b)

Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Free volume.

The free volume is the effective volume in which the molecules in the liquid can move and obey perfect gas law. In mixed solution of SEBS and acetonitrile, the free volume decreases with concentration of acetonitrile. It sudden decrease at one point with mole fraction of 0.6988 and hence nonlinear variations are absorbed. It increase and sudden decrease in further concentration. Similarly, in study of acetonitrile, the decrease in free volume indicates the variations in cohesive forces of this liquid system with changes in solute concentration. The change in size and shape of the molecules results in the structural rearrangements of the molecules in the mixture. The structural changes features are as a result of the reaction between like and unlike molecules during the mixing of liquids. From concentration-1, In case of SEBS and acetonitrile mixed solution attain maximum concentration at 0:20 with mole fraction of 0.00. From concentration-2, mixed solution attain maximum concentration of 18:2 with mole fraction of 0.198.

5.11. INTERMOLECULAR FREE LENGTH:

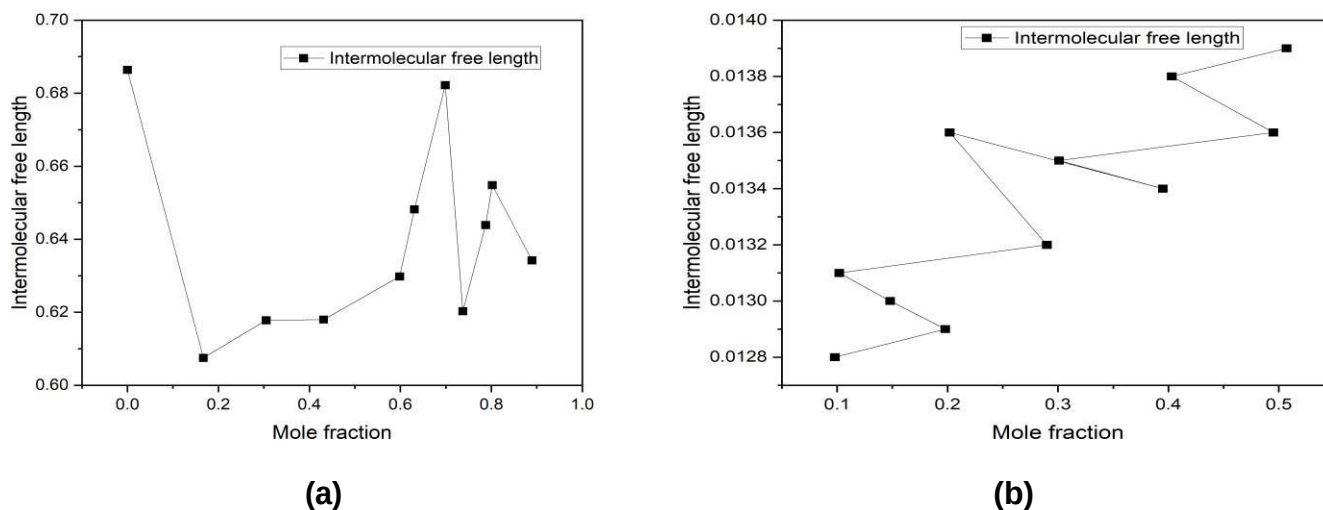
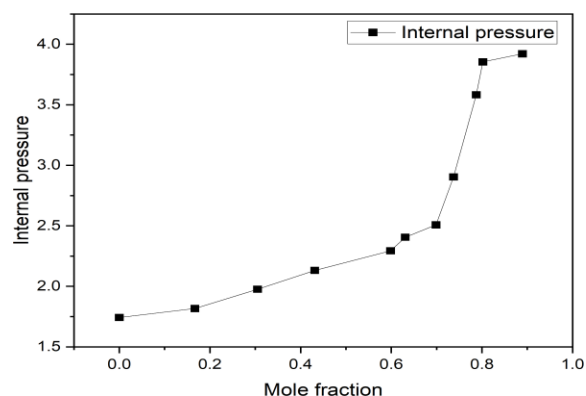


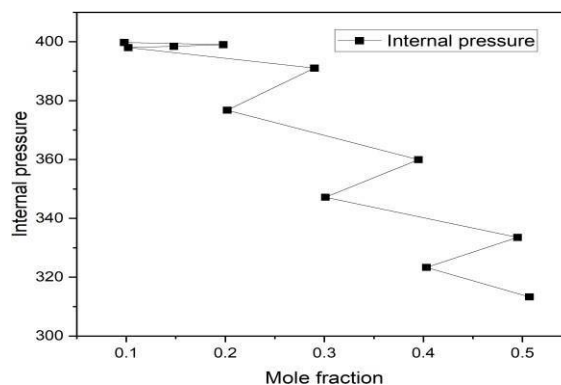
Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Intermolecular free length.

Intermolecular free length in binary liquid mixtures can be used access the attraction between the component molecules. It shows non-linear variation. Increase in concentration leads to decrease in gap between two species and it is referred as intermolecular free length. On the basis of sound propagation in liquid the increase in free length after mixing, decrease the sound velocity. The intermolecular free length has an inverse behavior of ultrasonic velocity. The intermolecular free length is found to be a predominant factor in determining the nature of sound velocity variation in liquid mixtures. Table shows the values of intermolecular free length of SEBS and acetonitrile solution. From concentration-1, It shows the decrease and sudden increase of concentration of acetonitrile and reaches maximum concentration at 0:20 with mole fraction of 0.00 and minimum concentration of 2:18 with mole fraction of 0.1668. The value of intermolecular free length in a binary mixture depends up on the concentration. The sudden increases and decreases indicates that there is a significant interaction present between the solute molecules due to which structural arrangement molecules are considerably affected. From concentration-2, it attain maximum concentration at 20:0 with mole fraction of 0.098. There is a rapid decrease and increase in concentration.

5.12. INTERNAL PRESSURE:



(a)



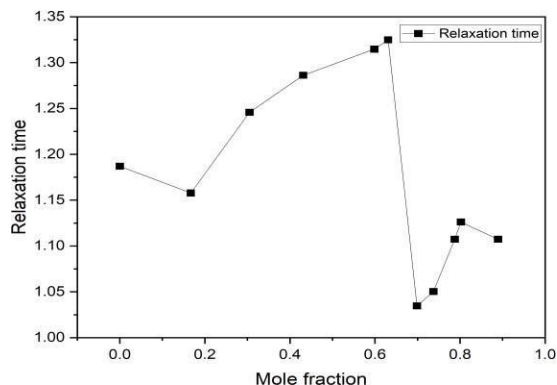
(b)

Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Internal pressure.

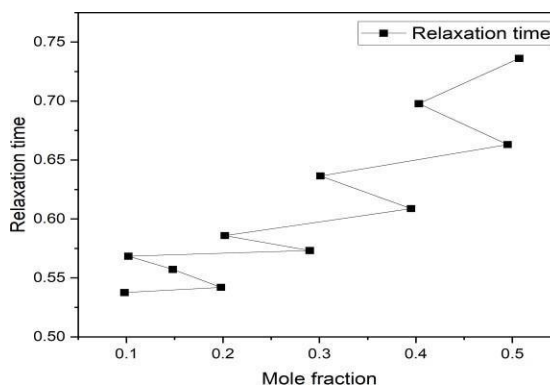
Internal pressure in binary mixtures can be used to access the intermolecular attraction between the components. Internal pressure is an energy volume co-efficient and is a measure of the attractions and repulsions of the molecules in the liquid systems. Its measurements are significant in the evolution of thermodynamic properties of liquid because it is closely related to ultrasonic velocity, viscosity and compressibility in the liquid phase. The internal pressure values reflect the net cohesive/adhesive forces available in the medium. Such forces will drastically change if the mole fraction of components changes.

From concentration-1, the internal pressure is linearly decreasing with concentration of acetonitrile. It attains maximum concentration at 20:0 with a mole fraction of 0.885. The concentration gets increase from low to high. From concentration-2, it attains maximum concentration of 0:20 with a mole fraction of 0.507. Non-linear variation is obtained in this concentration.

5.13. RELAXATION TIME:



(a)



(b)

Fig 5.1: (a) and (b) shows the concentration-1 and concentration-2 respectively of Mole fraction of SEBS and Relaxation time.

Acoustical relaxation time depends upon viscosity and compressibility. Relaxation time of a system can be used to characterize the intermolecular interactions. The values are calculated for system at different concentration. Relaxation process leads to absorption of the waves, which is related to structural changes in the liquid. The relaxation time shows a non-linear variation. From concentration-1, it shows maximum concentration at 10:10 with mole fraction of 0.6309. There is a rapid decrease and increase in concentration. The increase of relaxation time with concentration studies support solute-solvent interactions. From concentration-2, it attain maximum concentration of 20:0 with mole fraction of 0.098. There is a rapid increase and decrease in concentration.

5.14. TABLE EXPERIMENTAL VALUES OF ACOUSTICAL PARAMETERS FOR SEBS IN ACETONITRILE SOLUTION AT VARIOUS CONCENTRATION AT 303K (CONCENTRATION-1)

Composition SEBS:CH ₃ CN	Mole Fraction	Velocity (U) Ms ⁻¹	Density (ρ) Kgm ⁻³	Viscosity (η) Nsm ⁻¹	Adiabatic compressibility (Q _{ad}) $\times 10^{-10}$ Kg ⁻¹ ms ⁻²	Acoustic Impedance (Z) $\times 10^6$ Kgm ⁻² s ⁻¹	Relative Association (RA)	Surface tension (σ) Nm ⁻¹	Molar volume	Available volume	Free volume	Intermolecular free length	Internal pressure	Relaxation time
0:20	0.00	1284	862	5.64	5.3189	1.4317	1.009	36,337	9.468	4.233	4.482	0.6864	1.743	1.1870
2:18	0.1668	1292	856	5.25	5.2530	1.4552	1.011	36,438	9.216	4.180	4.450	0.6075	1.817	1.1578
4:16	0.3051	1266	851	5.05	5.2043	1.4642	1.015	36,650	8.825	4.207	3.920	0.6178	1.976	1.2458
6:14	0.4312	1268	832	4.77	5.1840	1.4708	1.017	36,950	8.432	3.746	3.475	0.6180	2.132	1.2862
8:12	0.5984	1240	836	4.62	5.1724	1.4761	1.020	37,165	7.933	3.654	3.095	0.6298	2.294	1.3146
10:10	0.6309	1218	828	4.40	5.1637	1.4788	1.021	37,530	7.302	3.563	2.924	0.6482	2.406	1.3248
12:8	0.6988	1208	820	4.36	5.1439	1.4839	1.023	37,636	6.420	2.790	2.046	0.6822	2.508	1.0347
14:6	0.7374	1216	813	4.16	5.1085	1.4875	1.023	37,912	6.233	2.583	2.654	0.6203	2.904	1.0503
16:4	0.7875	1222	805	3.95	5.1391	1.4903	1.024	37,073	5.527	2.452	2.265	0.6439	3.582	1.1047
18:2	0.8021	1160	798	3.75	5.0481	1.4975	1.026	38,269	5.417	2.345	2.125	0.6548	3.854	1.1262
20:0	0.8895	1138	792	3.56	5.0255	1.4803	1.027	38,372	5.230	2.205	1.095	0.6342	3.921	1.1074

5.15. TABLE EXPERIMENTAL VALUES OF ACOUSTICAL PARAMETERS FOR SEBS IN ACETONITRILE SOLUTION AT VARIOUS CONCENTRATION AT 303K (CONCENTRATION-2)

Composition SEBS:CH ₃ CN	Mole Fraction	Velocity (U) Ms ⁻¹	Density (ρ) Kgm ⁻³	Viscosity (η) Nsm ⁻¹	Adiabatic compressibility (Q _{ad}) $\times 10^{-10}$ Kg ⁻¹ ms ⁻²	Acoustic Impedance (Z) $\times 10^6$ Kgm ⁻² s ⁻¹	Relative Association (RA)	Surface tension (σ) Nm ⁻¹	Molar volume	Available volume	Free volume	Intermolecular free length	Internal pressure	Relaxation time
0:20	0.507	1144.0	970.4	0.9582	5.1421	15756	0.9068	75.092	365.35	21.40	1.38	0.0139	313.33	0.7362
2:18	0.403	1136.2	982.8	0.8968	5.0726	15410	0.9489	74.504	365.11	21.46	1.38	0.0138	323.34	0.6977
4:16	0.495	1120.5	1009.4	0.8579	5.9456	16904	0.9495	73.225	364.88	21.47	1.85	0.0136	333.51	0.6631
6:14	0.301	1112.3	1022.8	0.8310	5.8765	16528	0.9216	72.408	364.44	21.49	1.11	0.0135	347.19	0.6365
8:12	0.395	1104.2	1035.5	0.8072	5.8062	16010	0.9643	71.825	364.29	21.51	1.18	0.0134	359.95	0.6088
10:10	0.202	1096.3	1048.2	0.7730	5.7654	16800	0.9686	70.125	363.69	21.53	1.25	0.0136	376.77	0.5859
12:8	0.290	1112.0	1058.8	0.7676	5.9423	16293	0.9226	68.544	363.37	21.55	0.976	0.0132	391.03	0.5732
14:6	0.102	1136.6	1071.0	0.7539	5.7258	16725	0.9620	67.624	363.19	21.56	1.09	0.0131	398.02	0.5684
16:4	0.148	1152.1	1088.8	0.7231	5.6372	16600	0.9653	65.932	363.00	21.58	1.12	0.0130	398.45	0.5572
18:2	0.198	1164.2	1092.1	0.6992	5.5827	17722	0.9660	64.344	362.78	21.59	1.24	0.0129	399.02	0.5420
20:0	0.098	1175.6	1098.6	0.6875	5.5459	17375	0.9672	63.121	362.66	21.62	1.36	0.0128	399.76	0.5376

CHAPTER-6

5. CONCLUSION

Measuring density, viscosity and thermo acoustical study of styrene-ethylene-butylene-styrene in polar solvent at various concentration at 303k. The measurements of ultrasonic velocity and other parameters has been used in understanding the nature of intermolecular interactions in binary liquid mixtures. The low concentrated solution is prepared by dissolving 2grams of SEBS in 100 milliliters of acetonitrile. This solution takes one day to dissolve completely. The high concentration solution is prepared by dissolving 2.5grams of SEBS in 100 milliliters of acetonitrile. This solution takes one day to dissolve completely. For these measured values, the acoustic parameters are calculated and the calculated values are also tabulated. The velocity, density and viscosity of concentration 1 decrease rapidly, for concentration 2 they decrease and increase rapidly. The adiabatic compressibility decrease in concentration-1 and increase randomly and sudden decrease in value of concentration-2, whereas intermolecular free length decrease in concentration-1, increase in concentration-2 and acoustical impedance increase in concentration-1, decrease in concentration-2. From this we obtain the maximum and minimum concentration for the mixed solutions.

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