COMPONENTS:	EVALUATOR:
(1) Cesium chlorate; $CsClO_3$; [13763-67-2] (2) Water; H_2O; [7732-18-5]	H. Miyamoto Department of Chemistry Niigata University Niigata, Japan and M. Salomon US Army ET & DL Fort Monmouth, NJ, USA December, 1984

CRITICAL EVALUATION:

THE BINARY SYSTEM

Data for the solubility of $CsClO_3$ in water have been reported in 6 publications (1-6). The publications (1,4) report solubilities as a function of temperature (273-373 K), Treadwell and Ammann (2) report the solubility at 293.2 K, and in (3, 5, 6) solubilities in ternary systems are reported for 298.2 K. In (3 and 6), the detailed phase studies showed that at 298.2 K, the solid phase in the binary system is the anhydrous salt. Although no other study reports the nature of the solid phase over the experimental temperature range of 273-373 K, the evaluators assume it to be the anhydrous salt since when the solubility is plotted as a function of temperature, all data lie on a smooth monotonic curve indicating a single solid phase. Except for three rejected data points (see below), all data could be easily fitted to a single smoothing equation again indicating a single solid phase.

Table 1 summarizes the solubility data for $CsClO_3$ in water as a function of temperature. With the exception of Treadwell and Ammann's (2) use of mol kg^{-1} units, all other original data were reported in mass units. In Table 1 the evaluators have converted from the original units to mole fraction units, and both the original units as well as conversions to mol kg^{-1} units can be found in the compilations.

Table 1. Summary of Solubilities in the Binary System from 273-373 K[a]

T/K	χ	(ref)	T/K	χ	(ref)
273.2	0.002044	(1)	303.2	0.007873	(1)
273.2	0.002061	(4)	303.2	0.007803	(4)
281.2	0.002906	(1)	313.2	0.01149	(4)
283.2	0.003440	(4)	315.4	0.01229	(1)
293.0	0.005202	(1)	323.2	0.01590	(1)
293.2	0.005212	(4)	323.2	0.01610	(4)
293.2	0.0052	(2)	333.2	0.02177	(4)
298.2	0.006486	(4)	343.2	0.02896	(4)
298.2	0.006467	(5)	350.2	0.03352	(1)[e]
298.2	0.006448	(6)	353.2	0.03727	(4)[e]
298.2	0.006457	(6)[b]	363.2	0.04838	(4)
298.2	0.006419	(3)[c]	372.2	0.05988	(1)[e]
298.2	0.006448	(3)[d]	373.2	0.06073	(4)

[a] Mole fraction units converted from original mass units by the evaluators.

[b] Compilation of this work given in the $NaClO_3$ chapter.

[c] Compilation of this work given in the $KClO_3$ chapter.

[d] Compilation of this work given in the $RbClO_3$ chapter.

[e] Rejected data points. See text for discussion.

Giving all mole fraction solubilities in Table 1 equal weights of unity, three data points at 350.2, 353.2 and 372.2 K had to be rejected as their differences between calculated and observed solubilities exceeded twice the standard error of estimate. The remaining 23 data points were fitted to the smoothing equation with the following results:

$$Y_x = -15469.648/(T/K) - 34.5278\ln(T/K) + 233.128 + 2.2681 \times 10^{-3}(T/K) \quad [1]$$

$$\sigma_y = 0.026 \qquad \sigma_x = 6.7 \times 10^{-5}$$

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CRITICAL EVALUATION:

The 23 acceptable data points were also fitted to the smoothing equation based on mol kg^{-1} units, and the resulting equation is:

$$Y_m = -5780.517/(T/K) - 7.1403\ln(T/K) + 59.864 \quad [2]$$

$\sigma_y = 0.013$ $\qquad$ $\sigma_m = 0.008$

The solubilities calculated from the two smoothing equations are designated as *recommended* solubilities, and values at rounded temperatures are given in Table 2.

Table 2. Recommended Solubilities Calculated from the Smoothing Equations [1] and [2]

T/K	m/mol kg^{-1}	χ
273.2	0.114	0.002040
278.2	0.146	0.002627
283.2	0.186	0.003342
288.2	0.234	0.004204
293.2	0.291	0.005230
298.2	0.359	0.006441
303.2	0.439	0.007858
308.2	0.532	0.009500
313.2	0.640	0.01139
318.2	0.764	0.01355
323.2	0.906	0.01599
328.2	1.066	0.01875
333.2	1.246	0.02184
338.2	1.448	0.02527
343.2	1.672	0.02908
348.2	1.921	0.03327
353.2	2.195	0.03787
358.2	2.495	0.04289
363.2	2.822	0.04835
368.2	3.177	0.05427
373.2	3.561	0.06006

TERNARY SYSTEMS

Data for solubilities in ternary systems have been reported in 3 publications (3, 5, 6). A summary of these studies is given in Table 3. Two ternary systems $CsClO_3$-$KClO_3$-H_2O and $CsClO_3$-$RbClO_3$-H_2O were studied by Kirgintsev, Kashina, Vulikh and Korotkevich (3). Solid solutions were not formed in the former system, but in the latter, rubidium and cesium chlorate form a continuous series of solid solutions.

Kirgintsev and Kizitskii (5) studied solubilities in the $CsClO_3$-$Ca(ClO_3)_2$-H_2O system at 298 K, but did not study the system at high concentrations of calcium chlorate owing to high solution viscosity. Compositions of the solid phases were not reported.

Two ternary systems $CsClO_3$-$CsCl$-H_2O and $CsClO_3$-$NaClO_3$-H_2O were studied by Arkhipov and Kashina (6) using the isothermal method. The solid phases were CsCl and $CsClO_3$ in the former system, and $CsClO_3$ and $NaClO_3$ in the latter. Neither double salts nor solid solutions were reported.

COMPONENTS:

(1) Cesium chlorate; $CsClO_3$; [13763-67-2]

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

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December, 1984

CRITICAL EVALUATION:

Table 3. Summary of Solubility Studies in the Ternary Systems

Ternary system	T/K	Solid Phase	Ref
$CsClO_3$ - $KClO_3$ - H_2O	298	$CsClO_3$; $KClO_3$	3[a]
$CsClO_3$ - $RbClO_3$ - H_2O	298	$CsClO_3$; $RbClO_3$; Solid Sln	3[b]
$CsClO_3$ - $Ca(ClO_3)_2$ - H_2O	298	Not Given	5
$CsClO_3$ - CsCl - H_2O	298	$CsClO_3$; CsCl	6
$CsClO_3$ - $NaClO_3$ - H_2O	298	$CsClO_3$; $NaClO_3$	6[c]

[a] See the $KClO_3$ chapter for this compilation.

[b] See the $RbClO_3$ chapter for this compilation

[c] See the $NaClO_3$ chapter for this compilation.

OTHER MULTICOMPONENT SYSTEMS

The $CsClO_3$-CsCl-$NaClO_3$-NaCl-H_2O system was studied by Arkhipov and Kashina (6) at 298, 323 and 348 K. Solubilities in the quaternary systems, $CsClO_3$-CsCl-NaCl-H_2O and $CsClO_3$-$NaClO_3$-NaCl-H_2O, have been reported (6). Solid phases found in this study were the four pure components (CsCl, $CsClO_3$, NaCl, $NaClO_3$), and solid solutions formed from NaCl + CsCl.

The $RbClO_3$-RbCl-$CsClO_3$-CsCl-H_2O system was studied by Arkhipov, Kashina and Kuzina (7) at 298 K. Rubidium and cesium chloride formed a restricted series of solid solutions, and cesium and rubidium chlorate solid solutions were also reported.

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