COMPONENTS:	EVALUATOR:
(1) Potassium iodate; KIO_3; [7758-05-6]	H. Miyamoto Niigata University Niigata, Japan and Mark Salomon US Army ET & DL Fort Monmouth, NJ, USA
(2) Water; H_2O; [7732-18-5]	June, 1986

CRITICAL EVALUATION:

THE BINARY SYSTEM

Solubility data for KIO_3 in pure water have been reported in 30 publications (1-28, 35, 36). A summary of the solubility data over the temperature range 273-373 K is given in Table 1. Note that the data from references (15, 16, 20 and 31) have been compiled in the $LiIO_3$ chapter, and the data in reference (3) have been compiled in the $NaIO_3$ chapter. With the exception of the high temperature study of Benrath et al. (7) which employed the synthetic method, all other studies are based on the isothermal method. From Table 1 it is seen that a number of authors reported identical solubilities in more than one publication, and the evaluators have therefore treated these results as one independent measurement. Thus, at 298.2 K, the data in (3, 8, 10) have been treated as one independent solubility value as have the data reported in (17, 19, 23), and at 323.2 K in (18, 21, 26). Most authors reported the solid phase over the temperature range of 278-323 K as the anhydrous salt, and although Breusov et al. (11) and Benrath et al. (7) did not report the nature of the solid phases over the temperature range of 273-573 K, it probably is the anhydrous salt in all cases.

In fitting the solubility data to the two smoothing equations, a number of data points were rejected as the differences in smoothed (calculated) solubilities differed from the experimental values by more than 2σ (where σ is the standard error of estimate). The rejected data are referenced in Table 1, and it should be noted that the results of Wright (36) are so divergent from all other data that one must carefully question whether his results for ethanol-water mixtures are of any practical value.

Thirty-two data points over the temperature range 273-373 K (see Table 1) were fitted to the smoothing equations with the following results:

$$Y_x = -20587.2/(T/K) - 92.129\ \ell n\ (T/K) + 549.07 + 0.12250\ (T/K)$$

$$\sigma_y = 0.013 \qquad \sigma_x = 4.9 \times 10^{-5}$$

and

$$Y_m = -4037.0/(T/K) - 6.671\ \ell n\ (T/K) + 51.547$$

$$\sigma_y = 0.0079 \qquad \sigma_m = 0.0047$$

Table 2 lists the solubilities calculated from these two smoothing equations, and the smoothed solubilities are designated as *recommended* solubilities.

Benrath's data (7) over the temperature range of 390-573 K were treated separately, and the following smoothing equations were obtained:

$$Y_x = -9532/(T/K) - 30.702\ \ell n\ (T/K) + 188.09 + 0.03523(T/K)$$

$$\sigma_y = 0.024 \qquad \sigma_x = 8.3 \times 10^{-4}$$

and

$$Y_m = 298.8/(T/K) + 2.888\ \ell n\ (T/K) - 17.21$$

$$\sigma_y = 0.015 \qquad \sigma_m = 0.090$$

Smoothed solubilities based on Benrath's data are given in Table 3, and are designated as *tentative* solubilities.

COMPONENTS:	EVALUATOR:
(1) Potassium iodate; KIO_3; [7758-05-6]	H. Miyamoto Niigata University Niigata, Japan and Mark Salomon US Army ET & DL Fort Monmouth, NJ, USA
(2) Water; H_2O; [7732-18-5]	June, 1986

CRITICAL EVALUATION:

Table 1. Summary of solubilities in the KIO_3-H_2O system[a]

T/K	mol kg^{-1}	mole fraction	reference
273.2	0.221	0.00396	9
273.2	0.224	0.00402	11
278.2	0.259	0.00464	4
278.2	0.254	0.00456	3
278.2	0.2556	0.00458	5
283.2	0.300	0.00538	11
288.2	0.335	0.005994	2
293.2	0.378	0.006758	2
293.2	0.386	0.00690	35
293.2[a]	0.59	-----	36
298.2[a]	0.438	0.00783	11
298.2	0.431	0.00771	3,8,10
298.2	0.431	0.00771	13
298.2	0.432	0.00772	4
298.2	0.432	0.00772	12
298.2	0.4314	0.00771	5
298.2	0.4312	0.007709	6
298.2	0.431	0.00771	27
298.2	0.431	0.00771	35
298.2[a]	0.425	0.00760	2
298.2	0.428	0.00765	24
298.2	0.429	0.00766	17,19,23
298.2	0.4325	0.007732	28
298.2[a]	0.45	0.0080	14
303.2[a]	0.491	0.00877	1
303.2	0.482	0.00861	11
303.2	0.487	0.00869	35
313.2	0.585	0.01043	11
323.2[a]	0.5989	0.01067	22
323.2[a]	0.6228	0.01109	18,21,26
323.2[a]	0.703	0.01250	11
323.2	0.7112	0.01265	3
323.2	0.7112	0.01265	9
323.2	0.7106	0.01264	5
323.6	0.7206	0.01280	4
333.2	0.844	0.01498	11
343.2	0.985	0.01744	11
353.2	1.136	0.02005	11
363.2	1.306	0.02300	11
373.2	1.475	0.02588	11
373.2[a]	4.60	-----	36

[a] rejected data points

COMPONENTS:	EVALUATOR:
(1) Potassium iodate; KIO_3; [7758-05-6]	H. Miyamoto Niigata University Niigata, Japan and Mark Salomon US Army ET & DL Fort Monmouth, NJ, USA
(2) Water; H_2O; [7732-18-5]	June, 1986

CRITICAL EVALUATION:

Table 2. Smoothed solubilities from 273-373 K[a]

T/K	mol kg^{-1}[b]	mole fraction
273.2	0.223	0.00398
278.2	0.258	0.00461
283.2	0.296	0.00531
288.2	0.337	0.00605
293.2	0.382	0.00685
298.2	0.430	0.00770
303.2	0.481	0.00860
313.2	0.592	0.01039
323.2	0.715	0.01266
333.2	0.849	0.01497
343.2	0.992	0.01744
353.2	1.143	0.02009
363.2	1.300	0.00229
373.2	1.446	0.02593

[a]All data in this table are designated as *recommended*.

[b]Reference molality used in the smoothing equation is 0.431 mol/kg.

COMPONENTS:	EVALUATOR:
(1) Potassium iodate; KIO_3; [7758-05-6]	H. Miyamoto Niigata University Niigata, Japan and Mark Salomon US Army ET & DL Fort Monmouth, NJ, USA
(2) Water; H_2O; [7732-18-5]	June, 1986

CRITICAL EVALUATION:

Table 3. Smoothed solubilities from 393-573 K based on data from (7)[a]

T/K	mol kg^{-1}[b]	mole fraction
393.2	1.69	0.0294
403.2	1.85	0.0323
413.2	2.02	0.0353
423.2	2.20	0.0384
433.2	2.40	0.0417
443.2	2.60	0.0450
453.2	2.82	0.0485
463.2	3.04	0.0521
473.2	3.28	0.0558
483.2	3.53	0.0597
493.2	3.79	0.0638
503.2	4.07	0.0680
513.2	4.35	0.0724
523.2	4.66	0.0770
533.2	4.97	0.0818
543.2	5.30	0.0869
553.2	5.64	0.0922
563.2	6.00	0.0978
573.2	6.37	0.1038

[a]All data in this table are designated as *tentative*.

[b]Reference molality used in the smoothing equation is 3.69 mol/kg.

COMPONENTS:	EVALUATOR:
(1) Potassium iodate; KIO_3; [7758-05-6] (2) Water; H_2O; [7732-18-5]	Hiroshi Miyamoto Department of Chemistry Niigata University Niigata, Japan June, 1984

CRITICAL EVALUATION:

TERNARY SYSTEMS

1. One Saturating Component

Ricci and Nesse (28) measured solubilities of potassium iodate in mixtures of water and 1,4-dioxane at 298 K over the complete range of concentration from 0 to 100 % dioxane at intervals of 10 % by mass. The measurements cover a dielectric constant range from 2.10 to 78.50. The solubility of potassium iodate decreases with increasing dioxane concentration, that is, the solubility decreases with decreasing dielectric constant of the solvent mixture.

Bronsted (29) measured solubilities of potassium iodate in aqueous potassium hydroxide solutions at 298 K over the potassium hydroxide concentration range from 4.71 to 15.02 mol dm^{-3}. The temperature dependence of the solubility showed a minimum near the hydroxide concentration of 12 mol dm^{-3}.

2. Two Saturating Components

Summaries of solubilities in aqueous ternary systems with 2 saturating components are given in Tables 4-6.

The System With Iodic Acid. This system was studied by Meerburg (1) at 303 K and by Smith (9) at 278, 298 and 303 K. Two double salts $KIO_3.HIO_3$ and $KIO_3.2HIO_3$ are found in this system.

Systems With The Other Alkali Metal Iodates. Solubility studies of ternary systems containing potassium iodate and other alkali iodates have been reported in 5 publications (2, 12, 13, 15, 16) (see Table 4). The two ternary systems KIO_3-$NaIO_3$-H_2O are of the simple eutonic type, and no double salts form. The sodium salt in the solid phase at 278 K is the pentahydrate, and that at 298 and 323 K is the monohydrate. The solubility for the ternary KIO_3-$LiIO_3$-H_2O system has been reported in 2 publications (15, 16). The double salt $KIO_3.2LiIO_3$ was formed.

Table 4. Summary of solubility studies on ternary systems with potassium iodate and other alkali metal iodates

Ternary system	T/K	Solid phase
KIO_3 - $LiIO_3$ - H_2O	298	KIO_3, $LiIO_3$, $KIO_3.2LiIO_3$
KIO_3 - $LiIO_3$ - H_2O	323	KIO_3, $LiIO_3$, $KIO_3.2LiIO_3$
KIO_3 - $NaIO_3$ - H_2O	278	KIO_3, $NaIO_3.5H_2O$
KIO_3 - $NaIO_3$ - H_2O	298, 323	KIO_3, $NaIO_3.H_2O$
KIO_3 - $RbIO_3$ - H_2O	298	Not given
KIO_3 - $CsIO_3$ - H_2O	298	KIO_3, $CsIO_3$

Systems With Alkaline Earth Metal Iodates. The ternary KIO_3-$Mg(IO_3)_2$-H_2O system at 323 K has been studied by Vinogradov and Karataeva (25). The dominant feature in this system is the existence of the double salt $2KIO_3.Mg(IO_3)_2.4H_2O$. The ternary KIO_3-$Ba(IO_3)_2$-H_2O system was studied by Azarova and Vinogradov (24) and is of the simple eutonic type: no double salts were formed. Ternary systems with calcium and strontium iodate have not been studied.

COMPONENTS:	EVALUATOR:
(1) Potassium iodate; KIO_3; [7758-05-6]	Hiroshi Miyamoto Department of Chemistry Niigata University Niigata, Japan
(2) Water; H_2O; [7732-18-5]	June, 1984

CRITICAL EVALUATION:

Systems With Transition Metal and Rare Earth Iodates. Solubilities in ternary systems with transition metal iodates have been reported in 4 publications (18, 21, 22, 26), and are summarized in Table 5.

Table 5. Summary of solubility studies on ternary systems with KIO_3 and transition metal iodates

Ternary system	T/K	Solid phase	Reference
KIO_3 - $Mn(IO_3)_2$ - H_2O	323	KIO_3, $Mn(IO_3)_2.K_2[Mn(IO_3)_4(H_2O)_2]$	21
KIO_3 - $Co(IO_3)_2$ - H_2O	323	KIO_3, $Co(IO_3)_2.2H_2O$ $2KIO_3.Co(IO_3)_2.2H_2O$	18
KIO_3 - $Ni(IO_3)_2$ - H_2O	323	$KIO_3.Ni(IO_3)_2.2H_2O$ $K_2[Ni(IO_3)_2.(H_2O)_2]$	22
KIO_3 - $Cu(IO_3)_2$ - H_2O	323	KIO_3, $Cu(IO_3)_2.2H_2O$ $2KIO_3.Cu(IO_3)_2.2H_2O$	26
KIO_3 - $Zn(IO_3)_2$ - H_2O	323	KIO_3, $Zn(IO_3)_2.2H_2O$, $2KIO.Zn(IO_3)_2.2H_2O$	18

Double salts $2KIO_3.Co(IO_3)_2.2H_2O$ and $KIO_3.Zn(IO_3)_2.2H_2O$ were reported in (18) by Lepeshkov, Vinogradov and Karataeva. Further investigation of the double compounds by various physicochemical methods (21) suggest that the compounds are complexes with Co^{2+} or Zn^{2+} central ions in an octahedral environment of four IO_3^- ions and two water molecules. Vinogradov, Karataeva and Lepeshkov (26) reported that like the double compounds of potassium iodate with cobalt or zinc iodate, the double salt of potassium iodate and copper iodate is probably a complex with the following formula: $K_2[Cu(IO_3)_4(H_2O)_2]$. Therefore, the dominant feature in these systems is the existence of complex compounds with the general formula $K_2[M(IO_3)_4.(H_2O)_2]$ (M = Mn, Co, Ni, Cu and Zn), and the transition metal iodate in the solid phase is $M(IO_3)_2.2H_2O$(M = Co, Ni, Cu and Zn). Manganese iodate is the anhydrate.

The ternary KIO_3-$Nd(IO_3)_3$-H_2O system was studied by Tarasova, Vinogradov and Kudinov (23). The system is of the simple eutonic type, and no double salts form.

Although aluminum cannot be classified as a transition metal, this system is reviewed in this section. The ternary KIO_3-$Al(IO_3)_3$-H_2O system studied by Vinogradov and Tarasova (19) is eutonic, and no double compounds form.

System With Potassium Halides. Solubility studies for these ternary systems are summarized in Table 6. These systems are eutonic, and no double salts form.

Table 6. Summary of the ternary systems KIO_3 - Potassium halide - H_2O

Ternary system	T/K	Solid phase	Reference
KIO_3 - KCl - H_2O	278, 298, 323	KIO_3, KCl	3
KIO_3 - KBr - H_2O	278, 298, 322	KIO_3, KBr	5
KIO_3 - KI - H_2O	298	KIO_3, KI	6

COMPONENTS:	EVALUATOR:
(1) Potassium iodate; KIO_3; [7758-05-6]	Hiroshi Miyamoto Department of Chemistry Niigata University Niigata, Japan
(2) Water; H_2O; [7732-18-5]	June, 1984

CRITICAL EVALUATION:

System With The Other Potassium Salts. The ternary system KIO_3-K_2SO_4-H_2O was studied by Hill and Ricci (3). At 278, 298 and 323 K, compound formation such as those which form in the corresponding sodium system (32) does not occur. The potassium system is thus of the simple eutonic type.

The ternary system KIO_3-KNO_3-H_2O was studied by Hill and Brown (4). At 278, 298 and 323 K, no compound formation occurs which differs from the corresponding sodium salt systems (33, 34) where compound formation was observed.

The ternary system KIO_3-$KClO_3$-H_2O was studied by Ricci (8). Neither compound formation nor solid solution were observed at the temperature studied.

The ternary system KIO_3-K_2MoO_4-H_2O was studied by Ricci and Loprest (10). The results showed that the only solids are the pure anhydrous salts, and no double compounds form at 298 K.

The System With Potassium Hydroxide. Solubilities in the ternary KIO_3-KOH-H_2O system at 298 K have been studied by Leposhkov, Vinogradov and Tarasova (17). The phase diagram is of the simple eutonic type, and no double salts form.

OTHER MULTICOMPONENT SYSTEMS

The quaternary KIO_3-KI-KOH-H_2O system was studied by Malyshev, Kuz'menko, Novikov and Traul'ko (30) at 293, 333 and 353 K. The pH was adjusted to 13.8 with potassium hydroxide, and the authors stated that the solubility of potassium iodate in the alkaline medium is less than in the KIO_3-KI-H_2O ternary system. The compositions of the solid phase in equilibrium with the saturated solutions are KIO_3 and KI.

The quaternary system KIO_3-$LiIO_3$-HIO_3-H_2O has been studied by Azarova and Vinogradov (31) at 323 K. Three double salts, $KIO_3.2LiIO_3$, $KIO_3.HIO_3$ and $KIO_3.2HIO_3$ were formed, and lithium iodate and iodic acid formed a restricted range of solid solutions.

The KIO_3-$LiIO_3$-LiOH-KOH-H_2O system at 298 K was studied by Vinogradov, Lepeshkov and Tarasova (20). Solubilities in the quaternary systems KIO_3-$LiIO_3$-LiOH-H_2O and KIO_3-LiOH-KOH-H_2O have been reported, but data for the five component system were not given. Solid phases found in this study are the pure components $LiIO_3$, KIO_3, $LiOH.2H_2O$ and $KOH.2H_2O$. Solid solutions and the double salt $KIO_3.2LiIO_3$ were also found.

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COMPONENTS:	EVALUATOR:
(1) Potassium iodate; KIO_3; [7758-05-6] (2) Water; H_2O; [7732-18-5]	Hiroshi Miyamoto Department of Chemistry Niigata University Niigata, Japan June, 1984

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COMPONENTS:	EVALUATOR:
(1) Potassium iodate; KIO_3; [7758-05-6] (2) Water; H_2O; [7732-18-5]	Hiroshi Miyamoto Department of Chemistry Niigata University Niigata, Japan June, 1984

CRITICAL EVALUATION:

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