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NOTE

Computation of Molar Conductance at Infinite Dilution from Conductometric Data for a Complex Using Statistical Method

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In the present communication, the computation of molar conductance of a complex at infinite dilution from conductometric data is described.

The electrolytic behaviour of a complex in the various solvent systems depends upon resulting ionic strength of the solution at various concentrations. Thus in this situation Kohlrausch's empirical formula[1] is best fitted by considering the value of 'n' in the equation as 2 or 3 in most of the cases. Kohlraush's empirical formula may be given as:

$$\mu_v = \mu_\infty - D \times (C)^{1/n} \quad (1)$$

where μ_v = molar conductance at particular concentration
μ_∞ = molar conductance at infinite dilution
D = conductometric constant for the solvent system
C = molar concentration of the complex.

The various observations of μ_v with the variation of molar concentration (C) of the complex may be recorded from the standard conductometric apparatus (systronic). Using a well known statistical method[2] called as least square fit method, the values of μ_∞ and D may be computed.

In the present note the electrolytic behaviour in terms of μ_∞ for the complexes pentathiourea dicuprous nitrate and potassium trioxalato chromate in the various solvent systems has been given. The solvent systems used are as follows:

(a) demineralized water (Dm water)
(b) methanol + water (1 : 1) (aquo-methanol)
(c) ethanol + water (1 : 1) (aquo-ethanol)
(d) acetone + water (1 : 1) (aquo-acetone)
(e) acetic acid + water (1 : 1) (aquo-acetic acid)

In short a least square fit method applied for the present purpose may be given as follows:

Considering equation (1) a similar equation can be given as

$$Y = a_0 + a_1 x \quad (2)$$

where $Y = \mu_v$; $a_0 = \mu_\infty$; $a_1 = D$ and $x = \sqrt{C}$

TABLE-1

COMPUTED VALUES OF MOLAR CONDUCTANCE AT INFINITE DILUTION (μ_∞) in (mho cm^2 mol^{-1}) FOR THE COMPLEXES IN VARIOUS SOLVENT SYSTEMS

Complex	S.No.	C mole/litre	Dm. water		Aquo-methanol		Aquo-ethanol		Aquo-acetone		Aquo-acetic acid	
			$K \times 10^3$	μ_v	$K \times 10^3$	μ_v	$K \times 10^3$	μ_v	$K \times 10^3$	μ_v	$K \times 10^3$	μ_v
Pentathiourea	1.	0.0100	1.998	199.80	1.188	118.80	0.756	75.60	1.134	113.40	2.376	273.60
dicuprous	2.	0.0050	1.134	226.80	0.702	140.40	0.432	86.40	0.059	118.80	1.994	388.90
nitrate	3.	0.0033	0.810	245.45	0.486	147.27	0.324	98.18	0.432	130.90	1.728	526.63
	4.	0.0025	0.648	259.20	0.378	151.50	0.270	108.00	0.378	151.20	1.674	669.60
	5.	0.0020	0.540	270.00	0.313	156.50	0.226	113.00	0.342	162.00	1.566	783.00
	μ_∞		310.39		180.28		134.72		180.51		1024.39	
Potassium	1.	0.0100	2.052	205.20	1.728	172.80	1.728	172.80	1.620	162.00	2.160	216.00
trioxalato	2.	0.0050	1.728	345.60	1.512	302.40	1.404	280.80	0.972	194.40	1.836	367.20
chromate(III)	3.	0.0033	1.188	360.00	1.188	360.00	1.080	327.27	0.702	212.72	1.728	523.60
	4.	0.0025	1.080	432.00	0.972	388.80	0.864	345.60	0.540	216.00	1.674	669.60
	5.	0.0020	0.972	486.00	0.864	432.00	0.756	378.00	0.486	240.00	1.620	810.00
	μ_∞		632.83		590.12		506.88		278.17		1092.77	

Solution for obtaining most probable values of a_0 and a_1 may be given as:

$$a_0 = \frac{\Sigma Y \Sigma X^2 - \Sigma X \Sigma XY}{N\Sigma X^2 - (\Sigma X)^2} \quad (3)$$

$$a_1 = \frac{N \Sigma XY - \Sigma X \Sigma Y}{N \Sigma X^2 - (\Sigma X)^2} \quad (4)$$

where equations (3) and (4) involve the usual statistical notations.

The various values of specific conductance (K), molar conductance (μ_v) and molar conductance at infinite dilution (μ_∞) for the complexes under the present study have been reported in Table-1.

A comparative electrolytic behaviour of the complex in the various solvent systems has been found to show the following trend when μ_∞-values are considered

(a) For pentathiourea dicuprous nitrate

aquo-acetic acid > Dm. water > aquo-acetone ≈ aquo-methanol > aquo-ethanol

(b) For potassium trioxalato chromate

aquo-acetic acid > Dm. water > aquo-methanol ≈ aquo-ethanol > aquo-acetone

Conclusion

The molar conductance at infinite dilution for a complex from the various values of molar conductance at different molar concentrations may be computed from the Kohlrausch's empirical formula by using the statistical method called least square fit method. Thus the electrolytic behaviour of a complex in terms of molar conductance value at infinite dilution in the various solvent systems may be compared.

REFERENCES

1. Yuri Lyalikav, Physico-Chemical Analysis, Mir Publishers, Moscow (1968).
2. Cyril H. Goulden, Method of Statistical Analysis, Asia Publishing House, Bombay (1964).

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