IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

Human Journals
Research Article
October 2016 Vol.:4, Issue:4

Density and Excess Molar Volume of T-Butanol with Benzene and Toluene of the Temperature 313.15 K

IJSRM
INTERNATIONAL JOURNAL OF SCIENCE AND RESEARCH METHODOLOGY
An Official Publication of Human Journals

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Submission: 29 September 2016
Accepted: 7 October 2016
Published: 25 October 2016

HUMAN JOURNALS
www.ijsrm.humanjournals.com

Keywords: Excess molar volume, t-butanol, 313.15 K

ABSTRACT

Excess molar volume and density of t-butanol with Benzene and Toluene over the entire range of composition have been measured dilatometer at the temperature 313.15 K. The result indicates that there is Hydrogen bonding and electron donor-acceptor interaction between t-butanol with Benzene and Toluene.

INTRODUCTION

The behavior of self-associated t-butanol with aromatic Hydrocarbons has been interpreted by using the breaking of or stretching of hydrogen bond in t-butanol by addition of aromatic Hydrocarbons (1-5). The presence of weak electron donor-acceptor type interaction between aromatic Hydrocarbon and Hydroxyl Hydrogen of t-butanol has also been shown; It has been shown by various Investigation (6-9).

MATERIALS AND METHODS

Experimental

t-butanol, Benzene, Toluene was purified by standard procedure (10). The purifies of the final sample were checked by density determination at T = 313.15 K $(\pm 0.01\ \mathrm{K})$ densities agreed to within ± 0.5 kg m^{-1} with the corresponding values at 313.15 K (Table -1).

Binary mixture was prepared by knowing masses of each liquid in airtight stoppered glass bottles. The densities of pure liquid and their mixture were determined in 15 cm^3 double arm pycnometer (11-14).

The pycnometer was calibrated using conductivity water with 0.99705 cm^{-3} at its density. The pycnometer filled with air bubble free experimental liquid was kept in a transparent walled water bath in which the temperature was maintained to attained thermal equilibrium. The position of the liquid level in the two arms was recorded with traveling microscope which read correctly to ± 0.01 mm. the density values were reproducible within 5×10^{-5} g cm^{-3}.

The Excess molar volume as a function of composition was measured dilato -metrically as described by Singh and Bhatia (15). The temperature of the water bath was controlled with the bounds of ± 0.0 K. The uncertainly measured excess molar volume was not more than ± 0.5 percent.

RESULT AND DISCUSSION

The Excess molar volume and Densities of t-butanol with Benzene and Toluene at 313.15 K. are recorded in Table – 2 and shown graphically in fig. 1.

The Excess molar volume value has been calculated using the densities values of pure components and the binary mixture with the help following equation.

$$V^E = (x_1 M_1 + x_2 M_2)/\rho_{12} - (x_1 M_1/\rho_1) - (x_2 M_2/\rho_2)$$

Where, M_1, x_1, ρ_1 and M_2, x_2, ρ_2 are molecular weight, mole fraction and density of components 1 and 2 respectively of binary mixtures, ρ_{12} is the mixture density.

The V^E value for the present system is positive over the entire range of composition. All Excess molar volume aries from breaking of hydrogen bonds in self-associated t-butanol and physical dipole-dipole interaction between t-butanol monomers and multimers. In the real mixtures and the presences of weak electron donor-acceptor interaction between the Hydroxyl Hydrogen of t-butanol and π electron of Benzene and Toluene. As the electron donating power toluene is more than that of Benzene due to introduction of methyl group. The hydroxyl hydrogen should interact more strongly with the π- electron cloud of toluene than that of benzene. Thus Excess volume values should be smaller than those of the corresponding system containing Benzene.

ACKNOWLEDGMENT

Authors are the thankful to principal M.S.G. college Malegaon camp for the help support encouragement and the laboratory.

Table 1: Comparison of Experimental Density with Literature.

Liquid	Temp. K	$\rho \times 10^{-3}\ kg \cdot m^{-3}$	
		Expt.	Lit.
t-Butanol	313.15	0.7648	0.7648[17]
Benzene	313.15	0.8574	0.8576[18]
Toluene	313.15	0.8484	0.8484[19]

Table 2: Density (ρ) and Excess Molar Volume (V^E) for t-Butanol + Benzene.

Temp. K	x_1	ρ x10^{-3} kg.m^{-3}	V^Ex10^6 m^3.mol^{-1}
313.15	0.0000	0.8574	0.000
	0.0923	0.8456	0.299
	0.2003	0.8336	0.478
	0.3009	0.8232	0.577
	0.4005	0.8135	0.624
	0.5011	0.8042	0.628
	0.6007	0.7955	0.584
	0.7011	0.7870	0.519
	0.8005	0.7790	0.415
	0.9008	0.7715	0.248
	1.0000	0.7648	0.000

t-Butanol + Toluene.

Temp. K	x_1	ρ x10^{-3} kg.m^{-3}	V^Ex10^6 m^3.mol^{-1}
313.15	0.0000	0.8484	0.000
	0.1018	0.8388	0.246
	0.2034	0.8289	0.511
	0.3010	0.8195	0.730
	0.4022	0.8098	0.929
	0.5017	0.8005	1.070
	0.6006	0.7913	1.181
	0.7004	0.7829	1.153
	0.8007	0.7755	0.964
	0.9008	0.7694	0.584
	1.0000	0.7648	0.000

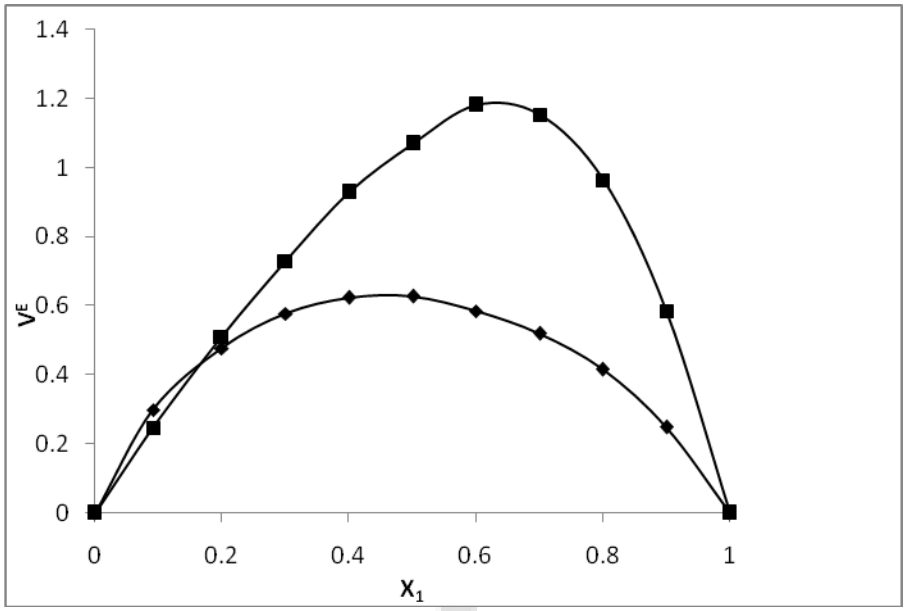

Figure 1: V^E value at 313.15 K for (x_1) t-butanol + $(1 - x_1)$ Benzene (■) and Toluene(♦).

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