

Sodium Pyrosulfite

<p>COMPONENTS:</p> <p>1. Sodium pyrosulfite; $\text{Na}_2\text{S}_2\text{O}_5$; [7681-57-4]</p> <p>2. Water; H_2O; [7732-18-5]</p>	<p>EVALUATOR:</p> <p>Mary R. Masson, Dept. of Chemistry, University of Aberdeen, Meston Walk, Old Aberdeen, AB9 2UE, Scotland, UK.</p> <p>June 1984.</p>
<p>CRITICAL EVALUATION:</p> <p>The binary system sodium pyrosulfite - water has been studied by only one group of workers (1), but data are also available from ternary systems (2 -8). Above 278.7 K the anhydrous salt is in equilibrium with solution. At lower temperatures, the stable solid phase is $\text{Na}_2\text{S}_2\text{O}_5 \cdot 7\text{H}_2\text{O}$ [91498-96-3] (264 - 279 K), and there is also a metastable solid phase, $\text{Na}_2\text{S}_2\text{O}_5 \cdot 6\text{H}_2\text{O}$ [91498-97-4] (263 - 277 K), according to Foerster <i>et al.</i> (1). Sotova <i>et al.</i> claim to have found, at 273.2 K, $\text{Na}_2\text{S}_2\text{O}_5$ (5) and $\text{Na}_2\text{S}_2\text{O}_5 \cdot 6\text{H}_2\text{O}$ (4,13). One of the points given in (4), which is also given in (5), namely 31.31 mass % of $\text{Na}_2\text{S}_2\text{O}_5$ is in agreement with the data given by Foerster <i>et al.</i> for the 7-hydrate. The other point from (4) agrees neither with the 6-hydrate nor 7-hydrate data in (1).</p> <p>There are four equations, for the equilibria with ice and with the three solids.</p> <p>(1) ice, for 263.5 - 273.2 K (data from (1)) $(T - 273.15) = -0.0150 - 0.365y + 0.00292y^2 - 0.000161y^3 \quad s = 0.015 \text{ (11 pts)}$ or $y = -0.0764 - 2.83(T - 273.2) + 0.0187 (T - 273.2)^2 + 0.00488(T - 273.2)^3 \quad s = 0.055 \text{ (11 pts)}$</p> <p>(2) $\text{Na}_2\text{S}_2\text{O}_5 \cdot 6\text{H}_2\text{O}$, for 263 - 277 K (data from (1)) $y = 33.0 + 1.29(T - 273.2) + 0.0226(T - 273.2)^2 - 0.0019(T - 273.2)^3 \quad s = 0.149 \text{ (19 pts)}$</p> <p>(3) $\text{Na}_2\text{S}_2\text{O}_5 \cdot 7\text{H}_2\text{O}$, for 264 - 27 K (data from (,4)) $y = 31.2 + 1.068(T - 273.2) - 0.00280(T - 273.2)^3 \quad s = 0.137 \text{ (9 pts)}$</p> <p>(4) $\text{Na}_2\text{S}_2\text{O}_5$, for 278 - 373 K (data from (1,2,3,6,7,8)) $y = 37.4 + 0.1026(T - 273.2) + 0.000186(T - 273.2)^2 \quad s = 0.288 \text{ (35 pts)}$</p> <p>In all the equations, T is the temperature in K, $y = 100w$ is the concentration expressed as mass % of $\text{Na}_2\text{S}_2\text{O}_5$, and s is the estimated standard deviation of the dependent variable about the regression line. In all cases, some, but not many, points were rejected.</p>	

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[7681-57-4]
2. Water; H_2O ; [7732-18-5]

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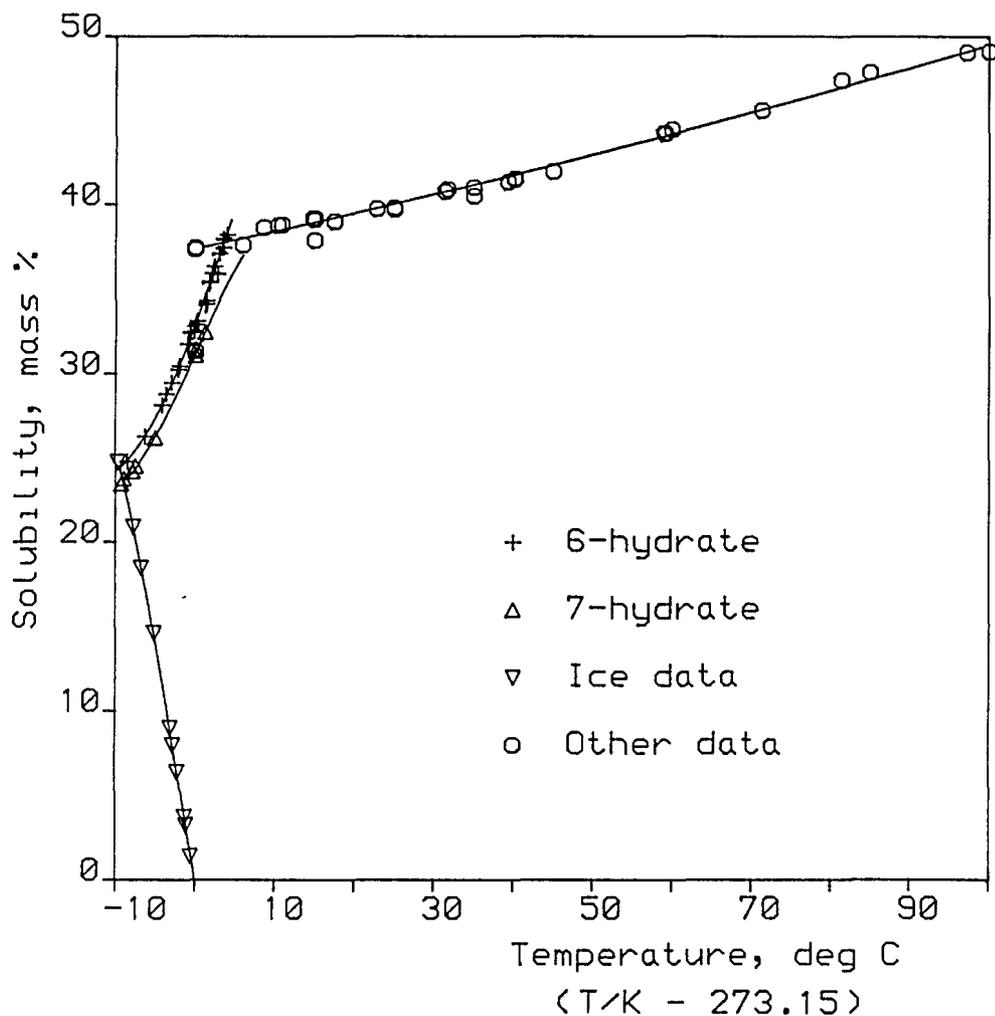
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CRITICAL EVALUATION: (continued)

TENTATIVE SOLUBILITIES

Although the data for the equilibrium with the anhydrous salt are essentially in agreement, there is a good deal of scatter, so the calculated solubilities are regarded as tentative. The following values were calculated from regression equation (4).

T/K	Solubility	
	mass %	molality mol/kg
278.2	37.9	3.21
283.2	38.4	3.28
293.2	39.5	3.43
303.2	40.6	3.60
313.2	41.8	3.78
323.2	43.0	3.97
333.2	44.2	4.17
343.2	45.5	4.39
353.2	46.8	4.63
363.2	48.1	4.88
373.2	49.5	5.16



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<p>CRITICAL EVALUATION: (continued)</p> <p>TERNARY SYSTEMS</p> <p><u>Sodium pyrosulfite - sodium sulfate - water.</u> Data for this system have been reported for 273.2 K (4,5), 288.2, 298.2, 308.2 and 318.2 K (6), 333.2 K (3) and 373.2 K (2). At temperatures up to 298.2 K the sulfate solid phase is $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$; at higher temperatures it is the anhydrous salt. The pyrosulfite solid phase at 273.2 K has already been discussed. At higher temperatures, it is the anhydrous salt. At temperatures of 298.2 K and above, an additional phase is formed. Jäger (6) reports this as $\text{Na}_2\text{S}_2\text{O}_5 \cdot 6\text{Na}_2\text{SO}_4$, which is in accordance with the data presented. Sotova, on the other hand (2,3) reports it as $\text{Na}_2\text{S}_2\text{O}_5 \cdot 8\text{Na}_2\text{SO}_4$. The Sotova data show much more scatter, so it is possible that Sotova should also have found $\text{Na}_2\text{S}_2\text{O}_5 \cdot 6\text{Na}_2\text{SO}_4$. However, Jäger's data for 318.2 K also show a bit of scatter, so it may be that the salt does not have a definite composition, or that both $\text{Na}_2\text{S}_2\text{O}_5 \cdot 6\text{Na}_2\text{SO}_4$ and $\text{Na}_2\text{S}_2\text{O}_5 \cdot 8\text{Na}_2\text{SO}_4$ are formed at the higher temperatures.</p> <p><u>Other ternary systems.</u> Data for sodium pyrosulfite - ethanol - water have been reported (7); the aqueous data for this system are in reasonable agreement with the other binary data. The solubilities measured under nitrogen are to be preferred. Some data for sodium hydrogen sulfite - sodium dithionite - water have been reported (10), but not much information was given. Systems involving sodium sulfite - sodium pyrosulfite - water (2,4,6,8,9) have been discussed in the evaluation for sodium sulfite. The sodium pyrosulfite - sodium chloride - water system (14) has also been studied.</p> <p>MORE COMPLEX SYSTEMS</p> <p>Systems involving sodium pyrosulfite, ammonium pyrosulfite, sodium chloride, and ammonium chloride (11), sodium sulfite, sodium pyrosulfite and sodium sulfate (12,13,15), and sodium pyrosulfite - sodium chloride - diethanolamine - water (14) have been studied.</p> <p>REFERENCES</p> <ol style="list-style-type: none"> 1. Foerster, F.; Brosche, A.; Norberg-Schutz, Chr. <i>Z. Phys. Chem.</i> <u>1924</u>, <i>10</i>, 435. 2. Sotova, N.N.; Torocheshnikov, N.S.; Kuznetsova, A.G.; Sokolova, E.I. <i>Khimiya i Tekhnol. Mineral'n. Solei i Galurgichesk. Pr.-v, Varna</i> <u>1978</u>, 53. 3. Sotova, N.N.; Torocheshnikov, N.S.; Kuznetsova, A.G.; Poroshkova, M.A. <i>Khimiya i Tekhnol. Mineral'n. Solei i Galurgichesk. Pr.-v, Varna</i> <u>1978</u>, 65. 4. Sotova, N.N.; Kuznetsova, A.G.; Torocheshnikov, N.S. <i>Zh. Priklad. Khim.</i> <u>1978</u>, <i>51</i>, 779; <i>J. Appl. Chem. USSR (Eng. Transl.)</i> <u>1978</u>, <i>51</i>, 760. 5. Sotova, N.N.; Kuznetsova, A.G.; Torocheshnikov, N.S.; Kononova, I.V. <i>Mezhvuz. Sb. Altaisk. Politekhn. In.-t</i> <u>1976</u>, <i>2(57)</i>, 150; and <i>Fiz.-Khim. Osn. Tekhnol. Pererab. Khim. Syr'ya</i> <u>1976</u>, <i>2</i>, 150. 6. Jäger, L.; Rejlek, M.; Klimeček, R.; Machala, J. <i>Chem. Prům.</i> <u>1960</u>, <i>10</i>, 518. 	

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CRITICAL EVALUATION: (continued) 7. Navrátil, J.; Nývlt, J. <i>Chem. Prům.</i> <u>1968</u> , 18, 612. 8. Arii, K. <i>Bull. Inst. Phys. Chem. Research</i> <u>1926</u> , 6, 1065 (in Japanese); <i>Sci. Rep. Tohoku Imp. Univ.</i> <u>1926</u> , 6, 1065. 9. Sotova, N.N.; Torocheshnikov, N.S.; Kuznetsova, A.G.; Poroshkova, M.A. <i>Khimiya i Tekhnol. Mineral'n. Solei i Galurgichesk. Pr.-v, Varnaul</i> <u>1978</u> , 59. 10. Iijima, T.; Kageyama, T. <i>Kanto Gakuin Daigaku Kogakubu Kenkyu Hokoku</i> <u>1972</u> , 16, 69. 11. Zil'berman, Ya.I.; Ivanov, P.T. <i>Zh. Priklad. Khim.</i> <u>1941</u> , 14, 939. 12. Kuznetsova, A.G.; Yaroshenko, L.B. <i>Zh. Priklad. Khim.</i> <u>1981</u> , 54, 2197. 13. Sotova, N.N.; Kuznetsova, A.G.; Torocheshnikov, N.S. <i>Zh. Priklad. Khim.</i> <u>1978</u> , 51, 940. 14. Yavorskii, V.T.; Perekupko, T.V.; Matsyk, L.V. <i>Zh. Priklad. Khim.</i> <u>1984</u> , 57, 3; <i>J. Appl. Chem. USSR (Eng. Transl.)</i> <u>1984</u> , 57, 1. 15. Kuznetsova, A.G.; Sedova, V.A. <i>VINITI Deposited Document</i> <u>1981</u> , 5711-81.	