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ELECTROCHEMICAL DATA

Part VII

Electrolytic Conductivity of Aqueous Solutions of Hydrobromic Acid

by

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Electrochemical Data

I. Introduction

The data on the electrolytic conductance of hydrobromic and hydrofluoric acids, and of alkali hydroxide solutions were studied during this period. While considerable progress was made in the evaluation of the data on hydrofluoric acid and the hydroxide solutions, only the work on hydrobromic acid is complete at this time, and will be the subject of this report.

II. Results

Table 1 contains the equivalent conductance at round concentations in absolute mhos of hydrobromic acid at 25°C. Appended to it are interpolation equations for the different concentration ranges, the standard deviations of the least squares fits, and references to the original data.

Table 2 gives the equivalent conductance at rounded concentrations of hydrobromic acid from -20 to 50°C. It is based on the data of Haase, Sauermann and Dücker, Z. physik. Chem. Neue Folge, 47, 3/4, 224 (1965).

Table 3 contains the interpolation equations, constants and coefficients used to compute the values of conductance given in Table 2. It also gives the standard deviations of the least squares fits used to derive the equations for the various concentration ranges at the temperatures given. The Λ_o values were obtained by the procedure described on page 2 of Part V of this series of reports. In fitting the data at 0, 5, 15, 25, 35, 45 and 55°C we obtained the following interpolation formulas:

$$\Lambda_o = 267.47 + 629.45 \times 10^{-2}t + 117.20 \times 10^{-4}t^2 - 282.67 \times 10^{-6}t^3 \quad (0\text{-}25°C)$$

$$\Lambda_o = 262.15 + 683.06 \times 10^{-2}t - 769.95 \times 10^{-5}t^2 - 233.38 \times 10^{-7}t^3 \quad (25\text{-}55°C)$$

In both cases the standard deviation of the fit is 0.0.

III. Future

As mentioned above, work is in progress on hydrofluoric acid and the alkali hydroxide solutions. A report on the acid should be ready by the next quarter.

TABLE 1 - Equivalent electrolytic conductance of aqueous solutions of hydrobromic acid at 25°C

c	Λ	c	Λ	c	Λ
0.0002	425.5	0.04	402.7	0.80	345.3
.0003	425.0	.05	400.4	.85	342.6
.0004	424.6	.06	398.4	.90	339.9
.0005	424.3	.07	396.5	.95	337.2
.0006	424.0	.08	394.9	1.0	334.5
.0007	423.7	.09	393.4	1.5	307.6
.0008	423.4	.10	391.9	2.0	281.7
.0009	423.2	.15	386.0	2.5	257.8
.001	422.9	.20	381.4	3.0	236.8
.002	421.0	.25	377.5	3.5	217.5
.003	419.6	.30	374.0	4.0	199.4
.004	418.5	.35	370.8	4.5	182.4
.005	417.5	.40	367.7	5.0	166.5
.006	416.6	.45	364.7	5.5	151.8
.007	415.8	.50	361.9	6.0	138.2
.008	415.1	.55	359.0	6.5	125.7
.009	414.4	.60	356.2	7.0	114.2
.01	413.7	.65	353.5	7.5	103.8

TABLE 1 (continued)

c	Λ	c	Λ	c	Λ
.02	408.9	.70	350.8	8.0	94.4
.03	405.4	.75	348.0	8.5	85.8

Concentration Range: 0.0000 - 0.10 s = 0.09

$$\Lambda = 427.74 - 159.02c^{1/2} + 210.8272c - 209.5470c^{3/2}$$

Dawson and Crann, J. Chem., Soc., London, 109, 1262 (1916)

Hlasko, J. chim. phys., 26, 125 (1929).

Concentration Range: 0.10 - 3.0 s = 0.08

$$\Lambda = 427.74 - 159.02c^{1/2} + 192.8124c - 177.2474c^{3/2} + 53.93903c^{2} - 3.746204c^{5/2}$$

Dawson and Crann, J. Chem., Soc., London, 109, 1262 (1916)

Hlasko, J. chim. phys., 26, 125 (1929).

Concentration Range: 3.0 - 8.5 s = 0.09

$$\Lambda = 427.74 - 159.02c^{1/2} + 130.5906c - 101.6916c^{3/2} + 29.49103c^{2} - 2.843402c^{5/2}$$

Haase, Sauermann and Dücker, Z. physik. Chem. Neue Folge, 47, 3/4, 224 (1965)

Hlasko, J. chim. phys., 26, 125 (1929).

TABLE 2 - Equivalent electrolytic conductance of aqueous solutions of hydrobromic acid from -20° to 50°C

c	-20°C	-10°C	0°C	10°C	20°C	30°C	40°C	50°C
0.50	----	-----	240.9	295.9	347.0	398.9	453.6	496.8
.75	----	-----	234.7	284.9	339.0	387.2	433.8	480.6
1.00	----	-----	229.6	276.0	329.0	380.4	418.6	465.2
1.25	----	-----	221.7	265.8	314.9	362.8	401.8	442.9
1.50	----	-----	209.5	254.9	298.9	340.6	381.8	421.4
1.75	----	-----	198.3	243.1	284.6	327.3	366.2	404.8
2.00	----	150.8	188.6	231.3	271.8	314.1	350.5	387.4
2.25	----	143.4	180.1	219.6	258.3	296.9	332.3	367.0
2.50	----	136.8	171.7	208.3	244.8	281.7	316.0	349.1
2.75	----	131.0	164.1	198.3	232.9	267.6	301.2	333.2
3.00	----	125.7	157.2	189.5	222.2	255.0	287.8	318.6
3.25	----	120.6	150.8	181.7	212.4	244.3	275.4	304.9
3.50	----	116.1	144.1	174.6	203.2	234.4	263.7	291.9
3.75	87.1	112.0	137.6	167.4	194.7	224.2	252.2	279.4
4.00	84.0	107.5	132.3	160.2	186.8	214.2	239.7	266.9
4.25	80.9	103.1	127.7	153.2	179.0	204.5	228.8	254.6
4.50	78.0	99.0	123.0	146.4	171.2	195.1	218.8	242.6
4.75	75.1	95.1	117.7	139.9	163.1	186.1	209.3	231.3
5.00	72.3	91.4	112.6	134.0	155.7	178.2	199.6	221.3
5.25	69.6	87.8	107.8	128.3	148.7	170.5	190.0	211.4
5.50	67.0	84.2	103.1	122.7	142.1	162.8	181.4	201.8

TABLE 2 (continued)

c	-20°C	-10°C	0°C	10°C	20°C	30°C	40°C	50°C
5.75	64.4	80.6	98.6	117.3	135.7	155.3	173.2	192.4
6.00	61.8	77.2	94.3	112.0	129.6	148.0	165.4	183.4
6.25	59.3	73.8	90.1	106.9	123.7	140.9	157.8	174.7
6.50	56.8	70.7	86.0	102.0	118.0	134.1	150.5	166.3
6.75	54.4	67.7	82.1	97.2	112.5	127.6	143.3	158.4
7.00	51.9	64.6	78.4	92.6	107.1	121.4	136.3	150.8

TABLE 3 - Interpolation equations, constants, coefficients, and standard deviation of fits for hydrobromic acid

$$\Lambda = A + Bc + Cc^2 + Dc^3 + Ec^4 + Fc^5 + Gc^6$$

t°C	A	B	C	D	E	F	G	s	c
-20	153.2186	-23.74458	1.984868	-0.09437269	---------	--------	----------	0.0	3.85-7.12
-10	269.7145	-96.49953	23.22557	-2.354479	---------	--------	----------	0.0	2.12-3.43
-10	-2182.739	2809.984	-1391.051	359.8999	-51.69493	3.913505	-0.1220707	0.1	3.43-7.08

$$\Lambda = \Lambda_o - Sc^{1/2} + Ac + Bc^{3/2} + Cc^2 + Dc^{5/2} \quad (s = 0.0)$$

t°C	Λ_o	S	A	B	C	D	c
0	267.47	88.96	383.7746	-924.1801	909.7568	-318.2496	0.65-1.27
0	267.47	88.96	221.8995	-206.9480	21.53078	18.09947	1.27-2.09
0	267.47	88.96	303.0124	-422.2153	209.3597	-35.63960	2.09-3.42
0	267.47	88.96	1030.928	-1472.506	711.2473	-115.0276	3.42-4.78
0	267.47	88.96	53.84782	-33.86838	6.592146	-0.2034687	4.78-7.05
10	331.59	115.41	517.3115	-1217.696	1138.968	-378.8095	0.65-1.18
10	331.59	115.41	-14.86989	305.0183	-326.0611	94.43531	1.18-2.11
10	331.59	115.41	418.1359	-573.9359	276.5141	-45.09855	2.11-3.29
10	331.59	115.41	-39.21039	125.1741	-77.38015	14.15616	3.29-4.81
10	331.59	115.41	66.16035	-43.75662	10.46823	-76.65289	4.81-7.01
20	398.05	144.48	182.2736	-162.3090	103.8241	-48.40040	0.65-1.23
20	398.05	144.48	565.2512	-928.6667	560.8808	-118.3103	1.23-2.12
20	398.05	144.48	581.8613	-844.4378	433.9378	-76.25953	2.12-3.25
20	398.05	144.48	479.9294	-643.1428	305.0230	-49.29015	3.25-4.76
20	398.05	144.48	174.1218	-164.6092	57.37973	-6.869268	4.76-6.98

TABLE 3 (continued)

t°C	Λ_o	S	A	B	C	D	c
30	460.14	174.71	952.2020	-2645.858	2806.021	-1017.448	0.65-1.23
30	460.14	174.71	2796.582	-6065.851	4514.621	-1130.280	1.23-2.04
30	460.14	174.71	251.6347	-189.8346	19.28790	9.967165	2.04-3.32
30	460.14	174.71	114.8066	-62.75681	6.837291	1.154146	3.32-4.74
30	460.14	174.71	-1.499032	63.95883	-37.66776	6.133478	4.74-6.91
40	523.06	207.21	771.4765	-1706.708	1518.772	-480.7958	0.65-1.21
40	523.06	207.21	1596.403	-3278.587	2389.530	-593.4768	1.21-2.00
40	523.06	207.21	622.8765	-851.3158	423.1395	-72.47076	2.00-3.74
40	523.06	207.21	1231.781	-1628.505	743.0089	-114.2550	3.74-5.08
40	523.06	207.21	280.8612	-268.7814	96.02265	-11.81506	5.08-6.89
50	584.43	241.50	647.1861	-1412.163	1392.202	-504.9734	0.64-1.25
50	584.43	241.50	1870.611	-3887.601	2867.502	-719.6425	1.25-2.01
50	584.43	241.50	850.1113	-1230.670	646.5982	-116.9136	2.01-3.32
50	584.43	241.50	28.24088	109.7581	-84.59918	16.49943	3.32-4.70
50	584.43	241.50	75.99004	3.194942	-18.72547	4.101969	4.70-6.85