

## Sodium Sulfite

COMPONENTS:		ORIGINAL MEASUREMENTS:		
1. Sodium sulfite; $\text{Na}_2\text{SO}_3$ ; [7757-83-7]		Hartlev, H.; Barrett, W.H.		
2. Water; $\text{H}_2\text{O}$ ; [7732-18-5]		<i>J. Chem. Soc.</i> <u>1909</u> , 95, 1178-85.		
VARIABLES:		PREPARED BY:		
Temperature: 269 - 357 K		Mary R. Masson		
EXPERIMENTAL VALUES:				
$t/^\circ\text{C}$	$\text{Na}_2\text{SO}_3$ g/100 g water	$\text{Na}_2\text{SO}_3$ mass %	$\text{Na}_2\text{SO}_3^{\text{a}}$ mol/kg	Solid <sup>b</sup> phase
- 1.9	13.09	11.570	1.038	A
2.0	14.82	12.910	1.176	A
5.9	17.61	14.970	1.397	A
10.6	20.01	16.670	1.587	A
18.2	15.31	20.200	2.008	A
23.5	29.92	23.030	2.374	A
29.0	34.99	25.920	2.776	A
33.5	39.64	28.390	3.145	A
37.2	44.08	30.590	3.497	A
37.0	28.01	21.880	2.222	B
	28.07	21.920	2.227	B
47.0	28.19	21.990	2.236	B
	28.07	21.920	2.227	B
55.6	28.21	22.000	2.238	B
59.8	28.89	22.410	2.292	B
	28.65	22.270	2.273	B
	28.75	22.330	2.281	B
60.4	28.29	22.050	2.244	B
84.0	28.26	22.030	2.242	B
<sup>a</sup> Molalities calculated by the compiler <sup>b</sup> Solid phases: A - $\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$ , B - $\text{Na}_2\text{SO}_3$				
(continued on next page)				
AUXILIARY INFORMATION				
METHOD APPARATUS/PROCEDURE:		SOURCE AND PURITY OF MATERIALS:		
<p>The solubility of the hydrated salt was determined by the sealed tube method (1). Weighed amounts of solid and water were sealed in small tubes. Two temperatures, differing by about 0.4 K, were found, at the higher of which small crystals were seen to dissolve and at the lower of which small crystals could be seen to grow. The mean of the two temperatures was taken as the temperature at which the weighed amount of solid dissolved in the weighed amount of water.</p> <p>The solubility of the anhydrous salt was determined by stirring excess of the salt with water under hydrogen, portions of the solutions were withdrawn from time to time and analysed for sulfite by reaction with excess of iodine and back-titration of the excess with standard thiosulfate.</p>		<p>Anhydrous sodium sulfite was prepared as follows. Pure sodium carbonate (Merck, 40g) was dissolved in 120 g of air-free water, and sulfur dioxide was passed into the solution until the gain in weight corresponded to complete conversion into sodium hydrogen sulfite. An equal quantity of sodium carbonate solution was then added. The solution was filtered under hydrogen through glass wool into a vessel maintained at over <math>100^\circ\text{C}</math>. On evaporation in a stream of hydrogen, crystals of the anhydrous salt separated. These were washed with water + alcohol then alcohol, and dried, under hydrogen. This salt was free from sulfate.</p>		
		<p>ESTIMATED ERROR:            For anhydrous salt, <math>s = 0.15</math> g/100 g            For hydrate, temperature error = <math>\pm 0.2</math> K</p>		
		<p>REFERENCES:            1. Hartley, H.; Thomas  <i>J. Chem. Soc. (Trans.)</i>, <u>1906</u>, 89, 1016.</p>		

<p>COMPONENTS:</p> <p>1. Sodium sulfite; <math>\text{Na}_2\text{SO}_3</math>; [7757-83-7]</p> <p>2. Water; <math>\text{H}_2\text{O}</math>; [7732-18-5]</p>	<p>ORIGINAL MEASUREMENTS:</p> <p>Hartley, H.; Barrett, W.H. <i>J. Chem. Soc.</i> <u>1909</u>, 95, 1178.</p>
---	---

## EXPERIMENTAL VALUES (continued):

t/°C	$\text{Na}_2\text{SO}_3$ g/100 g water	$\text{Na}_2\text{SO}_3$ mass %	$\text{Na}_2\text{SO}_3^a$ mol/kg	Solid phase
-0.76	2.15	2.10	0.170	ice
-1.37	4.21	4.04	0.334	"
-1.96	6.29	5.92	0.499	"
-2.77	9.44	8.63	0.749	"
-3.51	12.48	11.10	0.991	"
-4.50	17.91	15.19	1.421	"

The freezing points of the solutions of sodium sulfite were found by the "ordinary Beckmann method", under an atmosphere of hydrogen. The salt was added in the anhydrous form.

The ice curve cut the solubility curve at  $-3.5^\circ\text{C}$ , the eutectic temperature.

<sup>a</sup> Molalities calculated by the compiler.

<b>COMPONENTS:</b> 1. Sodium sulfite; $\text{Na}_2\text{SO}_3$ ; [7757-83-7] 2. Water; $\text{H}_2\text{O}$ ; [7732-18-5]		<b>ORIGINAL MEASUREMENTS:</b> Foerster, F.; Brosche, A.; Norberg-Schutz, Chr. Z. Phys. Chem. <u>1924</u> , 10, 435-96.
<b>VARIABLES:</b> Temperature: 270 - 372 K		<b>PREPARED BY:</b> Mary R. Masson
<b>EXPERIMENTAL VALUES:</b>		
	$\text{Na}_2\text{SO}_3$	$\text{Na}_2\text{SO}_3^a$
t/°C	mass %	mol/kg
- 1.3	11.25*	1.006
0.0	12.50	1.133
0.0	12.59	1.143
4.0	13.20*	1.207
9.15	15.47	1.452
9.2	15.60	1.466
16.5	19.14	1.878
16.6	19.07	1.870
19.9	20.82	2.086
22.4	21.89	2.223
24.0	22.76	2.338
26.85	24.32	2.550
27.0	24.39	2.559
28.0	25.07	2.655
28.2	25.36	2.696
29.05	25.59	2.729
33.0	27.99	3.084
33.1	27.98	3.082
33.1	28.15	3.108
33.8	28.58	3.175
34.65	28.78	3.206
34.7	28.86	3.219
35.4	29.27	3.283
35.9	29.89	3.382
*Results considered particularly reliable by the original authors.		
Solid phase in equilibrium was $\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$ .		
<sup>a</sup> Molalities calculated by the compiler (continued on next page)		
<b>AUXILIARY INFORMATION</b>		
<b>METHOD APPARATUS/PROCEDURE:</b> Solids were equilibrated with solution under a hydrogen atmosphere, in a vessel maintained in a thermostat. Samples for analysis were withdrawn through a tube plugged with cotton wool. Samples were reacted with an excess of standard iodine solution, and the excess was back-titrated with thiosulfate.		<b>SOURCE AND PURITY OF MATERIALS:</b> $\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$ was prepared by passing sulfur dioxide into a 25% solution of sodium hydroxide, taking care not to let the temperature rise above the transition temperature (34°C). When the temperature started to drop rapidly, the supply of sulfur dioxide was shut off. The hydrate crystallized out when then solution was cooled to 0°C.
		<b>ESTIMATED ERROR:</b> Temperature: $\pm 0.1$ K Analyses: no accurate estimate possible.
		<b>REFERENCES:</b>

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Sodium sulfite; $\text{Na}_2\text{SO}_3$ ; [7757-83-7]	Foerster, F.; Brosche, A.;
2. Water; $\text{H}_2\text{O}$ ; [7732-18-5]	Norberg-Schutz, Chr.
	Z. Phys. Chem. <u>1924</u> , 10, 435-96.

EXPERIMENTAL VALUES (continued):					
t/°C	Equilibration		$\text{Na}_2\text{SO}_3$	$\text{Na}_2\text{SO}_3^a$	Solid <sup>b</sup>
	time		mass %	mol/kg	phase
46.0	10 min		26.03	2.792	A
46.0	2 hr		26.35	2.839	A
50.4	15 min		25.85	2.766	A
56.25	10 min		24.80	2.617	A
94.4	10 min		21.44	2.165	A
52.5	16 hr		22.35	2.284	A
48.2	10 min		25.38	2.699	A
66.4	10 min		24.06	2.514	A
97.0	15 min		21.32	2.150	A
58.1	25 hr		25.12	2.662	A
58.1	93 hr		25.78	2.756	A
58.1	177 hr		24.79	2.615	A
54.8	48 hr		25.20*	2.673	B
70.0	100 min		23.85	2.485	B
99.0	24 hr		21.70	2.199	B
34.0	1 hr		26.00	2.788	B
34.0	6.5 hr		27.50	3.009	B
34.0	20 hr		27.70	3.040	B
34.0	92 hr		27.90	3.070	B
37.5	140 min		23.20	2.397	B
37.5	27 hr		26.95	2.927	B
37.5	29 hr		27.50	3.009	B
36.5	51 hr		27.65	3.032	B
34.5	69 hr		28.20	3.116	B
41.0	75 hr		27.35	2.987	B
41.0	78 hr		27.15*	2.957	B
50.0	40 min		23.85	2.485	B
50.0	220 min		24.90	2.631	B
49.9	315 min		25.20	2.673	B
49.7	21 hr		25.45	2.709	B
50.0	29 hr		25.60	2.730	B
50.1	44 hr		25.70	2.744	B
50.0	70 hr		25.90	2.773	B
50.0	93.5 hr		25.75*	2.752	B
66.5	4 hr		22.07	2.247	B
66.5	21 hr		23.82	2.481	B
35.7	30 min		23.05	2.377	C
35.6	150 min		24.40	2.561	C
35.7	20 hr		26.30	2.831	C
35.4	42.5 hr		27.25	2.972	C
35.7	66 hr		27.55	3.017	C
35.7	71 hr		27.60	3.025	C
35.6	90 hr		27.80*	3.055	C
35.6	115 hr		27.70	3.040	C

<sup>a</sup> Molalities calculated by the compiler.

<sup>b</sup> Solid phases: A -  $\text{Na}_2\text{SO}_3$  formed from  $\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$  on standing in contact with solution. B -  $\text{Na}_2\text{SO}_3$  formed on heating under vacuum at 70°C. C -  $\text{Na}_2\text{SO}_3$  formed on heating at 100°C at atmospheric pressure. The crystals were ground. (continued on next page)

COMPONENTS:		ORIGINAL MEASUREMENTS:		
1. Sodium sulfite; $\text{Na}_2\text{SO}_3$ ; [7757-83-7]		Foerster, F.; Brosche, A.;		
2. Water; $\text{H}_2\text{O}$ ; [7732-18-5]		Norberg-Schutz, Chr.		
		Z. Phys. Chem. <u>1924</u> , 10, 435-96.		
EXPERIMENTAL VALUES (continued):				
t/°C	$\text{Na}_2\text{SO}_3$ mass %	$\text{Na}_2\text{SO}_3^a$ mol/kg	Solid phase	
-0.667	1.865	0.151	ice	
-1.27	3.73	0.307	"	
-2.23	6.69	0.569	"	
-2.31	6.91	0.589	"	
-2.70	8.12	0.701	"	
-3.20	9.68	0.850	"	
-3.48	10.80	0.961	"	
-1.29	3.87	0.319	"	
-2.24	6.80	0.579	"	
-3.44	10.67	0.948	"	
A Beckmann apparatus was used for the determination of freezing points.				
a Molalities calculated by the compiler.				

COMPONENTS:		ORIGINAL MEASUREMENTS:		
1. Sodium sulfite; $\text{Na}_2\text{SO}_3$ ; [7757-83-7] 2. Water; $\text{H}_2\text{O}$ ; [7732-18-5]		Kobe, K.A.; Hellwig, K.C.  <i>Ind. Eng. Chem.</i> <u>1955</u> , 47, 1116-21.		
VARIABLES:		PREPARED BY:		
Temperature: 273 - 373 K		Mary R. Masson		
EXPERIMENTAL VALUES:				
t/°C	$\text{Na}_2\text{SO}_3$ g/100 g of water	$\text{Na}_2\text{SO}_3^a$ mass %	$\text{Na}_2\text{SO}_3^a$ mol/kg	Solid <sup>b</sup> phase
0.0	13.3	11.74	1.055	A
25.0	30.7	23.49	2.436	A
29.30	34.9	25.87	2.769	A
32.95	38.0	27.54	3.015	A + B
33.82	37.5	27.27	2.975	B
40.00	35.7	26.31	2.833	B
60.0	31.7	24.07	2.515	B
80.0	28.0	21.87	2.222	B
100.0	26.3	20.82	2.086	B
<sup>a</sup> Molalities and mass % values calculated by the compiler. <sup>b</sup> Solid phases: A - $\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}$ , B - $\text{Na}_2\text{SO}_3$				
AUXILIARY INFORMATION				
METHOD APPARATUS/PROCEDURE:		SOURCE AND PURITY OF MATERIALS:		
Solids were equilibrated with water in sealed borosilicate-glass tubes for up to 20 days. Solution was removed from the tube for analysis, under nitrogen. The measured and weighed aliquot was run into excess of standard iodine, the excess of which was back-titrated with sodium thiosulfate.		Sodium sulfite was obtained from J.T. Baker Chemical Co., and was found to assay at 100.1%. Dissolved oxygen was removed from distilled water by boiling under reduced pressure at 60 - 65°C for 1 hr. This water was stored under nitrogen for a maximum of 5 hr.		
		ESTIMATED ERROR:		
		No estimates possible.		
		REFERENCES:		



<p>COMPONENTS:</p> <p>1. Sodium sulfite; <math>\text{Na}_2\text{SO}_3</math>; [7757-83-7]</p> <p>2. Water; <math>\text{H}_2\text{O}</math>; [7732-18-5]</p>	<p>ORIGINAL MEASUREMENTS:</p> <p>Efanov, L.N.; Lel'kin, K.P.; Romashchenko, I.M.</p> <p><i>Zh. Neorg. Khim.</i> <u>1977</u>, 22, 217-9; <i>Russ. J. Inorg. Chem. (Eng. Transl.)</i> <u>1977</u>, 22, 120-1.</p>																								
<p>VARIABLES:</p> <p>Temperature: 303 - 308 K</p>	<p>PREPARED BY:</p> <p>Mary R. Masson</p>																								
<p>EXPERIMENTAL VALUES:</p> <p style="text-align: center;"><u>Solubility in water</u></p> <table data-bbox="367 566 902 889"> <thead> <tr> <th style="text-align: center;"><math>t/^\circ\text{C}</math></th> <th style="text-align: center;"><math>\text{Na}_2\text{SO}_3^a</math></th> </tr> </thead> <tbody> <tr><td style="text-align: center;">30.0</td><td style="text-align: center;">5.05</td></tr> <tr><td style="text-align: center;">31.6</td><td style="text-align: center;">5.27</td></tr> <tr><td style="text-align: center;">32.6</td><td style="text-align: center;">5.40</td></tr> <tr><td style="text-align: center;">33.1</td><td style="text-align: center;">5.60</td></tr> <tr><td style="text-align: center;">33.6</td><td style="text-align: center;">5.67</td></tr> <tr><td style="text-align: center;">33.7</td><td style="text-align: center;">5.66</td></tr> <tr><td style="text-align: center;">33.8</td><td style="text-align: center;">5.65</td></tr> <tr><td style="text-align: center;">34.0</td><td style="text-align: center;">5.16</td></tr> <tr><td style="text-align: center;">34.1</td><td style="text-align: center;">5.69</td></tr> <tr><td style="text-align: center;">34.3</td><td style="text-align: center;">5.61</td></tr> <tr><td style="text-align: center;">34.8</td><td style="text-align: center;">5.66</td></tr> </tbody> </table> <p>A large dip in the solubility was observed at <math>34.0^\circ\text{C}</math>, which is approximately the value for the transition temperature (between <math>\text{Na}_2\text{SO}_3 \cdot 7\text{H}_2\text{O}</math> and <math>\text{Na}_2\text{SO}_3</math>) found by other workers.</p> <p><sup>a</sup> Expressed in g-equivalents/l., i.e. mol (<math>\frac{1}{2}\text{Na}_2\text{SO}_3</math>)/l. The values quoted were read from the graph given by the authors.</p>		$t/^\circ\text{C}$	$\text{Na}_2\text{SO}_3^a$	30.0	5.05	31.6	5.27	32.6	5.40	33.1	5.60	33.6	5.67	33.7	5.66	33.8	5.65	34.0	5.16	34.1	5.69	34.3	5.61	34.8	5.66
$t/^\circ\text{C}$	$\text{Na}_2\text{SO}_3^a$																								
30.0	5.05																								
31.6	5.27																								
32.6	5.40																								
33.1	5.60																								
33.6	5.67																								
33.7	5.66																								
33.8	5.65																								
34.0	5.16																								
34.1	5.69																								
34.3	5.61																								
34.8	5.66																								
<p>AUXILIARY INFORMATION</p>																									
<p>METHOD APPARATUS/PROCEDURE:</p> <p>Equilibrium was approached from both higher and lower temperatures. Sulfite was determined by reaction with excess of iodine, and titration of the excess with thiosulfate.</p>	<p>SOURCE AND PURITY OF MATERIALS:</p> <p>Doubly distilled water was used. Analytical-reagent grade salt was used.</p> <hr/> <p>ESTIMATED ERROR:</p> <p>Temperature: <math>\pm 0.03</math> K</p> <p>Error in reading from graph: 0.2%</p> <hr/> <p>REFERENCES.</p>																								