Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

Der Chemica Sinica, 2015, 6(5):42-48

Pelagia Research Library
ISSN: 0976-8505
CODEN (USA) CSHIA5

Viscometric study of different chlorosubstituted azetidin-2-one at different concentration and temperature in 90% (EtOH+water) solvent

Ashfaq Husain M. Saudagar and Rahimullah S. Shaikh

Department of Chemistry, Govt. Vidarbha Institute of Science and Humanities, Amravati, (M.S.), India

---

ABSTRACT

β-Lactam nucleus containing drugs created their own identity and significances in medicinal and organic chemistry due to their pharmaceutical industrial biotechnological and agricultural sciences. Hence, this class of compounds has served an important and highly successful role in the pharmaceutical industries. we investigate the densities, specific viscosities of different chloro substituted azetidin-2-one drugs of different concentration in 90% (ethanol+water) solvent at various temperatures in the present work. The experimental data study the effect of concentration of solute on viscosity in ethanol-water mixtures. The experimental data study gives the idea about effect of temperature on the molecular interaction and nature of reaction..

Key words: Relative Viscosity, Specific Viscosity, Density, Falkenhagen coefficient, Jones-Dole coefficient.

INTRODUCTION

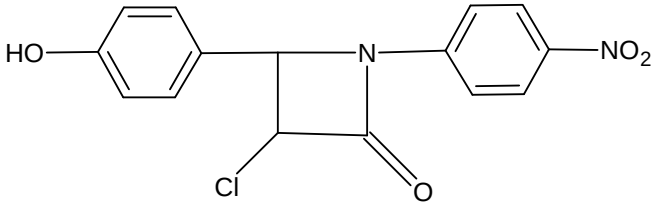
Liquid has so many important physical properties and Viscosity is one of the them. The liquids are viscous in nature due to the shearing effect in the liquid which is the movement of liquid layers over each other. The important information regarding solute-solute and solute-solvent interaction in an aqueous and in nonaqueous solution observed by Viscometric study. These compounds have wide range of medicinal and pharmaceutical properties viz. anti-psychotics[1], anti-cancer[2], anti-coccidial[3],cardiovascular[4], anti-diabetic and anti-oxidant[5], mutagenic[6], anti-convulsant and anti-inflammatory agents[7-8].While studying the pharmacokinetics and pharmacodynamics of *S-triazine and thiocarbamide group containing drug*the viscometric measurements, refractometric measurements, interferometric measurements play an important role in medicinal and drug chemistry [9-11]. Mehrotra et al[12] studied the solute-solvent interactions. The viscometric study of concentrated aqueous electrolyte solution at different concentrations studied by Berry and Irvings[13].The molecular interaction of an electrolyte in binary mixture of liquids studied by Das et al[14] and Kapadi et al[15]. The viscometric studies of some drugs including Metform in hydrochloride (MH),Ranitidine hydrochloride (RH), and Tramadol hydrochloride (TH) in aqueous solutions at various temperatures done by Dhondge et al[16]. Peshwe et al[17]has done viscometric studies on N,N-dimethyl acetamide and ethanol binary mixtures at various temperatures. The viscosity measurement of aqueous binary electrolyte having various molar Concentrations studied by Pandey et al.[18].

Viscosity concentration dependence of dilute electrolyte solutions was studied by The Jones-Doles equation[19] .The dependence of concentration of viscosity in concentrated electrolyte solution was studied by vand[20]. Density and viscosity measurements for 4-aminobutyric acid in different composition in aqueous metformin hydrochloride at various temperature carried out by Rajagopal et al[21] Dhondge et al[22] has done studies of density and viscosity

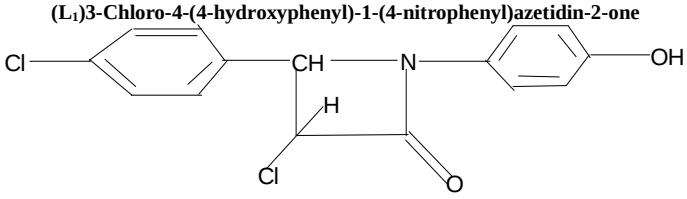
of thiamine hydrochloride - water and pyridoxine hydrochloride -water at various temperatures. Interactions of electrolyte in binary mixtures of two liquids have been studied in terms of β-coefficient of viscosity [23-25].Viscosity of 2,3,3,3- tetrafluoroprop-1-ene (R1234yf) in the temperature of 243 to 363 studied by X. Meng et al.[26]. Allmendinger et al[27] studied viscosity measurement of protein formulation using capillary electrophoresis instrumentation. Sagdeev et al [28] measured the density and viscosity of binary 1-hexene + 1-decene mixtures have been simultaneously measured over the temperature range from 298 to 470 K and at pressures up to 196 MPa. The Estimation of microstructure of titania particulate dispersion through viscosity measured by Lee et al[29]. Riyazuddeen et al[30] reported the effects of concentration and temperature on viscosity in (l-alanine/l-threonine/glycylglycine + aqueous d-glucose/aqueous sucrose) systems. Jo et al [31] has studied the viscosity measurements of multi-walled carbon nanotubes-based high temperature nanofluids. The viscosity measurements for squalane at high pressures to 350 MPa from T= (293.15 to 363.15) K studied by Segovia et al[32]. Viscosities of biodiesel fuels studied by Freitas et al[33]. Kazys et al [34] reported viscosity of highly viscous non-Newtonian fluids. Study of density, surface tension, and viscosity of quaternary ammonium-based ionic liquids ($[N_{222(n)}]Tf_2N$) done by Ghatee et al[35]. The study of of the (LiF + NaF + KF(eut.)+$Na_7Zr_6F_{31}$) fluoride system has been investigated by Peter Barborík et al[36].

MATERIALS AND METHODS

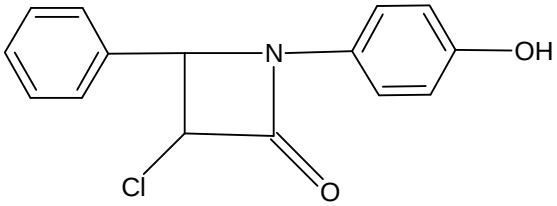
Carbon dioxide free double distilled water was used. Extra pure (E. Merck) dioxane was further purified by the prescribed procedure [39-38] and used for preparation of ligand solutions. The entire chemical used of A.R. grade. All weighing were made on Mechaniki Zaktady Precyzying Gdansk Balance [Poland make, (±0.001g)]. The density of solutions were determined by a bicapillary Pyknometer (±0.2%) having a bulb volume of about 10 cm^3 and capillary having an internal diameter of 1mm and calibrated with deionised doubly distilled water. The accuracy of density measurements were within ±0.1Kgm-3. The viscosities were measured by means of Ostwald's viscometer thoroughly cleaned and dried. The flow time of solutions were measured by using digital clock of racer company having error (±0.01Sec). The 0.1M concentrated solution of compound these were prepared in 90% Ethanol-Water mixture. In the same way, 0.075M, 0.05M and 0.025M solutions for the compounds L were prepared. The compound used during investigations is as depicted below,



(L_1)3-Chloro-4-(4-hydroxyphenyl)-1-(4-nitrophenyl)azetidin-2-one



(L_2) 3-chloro-4(4-chlorophenyl)-1-(4-hydroxyphenyl)azetidin-2-one



(L_3)3-chloro-1-(4-hydroxyphenyl)-4-phenylazetidin-2-one

Experimental Procedure:

The viscometer was kept in Elite thermostatic water bath and temperature variation was maintained at for each measurements, sufficient time was allowed to attain thermal equilibrium between viscometer and water bath. The

viscosities were measured by means of Ostwald's viscometer thoroughly cleaned and dried and taking the reading of different concentration solutions of L_1,L_2 and L_3.repectively at various temperature.

Observations and Calculations:
The present study deals with the investigation of viscosity of Ligands in 90% ethanol–water mixture at different concentration at various temperatures. The results obtained were mentioned in **Table 1 to 4**.

RESULTS AND DISCUSSION

The relative viscosity of each solution during study was determined by formula depicted below

$$\eta_r=(ds \times ts/dw \times tw)\times \eta_w \quad (1)$$

Where
η_r = Relative viscosity
η_w = Viscosity of water
ds = Density of solution
dw = Density of water
ts = Flow time for solution
tw = Flow time for water

And the relative viscosities have been analyzed by Jone's-Dole equation [31]

$$(\eta_r -1) /\sqrt{C}= \eta_{sp}/\sqrt{C} = A + B \sqrt{C} \quad (2)$$

Where
A = Falkenhagen coefficient
B = Jones-Dole coefficient
C = concentration of solutions

The Falkenhagen coefficient (A) measures the solute-solute interaction while Jones-Dole coefficient (B) measures the solute-solvent interaction.

Table No. – 1 - Determination of Relative and Specific Viscosities at Different Concentrations and Different Temperatures in 90% EtOH –Water mixture For L_1

Temp K	Conc C Mole/lit	$\sqrt{C}$ Mole$^{-1/2}$ lit$^{-1/2}$	Density gm/cc	Time Flow (Sec)	Relative Viscosity $\eta r = \eta/\eta 0$	Specific Viscosity $\eta sp = \eta r-1$	$\eta sp/\sqrt{C}$
293	0.1	0.3162	1.05014	405	1.8092	0.8092	2.559
	0.075	0.2739	1.04603	401	1.7844	0.7844	2.864
	0.05	0.2236	1.04203	399	1.7687	0.7687	3.4375
	0.025	0.1581	1.03803	397	1.753	0.753	4.7626
298	0.1	0.3162	1.05009	388	1.7959	0.7959	2.5169
	0.075	0.2739	1.04537	385	1.774	0.774	2.8263
	0.05	0.2236	1.04196	383	1.759	0.759	3.3946
	0.025	0.1581	1.03734	381	1.7421	0.7421	4.6935
303	0.1	0.3162	1.0497	371	1.7875	0.7875	2.4903
	0.075	0.2739	1.0447	369	1.7694	0.7694	2.8093
	0.05	0.2236	1.0409	367	1.7533	0.7533	3.369
	0.025	0.1581	1.0366	364	1.7319	0.7319	4.6291

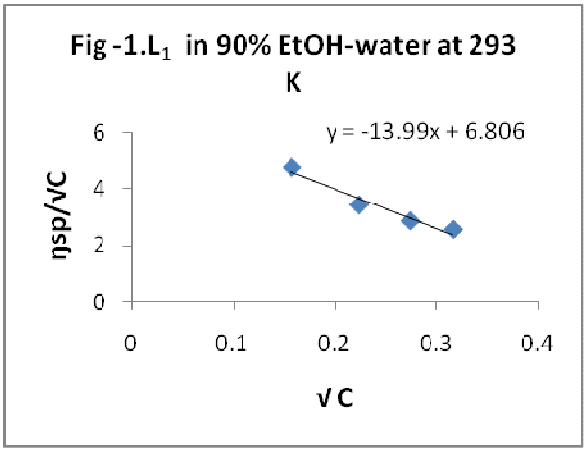
Table No. – 2 - Determination of Relative and Specific Viscosities at Different Concentrations and Different Temperatures in 90% EtOH –Water mixture For L_2

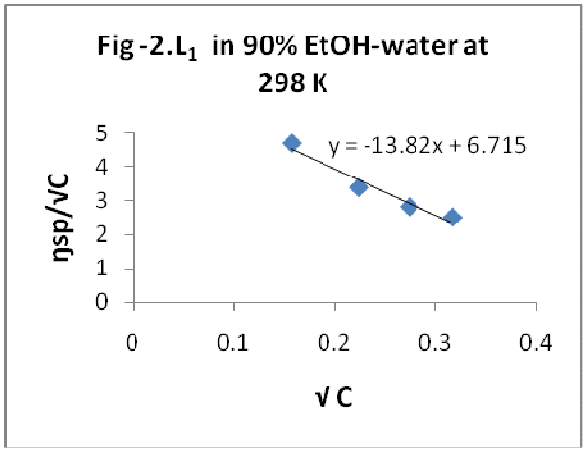
Temp K	Conc C Mole/lit	√ C $Mole^{-1/2}$ $lit^{-1/2}$	Density gm/cc	Time Flow (Sec)	Relative Viscosity ηr = η/η0	Specific Viscosity ηsp= ηr-1	ηsp/√C
293	0.1	0.3162	1.04213	397	1.76	0.76	2.4032
	0.075	0.2739	1.03803	395	1.7442	0.7442	2.7174
	0.05	0.2236	1.03402	393	1.7287	0.7287	3.2587
	0.025	0.1581	1.03012	391	1.7134	0.7134	4.5119
298	0.1	0.3162	1.0421	383	1.7592	0.7592	2.4009
	0.075	0.2739	1.0373	381	1.7421	0.7421	2.7098
	0.05	0.2236	1.0339	378	1.7227	0.7227	3.232
	0.025	0.1581	1.0293	377	1.7105	0.7105	4.4934
303	0.1	0.3162	1.0417	367	1.7547	0.7547	2.3865
	0.075	0.2739	1.0366	365	1.7367	0.7367	2.69
	0.05	0.2236	1.0328	363	1.7208	0.7208	3.2235
	0.025	0.1581	1.0286	362	1.709	0.709	4.4843

Table No. – 3 - Determination of Relative and Specific Viscosities at Different Concentrations and Different Temperatures in 90% EtOH –Water mixture For L_3

Temp K	Conc C Mole/lit	√ C $Mole^{-1/2}$ $lit^{-1/2}$	Density gm/cc	Time Flow (Sec)	Relative Viscosity ηr = η/η0	Specific Viscosity ηsp= ηr-1	ηsp/√C
293	0.1	0.3162	1.0301	385	1.6871	0.6871	2.1728
	0.075	0.2739	1.026	381	1.6629	0.6629	2.4206
	0.05	0.2236	1.022	379	1.6477	0.6477	2.8968
	0.025	0.1581	1.0181	377	1.6328	0.6328	4.0021
298	0.1	0.3162	1.03	-12	1.6799	0.6799	2.1499
	0.075	0.2739	1.0253	370	1.6586	0.6586	2.4049
	0.05	0.2236	1.0219	367	1.6441	0.6441	2.8804
	0.025	0.1581	1.0173	365	1.6277	0.6277	3.9698
303	0.1	0.3162	1.0296	363	1.6776	0.6776	2.1428
	0.075	0.2739	1.0246	-12	1.6553	0.6553	2.3929
	0.05	0.2236	1.0207	355	1.6398	0.6398	2.8611
	0.025	0.1581	1.0165	352	1.6236	0.6236	3.9443

The **Fig.1** to **9** are plotted between √ C versus ηsp/√C**.** The graph for each system gave linear straight line showing validity of Jone's –Dole equation. The slope of straight line gave value of b coefficient.





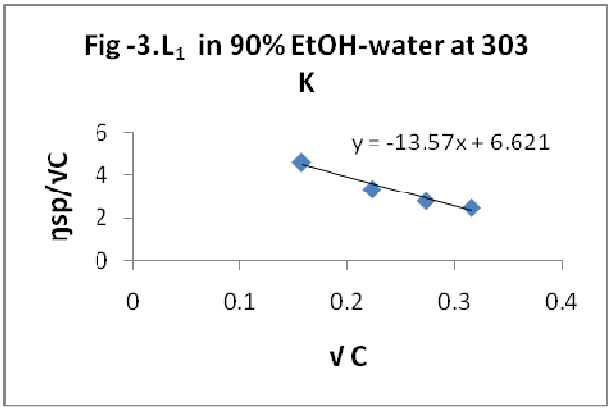


Fig -3.L1 in 90% EtOH-water at 303 K
y = -13.57x + 6.621
ηsp/√C
√ C

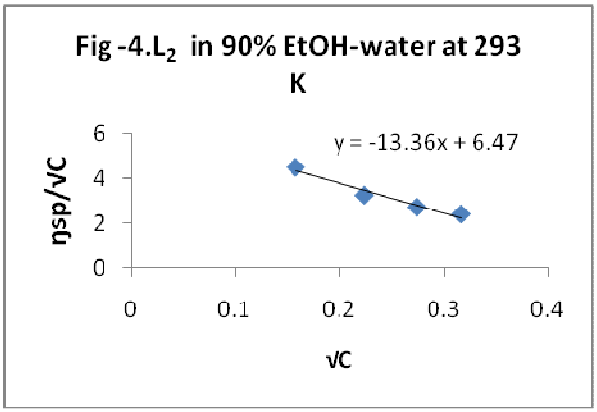


Fig -4.L2 in 90% EtOH-water at 293 K
y = -13.36x + 6.47
ηsp/√C
√C

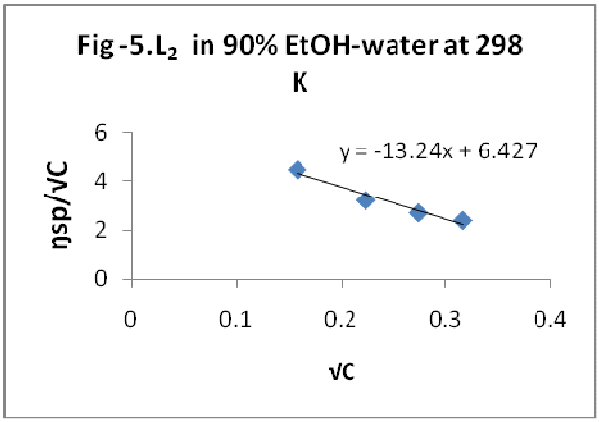


Fig -5.L2 in 90% EtOH-water at 298 K
y = -13.24x + 6.427
ηsp/√C
√C

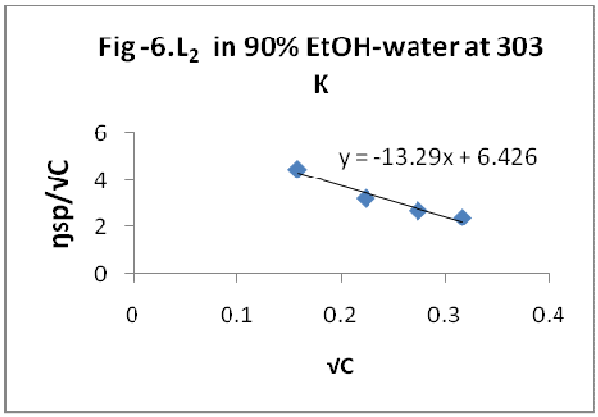


Fig -6.L2 in 90% EtOH-water at 303 K
y = -13.29x + 6.426
ηsp/√C
√C

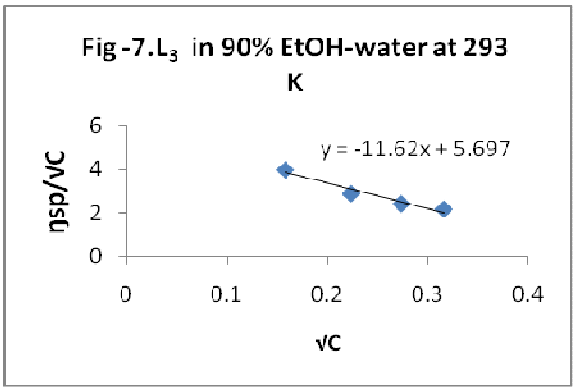


Fig -7.L3 in 90% EtOH-water at 293 K
y = -11.62x + 5.697
ηsp/√C
√C

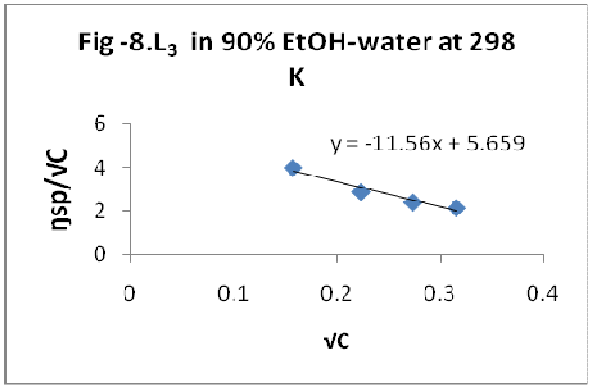


Fig -8.L3 in 90% EtOH-water at 298 K
y = -11.56x + 5.659
ηsp/√C
√C

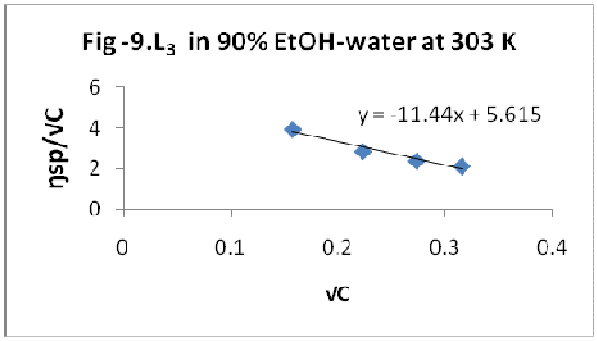


Fig -9.L3 in 90% EtOH-water at 303 K
y = -11.44x + 5.615
ηsp/√C
√C

Table No. – 4 - A and β Co-Efficient Value from Fig. 1 to 9 at various Temperatures for 90% Ethanol-Water Mixture

Temp in K	L_1		L_2		L_3	
	A	b	A	b	A	b
293	6.806	-13.99	6.47	-13.36	5.697	-11.62
298	6.715	-13.82	6.427	-13.24	5.659	-11.56
303	6.621	-13.57	6.426	-13.29	5.615	-11.44

From the results in **Table I-IV,** it is observed that, the decreasing concentration of ligand decreasing density of solution and relative viscosity for ligands in 90% ethanol-water mixture. Relative viscosity of all ligands is inversely proportional to temperatures. Among all three ligands ,L_3 has smallest relative viscosity due to absence of electron-withdrawing group as compare to other two ligands. The negative values of "A" and β-coefficient characterized as 'structure-breaker' indicating a weak solute-solvent interaction which is good for interactions in between the drug and the drug receptors shows best drug activity and drug effect and it favors pharmacokinetics and pharmacodynamics of drug. The value of A coefficient show that, the solute-solvent interaction is highest in ligand L_1 at 293K for 90% ethanol-water mixture and so they tend to interact with solvent molecules to lesser extent leading decrease in solute-solvent Interaction.

CONCLUSION

Values of β-coefficient for all ligands decreases with increasing the temperature which indicate that increasing the solute-solvent interaction. This study is an important for biochemical, pharmaceutical and medicinal sciences which directly focus on drug interaction with solvent at various temperature .This study gave information regarding pharmacodynamics and pharmacokinetics of drug.

Acknowledgment
I am very thankful to Dr. D. T. Tayade, sir and Krishna panpaliya GVISH College, Amravti for kindly cooperation.

REFERENCES

[1] D. Bateman., *Medicine,* **2003,** 31, 34-35**.**
[2] B. Banik., I. Banik, F. Becker., *Bioorg. Med. Chem.*, **2005**, 13, 3611.
[3] G. Liang., X. Qian, D. Feng, M Fisher., *Bioorg. Med. Chem. Lett*., **2008,** 18, 2019.
[4] S. Takai, M Muramatsu., Y. Okamoto, M. Miyazaki, *Eur. J. Pharmacol.*, **2004,** 1**,** 501.
[5] D. Reddy., R. Namratha, *Der Pharma Chemica,* **2013,**5(1), 235-240.
[6] H. Valette, F. Dolle, F. Hinnen, D. Marzin, *Nucl. Med. Biol*. **2002**, ,29, 849.
[7] P. Kohli, S. Srivastava., *J. Indian. Chem. Soc.* **2008**, 85 **,** , 326.
[8] S. Srivastava., S. Srivastava., *Indian J. Chem.*, **1999,***Sect B* 38 ,183.
[9] S. Nagar, H. Singh, *J. Med Chem.*, **2007**,16, 178-180.
[10] L. Hall, *J. Phys. Rev.***, 1998**, 73,775.
[11] J. Pandy, A. Shukla, R. Rai, K. Mishra, *J.Chem. Eng. Data*, **1989**, 34, 29.
[12] K. Mehrotra, K. Tandon K, M Rawat, *J.Ind.Chem.Soc*., **1992,** 69 **,**193-197.
[13] R. Barry, F. Irving, *J.Phys.Chem.* **1969,** 73**,** 2060-2068.
[14] S. Das, D Hazra, *Ind.J.Chem*., **1988,** 27**,** 898-906.
[15] U. Kapadi, P. Hankare, S. Chavan, *J.Ind.Chem.Soc*., **1994,** 72**,** 269.
[16] S. Dhondge. S. Zodape, D. Parwate, *J.Chem.Thermo.*, **2012,** 48**,** 207–212.
[17] A. Peshwe, B. Arbad, *Ind.Streams Res.J.*, **2011,** I(V) 51-57.
[18] J. Pandey, A. Yasmin, A. Sharma, *Ind.J.Chem.*, **1998,** 37A, 1094-1098.
[19] G. Jones, M Dole, *J.Am.Chem.Soc.*, **1929,** 51**,** 2950-2958.
[20] V. Vand, *J.Phys.Colloid.Chem.*, **1948,** 52, 277-282.
[21] K. Rajagopal, S. Jayabalakrishnan, J.Serb.Chem.Soc. **2011,** 76(1),129–142.
[22] S. Dhondge, D. Deshmukh, L Paliwal, *J.Chem.Thermo.*, **2013,** 58**,** 149–157.
[23] Maccarthy, Patrick, Z.Hillz, *J. Chemical Education*, **1986**, 63 (3), 16.
[24] P. Job, *Amnali di chimica Application*,**1928**,113, 9 (10).
[25] C. Huang, *Job Plot Method in Enzymology*, **1982**, 87, 509.
[26] C. João, J. Fernando, M. João, A. William, *Fluid Phase Equilibria*, **2013,** 353, 76– 86

[27] A. Allmendinger, L. Dieub, S. Fischer, R. Muellera, H. Mahlera, J. Huwyler*J.Pharma.Biomed.Analysis* **2014,**99, 51–58.
[28] D. Sagdeev, M. Fomin, M. Ilmutdin, *J.Mol.Liq.*, **2014,** 197, 160–170.
[29] B. Lee, S. Koo, *Powder Technology* **2014** 266, 16–21.
[30] Riyazuddeen, M. A Usmani, *ThermochimicaActa*, **2014,** 575, 331– 335.
[31] J. Jones, M. Dole, *J.Am.Chem.Soc.*, **1929,** 5 (1), 2950-2964 **.**
[32] J. Segovia, M. Carmen Martín, J. Zambrano, B. Mariana, *Fuel*, **2014,** 122, 223–228.
[33] J. María, X. Paredes, M. Freitas, J. Bazile, C. Boned, *J.Chem.Thermo.*, **2014,** 69, 201–208
[34] R. Kazys, L. Mazeika, R. Sliteris, *Ultrasonics*, **2014,** 54, 1104–1112.
[35] M. HadiGhatee, M. Bahrami, N. Khanjari *J.Chem.Therm0.*, **2013,** 65, 42–52.
[36] P. Barborík, *J.Chem.Thermodynamics*, **2014,** 76, 145–151.
[37] N.Patel, J. Patel,*Arabian Journal of Chemistry*,**2011**, 4, 403–411.
[38] R. Sharma, P. Samadhya, S. Srivastava , *J. Chem. Sci.*, **2012**, 124, 633–637.