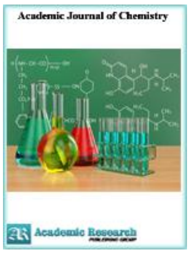


Academic Journal of Chemistry

ISSN(e): 2519-7045, ISSN(p): 2521-0211

Vol. 2, No. 7, pp: 61-64, 2017

URL: http://arpgweb.com/?ic=journal&journal=20&info=aims

Molar Conductivities, Salinity and Total Dissolved Solids of KBr and KCl in Aqueous Solution

Maduelosi N. J.* — Department of Chemistry, Rivers State University, Nkpolu- Oroworukwo, P.M.B 5080, Port Harcourt. Rivers State, Nigeria

Bagshaw A. P. — Department of Chemistry, Rivers State University, Nkpolu- Oroworukwo, P.M.B 5080, Port Harcourt. Rivers State, Nigeria

Ekezie C. M. — Department of Chemistry, Rivers State University, Nkpolu- Oroworukwo, P.M.B 5080, Port Harcourt. Rivers State, Nigeria

Abstract: The molar conductivity, salinity and total dissolved salt (TDS), were measured using electrical conductivity meter (Extech instrument DO 700). Different concentrations of KBr and KCl solutions (0.01, 0.02, 0.03, 0.04, 0.05 M)l were prepared separately by dissolving appropriate amount of each salt in distilled water. The results obtained showed that the molar conductivities, salinity and total dissolved solid values of KBr were higher than that of KCl. This observation was attributed to change in concentration, ion-solvent interactions, solubility and ionic size effects. The limiting molar conductivity at infinite dilution was determined graphically.

Keywords: Conductivity; KBr; KCl; Concentration; Salinity; Total dissolved solid.

1. Introduction

The study of the effect of concentration and ionic size on the molar conductivities of electrolytes has been a concern to many researchers. Measurement of conductivity is an important electro-analytical method used to access the performance of battery [1]. This is because it reveals the extent of the ion-solvent interactions in the solution. It's application in the high energy density batteries, photochemical cells, electrode deposition, wet electrolytic capacitor and electro-organic synthesis are among the most important application of electrolytic conduction. Agricultural and environmental soil assessments are renowned applications of salinity measurements.

Molar conductance, Λ_m, is known to be the conducting power of all the ions produced by one mole of electrolyte in a given solution [2]. It is well known that the flow of electricity through a solution of electrolytes is due to the migration of ions when potential difference is applied between the two electrodes. Sharma and Sharma [3], reported that molar conductance of solutions are affected by ionic mobility, concentration, temperature and inter- Ionic interactions. Temperature, solvation and solubility affect the salinity of an electrolyte. Akrawi, *et al.* [4] worked on the electrical conductivity of potassium halides in methanol at different temperature and concluded that both solubility, acidity constant and conductivity increase with increasing temperature.

2. Materials and Method

The materials used for this study are distilled water, KBr and KCl salts (Anal. Grade). The salts were vacuum dried at about 80-100% before use. The electrical conductivity meter (Extech Instrument DO 700) was calibrated before use. 250ml solution of varying concentrations of KBr and KCl were prepared. The salinity, TDS and specific conductivity measurements were carried out according to (USEPA 2501-B) standard method. The working temperature was 30^{0}C approximately. Conversion of specific conductivity (σ) into molar conductivity ($Scm^{-1}mol^{-1}$) was done using the formula:

Molar conductivity, $\Lambda_m = \sigma V$ Where V (volume of solution) = 1000/C

3. Results

The results of this work are provided in Tables 1, 2, 3 and figure 1 and 2 below.

*Corresponding Author

Table-1. Specific conductivity (σ) (Scm^{-1}), Salinity (SAL) and Total Dissolved Solids(TDS) values of KBr and KCl solutions at various concentrations(mol/dm^3)

	KBr			KCl		
Conc.mol/dm^3	σ(Scm^{-1})	Sal.(PPT)	TDS(g/l)	σ(Scm^{-1})	Sal.(PPT)	TDS(g/l)
0.01	$1.52x10^{-3}$	0.76	1.08	$1.50x10^{-3}$	0.74	1.06
0.02	$3.01x10^{-3}$	1.52	2.26	$2.75x10^{-3}$	1.40	2.05
0.03	$4.30x10^{-3}$	2.24	3.28	$4.12x10^{-3}$	2.14	3.15
0.04	$5.91x10^{-3}$	3.11	4.59	$5.50x10^{-3}$	2.89	4.23
0.05	$7.03x10^{-3}$	3.73	5.72	$6.61x10^{-3}$	3.50	5.27

Table-2. Molar Conductivities (Sm^2mol^{-1}) values of KBr and KCl solutions at various concentrations (mol/dm^3)

Conc mol/dm^3	**Molar Conductivities(Sm^2mol^{-1})**	
	KBr	**KCl**
0.01	1.516	1.496
0.02	1.505	1.375
0.03	1.433	1.373
0.04	1.480	1.375
0.05	1.406	1.322

Table-3. Molar conductivity and square root of concentration of KBr and KCl solutions

√Conc	**Molar conductivity(Sm^2mol^{-1}) KCl**	
	KBr	**KCl**
0.100	1.516	1.496
0.141	1.505	1.375
0.173	1.433	1.373
0.200	1.480	1.375
0.244	1.406	1.322

Table-4. Limiting molar conductivities $\Lambda^o m$ (Sm^2Mol^{-1}) of the Salts at infinite dilution

Samples	**Limiting molar conductivities**
KBr	1.5922
KCl	1.5653

Figure-1. Molar conductivity of KBr against square root of concentration

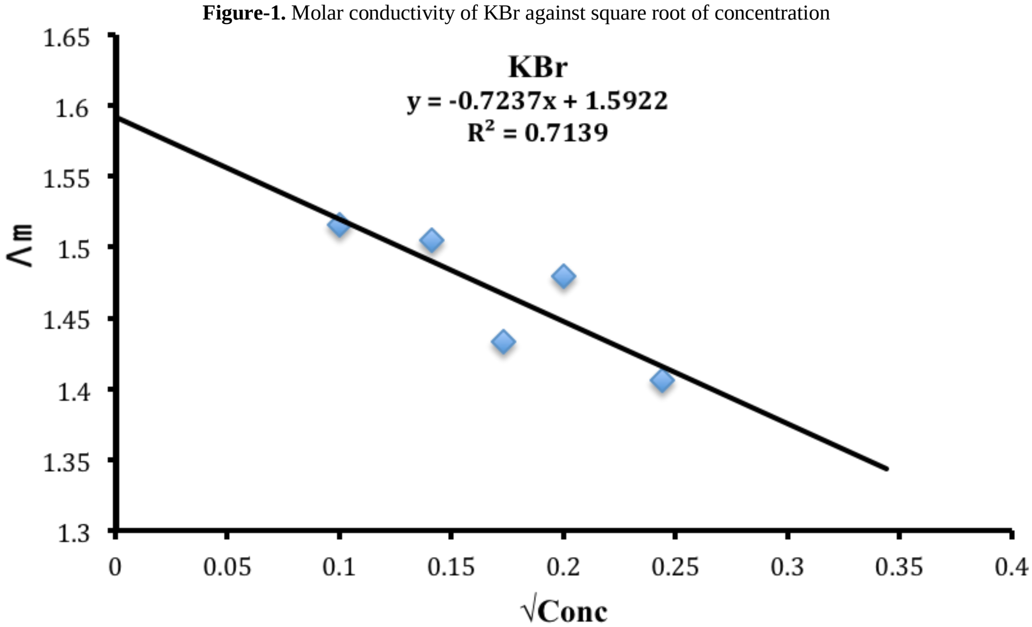
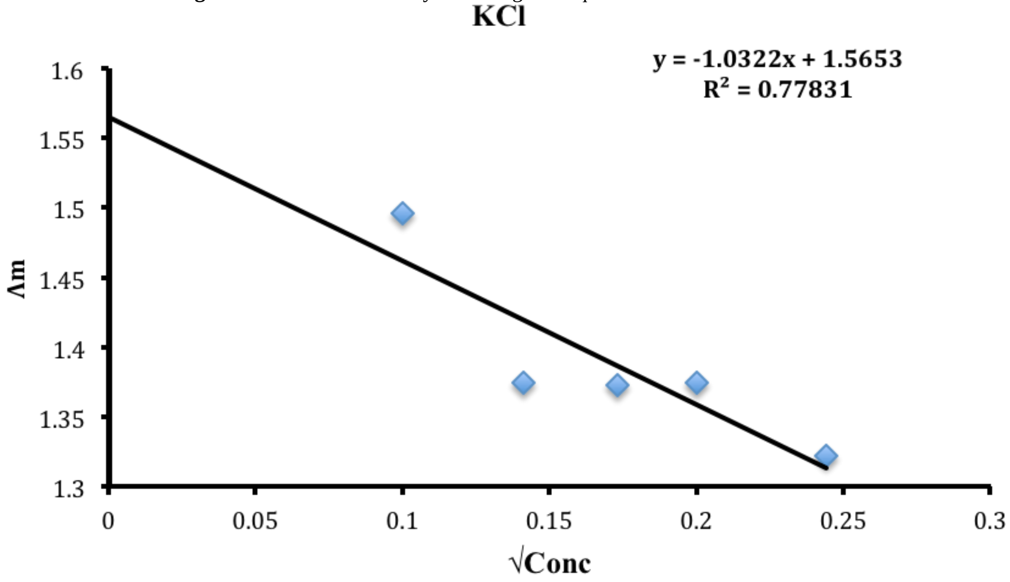


Figure-2. Molar conductivity of KCl against square root of concentration



4. Discussions

The plots of Λ_m Vs $\sqrt{C}$ (Figures 1 and 2) were made according to Kohlrausch square root law,

$$\Lambda_m = \Lambda^\circ_m - K\sqrt{C}$$

The intercept Λ°_m is known as the limiting molar conductivity at infinite dilution. In strong electrolyte, there is a tendency for molar conductance to approach a certain limiting value when the concentration approaches zero. The molar conductance at this point is known as molar conductance at infinite dilution and it is denoted by Λ^o_m. It should be understood that by infinite dilution, it means that a solution is so dilute that it has limiting molar conductance which does not increase on further dilution.

For strong electrolytes, this value is obtained by extrapolating the molar conductance graph to zero concentration as reported by Puri, *et al.* [2].

The results from this study show that KBr has higher molar conductivity values at various concentrations. The higher molar conductivity values are attributed to some factors like solvation and ionic radii of the KBr. The dissociation energy of KBr is 3.8eV, which is lower than that of KCl with the value of 4.26eV, therefore, since complete dissociation of a molecule leads to a higher conductivity value. KBr gave higher conductivity values than KCl. [3], made similar report.

Furthermore, the higher conductivity values in KBr could be attributed to the fact that the effective radius of small ions in solution give rise to strong electric field than larger ones therefore it drags the solvent through the solution as it migrates. This reduces the ionic mobility which in turn reduces conductivity. Also electrolytes whose metal ions are large have large molar conductivity values than those with small ionic size. [5].

Increase in concentration increases specific conductivity but decreases the molar conductivity of the solution [1]. The result on tables 1, 2 and 3 show that at low concentration, the molar conductivity values increased. This is attributed to electrophoretic effect, viscous effect and inter-ionic force that resulted from the spatial arrangement of the solution.

The result of the limiting molar conductivity of the electrolytes shown in table 4 were obtained by extrapolating the molar conductance graph to zero concentration as recommended by Puri, *et al.* [2]. The molar conductance of an electrolyte increases with increase in dilution due to increase in the degree of dissociation of the electrolyte and for strong electrolyte, there is a tendency for molar conductance to approach a certain limiting value when the concentration approaches zero. The molar conductance at this point is known as molar conductance at infinite dilution and it is denoted by Λ°m. The result in table 4 shows that KBr has a higher value than KCl.

The results on table 1 show that salinity and total dissolved solid increased with increase in concentration, with KBr having higher values than KCl. This may be due to the higher solubility and solvation power of KBr over KCl.

5. Conclusion

The results obtained from this work show that KBr has better electrical properties than KCl.

References

[1] Maduelosi, N. J., Abia, A. A., and Nwokobia, F. U., 2014. "Characterization Of Mixed Solvents Of Tetrahydrofuran And Acetonitrile For Magnesium Ion Battery." *Journal of Chemistry and Materials and Research*, vol. 6, pp. 188-193.

[2] Puri, B. R., Sharma, L. R., and Panthania, M. S., 2006. *Principles of Physical Chemistry*. Jalandhar, India: Vishal Publishing Co. pp. 843-865.

[3] Sharma, K. K. and Sharma, L. K., 1999. *A Testbook of Physical Chemistry*. Pvt Ltd, New Delhi: Vikas publishing House. pp. 426-435.

[4] Akrawi, B. A., Khali, S. M., and Dawod, A. M., 2006. "The Electrical Conductivity of Potassium Halides in Methanol at Different Temperatures." *Journal of Physical Chemistry,* vol. 17, pp. 68-75.

[5] Atkins, P. and Julio, P., 2002. *Atkins Physical chemistry*. Oxford: Oxford University Press. pp. 835-841.