COMPONENTS:	EVALUATOR:
(1) Rubidium chlorate; $RbClO_3$; [13446-71-4]	H. Miyamoto Chemistry Department Niigata University, Niigata, Japan and M. Salomon US Army ET & DL Fort Monmouth, NJ, USA
(2) Water; H_2O; [7732-18-5]	August 1984

CRITICAL EVALUATION:

THE BINARY SYSTEM

Solubility data in the binary $RbClO_3$ - H_2O system have been reported in seven publications (1-7). Three publications (1,2,4) report data only for the binary system whereas the remaining publications (3, 5-7) concern isothermal studies on ternary systems which include data for the binary system.

Although some investigators (1-4) did not report the nature of the solid phase, the evaluators assume it to be the anhydrous salt by analogy to the results found in the studies on ternary systems (see below).

A number of different analytical techniques were used to measure the solubilities. In (1-3) the total salt content was determined gravimetrically, and in (5-6) the chlorate content was determined by back titration of iron (II) sulfate with potassium permanganate. In (6) the rubidium content was also determined gravimetrically with sodium tetraphenylborate and by flame photometry. In (7) the chlorate content was determined by argentimetric titration with silver nitrate after reduction of chlorate to chloride.

The experimental solubility data for the binary system are summarized in Table 1 where the evaluators have made appropriate conversions to both mol kg^{-1} and mole fraction units (χ).

Table 1 Experimental solubility data for $RbClO_3$ in water.[a]

T/K	mol kg^{-1}	χ	(ref)	T/K	mol kg^{-1}	χ	(ref)
273.2	0.1265	0.002274	(1)	303.2	0.4779	0.008536	(4)
273.2	0.1282	0.002305	(4)	313.2	0.6827	0.01215	(4)
273.2	0.1282	0.002305	(5)	315.4	0.739	0.01314	(1)
281.2	0.182	0.003268	(1)	323.2	0.9430	0.01670	(4)
283.2	0.2109	0.003785	(4)	323.2	0.9430	0.01670	(5)
293.0	0.317	0.005678	(1)	323.2	0.946	0.01676	(1)
293.2	0.32	0.00573	(2)	333.2	1.3083	0.02303	(4)
293.2	0.3129	0.005605	(4)	343.2	1.7197	0.03005	(4)
298.2	0.3940	0.007048	(3)	349.2	2.020	0.03511	(1)
298.2	0.3940	0.007048	(5)	353.2	2.2704	0.03929	(4)
298.2	0.3920	0.007012	(7)	363.2	2.9040	0.04972	(4)
298.2	0.3893	0.006964	(4)	372.2	3.72	0.06281	(1)
298.2	0.406	0.007261	(6)	373.2	3.720	0.06281	(4)
303.2	0.474	0.008467	(1)				

[a] All data were converted by the evaluators to molality or mole fraction based on original experimental data reported in refs (1-7).

In evaluating the solubility data in Table 1, we used the two smoothing equations based on mole fractions (see the PREFACE, this volume),

$$Y_x = A/(T/K) + B\ell n(T/K) + C + D(T/K) \quad [1]$$

and based on molality (see the INTRODUCTION TO THE SOLUBILITY OF SOLIDS IN LIQUIDS and the PREFACE in Volume 13):

$$Y_m = A/(T/K) + B\ell n(T/K) + C \quad [2]$$

where

$$Y_m = \ell n(m/m_o) - nM_2(m - m_o) \quad [3]$$

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(1) Rubidium chlorate; $RbClO_3$; [13446-71-4] (2) Water; H_2O; [7732-18-5]	H. Miyamoto Chemistry Department Niigata University, Niigata, Japan and M. Salomon US Army ET & DL Fort Monmouth, NJ USA August, 1984

CRITICAL EVALUATION:

In eq. [3], m is the molality, m_o is a reference molality (the 298.2 K value was used for the present analyses), n is the hyration number in the solid phase (n = 0 for the present system), and M_2 is the molar mass of the solvent. Additional details on eqs. [2-3] can be found in the PREFACE to volume 13 of the Solubility Data Series (1). By giving all data equal weights, we found that three data points from Table 1 could be rejected on the basis that their differences in the experimental and calculated mole fraction solubilities exceeded $2\sigma_x$ (σ_x is the standard error of estimate as defined in eq. [3] of the $LiClO_3$-H_2O critical evaluation). The three data points rejected are from (2) for 293.2 K, from (6) at 298.2 K, and from (1) at 273.2 K. Fitting the remaining 24 data points to eqs. [1] and [2] above resulted in the following:

$$Y_x = -27167.445/(T/K) - 111.3525\ell n(T/K) + 673.495 + 0.145962(T/K) \quad [4]$$

$$\sigma_y = 0.033 \qquad \sigma_x = 0.00014$$

and

$$Y_m = -5904.5/(T/K) - 7.8407\ell n(T/K) + 64.466 \quad [5]$$

$$\sigma_y = 0.015 \qquad \sigma_m = 0.029$$

The solubilities calculated from eqs. [4] and [5] are designated as *recommended* solubilities, and values at rounded temperatures are given in Table 2 below.

Table 2. Recommended solubilities in the binary system calculated from the smoothing equations [4] and [5]

T/K	m/mol kg^{-1}	χ
273.2	0.1267	0.002286
283.2	0.2050	0.003714
293.2	0.3181	0.005743
298.2	0.3905	0.007025
303.2	0.4751	0.008510
313.2	0.6860	0.012164
323.2	0.9607	0.016860
333.2	1.3091	0.022769
343.2	1.7398	0.030078
353.2	2.2608	0.039009
363.2	2.8779	0.049818
373.2	3.5956	0.06283

COMPONENTS:	EVALUATOR:
(1) Rubidium chlorate; $RbClO_3$; [13446-71-4]	Hiroshi Miyamoto Department of Chemistry Niigata University Niigata, Japan
(2) Water; H_2O; [7732-18-5]	December 1984

CRITICAL EVALUATION:

TERNARY SYSTEMS

Data for the solubilities in ternary systems have been reported in 4 publications (3,5-7). A summary of these studies is given in Table 3.

Table 3. Summary of solubility studies in ternary systems

System	T/K	Solid Phase	Reference
$RbClO_3$ - $CsClO_3$ - H_2O	298	Not given	3
$RbClO_3$ - $KClO_3$ - H_2O	298	$RbClO_3$; $KClO_3$	3
$RbClO_3$ - RbCl - H_2O	273, 298, 323	$RbClO_3$; RbCl	5
$RbClO_3$ - $NaClO_3$ - H_2O	298	$RbClO_3$; $NaClO_3$	6
$RbClO_3$ - $RbNO_3$ - H_2O	298	$RbClO_3$; $RbNO_3$ Solid solution	7

The phase diagrams of the ternary systems, $RbClO_3$-RbCl-H_2O(5) and $RbClO_3$-$NaClO_3$-H_2O (6) are simple eutonic types, and no double salts are formed. Although the diagrams of the ternary $RbClO_3$-$CsClO_3$-H_2O(3) and $RbClO_3$-$KClO_3$-H_2O(3) were not reported by Kirgintsev, Kashina, Vulikh and Korotkevich in the original paper, the authors reported that rubidium and cesium chlorate form a continuous series of solid solutions, but potassium and rubidium chlorate do not form solid solutions. The solubility in the ternary $RbClO_3$-$RbNO_3$-H_2O system was studied by Shklovskaya, Arkhipov, Kuzina and Tsibulevskaya (7). The crystallization branch of rubidium nitrate and the solid solution based on rubidium chlorate were determined. In the lower concentration range of rubidium nitrate, a solid solution with rubidium chlorate was formed, and the distribution coefficient (see compilation sheet) of rubidium nitrate in the range of crystallization of solid solution is constant.

OTHER MULTICOMPONENT SYSTEMS

The solubility data for the $RbClO_3$-RbCl-$NaClO_3$-NaCl-H_2O system was reported by Arkhipov, Kashina and Kuzina (6). They found four crystallization regions in the system. Two ternary points were obtained corresponding to solutions saturated with: (1) NaCl+$NaClO_3$+$RbClO_3$; (2) NaCl+RbCl+$RbClO_3$ (see compilation sheet).
Solubilities in the $RbClO_3$-RbCl-$KClO_3$-KCl-H_2O system were studied by Arkhipov, Kashina and Kuzina (8). They found three crystallization fields in the systems: $KClO_3$, $RbClO_3$ and solid solutions of potassium and rubidium chlorides. The main part of the diagram is occupied by the crystallization field of rubidium chlorate (77%) followed by the field of potassium chlorate (20%), and of the solid solutions of potassium and rubidium chlorides (3%).

The $RbClO_3$-RbCl-$CsClO_3$-CsCl-H_2O system was also studied by Arkhipov, Kashina and Kuzina (9). Three crystallization regions were defined in the system: the field of $CsClO_3$-$RbClO_3$ continuous solid solutions which occupies 99 % of entire area of the diagram, and the fields of Cs(Rb)Cl and Rb(Cs)Cl solid solutions.

COMPONENTS:	EVALUATOR:
(1) Rubidium chlorate; $RbClO_3$; [13446-71-4] (2) Water; H_2O; [7732-18-5]	Hiroshi Miyamoto Department of Chemistry Niigata University Niigata, Japan December, 1984

CRITICAL EVALUATION:

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