COMPONENTS:	EVALUATOR:
(1) Iodic acid; HIO_3; [7782-68-5] (2) Water; H_2O; [7732-18-5]	H. Miyamoto Niigata University Niigata, Japan and M. Salomon US Army ET & DL Fort Monmouth, NJ, USA September, 1985

CRITICAL EVALUATION:

THE BINARY SYSTEM

Data for the solubility of HIO_3 in pure water have been reported in 17 publications (1-17). Studies involving ternary systems over the temperature range of 273 - 333 K, confirmed the solid phase to be anhydrous HIO_3. Groschuff (2) reported that the eutectic point of ice and HIO_3 is about 259 K, that the $HIO_3 \rightarrow HIO_3I_2O_5$ transition occurs at 383 K, and that the conversion of $HIO_3.I_2O_5$ (or HI_3O_8) to iodic pentoxide, I_2O_5 occurs between 463 K and 473 K. It is quite surprising that the phase diagram for the HIO_3-H_2O system reported in detail by Groschuff in 1905 has never been restudied to confirm both the accuracy and precision of Groschuff's results.

A number of compilations containing solubility data for both binary and ternary systems can be found in other chapters in this volume, or in the earlier volume to this series (27). The location of these compilations are reviewed in Table 1 below.

Table 1. Location of compilations containing HIO_3 solubility data.

System	Reference	Compilation found in
$LiIO_3$-HIO_3-H_2O	5,10,12,13,18,24	$LiIO_3$ chapter
$NaIO_3$-HIO_3-H_2O	1,21	$NaIO_3$ chapter
KIO_3-HIO_3-H_2O	1,4	KIO_3 chapter
$RbIO_3$-HIO_3-H_2O	9	$RbIO_3$ chapter
$CsIO_3$-HIO_3-H_2O	11	$CsIO_3$ chapter
NH_4IO_3-HIO_3-H_2O	1,8	NH_4IO_3 chapter
HIO_3 + alkaline earth metal iodates + H_2O	6,15,22	SDS Volume 14 (27)

The Ice Polytherm

The only experimental solubility data along the ice polytherm are those of Groschuff, and the evaluators were unsuccessful in fitting all these data to the smoothing equation. This problem is due to the large standard error of estimate σ_x obtained using all reported data points. This error could be reduced slightly, but too many data points must be ignored (or rejected), and the resulting smoothing equation becomes trivial. The original data for the ice polytherm can be found in the compilation of reference (2).

The HIO_3 Polytherm

While the data of Groschuff (2) still dominate this part of the phase diagram, there are sufficient data from other studies (see Table 2) which permit fitting of all data to the smoothing equation. As seen from the summary in Table 2, a number of data points were rejected, notably from references (2, 3, 7-9, 12). The remaining data, treated as 23 independent solubility determinations as indicated in Table 2, were fitted to the following smoothing equation:

$$Y_x = 8079/(T/K) + 45.062\ \ln (T/K) - 269.85 - 0.05330(T/K)$$

$$\sigma_y = 0.023 \qquad \sigma_x = 0.0037$$

Smoothed solubilities calculated from this smoothing equation are given in Table 3, and all calculated solubilities are designated as *tentative* values.

COMPONENTS:

(1) Iodic acid, HIO_3; [7782-68-5]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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September, 1985

CRITICAL EVALUATION:

Table 1. Experimental solubilities in the HIO_3-H_2O system

T/K	mass %	mole fraction	Reference
259.2[b]	72.8	0.215	2
273.2	73.56	0.2217	4
273.2	74.1	0.227	2
273.2[a]	75.89	0.2438	7
286.7	74.10	0.227	2
289.2[a]	75.8	0.241	2
291.2	74.55	0.231	2
293.2[a]	68.72	-----	3
293.2[a]	75.8	0.243	2
298.2	75.10	0.2360	13
298.2	75.25	0.2374	11
298.2	75.32	0.2381	6
298.2	75.33	0.2382	6
298.2	75.40	0.2389	5
298.2	75.40	0.2389	14
298.2	75.40	0.2389	17
298.2	75.56	0.2405	4
303.2	76.70	0.2521	1
313.2[a]	73.70	0.2230	12
313.2	77.7	0.263	2
323.2[a]	76.53	0.2503	8,9
323.2	77.69	0.2629	16
323.2	78.62	0.2736	10,15
323.2	78.78	0.2755	4
333.2	80.0	0.291	2
353.2	82.5	0.326	2
358.2	83.0	0.333	2
374.2	85.2	0.371	2
383.2[c]	86.5	0.396	2

[a]Rejected data. Solid phase is HIO_3 except as noted below.

[b]Solid phase is ice + HIO_3.

[c]Solid phase is HIO_3 + HI_3O_8.

COMPONENTS:

(1) Iodic acid, HIO_3; [7782-68-5]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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September, 1985

CRITICAL EVALUATION:

Table 3. Tentative solubilities in the HIO_3-H_2O system calculated from the smoothing equation[a]

T/K	mass %	mole fraction
259.2[b]	73.04	0.217
273.2	73.45	0.221
283.2	74.10	0.227
293.2	74.98	0.235
298.2	75.48	0.240
303.2	76.03	0.245
313.2	77.20	0.257
323.2	78.46	0.272
333.2	79.78	0.288
343.2	81.13	0.306
353.2	82.48	0.325
363.2	83.82	0.347
373.2	85.14	0.370
383.2[c]	86.42	0.394

[a] Solid phase is HIO_3 except as noted.

[b] Solid phase is ice + HIO_3.

[c] Solid phase is HIO_3 + HI_3O_8.

COMPONENTS:	EVALUATOR:
(1) Iodic acid; HIO_3; [7782-68-5] (2) Water; H_2O; [7732-18-5]	H. Miyamoto Niigata University Niigata, Japan and M. Salomon US Army ET & DL Fort Monmouth, NJ, USA September, 1985

CRITICAL EVALUATION:

The $HIO_3.I_2O_5$ Polytherm

Solubility data for HIO_3 for which the solid phase is $HIO_3.I_2O_5$ (or HI_3O_5) were reported only by Groschuff in 1905 (2). The four data points reported in (2) over the temperature range 383 - 433 K are given in the compilation of Groschuff's paper.

The phase diagram for the binary system over the entire experimental temperature range of 254 K to 433 K is given in Figure 1.

TERNARY SYSTEMS

Systems With One Saturating Component

The solubility of iodine pentoxide in sulfuric acid solutions containing 50 to 106 mass % acid at 279.92 K was reported by Lamb and Phillips: note that the mass % sulfuric acid in excess of 100 % represents the mass of H_2SO_4 equivalent to 100 g of the acid. Excess SO_3 accounts for mass % values greater than 100 %: e.g. the acid content of 106 % contained 29 mass % SO_3. All data (both the "initial" and "final" sets of data as given in the compilation) were used to plot the phase diagram for this system. The phase diagram is given in Figure 2. According to the authors (19), the "initial" set of data correspond to HIO_3 solubilities in which there is a slow transformation to a less soluble substance. The shape of the lower isotherm (based on the "final" set of solubility data) was attributed by Lamb and Phillips to the solubility of I_2O_5 and anhydro iodic acid (HI_3O_5). It would appear that this simple explanation to the complex phase diagram in Figure 2 is in fact too simple, and that new studies are required to correctly identify all solid phases present in this system.

The solubilities in HNO_3 and HF systems were reported in (2,3) and (7), respectively. In the latter work (7), several solutions of high HF content yielded a solid phase containing the compound $2HIO_3.3HF$.

Ternary Systems Containing Two Saturating Components

Saturated solutions containing HIO_3 and an alkali metal iodate have been summarized in Table 1 above. There does not appear to be any major disagreement in any of these works. However, it should be noted that for the $NaIO_3$-HIO_3-H_2O system, Meerburg (1) found the compounds $Na_2I_4O_{11}$ and $NaH_2I_3O_9$ but he did not report NaI_3O_8 which was found in the work of Shibuya and Watanabe (21).

The solubility of HIO_3 in solutions saturated with alkaline earth iodates and with transition and rare earth metal iodates are summarized in Tables 4 and 5, respectively. Note that all the compilations for the systems summarized in Table 4 were previously given in the earlier volume to this series (27).

QUATERNARY SYSTEMS

Two quaternary systems have been reported which are:

HIO_3 - $LiIO_3$ - KIO_3 - H_2O at 323 K (24)

and

HIO_3 - $LiIO_3$ - $Al(IO_3)_3$ - H_2O at 298 K (25).

The compilations for both (24 and 25) can be found in the $LiIO_3$ chapter in this volume.

COMPONENTS:

(1) Iodic acid; HIO_3; [7782-68-5]

(2) Water; H_2O; [7732-18-5]

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September, 1985

CRITICAL EVALUATION:

Table 4. Summary of ternary systems with alkaline earth iodates

Ternary system	T/K	Solid phase	Reference
HIO_3 - $Mg(IO_3)_2$ - H_2O	298	HIO_3; $Mg(IO_3)_2.4H_2O$	(6)
HIO_3 - $Mg(IO_3)_2$ - H_2O	323	HIO_3; $Mg(IO_3)_2.4H_2O$	(22)
HIO_3 - $Sr(IO_3)_2$ - H_2O	323	HIO_3; $Sr(IO_3)_2.H_2O$; $Sr(IO_3)_2.HIO_3.H_2O$	(15)
HIO_3 - $Ba(IO_3)_2$ - H_2O	298	$I_2O_5.H_2O(HIO_3)$; $Ba(IO_3)_2.H_2O$; $Ba(IO_3)_2.I_2O_5$	(6)

Table 5. Summary of ternary system with transition and rare earth metal iodates

Ternary system	T/K	Solid phase	Reference
HIO_3 - $Al(IO_3)_3$ - H_2O	298	HIO_3; $Al(IO_3)_3.6H_2O$ $Al(IO_3)_3.2HIO_3.6H_2O$	(13)
HIO_3 - $Zn(IO_3)_2$ - H_2O	323	HIO_3; $Zn(IO_3)_2.2H_2O$	(16)
HIO_3 - $Cd(IO_3)_2$ - H_2O	323	HIO_3; $Cd(IO_3)_2$; $2HIO_3.Cd(IO_3)_2$	(16)
HIO_3 - $La(IO_3)_3$ - H_2O	298	HIO_3; $La(IO_3)_2.2.5H_2O$; $La(IO_3)_3$	(23)
HIO_3 - $Sc(IO_3)_3$ - H_2O	298	HIO_3; $Sc(IO_3)_3.18H_2O$; $Sc(IO_3)_3.4HIO_3.18H_2O$	(14)
HIO_3 - $Nd(IO_3)_3$ - H_2O	298	HIO_3; $Nd(IO_3)_3$; $Nd(IO_3)_3.HIO_3.2H_2O$; $Nd(IO_3)_3.3HIO_3.2H_2O$	(17)

COMPONENTS:	EVALUATOR:
(1) Iodic acid; HIO_3; [7782-68-5] (2) Water; H_2O; [7732-18-5]	H. Miyamoto Niigata University Niigata, Japan September, 1985

CRITICAL EVALUATION:

REFERENCES

1. Meerburg, P. A. *Z. Anorg. Alleg. Chem.* 1905, *45*, 324.
2. Groschuff, E. *Z. Anorg. Alleg. Chem.* 1905, *47*, 331.
3. Guichard, M. *C. R. Hebd. Seances. Acad. Sci.* 1909, *148*, 923.
4. Smith, S. B. *J. Am. Chem. Soc.* 1947, *69*, 2285.
5. Ricci, J. E.; Amron, I. *J. Am. Chem. Soc.* 1951, *73*, 3613.
6. Ricci, J. E.; Freedman, A. J. *J. Am. Chem. Soc.* 1952, *74*, 1769.
7. Nikolaev, N. S.; Buslaev, Y. A. *Zh. Neorg. Khim.* 1956, *1*, 1672; *Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1956, *1*, 230.
8. Tatarinov, V. A. *Uch. Zap. Yarosl. Gas. Pedagog. Inst.* 1971, No. 95, 113.
9. Tatarinov, V. A. *Uch. Zap. Yarosl. Gas. Pedagog. Inst.* 1972, No. 103, 83.
10. Azarova, L. A.; Vinogradov, E. E.; Mikhailova, E. M.; Pakhomov, V. I. *Zh. Neorg. Khim.* 1973, *18*, 239; *Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1973, *18*, 124.
11. Tatarinov, V. A. *Uch. Zap. Yarostav. Gas. Pedagog. Inst* 1973, No. 120, 71.
12. Shklovskaya, R. M.; Arkhipov, S. M.; Kidyarov, B. I.; Mitnitskii, P. L.; *Izv. Sib. Otd. Akad. Nauk SSSR Ser. Khim. Nauk* 1976, (*6*), 89.
13. Shklovskaya, R. M.; Arkhipov, S. M.; Kidyarov, B. I.; Kuzina, V. A.; Tsibulrvskaya, K. A. *Zh. Neorg. Khim.* 1977, *22*, 1372; *Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1977, *22*, 747.
14. Vinogradov, E. E.; Lepeshkov, I. N.; Tarasova, G. N. *Zh. Neorg. Khim.* 1977, *22*, 2858; *Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1977, *22*, 1552.
15. Vinogradov, E. E.; Azarova, L. A.; Pakhomov, V. I. *Zh. Neorg. Khim.* 1978, *23*, 534; *Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1978, *23*, 297.
16. Lepeshkov, I. N.; Vinogradov, E. E.; Karataeva, I. M. *Zh. Neorg. Khim.* 1979, *24*, 2540; *Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1979, *24*, 1412.
17. Tarasova, G. N.; Vinogradov, E. E.; Kudinov, I. B. *Zh. Neorg. Khim.* 1982, *27*, 505; *Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1982, *27*, 287.
18. Lukasiewicz, T.; Pietaszewska, J.; Zmija, J. *Biul. Wojsk. Acad. Teck.* 1979, *28*(*12*) 85.
19. Lamb, A. B.; Phillips, A. W. *J. Am. Chem. Soc.* 1923, *45*, 108.
20. Moles, E.; Vitoria, A. P. *Ann. Soc. Esp. Fis. Quim.* 1932, *30*, 200.
21. Shibuya, M.; Watanobe, T. *Denki Kagaku* 1967, 35, 550.
22. Vinogradov, E. E.; Azarova, L. A. *Zh. Neorg. Khim.* 1977, *22*, 1666; *Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1977, *22*, 903.
23. Lyalina, R. B.; Soboleva, L. V. *Zh. Neorg. Khim.* 1975, *20*, 2568; *Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1975, *20*, 1424.
24. Azarova, L. A.; Vinogradov, E. E.; Lepeshkov, I. M. *Zh. Neorg. Khim.* 1978, *23*, 1952; *Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1978, *23*, 1072.
25. Shklovskaya, R. M.; Arkhipov, S. M.; Kidyarov, B. I.; Tsibulevskaya, K. A. *Zh. Neorg. Khim.* 1979, *24*, 253; *Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1979, *24*, 141.

COMPONENTS:

(1) Iodic acid; HIO_3; [7782-68-5]

(2) Water; H_2O; [7732-18-5]

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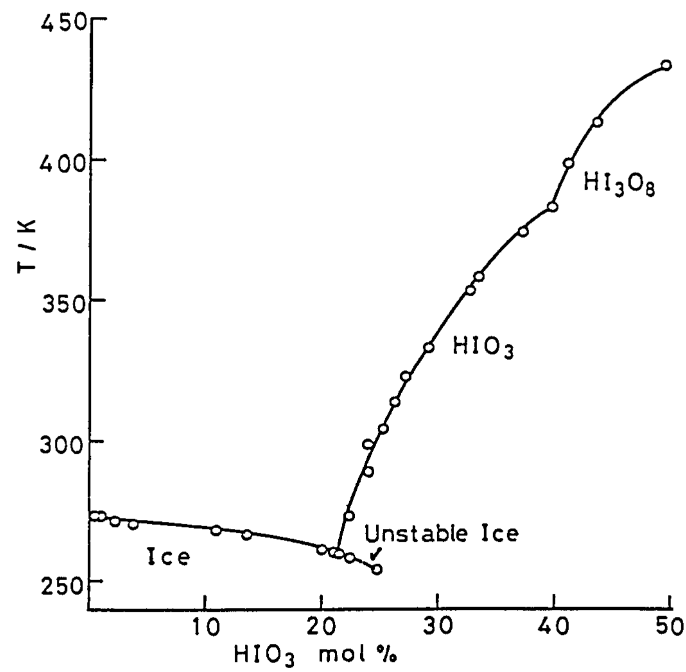
CRITICAL EVALUATION:

REFERENCES (Continued)

26. Erkasov, R. Sh.; Bermzhanov, B. A.; Nurakhmetov, N. N. *Zh. Neorg. Khim.* 1981, *26*, 1441-4; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1981, *26*, 776-8.

27. Miyamoto, H.; Salomon, M.; Clever, H. L. *IUPAC Solubility Data Series Volume 14: Alkaline Earth Metal Halates.* Pergamon Press, London, 1983.

Figure 1.



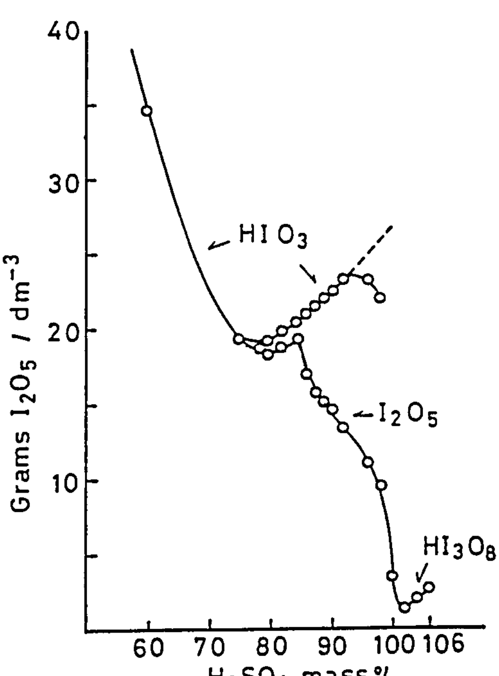


Figure 2.