J. Mountain Res. P-ISSN: 0974-3030, E-ISSN: 2582-5011 DOI: https://doi.org/10.51220/jmr.v16i2.5
Vol. 16(2) Special Issue ICRAMS-2021, (2021), 35-38

Ultrasonic Parameters of Some Ternary Liquid Mixture

H K Semwal[1*] • S C Bhatt[2] • S C Nautiyal[3]

[1] *Deptt.of Physics,PLM Govt.PG College,Rishikesh,Uttarakhand*
[2] *Deptt. of Physics, HNBGU Srinagar Garhwal,Uttarakhand*
[3] *Deptt.of Physics, Govt.PG College, Raipur, Dehradun,Uttarakhand*

*Corresponding Author Email: drhksemwal@gmail.com

Received: 2.8.2021; Revised: 6.10.2021; Accepted: 16.10.2021

Abstract: At different composition and frequeny ultrasonic velocity has been measured in some ternary liquid mixtures at room temperature with the help of ultrasonic interferometer. Composition and frequency dependent variation of relaxation time (τ) have been shown in Figs. And analyzed for these ternary liquid mixtures.

Keywords: Ultrasonic wave velocity, Ultrasonic attenuation, Relaxation time, Ternary liquid mixture.

Introduction

Measurement of ultrasonic velocity (Lopez et.al. 2013; Papari et.al. 2013; Rathnam et.al.2012; Sahin et.al. 2011) has been adequately employed in understanding the molecular interaction sinpure, binary,and higher order multi-component liquid mixtures. The propagation of ultrasonic velocity in a medium is a thermodynamic property and has come to be recognized as a very specific and unique tool for predicting and estimating various physio-chemical properties of the systems under consideration (Dey et.al. 2014; Bhatt et al 2020).

For the measurement of intrinsic viscosity, polynomial relations have been suggested by various investigators (Singh et al 1981) A correlation between the Huggins coefficients and the constant describing the solvated part has been reported (Semwal et.al. 2003, Semwal et al 2015).

Ultrasonic investigations of liquid mixtures consisting of polar and non-polar components are of considerable importance in understanding intermolecular interactions between the component molecules and they found applications in several industrial and technological processes (Mehra and Israni 2001)). A survey of literature reveals that the studies for the mixtures of normal alcohols with few normal chain hydrocarbons like hexane, heptanes and aromatic hydrocarbon like benzene and toluene have been done but no attempt have been made to study the various ultrasonic and thermodynamic properties for binary liquid mixture of heptadecane and butanol at various temperature.

In the present study we summarize our observations on ternary liquid mixtures. Relaxation time have been calculated at different frequency and different concentrations at room temperature, using the measured values of ultrasonic velocity, viscosity and density. There results thus obtained have been shown in Tables

and the variation of relaxation time with composition and frequency have been plotted.

Ultrasonic Parameters-

The ultrasonic velocity measurements are extensively used to study physio – chemical behavior of liquid with the help of measured ultrasonic velocity, density and viscosity and using following formula, some acoustic parameters like Ultrasonic attenuation and relaxation time have been calculated and results are tabulated and discussed.

The relaxation time is related to the viscosity & frequency and ultrasonic of waves as Relaxation time

$\tau = 4\eta/3\rho u^2$

Where

τ= relaxation time
η= viscosity
ρ= density of liquid mixture
u= ultrasonic velocity of waves

Results and Discussion-

Ultrasonic velocity has been measured by variable path interferometer at different frequencies from1MHZto 7 MHZ at room temperature in ternary liquid mixture.

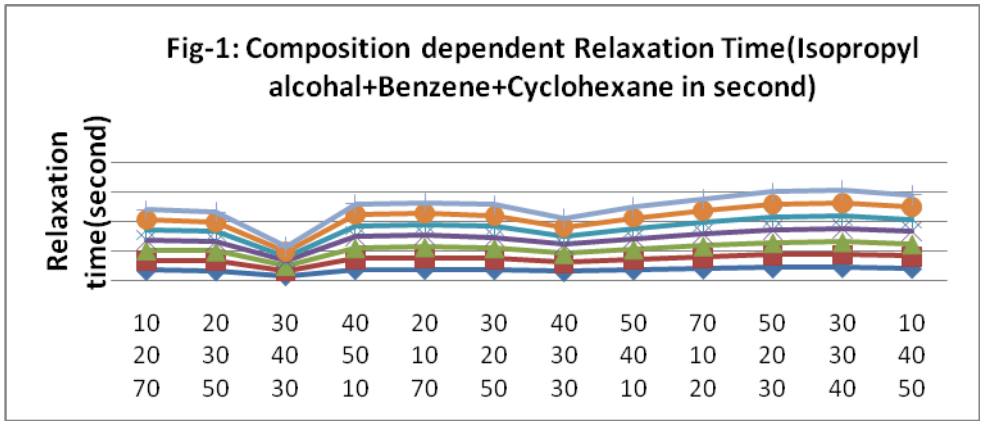
Relaxation time of ternary liquid mixtures (**Isopropyl alcohol + Benzene + Cyclohexane**) presented in Table-1. The graph of Composition & frequency dependent Relaxation time have been plotted in Fig.1, Fig.2

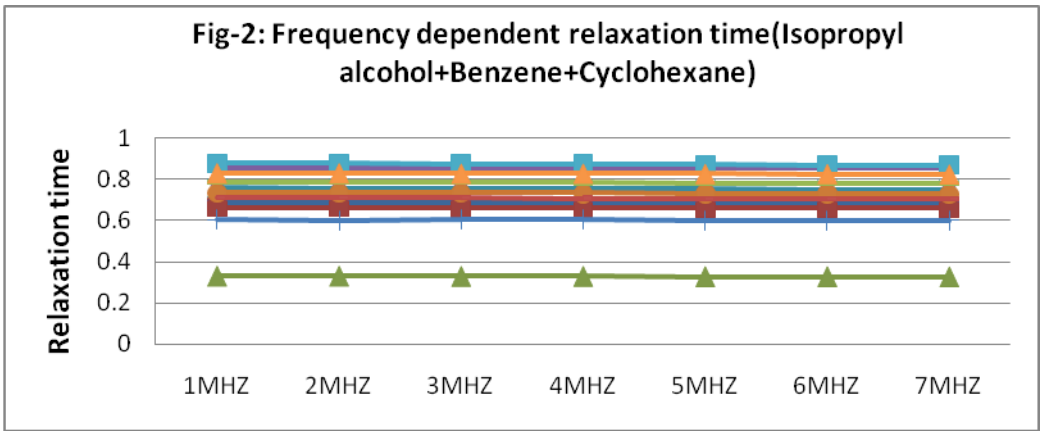
TABLE-1: Relaxation time for ternary liquid mixture (Isopropyl alcohol + benzene + Cyclohexane) at different frequencies and composition (room temperature)

TERNARY LIQUID MIXTURE COMPOSITION (VOLUME)			RELAXATION TIME AT DIFFERENT FREQUENCIES (SECOND)						
Isopro. Alcohol%	*Benzene%*	*Cyclohexane %*	**1MHz**	**2MHz**	**3MHz**	**4MHz**	**5MHz**	**6MHz**	**7MHz**
10	*20*	*70*	.685	.685	.684	.683	.682	.681	.680
20	*30*	*50*	.665	.664	.662	.661	.661	.660	.660
30	*40*	*30*	.330	.330	.329	.329	.328	.328	.327
40	*50*	*10*	.742	.741	.741	.740	.739	.739	.737
20	*10*	*70*	.760	.758	.758	.757	.756	.754	.753
30	*20*	*50*	.735	.734	.734	.733	.732	.732	.730
40	*30*	*30*	.606	.603	.605	.604	.602	.602	.601
50	*40*	*10*	.711	.710	.710	.709	.708	.708	.707
70	*10*	*20*	.785	.784	.784	.783	.782	.782	.781
50	*20*	*30*	.859	.859	.858	.856	.855	.854	.853
30	*30*	*40*	.878	.878	.876	.875	.874	.872	.871
10	*40*	*50*	.830	.830	.828	.828	.827	.826	.824

The relaxation time is calculated using formula $\tau=4\eta/3\rho U^2$.The values of relaxation time are shown in table-1 and plotted in graph in Fig.1 & Fig.2. From table-1 and Fig.1 & Fig.2, It is observed that relaxation time in ternary

liquid mixture (Isopropyl alcohol + Benzene + Cyclohexane) slightly decreases with increasing frequency while composition dependent relaxation time changes depend upon the composition percentage of particular liquid in ternary liquid mixture. However the relaxation time for ternary mixture having concentration Isopropyl alcohol + benzene + Cyclohexane = 40% + 30% + 30%, is showing lowest value, this may be due to the fact that at this composition , the liquid medium quickly acquainted with the changed environment.





References

Bhatt SC, Harikrishna Semwal, Vijendra Lingwal, Kuldeep Singh and B.S.Semwal. (2000). Relaxation Time and Ultrasonic Attenuation in Some Binary and Ternary Liquid Systems" J. Acous. Soc.Ind.,28(1-4):275-278

Dey Ranjan, Aditya Harshvardhan (2014). A Comparative study of Ultrasonic velocities of Binary and Multicomponent Liquid mixture at298.15K.", Journal of Energy and Chemical Engineering Jan 2014:2(1):pp1-7.

López AB, Alicia García-Abuín, Diego Gómez-Díaz, M. Dolores La Rubia and José M. Navaza(2013). Density, speed of sound, viscosity, refractive index and surface tension of N-methyl-2 pyrrolidene + diethanol amine (ortriethanolamine) from T = (293.15to323.15) K, Journal of Chemical Thermodynamics 61: 1-6

Mehra R and Israni R.(2001).'Excess functions heptadecane + 1-butanol at various

temperatures and validation of theoretical models for system' J.PureAppl.Ultrason.23:63-67.

Papari MMH, Ghodrati, F. Fadaei, R. Sadeghi, S. Behrouz, M.N. Soltani Rad and J.Moghadasi (2013).Volumetric and ultrasonic study of mixtures of 2-phenylethanolwith 1-butanoland2-methyl-1-butanol at T=(298.15 – 323.15)K and atmospheric pressure: Measurement and prediction Journal of Molecular Liquids, 180 :121-128

Rathnam MV, Kavita R. Bhanushali, Reema T. Sayed, and M. S. S. Kumar (2012).Acoustic, thermodynamics and transport properties of binary liquid mixtures of isopentyl acetate with aryl halides at 303.15K and 313.15 K Journal of Molecular Liquids 173 : 35-41

Sahin M, Ayranci E. (2011). Volumetric properties of (Ascorbic acid + Polyethylene glycol 3350 + water) system at T = 288.15, 298.15 and 308.15) K. J Chem Thermodynamics 43: 77-185.

Semwal HK, Bhatt SC (2015).'Acoustical Study of Ternary liquid mixture of water, Formic acid and Butyric acid. Int. J. Current research:7 (12):24116-24118

Semwal HK, .Bhatt SC and Semwal BS (2003). Acoustical study of binary liquid mixture of Acetic acid & Isopropyl-sulphide", Pure Appl. Ultrason.25:6-12

Semwal HK, Uniyal M and Bhatt SC (Year) Ultrasonic study of binary liquid mixture of n-Hexane and Acetic acid' International J. of Science and Research.

Singh YP, Das S, Maiti, S and Singh, RP (1981). J. pure Appl.Ultrason.3