Theoretical Velocities and Viscosities of Binary Mixtures of Di Methyl Malonate with Isomeric Xylenes at Different Temperatures

Pavan Krishna K[1], Anitha K[2], Sandhya Sri P.B.[3] & Ramesh Raju R[1*]

[1]*Department of Chemistry, Acharya Nagarjuna University, Nagarjuna Nagar, Gunturu-522510, AP, India.*

[2]*Department of Chemistry, Sri Krishna Devaraya University, Ananthapur-515003, AP, India.*

[3]*Department of Physics, K.B.N. College, Vijayawada-520001, AP, India.*

[*]*corresponding author e-mail: rrraju1@gmail.com, kesara.badri@gmail.com, anibios@gmail.com, sandhyasri.prathipati@kbncolleghe.ac.in*

Abstract

'Ultrasonic velocities' and 'densities' of the binary mixtures of Di Methyl Malonate with some isomeric xylenes have been measured at various temperature range with an interval of 5K over the entire range of mole fractions. Using Nomoto's relation (U_{NR}), impedance relation (U_{IR}), ideal mixing relation (U_{imx}), Junjie's relation (U_J) and Rao's specific velocity relation (U_R) the theoretical values of ultrasonic velocity were calculated. From these experimental and theoretical velocities the molecular interaction parameter (α) has been evaluated and discussed its variation with the composition mixture in terms of molecular relations. The viscosity information are correlated with some viscosity models such as Grunberg and Nisan, Heric& Brewer etc., and the results are correlated with the investigational results.

Key words:Di Methyl Malonate, Ultra sonic velocities, Theoretical Velocities, Theoretical Viscosities

Corresponding Author: R Ramesh Raju (rrraju1@gmail.com)

Introduction

To get an insight into molecular behavior of liquids, a variety of research techniques are in use in current years. At present stage of development ultrasonic techniques are producing productive results comparable with those of other methods in the explanation 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. Theoretical evaluation of ultrasonic velocity in binary liquid mixtures and its comparison with the experimental values reflects the molecular interaction in liquid mixtures, which is very useful to build comprehensive theoretical models for liquids. Several researchers [1-9] carried out investigations on liquid mixtures and correlated the experimental results of ultrasonic velocity with the theoretical relations of Nomoto's relation [10], ideal mixing relation (IMR) [11], impedance dependence relation (IDR) [12], Rao's velocity method (RVM) [13] and Junjie's method (JM) [14].Further, the best suitable theory for the given studied system is also picked out by computingthe average percentage error and Chi- Square test. The viscosity data are correlated with some best suitable theory for the given studied system is also picked out by computingthe average percentage error and Chi- Square test. The viscosity data are associated with some models of semi-empirical viscosity, such as Grunberg and Nissan[15], Katti-Chaudhri[16], Heric and Brewer[17], and Hind[18], and the findings are contrasted with the experimental results.

In the present investigation, experimentally determined ultrasonic sound velocities are compared with the theoretical relations like Nomoto, Rao's specific velocity and Junji's relation at various temperatures. Di Methyl Malonate (DMM) is mixed with Xylenes O-Xylene (OXL), M-Xylene (MXL) and P-Xylene(PXL) at entire range of mole fractions, to investigate the interactions across the component molecules. The findings are discussed in terms of molecular relations present in the investigated systems. The deviation from unity in 'U^2_{exp}/U^2_{imx}' variation, 'Average Percentage Error' (APE), Chi-square fitness test, was also evaluated to explain the system's non-ideality. The ratio of 'U^2_{exp}/U^2_{imx} offers a indication of the degree of interaction between mixture molecules, positive values of which indicate strong component interactions. Further, the mixture viscosities were correlated using Katti&Choudary, Heric and Brewer and Hind equations to test their relative applicability.

Experimental

Velocities were determined using single crystal ultrasonic pulse echo interferometer (ModelM-82,Mittal enterprises, India) working at 1 M Hz. The principle used in measurement of ultrasonic velocity waves of known frequency produced by quartz crystal in measuring cell13 .The ultrasonic interferometer has an accuracy of + 0.5m/s. The temperature of the solution was controlled by circulating water through the jacket of double walled cell. Measurements were made using constant temperature bath within + 0.01K.

Nomoto equation

A relation proposed by Rao stating that the ratio of temperature coefficients of velocity of sound and molar volume remains almost constant for pure liquids:

$$(\mathbf{1}/\boldsymbol{U})(\boldsymbol{dU}/\boldsymbol{dT})/\mathbf{1}/\boldsymbol{V})\,(\boldsymbol{dV}/\boldsymbol{dT}) = -\mathbf{3} \quad (1)$$

where 'T' denotes temperature in kelvin. upon integrating the above equation,

$$\boldsymbol{VU^{1/3}} = \boldsymbol{Const} = \boldsymbol{M}/\boldsymbol{\rho U^{1/3}} = \boldsymbol{R} \quad (2)$$

We can get U and ρ by experimental determination and M is the average molecular mass in a binary liquid mixture

$$\boldsymbol{M} = \boldsymbol{X_1 M_1} + \boldsymbol{X_2 M_2} \quad (3)$$

Where M_1 and M_2 denotes molecular mass of constituent components. With a simple manipulation of above relation we may get

$$\mathbf{U_{Nomoto}} = [(\mathbf{X_1 R_1} + \mathbf{X_2 R_2})/(\mathbf{X_1 V_1} + \mathbf{X_2 V_2})]^{3} \quad (4)$$

The Van Dael and Vangeel equation

In liquid mixtures, Van Deal proposed relation for ultrasonic velocity as

$$\mathbf{1/(X_1M_1 + X_2M_2) * 1/U_{imx}^2 = X_1/M_1U_1^2 + X_2/M_2U_2^2} \quad (5)$$

Where in liquid mixtureU_{imx} isthe idealmixing ultrasonic velocity. U_1&$U_2$is ultrasonic velocity in species.

The impedance relation

Impedance relation $\boldsymbol{U = \Sigma X_iZ_i / \Sigma X_i\rho_i}$ (6)

where $X_i$mole fraction, $\rho_i$is the density of resultant mixture and Z_i isthe acoustic impedance.

The Rao's specific velocity method relation

Rao's specific velocity method [14] $\boldsymbol{U = (\Sigma X_i r_i \rho)^3}$ (7)

where $X_i$mole fraction, U_i isthe ultrasonic velocity, $\rho_i$is the density of resultant mixture,r_i is the Rao's specific sound velocity= $U_i^{1/3}\rho_i$and Z_i isthe acoustic impedance.

The Junjie equation

Junjie equation

$$\boldsymbol{U_J = (X_1M_1/\rho_1 + X_2M_2/\rho_2)/[\{X_1M_1 + X_2M_2\}^{1/2}\{X_1M_1/\rho_1U_1^2 + X_2M_2/\rho_2U_2^2)\}^{1/2}]} \quad (8)$$

Where M_1,M_2 are molecular masses of resultant components.$\rho_1$and ρ_2 are the densities of constituent components.

Chi-square test for goodness of fit

Chi-square value is calculated for the binary liquid mixtures using Karl Pearson [19] formula

$$\chi^2 = \frac{\sum_{n=1}^{n}(U_{mix(obs)} - U_{mix(cal)})^2}{U_{mix(cal)}} \quad (9)$$

where n is the number of data used.

Average percentage error (APE)

The Average percentage error [21] calculated using the relation

$$APE = \frac{1}{n}\Sigma\frac{(U_{mix(obs)} - U_{mix(cal)})}{U_{mix(cal)}} \times 100 \quad (10)$$

where n isthe number of data used,$U_{mix(obs)}$= ultrasonicvelocities of investigated data

$U_{mix(cal)}$= ultrasonic velocities of computed data

Molecular association

Thedegreeofintermolecularinteractionormolecular association is given by

$$\alpha = \frac{U_{exp}^2}{U_{imx}^2} - 1 \quad (11)$$

Viscosity theories

Grunberg and Nissan proposed the following equation for viscosity of liquid mixtures at low temperatures,

$$\ln(\eta V) = X_1\ln(\eta_1V_1) + X_2\ln(\eta_2V_2) + X_1X_2G_{12} \quad (12)$$

Whereη_1 ,η_2 are viscosity of components di methyl malonate and o- xylene or m- xylene or p-xylene respectively,G_{12} is an interaction parameterwhich isthe functionofthe chemical natureofthe components and temperature. The value of G_{12}, obtained fromEq.(14) using experimental viscosity.

The Katti -Chaudhri(KC) equation is given by:

$$\ln(\eta V) = X_1\ln(\eta_1V_1) + X_2\ln(\eta_2V_2) + X_1X_2W_{visc}/RT \quad (13)$$

Where W_{vis} is the interaction energy for activation of viscousflow.

The three parameter Heric and Brewer model is of the following form:

$$\ln\eta = X_1\ln(\eta_1) + X_2\ln(\eta_2) + X_1\ln(M_1) + X_1\ln(M_2) - (\ln X_1M_1 + \ln X_1M_1)X_1X_2\Delta_{12} \quad (14)$$

The expression to determine the viscosity of the binary liquid mixtures proposed by Hind et al. is given by

$$\eta = X_1^2\eta_1 + X_2^2\eta_2 + 2X_1X_2H_{12} \quad (15)$$

where H_{12} is an association term.

Results & discussion

Several of the molecules are thought to be spherical in shape, which is not always true. According to Nomoto's theory, there is a presumption that when components are combined, the volume of the molecules will not shift and that there is no chance of contact between the components of the liquid mixture. Similarly, there is expectation for the creation of an ideal mixing relationship that the ratio of different heats of ideal mixtures and volumes is equal, meaning molecular interactions are not possible.Yet actually on the combining of two liquids there is a risk of reactions between the components of liquid mixtures.The interaction is due to various forces, such as dispersion forces, hydrogen bonding, transfer of charges, dipole-dipole interactions, and dipole-induced interactions.The discrepancy in the experimental velocity with the theoretical velocity values shows that the mixing of components involves intermolecular interactions among unlike molecules.The predictive potential of different ultrasonic theories usually depends on the frequency of the interactions that occur in a binary system.

From Tables -1 , 2 and 3 it is observed that there is strong agreement in impedance relationship between the experimental and theoretical values for the three systems being tested, followed by the relationship of Nomoto where higher deviations are found in the basic velocity of Rao.The interaction parameter is positive for the system over the entire composition range at all measured temperatures and the values are more positive in the middle composition range indicating heavy molecular interaction between different molecules.

The Di Methyl Malonate molecules have particular connections and molecules of OXL, MXL and PXL are associated through dipole-dipole association because of the presence of dynamic methylene group and electron releasing two methyl groups (-CH3) in the xylene molecules.Theπ-electron density of benzene ring derivatives depends on the group that is connected to it. The hetero molecular interaction between component molecules depends on the ring's net electron density and, moreover, depends on the relative orientation of the two ring groups. As the distance between the two group increases, inter molecular associations become increasingly dependent. The inter molecular interaction in ortho isomer creates a significant strain in the ring that induces an opposite pole at ortho, that of the ring than meta and para derivatives. Subsequently, the interactions were along these lines anticipated that would be weaker in the ortho derivatives, than the other two isomers. The molecular collaborations that are operative between the two segment molecules are because of the residual electric moments and dispersion forces which may not the altogether not the same as those forces that are available in pure liquids.Consequently, the non-ideality reflected in this analysis can also be expected through geometric variables, namely variation in the molecular shape and size of the components.

In addition, an attempt was made to test the suitability of empirical and semi-empirical relationships to match experimental viscosity data from the studied systems by taking into account a number of coefficients for empirical adjustment. The viscosities predicted demonstrate good accuracy as opposed to the experimental viscosities. The results obtained showed that the Katti- Choudary model predicts the viscosity data better than other predictive models that exist. Earlier researchers have noted the same results [20].

From the Table 4, it is observed that there is a good agreement between experimental and theoretical values. From the Table 5, it is observed that the interaction parameter values are positive for all the models. This again supports the presence of strong interaction between the consecutive molecules.

Conclusions

Impedance relationship holds well for the systems accompanied by Nomoto 's relationship in the binary xylenes systems with DMM. The observed variations of the theoretical velocity values from the experimental values are due to the presence of intermolecular interactions in the investigated systems. The same was also suggested by the interaction parameter.

Table 1: Experimental and computed values of velocities with their percentage of deviations for the system DMM +O-Xylene at 303.15, 308.15,313.15 and 318.15K

At 303.15K													
X_1	U_{EXP}	U_{NOM}	U_{IMP}	U_{VDV}	U_{JUN}	U_{RAO}	$\%U_N$	$\%U_{imp}$	$\%U_{VDV}$	$\%U_{JUN}$	$\%U_{RAO}$	U^2/U^2_{imx}	α
0.0000	1328.2	1328.2	1328.2	1328.2	1328.2	1328.2	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
0.1052	1332.1	1331.9	1333.2	1328.3	1326.4	1360.1	-0.0167	0.0802	-0.2865	-0.4257	2.1036	1.0058	0.0057
0.2092	1335.9	1335.5	1337.8	1329.2	1325.8	1385.5	-0.0296	0.1362	-0.5047	-0.7569	3.7126	1.0102	0.0101
0.3120	1339.7	1339.2	1342.0	1330.9	1326.4	1404.5	-0.0385	0.1710	-0.6570	-0.9949	4.8299	1.0133	0.0132
0.4137	1343.5	1342.9	1346.0	1333.5	1328.2	1416.9	-0.0437	0.1872	-0.7454	-1.1403	5.4631	1.0151	0.0150
0.5142	1347.2	1346.6	1349.7	1336.8	1331.2	1423.0	-0.0452	0.1870	-0.7715	-1.1928	5.6241	1.0156	0.0156
0.6135	1350.9	1350.3	1353.2	1340.9	1335.3	1422.9	-0.0430	0.1723	-0.7366	-1.1515	5.3286	1.0149	0.0148
0.7118	1354.5	1354.0	1356.5	1345.8	1340.8	1416.8	-0.0374	0.1449	-0.6416	-1.0146	4.5955	1.0130	0.0129
0.8089	1358.1	1357.7	1359.6	1351.5	1347.5	1404.9	-0.0282	0.1062	-0.4870	-0.7795	3.4465	1.0098	0.0098
0.9050	1361.7	1361.5	1362.5	1358.0	1355.7	1387.6	-0.0157	0.0575	-0.2732	-0.4428	1.9060	1.0055	0.0054
1.0000	1365.2	1365.2	1365.2	1365.2	1365.	1365.2	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
	σ		-0.0030	0.0124	-0.0514	-0.0798	0.3541						
	χ^2		0.0014	0.0255	0.4290	1.0274	22.6315						
308.15K													
0.0000	1313.5	1313.5	1328.2	1313.5	1328.2	1328.2	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
0.1052	1316.8	1317.5	1333.1	1313.9	1326.4	1360.1	0.0563	1.2414	-0.2193	0.7296	3.2882	1.0044	0.0044
0.2092	1321.0	1321.6	1337.7	1315.2	1325.8	1385.5	0.0411	1.2628	-0.4446	0.3596	4.8794	1.0089	0.0089
0.3120	1325.2	1325.6	1342.0	1317.3	1326.4	1404.4	0.0304	1.2633	-0.6022	0.0846	5.9730	1.0121	0.0121
0.4136	1329.4	1329.7	1346.0	1320.2	1328.1	1416.9	0.0242	1.2456	-0.6941	-0.0959	6.5772	1.0140	0.0140
0.5141	1333.5	1333.8	1349.7	1323.9	1331.1	1422.9	0.0222	1.2120	-0.7217	-0.1819	6.7047	1.0145	0.0145
0.6135	1337.6	1337.9	1353.2	1328.4	1335.3	1422.8	0.0245	1.1643	-0.6864	-0.1726	6.3716	1.0138	0.0138
0.7117	1341.6	1342.0	1356.4	1333.7	1340.7	1416.7	0.0309	1.1043	-0.5889	-0.0663	5.5974	1.0118	0.0118
0.8089	1345.6	1346.2	1359.5	1339.8	1347.5	1404.9	0.0413	1.0335	-0.4296	0.1395	4.4047	1.0086	0.0086
0.9049	1349.6	1350.3	1362.4	1346.7	1355.6	1387.6	0.0556	0.9531	-0.2087	0.4483	2.8181	1.0041	0.0041
1.0000	1354.5	1354.5	1365.2	1354.5	1365.2	1365.2	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
	σ		0.0032	0.0206	-0.0462	-0.0761	0.3632						
	χ^2		0.0017	0.0667	0.3543	0.9434	23.5515						
313.15K													
0.0000	1297.0	1297.0	1297.0	1297.0	1297.0	1297.0	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
0.1052	1298.8	1300.0	1301.2	1296.6	1294.8	1328.3	0.0935	0.1787	-0.1691	-0.3130	2.2705	1.0033	0.0033
0.2092	1302.8	1303.1	1305.0	1297.1	1293.7	1353.2	0.0504	0.1961	-0.4117	-0.6723	3.8925	1.0082	0.0082
0.3120	1305.7	1306.3	1308.7	1298.4	1293.8	1371.5	0.0423	0.2264	-0.5588	-0.9080	5.0418	1.0112	0.0112
0.4136	1308.9	1309.4	1312.0	1300.4	1295.1	1383.4	0.0375	0.2404	-0.6440	-1.0520	5.6936	1.0130	0.0130

0.5141	1312.0	1312.5	1315.2	1303.2	1297.5	1388.9	0.0359	0.2401	-0.6690	-1.1041	5.8598	1.0135	0.0135
0.6135	1315.1	1315.6	1318.1	1306.8	1301.1	1388.2	0.0376	0.2271	-0.6350	-1.0633	5.5562	1.0128	0.0128
0.7117	1318.2	1318.8	1320.9	1311.0	1306.0	1381.5	0.0425	0.2029	-0.5430	-0.9280	4.8023	1.0109	0.0109
0.8089	1321.2	1321.9	1323.5	1316.0	1312.0	1369.1	0.0504	0.1688	-0.3937	-0.6955	3.6205	1.0079	0.0079
0.9049	1324.2	1325.0	1325.9	1321.7	1319.4	1351.2	0.0614	0.1259	-0.1876	-0.3625	2.0358	1.0037	0.0037
1.0000	1328.2	1328.2	1328.2	1328.2	1328.2	1328.2	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
	σ		0.0045	0.0180	-0.0423	-0.0716	0.3702						
	χ^2		0.0033	0.0490	0.2966	0.8276	24.0924						
						318.15K							
0.0000	1284.2	1284.2	1284.2	1284.2	1284.2	1284.2	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
0.1052	1285.0	1286.7	1287.6	1283.4	1281.6	1314.9	0.1340	0.2041	-0.1213	-0.2629	2.3278	1.0024	0.0024
0.2092	1288.1	1289.2	1290.7	1283.4	1280.1	1339.1	0.0892	0.2091	-0.3598	-0.6161	3.9615	1.0072	0.0072
0.3120	1290.7	1291.7	1293.7	1284.2	1279.8	1356.8	0.0838	0.2353	-0.4998	-0.8431	5.1236	1.0100	0.0100
0.4136	1293.5	1294.3	1296.4	1285.7	1280.5	1368.0	0.0618	0.2289	-0.5992	-1.0000	5.7634	1.0120	0.0120
0.5141	1296.0	1296.8	1299.0	1288.0	1282.4	1372.9	0.0642	0.2323	-0.6189	-1.0461	5.9359	1.0124	0.0124
0.6135	1298.4	1299.4	1301.4	1290.9	1285.4	1371.6	0.0760	0.2321	-0.5753	-0.9955	5.6412	1.0116	0.0116
0.7117	1301.0	1301.9	1303.6	1294.5	1289.6	1364.4	0.0739	0.2060	-0.4925	-0.8699	4.8741	1.0099	0.0099
0.8089	1303.4	1304.5	1305.7	1298.9	1295.07	1351.4	0.0858	0.1834	-0.3435	-0.6390	3.6867	1.0069	0.0069
0.9049	1306.2	1307.0	1307.7	1303.9	1301.7	1333.0	0.0650	0.1182	-0.1753	-0.3464	2.0560	1.0035	0.0035
1.0000	1309.6	1309.6	1309.6	1309.6	1309.6	1309.6	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
	σ		0.0073	0.0184	-0.0380	-0.0667	0.3757						
	χ^2		0.0082	0.0506	0.2408	0.7167	24.5162						

Table 2: Experimental andtheoretical values of velocities along with their percentage of deviations for the system DMM +M-Xylene at 303.15,308.15,313.15 and 318.15K:

303.15K													
X_1	**U_{EXP}**	**U_{NOM}**	**U_{IMP}**	**U_{VDV}**	**U_{JUN}**	**U_{RAO}**	**$\%U_N$**	**$\%U_{imp}$**	**$\%U_{VDV}$**	**$\%U_{JUN}$**	**$\%U_{RAO}$**	**U^2/U^2_{imx}**	**α**
0.0000	1301.5	1301.5	1301.5	1301.5	1301.5	1301.5	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
0.1069	1308.2	1307.8	1310.3	1303.7	1301.0	1339.2	-0.0318	0.1611	-0.3399	-0.5483	2.3703	1.0068	0.0068
0.2121	1314.8	1314.1	1318.4	1306.9	1302.0	1369.6	-0.0580	0.2698	-0.6006	-0.9790	4.1657	1.0121	0.0121
0.3158	1321.2	1320.4	1325.8	1311.1	1304.3	1392.7	-0.0643	0.3478	-0.7708	-1.2791	5.4098	1.0156	0.0156
0.4179	1327.8	1326.7	1332.7	1316.1	1308.2	1408.6	-0.0786	0.3731	-0.8805	-1.4759	6.0882	1.0178	0.0178
0.5185	1334.1	1333.1	1339.1	1322.0	1313.5	1417.5	-0.0739	0.3781	-0.9045	-1.5417	6.2491	1.0183	0.0183
0.6176	1340.3	1339.5	1345.1	1328.8	1320.4	1419.4	-0.0597	0.3578	-0.8535	-1.4832	5.9068	1.0173	0.0173
0.7153	1346.5	1345.9	1350.6	1336.6	1328.9	1414.9	-0.0463	0.3055	-0.7386	-1.3068	5.0777	1.0149	0.0149
0.8116	1352.8	1352.3	1355.8	1345.2	1339.1	1404.1	-0.0372	0.2213	-0.5634	-1.0109	3.7892	1.0114	0.0114
0.9065	1358.9	1358.7	1360.6	1354.7	1351.2	1387.4	-0.0139	0.1264	-0.3096	-0.5704	2.0930	1.0062	0.0062
1.0000	1365.2	1365.2	1365.2	1365.2	1365.2	1365.2	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
	σ		-0.0046	0.0253	-0.0601	-0.1032	0.3918						
	χ^2		0.0036	0.1050	0.5802	1.6951	27.7002						
308.15K													
0.0000	1281.0	1281.0	1301.5	1281.0	1301.5	1301.5	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
0.1069	1287.5	1288.2	1310.3	1284.0	1301.0	1339.2	0.0554	1.7710	-0.2693	1.0502	4.0158	1.0054	0.0054
0.2121	1294.4	1295.5	1318.4	1288.0	1302.0	1369.6	0.0817	1.8532	-0.4914	0.5846	5.8106	1.0099	0.0099

0.3158	1301.7	1302.7	1325.8	1293.0	1304.3	1392.7	0.0796	1.8550	-0.6677	0.2037	6.9930	1.0135	0.0135
0.4179	1309.4	1310.0	1332.7	1298.9	1308.2	1408.6	0.0486	1.7820	-0.8009	-0.0930	7.5773	1.0162	0.0162
0.5185	1317.2	1317.4	1339.1	1305.8	1313.5	1417.5	0.0129	1.6646	-0.8680	-0.2798	7.6109	1.0176	0.0176
0.6176	1324.7	1324.7	1345.1	1313.6	1320.4	1419.4	0.0063	1.5414	-0.8370	-0.3212	7.1559	1.0170	0.0170
0.7153	1331.9	1332.1	1350.6	1322.3	1328.9	1414.9	0.0173	1.4050	-0.7193	-0.2250	6.2296	1.0145	0.0145
0.8116	1339.3	1339.6	1355.8	1332.0	1339.1	1404.1	0.0157	1.2281	-0.5451	-0.0165	4.8318	1.0110	0.0110
0.9065	1346.7	1347.0	1360.6	1342.8	1351.2	1387.4	0.0232	1.0356	-0.2925	0.3324	3.0200	1.0059	0.0059
1.0000	1354.5	1354.5	1365.2	1354.5	1365.2	1365.2	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
	σ		0.0034	0.0390	-0.0553	-0.1018	0.4024						
	χ^2		0.0026	0.2441	0.4949	1.6454	28.8713						
313.15 K													
0.0000	1297.0	1297.0	1297.0	1297.0	1297.0	1297.0	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
0.1069	1299.2	1300.1	1301.3	1296.7	1294.1	1333.2	0.0682	0.1647	-0.1936	-0.3931	2.6205	1.0039	0.0039
0.2121	1302.2	1303.2	1305.3	1297.2	1292.5	1361.7	0.0753	0.2397	-0.3839	-0.7452	4.5695	1.0077	0.0077
0.3158	1305.5	1306.3	1309.0	1298.5	1292.2	1382.4	0.0601	0.2669	-0.5350	-1.0188	5.8902	1.0108	0.0108
0.4179	1309.2	1309.4	1312.4	1300.6	1293.2	1395.4	0.0150	0.2420	-0.6570	-1.2218	6.5868	1.0133	0.0133
0.5185	1312.8	1312.5	1315.5	1303.4	1295.5	1401.0	-0.0216	0.2059	-0.7139	-1.3159	6.7194	1.0144	0.0144
0.6176	1316.0	1315.6	1318.4	1307.0	1299.2	1399.4	-0.0269	0.1835	-0.6851	-1.2776	6.3370	1.0138	0.0138
0.7153	1318.8	1318.8	1321.1	1311.3	1304.2	1390.9	-0.0012	0.1764	-0.5723	-1.1048	5.4681	1.0115	0.0115
0.8116	1321.5	1321.9	1323.7	1316.2	1310.7	1375.9	0.0326	0.1633	-0.3993	-0.8168	4.1197	1.0080	0.0080
0.9065	1324.5	1325.1	1326.0	1321.9	1318.7	1354.9	0.0442	0.1154	-0.1970	-0.4391	2.2954	1.0040	0.0040
1.0000	1328.3	1328.3	1328.3	1328.3	1328.3	1328.3	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
		σ	0.0025	0.0175	-0.0436	-0.0842	0.4231						
		χ^2	0.0024	0.0474	0.3160	1.1402	31.9165						
318.15K													
0.0000	1241.0	1241.0	1241.0	1241.0	1241.0	1241.0	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
0.1069	1245.5	1247.7	1250.5	1243.7	1240.8	1279.2	0.1773	0.4054	-0.1408	-0.3793	2.7074	1.0028	0.0028
0.2121	1251.6	1254.5	1259.3	1247.4	1242.0	1310.2	0.2278	0.6154	-0.3336	-0.7676	4.6805	1.0067	0.0067
0.3158	1258.4	1261.2	1267.4	1252.0	1244.7	1333.9	0.2247	0.7117	-0.5070	-1.0911	5.9961	1.0102	0.0102
0.4179	1265.7	1268.0	1274.8	1257.5	1248.8	1350.3	0.1848	0.7183	-0.6464	-1.3319	6.6845	1.0131	0.0131
0.5185	1272.8	1274.9	1281.7	1263.9	1254.6	1359.7	0.1639	0.6974	-0.6979	-1.4329	6.8255	1.0141	0.0141
0.6176	1279.5	1281.8	1288.1	1271.2	1261.9	1362.2	0.1773	0.6698	-0.6475	-1.3755	6.4617	1.0131	0.0131
0.7153	1286.5	1288.7	1294.0	1279.4	1270.9	1358.1	0.1711	0.5860	-0.5489	-1.2076	5.5656	1.0111	0.0111
0.8116	1293.8	1295.6	1299.6	1288.5	1281.8	1347.7	0.1444	0.4490	-0.4034	-0.9235	4.1697	1.0081	0.0081
0.9065	1300.2	1302.6	1304.8	1298.6	1294.7	1331.4	0.1866	0.3520	-0.1217	-0.4259	2.4025	1.0024	0.0024
1.0000	1309.7	1309.7	1309.7	1309.7	1309.7	1309.7	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
		σ	0.0165	0.0517	-0.0407	-0.0904	0.4311						
		χ^2	0.0395	0.4026	0.2790	1.2910	32.0915						

Table 3: Experimental and theoretical values of velocities along with their percentage of deviations for the system DMM +P-Xylene at 303.15,308.15,313.15 and318.15K:

X_1	U_{EXP}	U_{NOM}	U_{IMP}	U_{VDV}	U_{JUN}	U_{RAO}	$\%U_N$	$\%U_{imp}$	$\%U_{VDV}$	$\%U_{JUN}$	$\%U_{RAO}$	U^2/U^2_{imx}	A
303.15K													
0.0000	1286.3	1286.3	1286.3	1286.3	1286.3	1286.3	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
0.1073	1294.3	1294.0	1297.3	1289.7	1286.6	1326.5	-0.0206	0.2325	-0.3522	-0.5948	2.4886	1.0071	0.0071
0.2129	1302.5	1301.8	1307.4	1294.2	1288.4	1359.2	-0.0529	0.3764	-0.6375	-1.0787	4.3541	1.0129	0.0129
0.3167	1310.4	1309.6	1316.7	1299.6	1291.8	1384.4	-0.0570	0.4816	-0.8192	-1.4129	5.6484	1.0166	0.0166
0.4190	1318.5	1317.4	1325.2	1306.0	1296.8	1402.1	-0.0804	0.5089	-0.9467	-1.6434	6.3387	1.0192	0.0192
0.5196	1326.0	1325.3	1333.1	1313.4	1303.5	1412.5	-0.0519	0.5369	-0.9508	-1.6982	6.5232	1.0193	0.0193
0.6187	1334.0	1333.2	1340.5	1321.7	1311.9	1415.9	-0.0585	0.4843	-0.9188	-1.6592	6.1364	1.0186	0.0186
0.7162	1341.7	1341.2	1347.3	1331.1	1322.1	1412.5	-0.0389	0.4178	-0.7905	-1.4606	5.2745	1.0160	0.0160
0.8123	1349.5	1349.1	1353.7	1341.4	1334.3	1402.6	-0.0268	0.3083	-0.5991	-1.1285	3.9357	1.0121	0.0121
0.9068	1357.3	1357.2	1359.6	1352.8	1348.6	1386.7	-0.0072	0.1745	-0.3294	-0.6391	2.1716	1.0066	0.0066
1.0000	1365.2	1365.2	1365.2	1365.2	1365.2	1365.2	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
	σ		-0.0039	0.0351	-0.0639	-0.1147	0.4074						
	χ^2		0.0028	0.1999	0.6546	2.0782	29.8773						
308.15K													
0.0000	1265.6	1265.6	1286.3	1265.6	1286.3	1286.3	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
0.1073	1273.7	1274.3	1297.3	1269.8	1286.6	1326.5	0.0502	1.8573	-0.3012	1.0166	4.1499	1.0061	0.0061
0.2129	1282.0	1283.0	1307.4	1275.1	1288.4	1359.2	0.0803	1.9806	-0.5407	0.5023	6.0219	1.0109	0.0109
0.3167	1291.3	1291.8	1316.7	1281.3	1291.8	1384.4	0.0364	1.9608	-0.7743	0.0384	7.2036	1.0157	0.0157
0.4190	1300.5	1300.6	1325.2	1288.6	1296.8	1402.1	0.0103	1.9000	-0.9125	-0.2821	7.8105	1.0185	0.0185
0.5196	1309.2	1309.5	1333.1	1296.9	1303.5	1412.5	0.0230	1.8270	-0.9360	-0.4368	7.8901	1.0190	0.0190
0.6187	1318.3	1318.4	1340.5	1306.3	1311.9	1415.9	0.0072	1.6796	-0.9122	-0.4893	7.3990	1.0185	0.0185
0.7162	1326.8	1327.4	1347.3	1316.7	1322.1	1412.5	0.0430	1.5446	-0.7617	-0.3550	6.4557	1.0154	0.0154
0.8123	1336.5	1336.4	1353.7	1328.2	1334.3	1402.6	-0.0074	1.2866	-0.6210	-0.1643	4.9493	1.0125	0.0125
0.9068	1345.6	1345.4	1359.6	1340.8	1348.6	1386.7	-0.0133	1.0425	-0.3593	0.2219	3.0569	1.0072	0.0072
1.0000	1354.5	1354.5	1365.2	1354.5	1365.2	1365.2	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
	σ		0.0023	0.0470	-0.0617	-0.1145	0.4370						
	χ^2		0.0017	0.3568	0.6050	2.0513	34.0364						
313.15K													
0.0000	1249.8	1249.8	1249.8	1249.8	1249.8	1249.8	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
0.1073	1256.4	1257.5	1260.8	1253.3	1250.1	1293.7	0.0851	0.3477	-0.2485	-0.5004	2.9693	1.0050	0.0050
0.2129	1263.6	1265.2	1270.8	1257.7	1251.9	1326.8	0.1288	0.5744	-0.4601	-0.9187	5.0037	1.0093	0.0093
0.3167	1271.2	1272.9	1280.0	1263.2	1255.3	1352.5	0.1356	0.6947	-0.6325	-1.2499	6.3921	1.0128	0.0128
0.4190	1279.4	1280.7	1288.5	1269.5	1260.3	1370.3	0.1024	0.7139	-0.7707	-1.4958	7.1047	1.0156	0.0156
0.5196	1287.7	1288.5	1296.4	1276.9	1266.9	1382.0	0.0648	0.6754	-0.8408	-1.6185	7.3241	1.0170	0.0170
0.6187	1295.6	1296.4	1303.7	1285.2	1275.2	1385.0	0.0605	0.6234	-0.8065	-1.5773	6.8986	1.0163	0.0163
0.7162	1303.7	1304.3	1310.5	1294.4	1285.3	1382.4	0.0461	0.5197	-0.7112	-1.4092	6.0383	1.0144	0.0144
0.8123	1311.3	1312.2	1316.8	1304.7	1297.4	1371.7	0.0720	0.4194	-0.5050	-1.0569	4.6082	1.0102	0.0102
0.9068	1320.2	1320.2	1322.7	1315.9	1311.7	1357.0	0.0021	0.1903	-0.3225	-0.6454	2.7862	1.0065	0.0065
1.0000	1328.3	1328.3	1328.3	1328.3	1328.3	1328.3	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
		σ	0.0070	0.0473	-0.0533	-0.1061	0.4638						
		χ^2	0.0087	0.3556	0.4498	1.7430	37.5595						

318.15 K													
0.0000	1229.7	1229.7	1229.7	1229.7	1229.7	1229.7	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
0.1073	1236.0	1237.5	1240.9	1233.3	1230.1	1275.0	0.1217	0.3955	-0.2163	-0.4740	3.1543	1.0043	0.0043
0.2129	1243.1	1245.3	1251.1	1237.9	1232.1	1308.1	0.1850	0.6497	-0.4119	-0.8814	5.2356	1.0083	0.0083
0.3167	1250.8	1253.2	1260.5	1243.5	1235.6	1333.0	0.1948	0.7778	-0.5841	-1.2164	6.5740	1.0118	0.0118
0.4190	1259.0	1261.2	1269.2	1250.0	1240.7	1351.6	0.1721	0.8098	-0.7137	-1.4567	7.3569	1.0144	0.0144
0.5196	1267.6	1269.1	1277.2	1257.5	1247.4	1362.9	0.1223	0.7588	-0.7968	-1.5941	7.5212	1.0161	0.0161
0.6187	1275.5	1277.2	1284.6	1265.9	1255.8	1365.7	0.1329	0.7197	-0.7475	-1.5383	7.0767	1.0151	0.0151
0.7162	1283.9	1285.2	1291.5	1275.3	1266.1	1363.7	0.1031	0.5966	-0.6662	-1.3826	6.2133	1.0135	0.0135
0.8123	1291.2	1293.3	1298.0	1285.7	1278.4	1354.1	0.1605	0.5226	-0.4261	-0.9933	4.8654	1.0086	0.0086
0.9068	1300.4	1301.5	1304.0	1297.2	1292.9	1339.8	0.0820	0.2782	-0.2481	-0.5800	3.0288	1.0050	0.0050
1.0000	1309.7	1309.7	1309.7	1309.7	1309.7	1309.7	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000
		σ	0.0127	0.0547	-0.0484	-0.1025	0.4809						
		χ^2	0.0243	0.4601	0.3738	1.6171	39.6212						

Table-4: Experimental and calculated values of viscosity, η (m Pa s), for the binary mixtures of Di methyl malonate and Isomeric Xylenes at different temperatures:

o-Xylene										
303.15K						308.15K				
X1	η Expt	η GN	η KC	η HB	η H	η Expt	η GN	η KC	η HB	η H
0.0000	0.7130	0.7130	0.7130	0.7130	0.7130	0.6692	0.6692	0.6692	0.6692	0.6692
0.1052	0.8890	1.0661	1.0663	1.0658	1.2891	0.7996	0.9607	0.9610	0.9605	1.1236
0.2092	1.2520	1.4695	1.4698	1.4690	1.7419	1.0440	1.2824	1.2828	1.2819	1.4815
0.3120	1.7566	1.8722	1.8727	1.8716	2.0754	1.5057	1.5953	1.5957	1.5947	1.7461
0.4137	2.3730	2.2110	2.2114	2.2104	2.2939	1.9989	1.8539	1.8544	1.8533	1.9205
0.5142	2.9989	2.4256	2.4259	2.4252	2.4008	2.4779	2.0170	2.0173	2.0165	2.0076
0.6135	2.8099	2.4785	2.4786	2.4783	2.4001	2.3554	2.0591	2.0592	2.0587	2.0104
0.7118	2.4606	2.3644	2.3643	2.3644	2.2952	2.0582	1.9765	1.9765	1.9764	1.9316
0.8089	2.1782	2.1107	2.1106	2.1108	2.0898	1.8358	1.7878	1.7877	1.7878	1.7741
0.9050	1.8096	1.7669	1.7668	1.7670	1.7869	1.5709	1.5266	1.5265	1.5266	1.5404
1.0000	1.3902	1.3902	1.3902	1.3902	1.3902	1.2331	1.2331	1.2331	1.2331	1.2331
313.15K						318.15K				
0.0000	0.6318	0.6318	0.6318	0.6318	0.6318	0.5970	0.5970	0.5970	0.5970	0.5970
0.1052	0.7360	0.8781	0.8783	0.8779	1.0033	0.6555	0.7942	0.7944	0.7940	0.8792
0.2092	0.9790	1.1431	1.1434	1.1426	1.2971	0.8590	0.9998	1.0001	0.9993	1.1041
0.3120	1.4035	1.3965	1.3970	1.3960	1.5156	1.2078	1.1930	1.1934	1.1924	1.2738
0.4137	1.7966	1.6049	1.6054	1.6044	1.6614	1.5000	1.3519	1.3524	1.3513	1.3900
0.5142	2.2110	1.7382	1.7385	1.7377	1.7369	1.8000	1.4572	1.4576	1.4566	1.4545
0.6135	2.0068	1.7777	1.7779	1.7774	1.7443	1.6500	1.4966	1.4968	1.4962	1.4690
0.7118	1.8124	1.7202	1.7202	1.7201	1.6860	1.5300	1.4669	1.4670	1.4666	1.4352
0.8089	1.5640	1.5779	1.5778	1.5779	1.5643	1.3200	1.3744	1.3744	1.3742	1.3548
0.9050	1.3266	1.3743	1.3742	1.3743	1.3811	1.2300	1.2326	1.2326	1.2326	1.2291
1.0000	1.1386	1.1386	1.1386	1.1386	1.1386	1.0598	1.0598	1.0598	1.0598	1.0598

m-Xylene										
303.15K						308.15K				
0.0000	0.5510	0.5510	0.5510	0.5510	0.5510	0.5220	0.5220	0.5220	0.5220	0.5220
0.1069	0.7700	0.8905	0.8907	0.8903	1.1723	0.6990	0.8128	0.8130	0.8127	1.0279
0.2121	1.1420	1.3064	1.3068	1.3061	1.6594	1.0550	1.1578	1.1582	1.1575	1.4254
0.3158	1.6950	1.7483	1.7488	1.7479	2.0190	1.4200	1.5154	1.5158	1.5150	1.7196
0.4179	2.3540	2.1419	2.1423	2.1415	2.2561	1.9330	1.8282	1.8286	1.8279	1.9146
0.5185	2.9750	2.4116	2.4118	2.4114	2.3761	2.5190	2.0408	2.0410	2.0406	2.0149
0.6176	2.7780	2.5047	2.5046	2.5047	2.3841	2.3660	2.1148	2.1147	2.1147	2.0247
0.7153	2.4330	2.4079	2.4076	2.4080	2.2850	2.0520	2.0408	2.0406	2.0409	1.9477
0.8116	2.2040	2.1497	2.1493	2.1499	2.0833	1.8720	1.8397	1.8394	1.8399	1.7876
0.9065	1.8000	1.7880	1.7878	1.7882	1.7835	1.5820	1.5537	1.5535	1.5538	1.5482
1.0000	1.3900	1.3900	1.3900	1.3900	1.3900	1.2330	1.2330	1.2330	1.2330	1.2330
313.15K						318.15K				
0.0000	0.4930	0.4930	0.4930	0.4930	0.4930	0.4680	0.4680	0.4680	0.4680	0.4680
0.1069	0.6590	0.7512	0.7514	0.7511	0.9291	0.6060	0.6786	0.6787	0.6784	0.8051
0.2121	0.9780	1.0522	1.0525	1.0519	1.2724	0.8780	0.9152	0.9156	0.9150	1.0729
0.3158	1.3210	1.3604	1.3608	1.3600	1.5276	1.1310	1.1524	1.1528	1.1521	1.2747
0.4179	1.8130	1.6286	1.6289	1.6283	1.6981	1.5850	1.3583	1.3586	1.3580	1.4132
0.5185	2.2340	1.8115	1.8117	1.8113	1.7877	1.9250	1.5031	1.5032	1.5029	1.4911
0.6176	2.1370	1.8782	1.8781	1.8782	1.7998	1.7120	1.5658	1.5658	1.5658	1.5111
0.7153	1.7850	1.8205	1.8203	1.8206	1.7379	1.5490	1.5396	1.5394	1.5396	1.4756
0.8116	1.6170	1.6545	1.6543	1.6547	1.6051	1.2980	1.4322	1.4320	1.4323	1.3871
0.9065	1.4000	1.4138	1.4136	1.4139	1.4044	1.2130	1.2637	1.2635	1.2638	1.2478
1.0000	1.1390	1.1390	1.1390	1.1390	1.1390	1.0600	1.0600	1.0600	1.0600	1.0600
p-Xylene										
303.15K						308.15K				
0.0000	0.5760	0.5760	0.5760	0.5760	0.5760	0.5440	0.5440	0.5440	0.5440	0.5440
0.1073	0.8070	0.9311	0.9314	0.9310	1.2175	0.7470	0.8563	0.8566	0.8562	1.0901
0.2129	1.1640	1.3645	1.3650	1.3642	1.7188	1.0390	1.2282	1.2286	1.2279	1.5167
0.3167	1.8010	1.8201	1.8207	1.8196	2.0858	1.4400	1.6113	1.6115	1.6109	1.8289
0.4190	2.4100	2.2208	2.2213	2.2204	2.3255	2.0800	1.9426	1.9426	1.9422	2.0326
0.5196	2.9900	2.4878	2.4880	2.4875	2.4431	2.5790	2.1596	2.1599	2.1594	2.1324
0.6187	2.8260	2.5689	2.5688	2.5689	2.4445	2.5410	2.2226	2.2221	2.2225	2.1331
0.7162	2.6150	2.4544	2.4541	2.4545	2.3350	2.2310	2.1249	2.1241	2.1250	2.0394
0.8123	2.2180	2.1771	2.1767	2.1773	2.1193	1.9900	1.8933	1.8931	1.8935	1.8552
0.9068	1.8110	1.7996	1.7994	1.7997	1.8031	1.6100	1.5778	1.5782	1.5779	1.5854
1.0000	1.3900	1.3900	1.3900	1.3900	1.3900	1.2330	1.2330	1.2330	1.2330	1.2330
313.15K						318.15K				
0.0000	0.5130	0.5130	0.5130	0.5130	0.5130	0.4870	0.4870	0.4870	0.4870	0.4870
0.1073	0.6850	0.7821	0.7825	0.7820	0.9690	0.6390	0.7209	0.7214	0.7208	0.8691
0.2129	0.9700	1.0946	1.0947	1.0943	1.3266	0.9180	0.9864	0.9866	0.9862	1.1699
0.3167	1.3300	1.4113	1.4110	1.4109	1.5898	1.1870	1.2517	1.2512	1.2513	1.3928

0.4190	1.9130	1.6837	1.6828	1.6833	1.7636	1.6390	1.4788	1.4779	1.4785	1.5419
0.5196	2.3740	1.8643	1.8636	1.8641	1.8516	2.1050	1.6313	1.6303	1.6311	1.6203
0.6187	2.1470	1.9229	1.9219	1.9229	1.8580	1.8910	1.6858	1.6845	1.6858	1.6312
0.7162	1.9650	1.8534	1.8532	1.8535	1.7865	1.7170	1.6369	1.6364	1.6370	1.5777
0.8123	1.6640	1.6744	1.6745	1.6745	1.6405	1.4240	1.4975	1.4978	1.4977	1.4628
0.9068	1.3720	1.4224	1.4238	1.4225	1.4238	1.2440	1.2947	1.2963	1.2947	1.2895
1.0000	1.1390	1.1390	1.1390	1.1390	1.1390	1.0600	1.0600	1.0600	1.0600	1.0600

Table 5:Interaction Parameters and the corresponding standard deviations (σ) for the binary mixtures of dimethyl malonate and studied isomeric xylenes at differenttemperatures.

DMM + OXL								
Temperature	**G12**	**σ**	**Wvis/RT**	**σ**	**Δ12**	**σ**	**H12**	**Σ**
303.15K	0.8104	0.2392	0.8111	0.2392	0.8098	0.2393	1.0295	0.327
308.15K	0.8547	0.2057	0.8554	0.2056	0.854	0.2058	0.8499	0.2686
313.15K	0.8105	0.1926	0.811	0.1925	0.81	0.1927	0.6996	0.2272
318.15K	0.8164	0.1446	0.817	0.1445	0.8159	0.1448	0.5454	0.17
DMM+MXL								
303.15K	0.6702	0.2203	0.6711	0.2203	0.6689	0.2203	1.0369	0.3309
308.15K	0.6594	0.1837	0.6603	0.1837	0.6588	0.1837	0.8356	0.2693
313.15K	0.6063	0.1726	0.607	0.1727	0.6059	0.1727	0.6923	0.2304
318.15K	0.633	0.1668	0.6333	0.167	0.6329	0.167	0.5492	0.1926
DMM+PXL								
303.15K	0.6701	0.2092	0.6711	0.2092	0.6687	0.2092	1.0561	0.3313
308.15K	0.6985	0.1987	0.6996	0.1989	0.6978	0.1987	0.9358	0.3034
313.15K	0.6805	0.2023	0.683	0.2028	0.6801	0.2024	0.7776	0.2625
318.15K	0.6359	0.1795	0.6397	0.1801	0.6356	0.1795	0.6378	0.2222

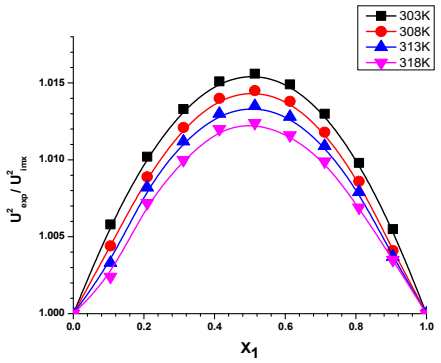

Figure1:Variation of U^2exp/U^2imx with the mole fraction ofDMM for the system DMM + o-Xylene

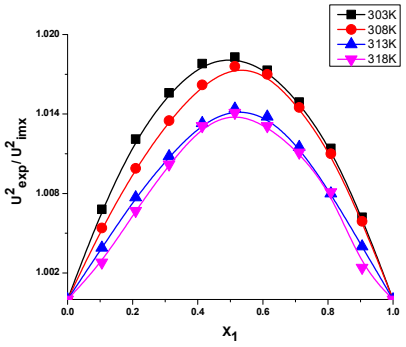

Figure 2:Variation of U^2exp/U^2imx with the mole fraction ofDMM for the systemDMM + m-Xylene

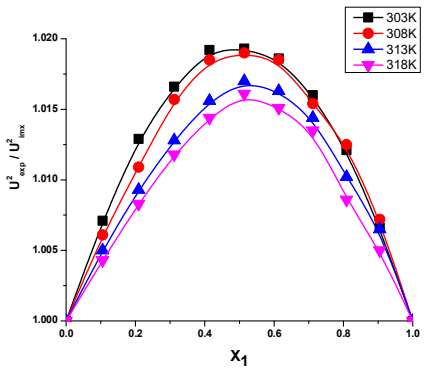

Figure 3:Variation of U^2exp/U^2imx with the mole fraction of DMM for the systemDMM + P-xylene

References

[1] C.Rambabu, P.B.Sandhya Sri. Zareena Begum; *International Scholarly Research Network ISRN Physical Chemistry*, Volume, Article ID 943429, **(2012)**12**.**

[2] SkFakruddin, Babavalia, P.Shakira, Ch Srinivasu, K. Narendra, KIJOMS, 1(3), **(2015) ,** 172

[3] N.Santhi, P.L.Sabarathinam, M.Emayavaramban, C. Gopi, C.Manivannan; *E.J.of Chemistry*, 7(2), **(2010)** 648**.**

[4] Ezekiel Dixon Dikio, *Orient. J. Chem.*, , 30 (3), **(2014)** 953**.**

[5] K.Raju, K.Karpagavalli; *J. Converg. Inf. Technol. Sci.*, 1, **(2009)** 32.

[6] Prabhakar, K.RajaGopal; *J.Pure Appl.Ultrason.*, 27, **(2005)** 41.

[7] YuvaRani, S.Sunitha; *E.J.of Chemistry*, 6(SI), **(2009)** S235.

[8] S. Ravi Chandran, K. Rama Nathan; *Augñt*, 1(2), **(2010)** 695-702.

[9] Vaidya Rohit , S Karthiyayini. and K N Millerjothi , *Res J Chem Sci.*, 5(10), **(2015)**, 33.

[10] a)O.Nomoto; *J.Phys.Soc.*, Japan, 4, 280 (1949); (b) 13, 1528 (1958); (c) *J.Chem.Phys.*, 21, **(1953)** 950.

[11] W.VanDael, E.Vangael; *Pro Int Conf on Calori metric and Thermodynamics*, Warsaw, **(1955)** 555.

[12] Shipra Baluja, P.H. Parsania; Asian.J.Chem, 7, **(1955)** 417.

[13] V.D.Gokhale, N.N Bhagavat;, *J.Pure Appl.Ultrason.*11, **(1989)** 21.

[14] Z.Junjie; *J.ChinaUniv.Sci.Techn.*., 14, **(1984)** 298.

[15] L.Grunberg, A.H.Nissan; Mixture law for viscosity, Nature, 164, **(1973)** 799.

[16] P.K.Katti, M.M.Chaudhri; J.Chem.Eng.Data, 9, **(1964)** 442.

[17] E.L.Heric, J.G.Brewer; J.Chem.Eng.Data, 12 **(1967)** 574.

[18] R.K.Hind, E.McLaughlin, A.R.Ubbelohde; Trans.Faraday Soc., 56, **(1960)** 328.

[19] K. Pearson; Fundamentals of Mathematical Statistics, S.G. Gupta, V.K .Kapoor, S. Chand, Company, (Eds.); New Delhi, India, **(1973)** 903.

[20] Omer E Amin, Ahmed Adam Akl, M. Awwad, Int J Ind Chem, DOI 10.1007/s40090-016- 0100-1