

A Study of Conductivity of the Systems: Water—0.2 N Sodium Salts of Fatty Acids and Alcohols in Presence of Free Acid or Alkali

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With 3 Figures

Summary

For the systems: "Water—0.2N sodium salts of fatty acids and alcohols (3-methyl butanol-1 or hexanol-1) in presence of free acids and sodium hydroxide" the specific conductivity decreases with the increase in the chain length of the soap as well as of the alcohol. The specific conductivity of the solutions increases with the increase in sodium hydroxide concentration. In the plot of specific conductivity and sodium hydroxide concentration, the curvature is more marked in the case of lower soaps than the higher soaps.

Inhaltsübersicht

Es wurde die spezifische Leitfähigkeit des ternären Systems Wasser/0,2 normale Natriumsalze von Fettsäuren und Alkoholen in Gegenwart von freier Säure oder Alkali gemessen. Dabei wurde gefunden, daß die spezifische Leitfähigkeit mit steigender Kettenlänge des Alkohols fällt. Sie steigt mit steigender Alkalikonzentration.

Introduction

In the previous communication¹⁾, the specific conductivity of the system: Water—0.2N sodium salts of fatty acids and butanol-1 in presence of free acid or alkali has been studied. In the present work the specific conductivity of the system in presence of 3-methyl butanol-1 and hexanol-1 has been determined.

Experimental

All the chemicals have been purified by the methods described in the previous communications²⁾³⁾ and the conductivity has also been measured at 35.0° C by the same method and the results are given in tables 1 to 12.

¹⁾ A. N. BOSE and K. N. MEHROTRA, *Kolloid-Z.* **158**, 39 (1958).

²⁾ A. N. BOSE and K. N. MEHROTRA, *J. Colloid Sc.* **11**, 250 (1956).

³⁾ A. N. BOSE and K. N. MEHROTRA, *Z. physik. Chem.* **206**, 339 (1957); **207**, 355 (1957).

Results and Discussion

3-methyl butanol-1 systems

Caprylate system: From the results given in table 1 it is observed that the specific conductivity of the solutions for 5% 3-methyl butanol-1 is higher than that for 10% 3-methyl butanol-1 solutions.

Table 1

System: Water—0.2N sodium caprylate-3-methyl butanol-1 with caprylic acid or sodium hydroxide. Specific conductivity in mhos temperature 35.0° C

% of the acid neutralised or concentration of sodium hydroxide	Concentration of 3-methyl butanol-1 in volume		
	5%	10%	90%
25%	—	—	0.00005682
50%	—	—	0.00009065
75%	—	—	0.00010140
100%	0.01187	0.01087	0.00011080
0.2N	0.04995	0.04538	—
0.4N	0.08498	—	—
0.6N	0.11740	—	—
0.8N	0.12950	—	—
1.4N	0.13680	—	—
1.6N	0.15310	—	—

of this system are lower than that for butanol-1 system for all the concentrations of alcohol, acid and sodium hydroxide. This is due to the fact that the number of carbon atoms in 3-methyl butanol-1 is more than in butanol-1, as a result of which the size of the micelles in the former is bigger than in the latter and hence the conductivity of 3-methyl butanol-1 solutions is lower than that for butanol-1 solutions.

The specific conductivity of the solutions increases with the increase in sodium hydroxide concentration. The differences between the conductivity values of 5% and 10% 3-methyl butanol-1 solutions are given in table 8. The results are in agreement with the butanol-1 systems.

Caprate system: Results of table 2 show that in the case of caprate system too, the conductivity of the solutions goes on decreasing with the increase in the 3-methyl butanol-1 concentration. The values of the 3-methyl butanol-1 and caprate system are lower than that for 3-methyl butanol-1-caprylate system and are also lower than of caprate-butanol-1 system. The explanation is the same as given for caprylate system.

The differences between the conductivity values for 5% and 10% and for 10% and 20% 3-methyl butanol-1 solutions are given in table 8. It is observed that the difference between 5% and 10% 3-methyl butanol-1 values is less than the difference between 10% and 20% conductivity values. The results are in agreement with the butanol-1 system.

Table 2

System: Water—0.2N sodium caprate-3-methyl butanol-1 with capric acid or sodium hydroxide

% of the acid neutralised or concentration of sodium hydroxide	Concentration of 3-methyl butanol-1 in volume			
	5%	10%	20%	90%
25%	—	—	—	0.00005133
50%	—	—	—	0.00008943
75%	0.007960	0.007796	—	0.00009546
100%	0.01135	0.01050	0.008968	0.0001025
0.2N	0.04674	0.03516	—	—
0.4N	0.08373	0.04742	—	—

Laurate system: From the results given in table 3 it is observed that in the case of laurate system, the conductivity values for 5% 3-methyl butanol-1 solutions are lower than that for 10% 3-methyl butanol-1 solutions. In this behaviour this system resembles with laurate-butanol-1 system but differs from 3-methyl butanol-1 and caprate or caprylate systems. The values for laurate system are lower than that for caprate and caprylate systems containing the same amount of 3-methyl butanol-1 and sodium hydroxide.

Table 3

System: Water—0.2N sodium laurate 3-methyl butanol-1 with lauric acid or sodium hydroxide

% of the acid neutralised or concentration of sodium hydroxide	Concentration of 3-methyl butanol-1 in volume				
	5%	10%	20%	70%	80%
75%	0.007578	0.007685	—	—	—
100%	0.01032	0.01033	0.008863	0.0007375	0.0002600
0.2N	0.046620	0.03501	—	—	—
0.4N	0.08254	0.04696	—	—	—

The differences between the conductivity values for 5% and 10%, 10% and 20% and for 70% and 80% 3-methyl butanol-1 concentrations are given in table 8. The results are in agreement with the lower acid systems.

In presence of free sodium hydroxide the specific conductivity values for 5% 3-methyl butanol-1 are higher than that for 10% solu-

tions. The conductivity of the solutions increases with the increase in sodium hydroxide concentration as in case of lower acid systems.

Myristate system: The behaviour of the myristate system (table 4) is similar to the laurate system except that the values of the former are lower than the latter for all concentrations of alcohol, acid

Table 4

System: Water—0.2N sodium myristate-3-methyl butanol-1 with myristic acid or sodium hydroxide

% of the acid neutralised or concentration of sodium hydroxide	Concentration of 3-methyl butanol-1 in volume				
	5%	10%	20%	70%	80%
75%	0.007399	0.007643	—	—	0.0001495
100%	0.009948	0.01024	0.008756	0.0006412	0.0002258
0.2N	0.04646	0.03497	—	—	—
0.4N	0.08199	0.04679	—	—	—

and alkali. The differences in conductivity values for 5% and 10%, 10% and 20% and for 70% and 80% are given in table 8 and are in agreement with those for lower acid systems.

Palmitate system: Results for table 5 show that the behaviour of the palmitate system is similar to the myristate system. The differences in conductivity values for 5% and 10% and for 70% and 80%

Table 5

System: Water—0.2N sodium palmitate-3-methyl butanol-1 with palmitic acid or sodium hydroxide

% of the acid neutralised or concentration of sodium hydroxide	Concentration of 3-methyl butanol-1 in volume			
	5%	10%	70%	80%
75%	—	0.007413	—	0.0001445
100%	0.009840	0.01014	0.0005526	0.0002128
0.2N	0.04637	0.03430	—	—
0.4N	0.08192	0.04662	—	—

3-methyl butanol-1 concentrations are given in table 8. The values of the palmitate system are lower than the myristate system for all concentrations of 3-methyl butanol-1, acid and alkali. The specific conduc-

tivity of the solutions increases with the increase in sodium hydroxide concentration and the results are in agreement with those for lower acid systems.

Stearate system: From the results given in table 6 it is observed that for 100% neutralised solutions the specific conductivity for 10% 3-methyl butanol-1 is higher than that for 5% 3-methyl butanol-1

Table 6

System: Water—0.2N sodium stearate-3-methyl butanol-1 with stearic acid or sodium hydroxide

% of the acid neutralised or concentration of sodium hydroxide	Concentration of 3-methyl butanol-1 in volume			
	5%	10%	70%	80%
100%	0.009519	0.01000	0.0005043	0.0002002
0.2N	0.04626	0.03415	—	—
0.4N	0.08021	0.04628	—	—

whereas in the presence of free sodium hydroxide the specific conductivity for 10% 3-methyl butanol-1 solutions is lower than that for 5% 3-methyl butanol-1 solutions.

The differences in conductivity values for 5% and 10% and for 70% and 80% 3-methyl butanol-1 solutions are given in table 8. The specific conductivity decreases with the increase in the number of carbon atoms in the soap as well in the alcohol:

Oleate system: Results of table 7 show that in 100% neutralised acid solutions the conductivity values for 5% and 10% 3-methyl butanol-1 are almost the same as in the case of laurate system. The differences in

Table 7

System: Water—0.2N sodium oleate-3-methyl butanol-1 with oleic acid or sodium hydroxide

% of the acid neutralised or concentration of sodium hydroxide	Concentration of 3-methylbutanol-1 in volume				
	5%	10%	20%	70%	80%
100%	0.01040	0.01039	0.008808	0.0005142	0.0002258
0.2N	0.04559	0.02835	—	—	—
0.4N	0.08008	0.04731	—	—	—

conductivity values for 10% and 20% and for 70% and 80% 3-methyl butanol-1 concentrations are given in table 8. The conductivity of the solutions increases with the increase in sodium hydroxide concentration and decreases with the increase in 3-methyl butanol-1 concentration.

All the results are in agreement with the systems of other acids and with the butanol-1 and oleate system.

Table 8

Sodium salts of the fatty acids	Concentration of 3-methyl butanol-1 in volume	75% neutralised acid		100% neutralised acid	
		Specific conductivity	Difference	Specific conductivity	Difference
Caprylate	5%	—		0.01187	} 0.00100
	10%	—		0.01087	
Caprate	5%	0.007960	} 0.000164	0.01135	} 0.00085
	10%	0.007796		0.01050	
	20%	—	—	0.008968	
Laurate	5%	0.007578	} -0.000107	0.01032	} -0.00001
	10%	0.007685		0.01033	
	20%	—	—	0.008863	
	70%	—	—	0.0007375	} 0.0004775
	80%	—	—	0.0002600	
Myristate	5%	0.007399	} -0.000244	0.009948	} -0.000292
	10%	0.007643		0.010240	
	20%	—	—	0.008756	
	70%	—	—	0.0006412	} 0.0004154
	80%	0.0001495	—	0.0002258	
Palmitate	5%	—	—	0.009840	} -0.000300
	10%	0.007413	—	0.010140	
	70%	—	—	0.0005526	} 0.0003398
	80%	—	—	0.0002128	
Stearate	5%	—	—	0.009519	} -0.000481
	10%	—	—	0.010000	
	70%	—	—	0.0005043	} 0.0003041
	80%	—	—	0.0002002	
Oleate	5%	—	—	0.01040	} 0.00001
	10%	—	—	0.01039	
	20%	—	—	0.008808	
	70%	—	—	0.0005142	} 0.0002884
	80%	—	—	0.0002258	

Hexanol-1 systems

From the results given in tables 9 to 12, it is observed that the specific conductivity of the solutions increases as the hexanol-1 concentration increases from 1% to 4% in case of all the soaps. The differences

Table 9
System: Water—0.2N sodium caprylate-hexanol-1
with caprylic acid or sodium hydroxide

% of the acid neutralised or concentration of sodium hydroxide	Concentration of hexanol-1		
	1%	2%	3%
100%	0.01187	—	—
0.2N	0.05259	0.04616	0.02726
0.4N	0.09568	0.06436	0.04478
0.6N	0.1381	0.09212	0.08060
0.8N	0.1757	0.1347	0.1215
1.0N	0.2105	—	—
1.2N	0.2460	—	—
1.4N	0.2755	—	—
1.6N	0.3055	—	—

Table 10
System: Water—0.2N sodium caprate-hexanol-1 with capric acid or sodium hydroxide

% of the acid neutralised or concentration of sodium hydroxide	Concentration of hexanol-1 in volume			
	1%	2%	3%	4%
100%	0.01160	0.01184	0.01191	0.01199
0.2N	0.05137	0.04841	—	—
0.4N	0.09198	0.07461	—	—
0.6N	0.1301	—	—	—
0.8N	0.1680	—	—	—
1.0N	0.2020	—	—	—
1.2N	0.2320	—	—	—

in conductivity values are given in table 12 for 1% increase of hexanol-1 concentration. The values for the differences decrease with the increase in hexanol-1 concentration and increase with the increase in the number of carbon atoms in the soap.

Table 11

System: Water — 0.2N sodium laurate-hexanol-1 with lauric acid or sodium hydroxide

% of the acid neutralised or concentration of sodium hydroxide	Concentration of hexanol-1 in volume			
	1%	2%	3%	4%
100%	0.009033	0.009583	0.009851	0.009965
0.2N	0.05105	0.05067	—	—
0.4N	0.08900	0.08487	—	—
0.6N	0.1230	—	—	—
0.8N	0.1575	—	—	—

Table 12

Sodium salts of fatty acids	Concentration of hexanol-1 in volume	100% neutralised acid systems	
		Specific conductivity	Difference
Caprylate	1%	0.01187	
Caprate	1%	0.011607	} 0.00024 0.00007 0.00008
	2%	0.01184	
	3%	0.01191	
	4%	0.01199	
Laurate	1%	0.009033	} 0.000550 0.000268 0.000114
	2%	0.009583	
	3%	0.009851	
	4%	0.009965	
Myristate	1%	0.007743	} 0.000664 0.000590 0.000277
	2%	0.008407	
	3%	0.008997	
	4%	0.009274	
Palmitate	2%	0.006801	} 0.001004 0.000654
	3%	0.007805	
	4%	0.008459	
Stearate	3%	0.007360	} 0.000649
	4%	0.008009	
Oleate	1%	0.007986	} 0.000529 0.000518 0.000246
	2%	0.008515	
	3%	0.009033	
	4%	0.009279	

The conductivity of the solutions decreases with the increase in the chain length of the acid in the soap in presence of all concentrations of hexanol-1 and sodium hydroxide.

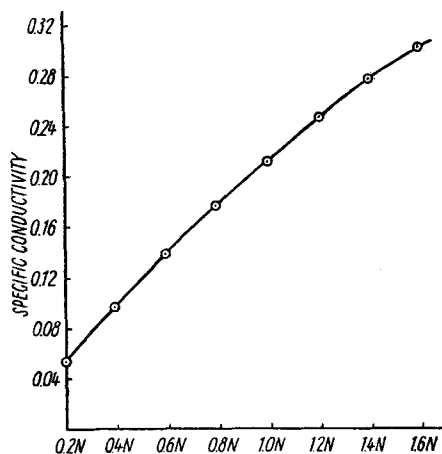


Fig. 1. Specific conductivity-sodium hydroxide concentration curve for the system: Water-sodium caprylate-1% hexanol-1 and sodium hydroxide

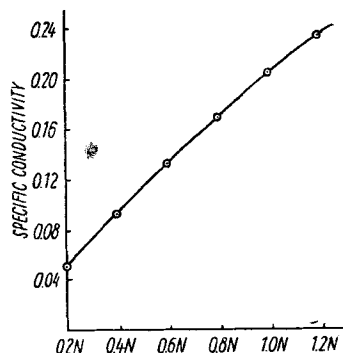


Fig. 2. Specific conductivity-sodium hydroxide concentration curve for the system: Water-sodium caprate-1% hexanol-1 and sodium hydroxide

In the presence of free sodium hydroxide, the conductivity of the solutions increases with the increase in sodium hydroxide concentration. The values of specific conductivity has been plotted against sodium hydroxide concentration (Fig. 1, 2 and 3) for caprylate, caprate and laurate systems. In the case of laurate system the curvature is not so marked as in case of caprylate and caprate systems. The results are in agreement with the butanol-1 systems.

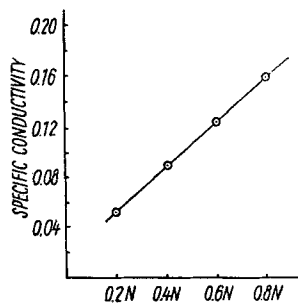


Fig. 3. Specific conductivity-sodium hydroxide concentration curve for the system: Water-sodium laurate-1% hexanol-1 and sodium hydroxide

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