COMPONENTS:	EVALUATOR:
(1) Potassium Bromate; $KBrO_3$; [7758-01-2]	H. Miyamoto Niigata University Niigata, Japan and M. Salomon U.S. ARMY ET & DL Fort Monmouth, NJ, USA June, 1985
(2) Water; H_2O; [7732-18-5]	

CRITICAL EVALUATION:

THE BINARY SYSTEM

Solubility data for the binary $KBrO_3$-H_2O system have been reported in 13 publications (1-13). Breusov et al. (13) also cite data from a handbook (14) which the evaluators cannot trace. For those solubility values from (14) which we cannot locate, the majority are much higher than those reported in (1-13), and they must be rejected in any case. Note that the compilation of reference (6) is given in the $KClO_3$ chapter.

No hydrates of $KBrO_3$ have been reported, and the solid phase in all studies is the anhydrous salt. All studies employed the isothermal method with the exception of the study by Benrath et al. (5) who used the synthetic method over the temperature range of 407-585 K. In analyzing the solubility data, we have treated the low and high temperature data separately: i.e. from the isothermal studies over the temperature range of 273-373 K, and from the synthetic study over the temperature range of 407-585 K. Summaries of these data are given in Tables 1 and 2, respectively.

Table 1. Experimental Solubilities from 273-373 K[a]

T/K	mass %	χ	(ref)	T/K	mass %	χ	(ref)
273.2	2.98	0.003303	(13)	303.15	8.785	0.01028	(3)
273.2	2.96	0.003280	(4)	303.2	8.84	0.01035	(13)
278.15	3.642	0.004061	(3)	308.15	10.13	0.01201	(3)
283.15	4.510	0.005069	(3)	313.15	11.58	0.01393	(3)
283.2	4.54	0.005104	(13)	313.2	11.70	0.01409[b]	(4)
288.15	5.397	0.006117	(3)	313.2	11.67	0.01405	(13)
293.15	6.460	0.007395	(3)	318.15	13.08	0.01597	(3)
293.2	6.43	0.007359	(4)	323.15	14.69	0.01824	(3)
293.2	6.42	0.007346	(13)	323.2	14.82	0.01842	(13)
298.15	7.733	0.008712	(3)	333.2	18.21	0.02345	(4)
298.15	7.533	0.008712	(6)	333.2	18.08	0.02325	(13)
298.15	7.635[b]	0.008839	(7)	343.2	21.76	0.02913	(13)
298.2	7.49	0.008658	(9)	353.2	25.53	0.03566	(4)
298.2	7.53	0.008708	(10)	353.2	25.35	0.03534[b]	(13)
298.2	7.7[b]	0.00892	(11)	363.2	29.40	0.04299	(13)
298.2	7.49	0.008658	(12)	373.2	33.31	0.05113	(13)
298.2	7.52	0.008696	(8)				
298.2	7.55	0.008733	(13)				

[a]Mole fraction solubilities calculated by evaluators.

[b]Rejected data points (see text for discussion).

Table 2. High Temperature Solubility Data from ref. (5)[a]

T/K	mass %	χ	T/K	mass %	χ
407.2	43.6	0.07697	499.2	70.6	0.2057
422.2	48.4	0.09189	503.2	72.6	0.2223
433.2	51.1	0.1013	522.2	72.6	0.2223
440.2	53.5	0.1104	527.2	74.4	0.2387
443.2	54.1	0.1128	538.2	77.2	0.2675
445.2	57.3	0.1265	547.2	79.1	0.2899
449.2	59.9	0.1388	552.2	81.1	0.3164
466.2	63.2	0.1563	559.2	81.4	0.3207
477.2	64.2	0.1621	570.2	83.1	0.3466
484.2	67.4	0.1824	585.2	86.4	0.4066

[a]Mole fraction solubilities calculated by evaluators.

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CRITICAL EVALUATION:

Solubility data in mol dm^{-3} units were reported in (1,2), and while Ricci et al. (3,6) reported data in mass % units, densities for the saturated solutions were also given enabling the evaluators to convert these mass units into volume units. Table 3 lists the solubility data in volume units from 278-313 K.

Table 3. Experimental Solubilities Based on Volume Units[a]

T/K	density/g cm^{-3}	c/mol dm^{-3}	reference
278.15	1.024	0.2233	3
283.15	1.035	0.2795	3
288.15	1.042	0.3367	3
293.15	1.048	0.4054	3
298.15	1.054	0.4754	3,6
298.2	----	0.4715[b]	1
298.2	----	0.478	2
303.15	1.062	0.5587	3
308.15	1.074	0.6515	3
313.15	1.083	0.7510	3

[a]Original data from (3,6) are in mass %, and conversions to mol dm^{-3} calculated by evaluators using experimental densities of saturated solutions given in the table.

[b]Rejected data point.

Over the temperature range of 273-373 K, the mole fraction solubility data were fitted to the smoothing equation, and four data points were rejected on the basis that the difference between calculated and observed solubilities exceeded $2\sigma_m$ (see Table 1 for rejected data points). The remaining 30 data points were used to obtain the following smoothing equation:

$$Y_x = -22549.21/(T/K) - 83.2220\ell n(T/K) + 514.161 + 0.092301(T/K) \quad [1]$$

$$\sigma_y = 0.011 \qquad \sigma_x = 6.3 \times 10^{-5}$$

The smoothed solubilities calculated from eq. [1] are designated as *recommended* values, and are given in Table 4.

Over the temperature range of 407-585 K, the data of Benrath et al. (5) were used to obtain the following smoothing equation:

$$Y_x = -45971.8/(T/K) - 169.820\ell n(T/K) + 1060.642 + 0.16898(T/K) \quad [2]$$

$$\sigma_y = 0.079 \qquad \sigma_x = 0.0086$$

The standard error in the solubilities is quite high, and we designate the calculated (smoothed) solubilities as *tentative* values. Using eq. [2] to calculate solubilities outside the experimental temperature range is not recommended. The melting point of $KBrO_3$ calculated from eq. [2] is 660.1 K which is not in good agreement with the handbook value of 623 K (15): according to (15) the pure salt decomposes at 643 K.

For the solubilities in mol kg^{-1} units over the temperature range of 273-373 K, the 30 acceptable data used to derive the smoothing equation [1] were fitted to the following smoothing equation:

$$Y_m = -6137.40/(T/K) - 10.4118\ell n(T/K) + 79.904 \quad [3]$$

$$\sigma_y = 0.0070 \qquad \sigma_m = 0.0088$$

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CRITICAL EVALUATION:

The mol kg^{-1} solubilities calculated from eq.[3] are designated as *recommended* values, and values at rounded temperatures are given in Table 4.

The solubilities in units of mol dm^{-3} were fitted to the simple smoothing equation:

$$\ell n(c/\text{mol dm}^{-3}) = -7507.54/(T/K) - 15.3273\ell n(T/K) + 111.769 \quad [4]$$

$$\sigma_c = 0.0018$$

We designate the smoothed solubilities as *tentative*, and values from 278-313 K are given in Table 4.

Table 4. Recommended and Tentative Solubilities Calculated from the Smoothing Equations [1], [3], [4]. Solid Phase is the Anhydrous Salt.

T/K	χ[a]	m/mol kg^{-1}[a]	c/mol dm^{-3}[b]
273.2	0.003294	0.1848	
278.2	0.004098	0.2286	0.2266
283.2	0.005036	0.2809	0.2777
288.2	0.006116	0.3404	0.3364
293.2	0.007347	0.4099	0.4030
298.2	0.008737	0.4883	0.4777
303.2	0.01029	0.5766	0.5608
308.2	0.01202	0.6743	0.6522
313.2	0.01392	0.7849	0.7519
318.2	0.01601	0.9043	
323.2	0.01827	1.038	
333.2	0.02335	1.336	
343.2	0.02918	1.679	
353.2	0.03574	2.066	
363.2	0.04303	2.493	
373.2	0.05105	2.955	

[a]Recommended values.

[b]Tentative values.

TERNARY SYSTEMS

The solubility of $KBrO_3$ in ternary systems have been reported in a number of publications (3, 4, 6, 8-12), and detailed information can be found in the compilations. Since no two studies are exactly alike, comparisons cannot be made and therefore critical evaluation is not possible at this time.

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CRITICAL EVALUATION:

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