

COMPONENTS:		ORIGINAL MEASUREMENTS:																																																																																							
(1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4]		Sokolov, S.J.																																																																																							
(2) Diammonium hydrogenphosphate; $(NH_4)_2HPO_4$; [7783-28-0]		Kaliy 1937, 2, 28-32.																																																																																							
(3) Water; H_2O ; [7732-18-5]																																																																																									
VARIABLES:		PREPARED BY:																																																																																							
Composition at 0°C.		J. Eysseltová																																																																																							
EXPERIMENTAL VALUES:																																																																																									
Solubility in the $K_2HPO_4-(NH_4)_2HPO_4-H_2O$ system at 0°C.																																																																																									
<table> <thead> <tr> <th>K_2HPO_4 mass%</th><th>K_2HPO_4 mol/kg^a</th><th>$(NH_4)_2HPO_4$ mass%</th><th>$(NH_4)_2HPO_4$ mol/kg^a</th><th>H_2O mass%</th><th>solid^b phase</th></tr> </thead> <tbody> <tr><td>----</td><td>----</td><td>36.24</td><td>4.30</td><td>63.76</td><td>A</td></tr> <tr><td>7.94</td><td>0.75</td><td>31.93</td><td>4.02</td><td>60.13</td><td>"</td></tr> <tr><td>15.66</td><td>1.61</td><td>28.60</td><td>3.88</td><td>55.74</td><td>"</td></tr> <tr><td>17.82</td><td>1.86</td><td>27.36</td><td>3.77</td><td>54.82</td><td>"</td></tr> <tr><td>29.34</td><td>3.41</td><td>21.39</td><td>3.28</td><td>49.27</td><td>"</td></tr> <tr><td>38.35</td><td>5.02</td><td>17.86</td><td>3.08</td><td>43.79</td><td>"</td></tr> <tr><td>43.74</td><td>6.08</td><td>15.01</td><td>2.75</td><td>41.25</td><td>"</td></tr> <tr><td>48.90</td><td>7.74</td><td>14.87</td><td>3.10</td><td>36.23</td><td>A + B</td></tr> <tr><td>48.58</td><td>7.58</td><td>14.66</td><td>3.01</td><td>36.76</td><td>B</td></tr> <tr><td>48.52</td><td>6.61</td><td>9.35</td><td>1.68</td><td>42.12</td><td>"</td></tr> <tr><td>48.14</td><td>6.05</td><td>6.22</td><td>1.03</td><td>45.64</td><td>"</td></tr> <tr><td>47.64</td><td>5.72</td><td>4.59</td><td>0.72</td><td>47.77</td><td>"</td></tr> <tr><td>45.72</td><td>4.83</td><td>-----</td><td>-----</td><td>54.28</td><td>"</td></tr> </tbody> </table>						K_2HPO_4 mass%	K_2HPO_4 mol/kg ^a	$(NH_4)_2HPO_4$ mass%	$(NH_4)_2HPO_4$ mol/kg ^a	H_2O mass%	solid ^b phase	----	----	36.24	4.30	63.76	A	7.94	0.75	31.93	4.02	60.13	"	15.66	1.61	28.60	3.88	55.74	"	17.82	1.86	27.36	3.77	54.82	"	29.34	3.41	21.39	3.28	49.27	"	38.35	5.02	17.86	3.08	43.79	"	43.74	6.08	15.01	2.75	41.25	"	48.90	7.74	14.87	3.10	36.23	A + B	48.58	7.58	14.66	3.01	36.76	B	48.52	6.61	9.35	1.68	42.12	"	48.14	6.05	6.22	1.03	45.64	"	47.64	5.72	4.59	0.72	47.77	"	45.72	4.83	-----	-----	54.28	"
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The mixtures were equilibrated isothermally for several days. The P_2O_5 content was determined gravimetrically as $Mg_2P_2O_7$, potassium was determined gravimetrically as $KClO_4$, and nitrogen was determined by the Kjeldahl method.	Purified, commercial materials were used, but no details are given.																																																																																								
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COMPONENTS:		ORIGINAL MEASUREMENTS:	
(1) Dipotassium dhydrogenphosphate; K_2HPO_4 ; [7758-11-4]		1. Bergman, A.G.; Dzuev, A.D. <i>Uch. Zap. Kabardino-Balkar. Univ. Ser. Sel. Khoz., Khim.-Biol.</i> 1966, 29, 40-4.	
(2) Diammonium hydrogenphosphate; $(NH_4)_2HPO_4$; [7783-28-0]		2. Bergman, A.G.; Dzuev, A.D.; Opredelnikova L.V. <i>Zh. Prikl. Khim.</i> 1967, 40, 1838-41.	
(3) Water; H_2O ; [7732-18-5]			

VARIABLES:		PREPARED BY:			
Temperature and composition.		J. Eyseltová			
EXPERIMENTAL VALUES:					
Composition and crystallization temperature of invariant points in the $K_2HPO_4-(NH_4)_2HPO_4-H_2O$ system.					
$t/^\circ C.$	K_2HPO_4 mass% mol/kg ^a	$(NH_4)_2HPO_4$ mass% mol/kg ^a	H_2O mass% solid ^b phase		
-18	30 5.23	13 2.35	57 A + D + F		
-6	41 7.65	14 2.52	45 A + D + E		
5	50 10.22	12.5 2.60	37.5 A + B + E		
22	57	11	32 B + C + E		

^aThe mol/kg H_2O values were calculated by the compiler.

^bThe solid phases are: A = $K_2HPO_4 \cdot 6H_2O$; B = $K_2HPO_4 \cdot 3H_2O$; C = K_2HPO_4 ; D = $(NH_4)_2HPO_4 \cdot 2H_2O$; E = $(NH_4)_2HPO_4$; F = ice.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
A visual polythermic method was used. The disappearance of the last crystals was observed.	Reagent grade K_2HPO_4 was recrystallized from water before use. Reagent grade $(NH_4)_2HPO_4$ was recrystallized from ammoniacal solutions before use.
	ESTIMATED ERROR: No details are given.
	REFERENCES:

COMPONENTS:						ORIGINAL MEASUREMENTS:				
(1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4]						Bergman, A.G.; Velikanova, L.V.				
(2) Potassium carbonate; K_2CO_3 ; [584-08-7]						Zh. Neorg. Khim. 1968, 13, 557-61.				
(3) Water; H_2O ; [7732-18-5]										
VARIABLES:										
Temperature and composition.			PREPARED BY:							
			J. Eysseltová							
EXPERIMENTAL VALUES:										
Crystallization temperature and composition of invariant points in the $K_2HPO_4-K_2CO_3-H_2O$ system.										
$t/^\circ C.$	K_2HPO_4 mass%	K_2HPO_4 mol/kg ^a	K_2CO_3 mass%	K_2CO_3 mol/kg ^a	H_2O mass%	H_2O solid phases ^b				
-37	4	0.40	39	4.95	57	ice + A + D				
-31.5	21.5	2.17	21.8	2.78	56.7	ice + A + B				
72	44.2	8.02	24.2	5.54	31.6	B + C + F				
53	32.5	5.15	31.3	6.25	36.2	B + E + F				
-7	3.2	0.37	48.3	7.20	48.5	B + D + E				
^a The mol/kg H_2O values were calculated by the compiler.										
^b The solid phases are: A = $K_2HPO_4 \cdot 6H_2O$; B = $K_2HPO_4 \cdot 3H_2O$; C = K_2HPO_4 ; D = $K_2CO_3 \cdot 6H_2O$; E = $2K_2CO_3 \cdot 3H_2O$; F = K_2CO_3 .										
Solubility isotherms in the temperature range -20 to +80°C are given in graphical form only.										
Relative areas of individual crystallization fields are: ice-16.06%; $K_2CO_3 \cdot 6H_2O$ -0.86%; $2K_2CO_3 \cdot 3H_2O$ -3.26%; $K_2HPO_4 \cdot 6H_2O$ -7.62%; $K_2HPO_4 \cdot 3H_2O$ -11.38%; K_2CO_3 -40.82%; K_2HPO_4 -20%.										
AUXILIARY INFORMATION										
METHOD/APPARATUS/PROCEDURE:				SOURCE AND PURITY OF MATERIALS:						
A visual polythermic method was used in the temperature range of -37 to 80°C.				No information is given.						
				ESTIMATED ERROR:						
				The precision of the temperature was ± 0.2 to 0.4 K.						
				REFERENCES:						

COMPONENTS: (1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4] (2) Urea; CH_4N_2O ; [57-13-6] (3) Water; H_2O ; [7732-18-5]		ORIGINAL MEASUREMENTS: Bergman, A.G.; Velikanova, L.V. <i>Zh. Neorg. Khim.</i> 1968, 13, 1158-62.				
VARIABLES: Temperature and composition.		PREPARED BY: J. Eysseltová				
EXPERIMENTAL VALUES:						
Temperature and composition of invariant points in the $K_2HPO_4-CO(NH_2)_2-H_2O$ system.						
$t/^\circ C.$	K_2HPO_4 mass%	K_2HPO_4 mol/kg ^a	urea mass%	urea mol/kg ^a	H_2O mass%	H_2O solid phases ^b
-19.7	27.3	2.62	13	3.62	59.7	A + B + E
-9.8	33.4	3.49	11.7	3.54	54.9	B + E + F
63	59.3	13.09	14.7	9.41	26	D + F + G
77.3	40.2	11.09	39	31.21	20.8	D + G + H
12	56.5	8.31	4.5	1.92	39	B + C + F
38.3	66.2	13.76	6.2	3.74	27.6	C + D + F
^a The mol/kg H_2O values were calculated by the compiler.						
^b The solid phases are: A = ice; B = $K_2HPO_4 \cdot 6H_2O$; C = $K_2HPO_4 \cdot 3H_2O$; D = K_2HPO_4 ; E = α -urea; F = β -urea; G = γ -urea; H = δ -urea.						
Solubility isotherms in the temperature range of -10 to +80°C are given in graphical form only.						
Relative areas of the crystallization fields are: $K_2HPO_4 \cdot 6H_2O$ -4.61%; ice-14.05%; $K_2HPO_4 \cdot 3H_2O$ -1.51%; K_2HPO_4 -31.73%; α -urea-3.73%; β -urea-17.33%; γ -urea-13.27%; δ -urea-13.77%.						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE: Twelve parts of the system were studied by using a visual polythermic method. The cooling agent was solid carbon dioxide, either alone or with acetone.	SOURCE AND PURITY OF MATERIALS: No information is given.					
		ESTIMATED ERROR: On the crystallization curves the temperature had a precision of $\pm 0.4^\circ C$. On the rest of the system it was $\pm 0.2^\circ C$.				
		REFERENCES:				

COMPONENTS: (1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4] (2) Urea; CH_4N_2O ; [57-13-6] (3) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Bergman, A.G.; Dzuev, A.D. <i>Uch. Zap. Kabardino-Balkan. Univ., Ser. Sel.' -Khoz. Khim.-Biol.</i> <u>1969</u> , 29, 40-4.
VARIABLES: Temperature and composition.	PREPARED BY: J. Eysseltová
EXPERIMENTAL VALUES:	
<p>The authors report that the crystallization surface in the K_2HPO_4-$CO(NH_2)_2$-H_2O system consists of ten fields: ice; four modifications of urea; three crystal forms of K_2HPO_4 (the hexahydrate, the trihydrate and the anhydrous form); and two ternary compounds (but these are not specified).</p> <p>The eutectic temperature is $-19^{\circ}C$. The composition of the eutectic point is: 28 mass% K_2HPO_4 (2.70 mol/kg H_2O-compiler); 12.5 mass% urea (3.50 mol/kg H_2O-compiler) and 59.5 mass% water.</p> <p>The isotherms are given only in graphical form.</p>	
AUXILIARY INFORMATION	
METHOD/APPARATUS/PROCEDURE: A visual polythermic method was used. The disappearance and the appearance of the first crystals was observed. Solid CO_2 was used as the cooling agent.	SOURCE AND PURITY OF MATERIALS: Reagent grade K_2HPO_4 was dried at $170^{\circ}C$ before use. Reagent grade urea was recrystallized from ethanol and had a melting point of $132.5^{\circ}C$.
	ESTIMATED ERROR: Nothing is stated.
	REFERENCES:

COMPONENTS: (1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4] (2) Potassium nitrate; KNO_3 ; [7757-79-1] (3) Water; H_2O ; [7732-18-5]		ORIGINAL MEASUREMENTS: Endovitskaya, M.R.; Vereshchagina, V.I. <i>Zh. Neorg. Khim.</i> , 1972, 17, 877-9.				
VARIABLES: Temperature and composition.		PREPARED BY: J. Eysseltova				
EXPERIMENTAL VALUES:						
Composition and crystallization temperature of invariant points in the $K_2HPO_4-KNO_3-H_2O$ system.						
<i>t</i> /°C.	K_2HPO_4 mass%	K_2HPO_4 mol/kg ^a	KNO_3 mass%	KNO_3 mol/kg ^a	H_2O mass%	solid ^b phase
31.5	31.5	3.28	13.5	2.42	55	B + D + E
-8	19.5	1.49	5.5	1.49	75	A + B + F
-11	38	3.69	3	0.50	59	B + C + D
-14	38	3.60	1.5	0.24	60.5	B + C + F
^a The mol/kg H_2O values were calculated by the compiler.						
^b The solid phases are: A = α - KNO_3 ; B = β - KNO_3 ; C = $K_2HPO_4 \cdot 6H_2O$; D = $K_2HPO_4 \cdot 3H_2O$; E = K_2HPO_4 ; F = ice.						
Some of the data in the article are given only in graphical form.						
AUXILIARY INFORMATION						
METHOD/APPARATUS/PROCEDURE: A visual polythermic method was used. Solid carbon dioxide served as the cooling agent.	SOURCE AND PURITY OF MATERIALS: No information is given.					
		ESTIMATED ERROR: The temperature had a precision of $\pm 0.1^\circ C$.				
REFERENCES:						

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4]	Mráz, R.; Srb, V.; Tichý, S.; Vosolsobek, J. <i>Chem. Prum.</i> 1976, 26, 511-4.
(2) Potassium chloride; KCl; [7747-40-7]	
(3) Water; H_2O ; [7732-18-5]	

VARIABLES: Temperature and composition.	PREPARED BY: J. Eyseltová
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EXPERIMENTAL VALUES: Solubility isotherms in the K_2HPO_4 -KCl- H_2O system.					
K_2HPO_4 mass%	KCl mass%	H_2O mol/kg ^a	H_2O mass%	solid ^b phase	
temp. = 25°C.					
0	0	26.4	4.81	73.6	A
0	0	26.6	4.86	73.4	"
1.3	0.10	26.0	4.79	72.7	"
2.0	0.15	24.8	4.54	73.2	"
2.1	0.16	24.2	4.40	73.7	"
15.7	1.36	18.1	3.66	66.2	"
20.2	1.83	16.6	3.52	63.2	"
17.3	1.49	16.3	3.29	66.4	"
17.5	1.49	15.5	3.10	67.0	"
26.4	2.49	12.9	2.85	60.7	"
31.5	3.15	11.2	2.62	57.3	"
42.2	5.05	9.9	2.77	48.0	"
38.3	4.17	9.0	2.29	52.7	"
42.2	4.83	7.7	2.06	50.1	A + B
44.4	5.34	7.9	2.22	47.7	B
46.8	5.79	6.8	1.96	46.4	"
50.9	6.81	6.2	1.93	42.9	"
59.0	8.77	2.4	0.83	38.6	B + C
61.8	9.93	2.5	0.93	35.7	C
66.4	12.10	2.1	0.89	31.5	"
62.6	10.15	2.0	0.75	35.4	"
66.5	12.11	2.0	0.85	32.5	"

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Saturated solutions were prepared at a temperature about 5 K higher than that of the isotherm to be studied. The samples were equilibrated for 4 hours with constant stirring. After being quiescent for 1 hour the phases were separated from each other and samples were taken for analysis. Silver content was determined by the Volhard method. HPO_4^{2-} ions were precipitated with excess $Bi(NO_3)_3$ and the Bi^{3+} ions were back titrated with Komplexon III.	No information is given.
	ESTIMATED ERROR: The temperature was controlled to within ± 0.2 K. The accuracy of the analysis for hydrogenphosphate ions was at least $\pm 3\%$.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4]	Mráz, R.; Srb, V.; Tichý, S.; Vosolsobě, J. <i>Chem. Prům.</i> 1976, 26, 511-4.
(2) Potassium chloride; KC1; [7747-40-7]	
(3) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES cont'd:

Solubility isotherms in the K_2HPO_4 -KC1- H_2O system.

K_2HPO_4 mass%	KC1 mass%	H_2O mass%	solid ^b phase
temp. = 25°C.			
59.3	8.64	1.3	0.44
66.7	11.70	0.6	0.24
67.9	12.18	0.1	0.04
60.2	8.68	0	0
temp. = 50°C.			
0	0	29.6	5.63
5.6	0.47	27.3	5.45
9.2	0.78	23.8	4.76
14.0	1.24	21.5	4.47
39.1	4.49	11.0	2.95
59.8	9.61	4.5	1.69
69.5	13.71	1.4	0.64
70.0	13.39	0	0
temp. = 75°C.			
0	0	33.2	6.66
5.9	0.52	29.6	6.15
10.0	0.91	27.1	5.77
13.7	1.28	25.0	5.46
20.2	2.02	22.4	5.23
47.3	6.38	10.2	3.21
60.1	9.85	4.9	1.87
69.4	13.93	2.0	0.93
73.9	16.25	0	0
			26.1
			C

^aThe mol/kg H_2O values were calculated by the compiler.^bThe solid phases are: A = KC1; B = $2KCl \cdot K_2HPO_4 \cdot 5H_2O$; C = K_2HPO_4 .

The authors state that, in fields where salts other than KC1 exist as equilibrium solid phases, the precision of the results is poor because of the high viscosity of the saturated solutions. For the same reason, the authors could not determine the composition of eutonic solutions at 50°C and 75°C. They estimate that these solutions contain about 3% KC1 at 50°C and less than 2% KC1 at 75°C.

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(1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4]						Beremzhanov, B.A.; Voronina, L.V.; Savich, R.F.																																																																																																																																																									
(2) Potassium borate; KBO_2 ; [13709-94-9]						Khim. Khim. Tekhnol. (Alma Ata) 1978, 29-36.																																																																																																																																																									
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<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3">K_2HPO_4</th> <th colspan="3">KBO_2</th> <th rowspan="2">refr. index</th> <th rowspan="2">pH</th> <th rowspan="2">solid phase^b</th> </tr> <tr> <th>mass%</th> <th>mol%</th> <th>mol/kg^a</th> <th>mass%</th> <th>mol%</th> <th>mol/kg^a</th> </tr> </thead> <tbody> <tr><td>-----</td><td>-----</td><td>-----</td><td>0.368^a</td><td>0.081</td><td>0.045</td><td>1.441</td><td>14.0</td><td>A</td></tr> <tr><td>86.03^a</td><td>36.42</td><td>35.4</td><td>-----</td><td>-----</td><td>-----</td><td>1.380</td><td>9.45</td><td>B</td></tr> <tr><td>67.13</td><td>17.25</td><td>11.74</td><td>0.056</td><td>0.032</td><td>0.020</td><td>1.421</td><td>10.12</td><td>C</td></tr> <tr><td>56.35</td><td>11.68</td><td>7.43</td><td>0.117</td><td>0.051</td><td>0.032</td><td>1.423</td><td>10.81</td><td>"</td></tr> <tr><td>49.49</td><td>9.27</td><td>5.64</td><td>0.152</td><td>0.059</td><td>0.036</td><td>1.424</td><td>11.15</td><td>"</td></tr> <tr><td>45.57</td><td>7.95</td><td>4.82</td><td>0.176</td><td>0.064</td><td>0.039</td><td>1.426</td><td>11.76</td><td>"</td></tr> <tr><td>44.59</td><td>7.55</td><td>4.64</td><td>0.211</td><td>0.075</td><td>0.046</td><td>1.428</td><td>12.85</td><td>"</td></tr> <tr><td>44.10</td><td>7.50</td><td>4.55</td><td>0.257</td><td>0.076</td><td>0.056</td><td>1.430</td><td>13.48</td><td>A + C</td></tr> <tr><td>27.93</td><td>3.86</td><td>2.23</td><td>0.281</td><td>0.075</td><td>0.047</td><td>1.431</td><td>13.49</td><td>"</td></tr> <tr><td>15.68</td><td>1.89</td><td>1.07</td><td>0.298</td><td>0.073</td><td>0.042</td><td>1.432</td><td>13.50</td><td>"</td></tr> <tr><td>14.21</td><td>1.66</td><td>0.95</td><td>0.295</td><td>0.074</td><td>0.042</td><td>1.432</td><td>13.52</td><td>"</td></tr> <tr><td>12.25</td><td>1.42</td><td>0.80</td><td>0.304</td><td>0.075</td><td>0.042</td><td>1.433</td><td>13.54</td><td>"</td></tr> <tr><td>11.27</td><td>1.21</td><td>0.73</td><td>0.316</td><td>0.076</td><td>0.043</td><td>1.433</td><td>13.58</td><td>"</td></tr> <tr><td>10.78</td><td>0.99</td><td>0.70</td><td>0.323</td><td>0.077</td><td>0.044</td><td>1.434</td><td>13.64</td><td>"</td></tr> <tr><td>6.86</td><td>0.77</td><td>0.42</td><td>0.328</td><td>0.077</td><td>0.043</td><td>1.434</td><td>13.81</td><td>"</td></tr> </tbody> </table>										K_2HPO_4			KBO_2			refr. index	pH	solid phase ^b	mass%	mol%	mol/kg ^a	mass%	mol%	mol/kg ^a	-----	-----	-----	0.368 ^a	0.081	0.045	1.441	14.0	A	86.03 ^a	36.42	35.4	-----	-----	-----	1.380	9.45	B	67.13	17.25	11.74	0.056	0.032	0.020	1.421	10.12	C	56.35	11.68	7.43	0.117	0.051	0.032	1.423	10.81	"	49.49	9.27	5.64	0.152	0.059	0.036	1.424	11.15	"	45.57	7.95	4.82	0.176	0.064	0.039	1.426	11.76	"	44.59	7.55	4.64	0.211	0.075	0.046	1.428	12.85	"	44.10	7.50	4.55	0.257	0.076	0.056	1.430	13.48	A + C	27.93	3.86	2.23	0.281	0.075	0.047	1.431	13.49	"	15.68	1.89	1.07	0.298	0.073	0.042	1.432	13.50	"	14.21	1.66	0.95	0.295	0.074	0.042	1.432	13.52	"	12.25	1.42	0.80	0.304	0.075	0.042	1.433	13.54	"	11.27	1.21	0.73	0.316	0.076	0.043	1.433	13.58	"	10.78	0.99	0.70	0.323	0.077	0.044	1.434	13.64	"	6.86	0.77	0.42	0.328	0.077	0.043	1.434	13.81	"
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COMPONENTS:				ORIGINAL MEASUREMENTS:									
(1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4]				Beremzhanov, B.A.; Voronina, L.V.; Savich, R.F.									
(2) Potassium borate; KBO_2 ; [13709-94-9]				Khim. Khim. Tekhnol. (Alma Ata) <u>1978</u> , 29-36.									
(3) Water; H_2O ; [7732-18-5]													
EXPERIMENTAL VALUES cont'd:													
Solubility isotherm in the $K_2HPO_4-KBO_2-H_2O$ system at 50°C.													
K_2HPO_4 mass%	K_2HPO_4 mol%	K_2HPO_4 mol/kg ^a	KBO_2 mass%	KBO_2 mol%	KBO_2 mol/kg ^a	refr. index	pH	solid ^b phase					
---	----	----	0.369 ^a	0.090	0.046	1.445	14.0	A					
91.76 ^a	53.50	-----	-----	-----	-----	1.390	9.65	B					
74.48	22.94	16.86	0.164	0.109	0.078	1.398	11.20	C					
69.58	18.98	13.21	0.176	0.096	0.071	1.400	11.40	"					
66.15	16.89	11.28	0.187	0.088	0.067	1.405	11.48	"					
64.68	15.62	10.58	0.211	0.087	0.074	1.410	11.50	"					
63.70	15.25	10.14	0.234	0.127	0.079	1.415	11.56	"					
61.25	14.06	9.13	0.246	0.120	0.077	1.427	11.63	"					
60.76	14.00	8.96	0.290	0.119	0.090	1.430	11.70	"					
58.80	12.74	8.25	0.292	0.116	0.087	1.433	11.75	A + C					
50.96	9.67	5.99	0.234	0.100	0.058	1.434	11.88	A					
39.20	6.13	3.71	0.176	0.083	0.035	1.435	12.27	"					
24.50	3.20	1.89	0.211	0.068	0.034	1.436	12.39	"					
12.65	1.42	0.83	0.292	0.061	0.040	1.438	12.65	"					
9.80	0.99	0.62	0.304	0.059	0.041	1.440	12.88	"					
9.31	0.98	0.59	0.328	0.058	0.044	1.443	13.05	"					
7.35	0.77	0.46	0.332	0.057	0.043	1.443	13.27	"					
6.37	0.58	0.39	0.339	0.057	0.044	1.444	13.54	"					
5.90	0.57	0.36	0.351	0.056	0.045	1.444	13.70	"					
1.96	0.18	0.12	0.374	0.055	0.046	1.445	13.70	"					

^aThese values were calculated by the compiler.

^bThe solid phases are: A = KBO_2 ; B = K_2HPO_4 ; C = $K_2HPO_4 \cdot 3H_2O$.

COMPONENTS:											
(1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4]				ORIGINAL MEASUREMENTS: Velikanova, L.V.; Bergman, A.G. <i>Izv. Vysch. Ucheb. Zaved., Khim. Khim. Tekhnol.</i> <u>1974</u> , 17, 7-10 and 1513-6.							
(2) Potassium carbonate; K_2CO_3 ; [584-08-7]											
(3) Urea; CH_4N_2O ; [57-13-6]											
(4) Water; H_2O ; [7732-18-5]											
VARIABLES:				PREPARED BY:							
Temperature and composition.				J. Eysseltová							
EXPERIMENTAL VALUES:											
Monovariant points in the $K_2HPO_4-K_2CO_3-CO(NH_2)_2-H_2O$ system.											
$t/^\circ C.$	K_2CO_3 mass%	K_2HPO_4 mol/kg ^a	$CO(NH_2)_2$ mass%	H_2O mol/kg ^a							
					mass%	solid phase ^b					
Section I: $(25\% K_2CO_3 + 75\% K_2HPO_4)-CO(NH_2)_2-H_2O$											
-22	7.25	0.89	21.75	2.13	12.4	3.52	58.6				
-10.5	8.75	1.17	26.25	2.80	11.3	3.50	53.7				
3.7	12.05	1.95	36.15	4.65	7.2	2.68	44.6				
34	13.65	2.19	30.95	3.94	10.4	3.84	35				
50.6	15	3.93	45	9.36	12.4	7.48	27.6				
54	14.7	3.92	43.9	9.29	14.3	8.78	27.1				
-16.9	9.25	1.06	27.75	2.52	0	0	63				
5	13.58	2.14	40.72	5.11	0	0	45.7				
57.5	16.82	3.72	50.48	8.86	0	0	32.7				
Section II: $(50\% K_2CO_3 + 50\% K_2HPO_4)-CO(NH_2)_2-H_2O$											
-35	21	2.86	21	2.27	5	1.57	53				
-6	22.2	3.29	22.2	2.61	7.2	2.46	48.5				
37 ^c	50		50		13.7		33.8				
39.6	26.3	5.74	26.3	4.56	14.3	7.19	33.1				
61	25.4	7.23	25.4	5.74	23.8	15.60	25.4				
-31.5	21.75	2.78	21.75	2.20	0	0	56.5				
51.5	31.5	6.15	31.5	4.88	0	0	37				
Section III: $(75\% K_2CO_3 + 25\% K_2HPO_4)-CO(NH_2)_2-H_2O$											
-37.5	30.75	4.09	10.25	1.08	4.7	1.44	55				
-12.5	31.05	4.38	10.35	1.16	7.4	2.40	51.2				
25.2	38.1	7.33	12.7	1.93	11.6	5.13	37.6				
(continued next page)											
AUXILIARY INFORMATION											
METHOD/APPARATUS/PROCEDURE:				SOURCE AND PURITY OF MATERIALS:							
A visual polythermic method was used. The nature of the solid phases was checked by microphotographical techniques.				No information is given.							
				ESTIMATED ERROR:							
				No information is given.							
				REFERENCES:							

COMPONENTS:

- (1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4]
- (2) Potassium carbonate; K_2CO_3 ; [584-08-7]
- (3) Urea; CH_4N_2O ; [57-13-6]
- (4) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Velikanova, L.V.; Bergman, A.G.

Izv. Vysch. Ucheb. Zaved., Khim. Khim.

Tekhnol. Russ. 1974, 17, 7-10 and 1513-6.

EXPERIMENTAL VALUES cont'd:

Monovariant points in the $K_2HPO_4-K_2CO_3-CO(NH_2)_2-H_2O$ system.

$t/^\circ C$.	K_2CO_3 mass% mol/kg ^a	K_2HPO_4 mass% mol/kg ^a	$CO(NH_2)_2$ mass% mol/kg ^a	H_2O mass% solid phase ^b
37.5	37.5	8.00	12.5	2.11
56.5	35.4	9.59	11.8	2.53
69.7	31.27	10.77	10.43	2.85
-35.5	32.55	4.16	10.85	1.10
-29.2	42.6	7.13	14.2	1.88
86.5	48.75	10.07	16.25	2.66

Section IV: (45% K_2CO_3 + 55% K_2HPO_4) - $CO(NH_2)_2-H_2O$

-27	15.03	1.88	18.37	1.83	9	2.60	57.6	ice + A + G
-8.6	18.54	2.67	22.66	2.59	8.6	2.86	50.2	A + G + H
-7.5	19.17	2.76	23.43	2.68	7.3	2.42	50.2	A + B + H
41.8	24.3	5.46	29.7	5.29	13.8	7.13	32.2	B + D + H
45.6	24.07	5.56	29.43	5.39	15.2	8.08	31.3	D + H + I
63.7	22.59	6.68	27.61	6.49	25.4	17.33	24.4	D + I + J
-21.6	17.73	2.11	21.67	2.05	0	0	60.6	ice + A
-6.6	21.78	3.05	26.62	2.96	0	0	51.6	A + B
55.8	29.30	6.07	35.80	5.88	0	0	34.9	B + D

Section V: (85% K_2CO_3 + 15% K_2HPO_4) - $CO(NH_2)_2-H_2O$

-40	33.68	4.30	6.12	0.62	3.6	1.05	55.6	ice + B + G
-12.5	37.65	5.50	6.65	0.77	6.2	2.08	49.5	B + G + H
14.3	41.48	7.26	7.32	1.01	9.9	3.99	41.3	B + E + H
30	40.3	7.75	7.1	1.08	15	6.64	37.6	E + H + I
51.4	36.8	8.87	6.5	1.24	26.7	14.81	30	E + I + J
68.7	28.73	9.66	5.07	1.35	44.7	34.61	21.5	D + E + J
-36.5	36.98	4.73	6.52	0.66	0	0	56.5	ice + B
16.6	46.16	7.30	8.14	1.02	0	0	45.7	B + E
106.5	56.25	12.20	9.98	1.70	0	0	33.5	D + E

Section VI: (90% K_2CO_3 + 10% K_2HPO_4) - $CO(NH_2)_2-H_2O$

-40.7	36.54	4.77	4.06	0.42	4	1.20	55.4	ice + F + G
-22	40.77	5.89	4.53	0.52	4.7	1.56	50	B + F + G
7	45	7.75	5	0.68	8	3.17	42	B + E + G
15.5	44.37	7.98	4.93	0.70	10.5	4.34	40.2	E + G + H
40.2	41.13	8.65	4.57	0.76	19.9	9.63	34.4	E + H + I
58.7	34.83	9.36	3.87	0.82	34.4	21.29	26.9	E + I + J
-37	38.7	4.91	4.3	0.43	0	0	57	ice + B
-13.5	44.3	6.30	4.92	0.55	0	0	50.8	B + F
10.5	47.8	7.37	5.3	0.64	0	0	46.9	E + F
116.5	60.0	13.04	6.7	1.14	0	0	33.3	D + E

the quaternary eutectic point

-41.5	34.32	4.14	3.22	0.31	2.52	0.62	59.92	ice + A + F + G
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The relative areas of crystallization of the individual phases are:

Section	ice	A	B	C	D	E	F	G	H	I	J
I	13.64	3.46	2.81	29.32	0	0	0	3.88	12.22	10.82	23.85
II	14.47	0	4	0	31.3	0	0	5.82	12.33	9.82	22.86
III	13.99	0	2.61	0	33.9	2.73	0	4.36	13	10.63	18.74
IV	13.81	1.83	3.79	0	32.35	0	0	5.01	11.69	12.33	19.19
V	14.13	0	1.43	0	36.21	0	0	5.89	10.56	10.43	16.8
VI	14.79	0	0.66	0	32.78	6.36	0.69	8.4	10.3	10.13	15.89

^aThe mol/kg H_2O values have been calculated by the compiler.^bThe solid phases are: A = $K_2HPO_4 \cdot 6H_2O$; B = $K_2HPO_4 \cdot 3H_2O$; C = K_2HPO_4 ; D = K_2CO_3 ;E = $2K_2CO_3 \cdot 3H_2O$; F = $K_2CO_3 \cdot 6H_2O$; G = α -urea; H = β -urea; I = γ -urea; J = δ -urea.^cAn obvious error - compiler.

COMPONENTS:		ORIGINAL MEASUREMENTS:																																																																																																																																														
(1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4]		Torochevnikov, N.S.; Rodionova, T.M.; Kirsanova, L.D.																																																																																																																																														
(2) Ammonium dihydrogenphosphate; $NH_4H_2PO_4$; [7722-76-1]		VINITI 1979, 2909, 17 p.																																																																																																																																														
(3) Diammonium hydrogenphosphate; $(NH_4)_2HPO_4$; [7783-28-0]																																																																																																																																																
(4) Water; H_2O ; [7732-18-5]																																																																																																																																																
VARIABLES:		PREPARED BY:																																																																																																																																														
Temperature and amount of K_2HPO_4 in solutions with a ratio of $NH_4H_2PO_4/(NH_4)_2HPO_4 = 2.34$.		J. Eysseltová																																																																																																																																														
EXPERIMENTAL VALUES:																																																																																																																																																
Part 1. Solubility polytherm along the sections of the $NH_4H_2PO_4-(NH_4)_2HPO_4-K_2HPO_4-H_2O$ system.																																																																																																																																																
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A visual polythermic method was used in the temperature range of -20 to +20°C. The disappearance of the last crystal was observed. The mixtures were prepared by weight and heated, while being stirred, at a rate of 0.5 deg/min. The analyses have been described elsewhere (1).		Chemically pure salts were recrystallized, washed with ethanol, and dried below 60°C.																																																																																																																																														
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		1. Vinnik, M.M.; Erbanova, L.N., et al. <i>Metody Analiza Fosfatnogo Syrja</i> , Moscow, 1975, p. 215.																																																																																																																																														

Dipotassium Hydrogenphosphate

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4]	Torochestnikov, N.S.; Rodionova, T.M.; Korsanova, L.D.
(2) Ammonium dihydrogenphosphate; $NH_4H_2PO_4$; [7722-76-1]	VINITI 1979, 2909, 17 p.
(3) Diammonium dydrogenphosphate; $(NH_4)_2HPO_4$; [7783-28-0]	
(4) Water; H_2O ; [7732-18-5]	

EXPERIMENTAL VALUES cont'd:

Part 1. Solubility polytherm along the sections of the $NH_4H_2PO_4 - (NH_4)_2HPO_4 - K_2HPO_4 - H_2O$ system.

$t/^\circ C.$ ^a	composition (g of each component)				A_1 ^c	mass% ammonium phosphates
	$NH_4H_2PO_4$	$(NH_4)_2HPO_4$	$K_2HPO_4 \cdot 2H_2O$ ^b	H_2O		
8	----	----	29.8211	15	50	-----
4	1	0.4274	19.8807	10	50	4.56
2	2	0.8548	29.8211	15	50	6.00
-0.5	3	1.2822	29.8211	15	50	8.72
-3	4	1.7096	29.8211	15	50	11.27
-3.5	4.5	1.9233	29.8211	15	50	12.50
-5	5	2.1370	29.8211	15	50	13.73
7	5.5	2.3507	29.8211	15	50	14.90
13.5	6	2.5644	29.8211	15	50	16.04
13	----	----	27.2952	10	55	-----
10.5	1	0.4274	27.2952	10	55	3.70
9	2	0.8548	27.2952	10	55	7.10
4.5	3	1.2822	27.2952	10	55	10.3
8	3.5	1.4970	27.2952	10	55	11.8
12	4	1.7096	27.2952	10	55	13.3
3	----	----	24.5162	15	46.4	-----
-8.5	4.0533	1.7322	24.5162	15	46.4	12.77
-10	4.6573	1.9903	24.5162	15	46.4	14.4
11.5	5.6232	2.4031	24.5162	15	46.4	16.85
12	----	----	24.3237	10	53	-----
1.7	2.8571	1.2210	24.3237	10	53	10.62
0	3.3453	1.4296	24.3237	10	53	12.21
10	2.4576	1.0503	34.5454	10	58	7.3

^aThe temperature at which the last crystal disappeared.

^bThis is probably a typographical error. The dihydrate is not mentioned anywhere in the text and on the basis of the compiler's recalculation the starting material appears to be the trihydrate.

^cThis is a constant, near to but not identical with the mass% of the binary solution of K_2HPO_4 lying on the section studied.

Part 2. The compiler has recalculated the data in Part 1 assuming that the starting dipotassium hydrogenphosphate is $K_2HPO_4 \cdot 3H_2O$. The recalculated values are given below.

K_2HPO_4	$NH_4H_2PO_4$	$(NH_4)_2HPO_4$	H_2O	$t/^\circ C.$
mass%	mol/kg	mass%	mol/kg	mass%
25.0	1.9	----	----	75.0 -7
23.7	1.9	3.64	0.4	71.1 -6.9
23.3	1.9	4.67	0.6	70.0 -7.2
22.9	1.9	5.77	0.7	68.8 -7.7
22.2	1.9	7.88	1.0	66.5 -9
20.6	2.0	13.3	1.9	60.4 -9
20.2	2.0	14.2	2.1	59.5 -6.5
19.9	2.0	15.2	2.3	58.4 -2.5
19.6	1.9	15.8	2.4	57.8 -2
18.9	1.9	17.8	2.8	55.6 4.5
18.4	1.9	18.1	3.1	54.3 10.5
18.3	1.9	19.4	3.1	54.0 9
17.7	1.9	21.1	3.5	52.2 17

(continued next page)

COMPONENTS:

- (1) Dipotassium hydrogenphosphate; K_2HPO_4 ; [7758-11-4]
- (2) Ammonium dihydrogenphosphate; $NH_4H_2PO_4$; [7722-76-1]
- (3) Diammonium hydrogenphosphate; $(NH_4)_2HPO_4$; [7783-28-0]
- (4) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Torochestnikov, N.S.; Rodionova, T.M.; Kirsanova, L.D.
VINITI 1979, 2909, 17 p.

EXPERIMENTAL VALUES cont'd:

Part 2. The compiler has recalculated the data in Part 1 assuming that the starting dipotassium hydrogenphosphate is $K_2HPO_4 \cdot 3H_2O$. The recalculated values are given below.

K_2HPO_4 mass%	K_2HPO_4 mol/kg	$NH_4H_2PO_4$ mass%	$NH_4H_2PO_4$ mol/kg	$(NH_4)_2HPO_4$ mass%	$(NH_4)_2HPO_4$ mol/kg	H_2O mass%	$t/^\circ C.$
45.7	4.8	----	----	----	----	54.3	2
44.0	4.8	2.57	0.4	1.10	0.2	52.3	-2
42.5	4.8	4.96	0.8	2.12	0.3	50.4	-5
41.0	4.8	7.19	1.3	3.07	0.5	48.7	-8
39.7	4.8	9.27	1.7	3.96	0.6	47.1	-11
39.0	4.8	10.3	1.9	4.38	0.7	46.3	-13
38.4	4.8	11.2	2.1	4.79	0.8	45.6	6
37.8	4.8	12.1	2.4	5.19	0.9	44.9	10
50.8	5.9	----	----	----	----	49.2	8
48.5	5.9	3.19	0.6	1.36	0.2	47.0	4
47.7	5.9	4.19	0.8	1.79	0.3	46.3	2
46.3	5.9	6.10	1.2	2.61	0.4	44.9	-0.5
45.0	5.9	7.91	1.6	3.38	0.6	43.7	-3
44.4	5.9	8.78	1.8	3.75	0.7	43.1	-3.5
43.8	5.9	9.62	2.0	4.11	0.7	42.5	-5
43.2	5.9	10.4	2.2	4.46	0.8	41.9	7
42.6	5.9	11.2	2.4	4.80	0.9	41.3	13.5
55.8	7.3	----	----	----	----	44.2	13
53.8	7.3	2.58	0.5	1.10	0.2	42.5	10.5
51.9	7.3	4.98	1.1	2.12	0.4	41.0	9
50.1	7.3	7.21	1.6	3.08	0.6	39.6	4.5
49.2	7.3	8.27	1.8	3.53	0.7	38.9	8
48.4	7.3	9.30	2.1	3.97	0.8	38.3	12
47.3	5.2	----	----	----	----	52.7	3
41.3	5.2	8.94	1.7	3.82	0.6	45.9	-8.5
40.5	5.2	10.1	1.9	4.31	0.7	45.1	-10
39.3	5.2	11.8	2.3	5.05	0.9	43.8	11.5
54.1	6.8	----	----	----	----	45.9	12
48.3	6.8	7.44	1.6	3.17	0.6	41.0	1.7
47.5	6.8	8.55	1.8	3.65	0.7	40.3	0
54.9	8.3	5.11	1.2	2.18	0.4	37.8	10

Part 3. Graphically derived solubility isotherms in the $NH_4H_2PO_4 - (NH_4)_2HPO_4 - K_2HPO_4 - H_2O$ system.

authors' data^a

compiler's recalculations

K_2HPO_4 mass%	ammonium phosphates		K_2HPO_4 mass%	$NH_4H_2PO_4$ mass%	$NH_4H_2PO_4$ mol/kg	$(NH_4)_2HPO_4$ mass%	$(NH_4)_2HPO_4$ mol/kg	H_2O mass%
	K_2HPO_4 mass%	$NH_4H_2PO_4$ mass%						
temp. = -10°C.								
0	21	0	0	14.7	1.6	6.28	0.6	79.0
45	12.25	39.5	4.7	8.58	1.5	3.66	0.6	48.3
46.4	14.4	39.7	5.0	10.1	1.9	4.31	0.7	45.9
45	14.85	38.3	4.7	10.4	1.9	4.44	0.7	46.9
25	18.3	20.4	1.9	12.8	1.8	5.47	0.7	62.3
36.5	0	36.5	3.3	0	0	0	0	63.5

COMPONENTS:		ORIGINAL MEASUREMENTS:					
(1) Dipotassium hydrogenphosphate: K_2HPO_4 ; [7758-11-4]		Torochestnikov, N.S.; Rodionova, T.M.; Kirsanova, L.D.					
(2) Ammonium dihydrogenphosphate; $NH_4H_2PO_4$; [7722-76-1]		VINITI 1979, 2909, 17 p.					
(3) Diammonium hydrogenphosphate; $(NH_4)_2HPO_4$; [7783-28-0]							
(4) Water: H_2O ; [7732-18-5]							

EXPERIMENTAL VALUES cont'd:

Part 3. Graphically derived solubility isotherms in the $NH_4H_2PO_4-(NH_4)_2HPO_4-K_2HPO_4-H_2O$ system.

authors' data ^a		compiler's recalculations					
K_2HPO_4 mass%	ammonium phosphates mass%	K_2HPO_4 mass%	$NH_4H_2PO_4$ mol/kg	$NH_4H_2PO_4$ mass%	$(NH_4)_2HPO_4$ mass%	$(NH_4)_2HPO_4$ mol/kg	H_2O mass%
temp. = -5°C.							
0	24.4	0	0	17.1	2.0	7.30	0.7
45	7.1	41.8	4.7	4.97	0.8	2.12	0.3
46.4	8.85	42.3	5.0	6.20	1.1	2.64	0.4
50.0	13.7	43.1	5.7	9.59	1.9	4.10	0.7
45.0	15.2	38.2	4.7	10.6	2.0	4.55	0.7
25.0	20.9	19.8	1.9	14.6	2.1	6.25	0.8
39.75	0	39.75	3.8	0	0	0	60.25
temp. = 0°C.							
0	26.9	0	0	18.8	2.2	8.05	0.8
45.0	1.85	44.2	4.7	1.29	0.2	0.55	0.07
46.4	3.3	44.9	5.0	2.31	0.4	0.98	0.1
50.0	8.55	45.7	5.7	5.99	1.1	2.55	0.4
53.0	12.25	46.5	6.5	8.58	1.8	3.66	0.7
50.0	14.2	42.9	5.7	9.94	2.0	4.25	0.8
45.0	15.5	38.0	4.7	10.9	2.0	4.64	0.8
25.0	23.3	19.2	1.9	16.3	2.5	6.97	0.9
43.2	0	43.2	4.4	0	0	0	56.8
temp. = 10°C.							
0	31.65	0	0	22.2	2.8	9.47	1.0
53.0	2.05	51.9	6.5	1.43	0.3	0.61	0.1
55.0	4.4	52.6	7.0	3.08	0.6	1.31	0.2
58.0	7.3	53.8	7.9	5.11	1.1	2.18	0.4
55.0	12.5	48.1	7.0	8.75	1.9	3.74	0.7
50.0	15.4	42.3	5.7	10.8	2.2	4.61	0.8
45.0	17.35	37.2	4.7	12.2	2.3	5.2	0.9
25.0	27.4	18.2	1.9	19.2	3.1	8.2	1.1
52.0	0	52.0	6.2	0	0	0	48.0

The authors state that the equilibrium solid phases are $NH_4H_2PO_4$, KH_2PO_4 and an unspecified double salt. There is no mention of the degree of hydration.

^aConcerning the mass% of K_2HPO_4 , see footnote b under Part 1.

Part 4. Solubility in the $NH_4H_2PO_4-(NH_4)_2HPO_4-K_2HPO_4-H_2O$ system at 0°C.

Nr	$NH_4H_2PO_4$		$(NH_4)_2HPO_4$		K_2HPO_4		H_2O mass%
	mass%	mol/kg ^a	mass%	mol/kg ^a	mass%	mol/kg ^a	
1	20.0	3.57	31.4	4.89	----	----	48.6
2	23.2	4.18	25.0	3.92	3.6	0.42	48.2
3	10.7	2.13	10.4	1.81	35.4	4.67	43.6
4	7.5	1.68	7.2	1.40	46.5	6.88	32.9
5	6.8	1.53	7.6	1.49	47.0	6.99	38.6
6	15.6	2.82	23.6	3.72	12.8	1.53	48.0
7	2.8	0.64	2.15	0.43	57.3	8.71	37.7

^aThe mol/kg H_2O values were calculated by the compiler.

COMPONENTS:	EVALUATOR:
(1) Tripotassium phosphate; K_3PO_4 ; [7778-53-2]	J. Eyseltová Charles University Prague, Czechoslovakia
(2) Water; H_2O ; [7732-18-5]	May 1985

CRITICAL EVALUATION:

THE BINARY SYSTEM

The situation with this system is similar to that for the $K_2HPO_4-H_2O$ system. There are insufficient data to use the solubility equation described in the section on NaH_2PO_4 (chap. 3). Solubility measurements were made by Ravich (1). However, there are only a few additional data: four experimental values in ref (2), two in ref (3), and one in each of two other papers (4,5). All these other values are 1-10% lower than those of Ravich (1). Therefore, no values can be recommended for the solubility of tripotassium phosphate in water.

There is also uncertainty with respect to the degree of hydration of the tripotassium phosphate. Ravich (1) reported the existence of a stable heptahydrate and trihydrate and a metastable enneahydrate. However, it is possible that there is some error in his assignment of stability and metastability to the eutonic solutions. Some authors (2,6) also report the existence of an octahydrate as the stable phase at room temperature, but neither Ravich (7,8) nor Berg (9-11) observed an octahydrate in their detailed studies of the $K_2O-P_2O_5-H_2O$ system. Therefore, the evaluator concludes that the existence of the octahydrate has not been established.

MULTICOMPONENT SYSTEMS

Several ternary and one quaternary systems have been studied but there are insufficient solubility values to enable any to be recommended.

1. The $K_3PO_4-NH_3-H_2O$ system. A miscibility gap was found in this system (2).
2. The $K_3PO_4-KBO_2-H_2O$ system. Solubility measurements were made for this system at 298 K (6). The method of analysis for phosphate used in this study was incorrect, giving values that were in error by +30-80%.
3. The $K_3PO_4-K_2SO_4-H_2O$ system. This system was studied at 343 K (4) and the existence of the compound $K_2SO_4 \cdot K_3PO_4 \cdot 9H_2O$ was reported.
4. The $K_3PO_4-KNO_2-H_2O$ system. Solubility values were measured at 298 K (5). Neither new compounds, e.g., $K_3PO_4 \cdot KNO_2$, nor solid solutions are present in this system.
5. The $K_3PO_4-K_2SO_4-KVO_3-H_2O$ system. A study was made of this system at 308 and 333 K (3). In addition to the components and their hydrates, the following were reported as equilibrium solid phases:
 - (i) $4K_2O \cdot P_2O_5 \cdot V_2O_5 \cdot 30H_2O$; (ii) $4K_2O \cdot P_2O_5 \cdot V_2O_5 \cdot 24H_2O$;
 - (iii) $4K_2O \cdot P_2O_5 \cdot V_2O_5 \cdot 22H_2O$; (iv) $4K_2O \cdot P_2O_5 \cdot V_2O_5 \cdot 18H_2O$;
 - (v) $5K_2O \cdot P_2O_5 \cdot 2SO_3 \cdot 30H_2O$; and (vi) $5K_2O \cdot P_2O_5 \cdot 2SO_3 \cdot 22H_2O$. The ratio K:P:S for (v) and (vi) is the same as that reported by others (4).

References

1. Ravich, M.I. *Izv. Akad. Nauk SSSR, Ser. Khim.* 1938, 141.
2. Janecke, E. Z. *Physik. Chem.* 1927, 127, 71.
3. Gasanova, Kh.D.; Abduragimova, R.A. *Ukr. Khim. Zh.* 1978, 44, 158.
4. Rustamov, K.A.; Rza-Zade, P.F.; Abduragimova, R.A. *Obl. Neorg. Fiz. Khim.* 1971, 167.
5. Protsenko, P.I.; Ivleva, T.I.; Rubleva, V.V.; Berdyukova, V.A.; Edush, T.V. *Zh. Prikl. Khim. (Leningrad)* 1975, 48, 1055.
6. Beremzhanov, B.A.; Voronina, L.V.; Savich, R.F. *Khim. Tekhnol. (Alma Ata)* 1978, 29.
7. Ravich, M.I. *Kaliy* 1936, 10, 33.
8. Ravich, M.I. *Izv. Akad. Nauk SSSR* 1938, 167.
9. Berg, A.G. *Izv. Akad. Nauk SSSR* 1933, 167.
10. Berg, A.G. *Izv. Akad. Nauk SSSR* 1938, 147.
11. Berg, A.G. *Izv. Akad. Nauk SSSR* 1938, 161.

Tripotassium Phosphate

COMPONENTS: (1) Tripotassium phosphate; K_3PO_4 ; [7778-53-2] (2) Water; H_2O ; [7732-18-5]		ORIGINAL MEASUREMENTS: Jänecke, E. <i>Z. Phys. Chem.</i> 1927, 127, 71-92.					
VARIABLES: Temperature and composition.		PREPARED BY: J. Eysseltová					
EXPERIMENTAL VALUES:							
Crystallization temperatures and composition of saturated solutions existing in equilibrium with crystalline $K_3PO_4 \cdot 8H_2O$.							
$t/^\circ C.$	H_2O conc ^b	$K_3PO_4^a$ mass%	mass%	mol/kg			
45.1	68	40.3	59.7	6.98			
43.2	75	43.0	57.0	6.24			
23.3	104	51.0	49.0	4.52			
7.5	125	55.8	44.2	3.73			
^a These values were calculated by the compiler.							
^b The concentration unit is: g/100 g K_3PO_4 .							
AUXILIARY INFORMATION							
METHOD/APPARATUS/PROCEDURE: The salt was added to the water and the mixture was heated until total liquefaction occurred. A cooling curve of the mixture was then measured. The methods of analysis are not described.	SOURCE AND PURITY OF MATERIALS: Merck pure K_3PO_4 was used and was further purified by dissolving the salt in water and passing NH_3 through the solution for 2-3 hours. The octahydrate precipitated from the solution.						
	Analysis: found calculated H_2O 40.00% 40.58% P_2O_5 19.10% 19.95% K_2O 40.14% 39.47%						
	ESTIMATED ERROR: No information is given.						
	REFERENCES:						

COMPONENTS:					ORIGINAL MEASUREMENTS:				
(1) Tripotassium phosphate; K_3PO_4 ; [7778-53-2]					Ravich, M.I. Izv. AN SSSR. ser. Khim. 1938, 141-6.				
(2) Water; H_2O ; [7732-18-5]									
VARIABLES:					PREPARED BY:				
Temperature and composition.					J. Eyseltová				
EXPERIMENTAL VALUES: Compositions and crystallization temperatures in the $K_3PO_4-H_2O$ system.									
$t/^\circ C.$	K_3PO_4 mass%	K_3PO_4 mol%	H_2O mol/kg ^a	solid _b phase	$t/^\circ C.$	K_3PO_4 mass%	K_3PO_4 mol%	H_2O mol/kg ^a	solid _b phase
-1.18	4.54	0.40	0.22	ice	42.6	59.46	11.06	6.90	B
-2.60	9.75	0.91	0.50	"	44.5	60.84	11.64	7.31	"
-4.6	15.43	1.52	0.85	"	45.4	61.94	12.13	7.66	"
-7.7	21.74	2.30	1.30	"	45.6	62.51	12.39	7.85	"
-12.0	27.34	3.09	1.77	"	45.6	63.12	12.68	8.06	"
-15.8	31.53	3.76	2.16	"	45.4				
-20.0	35.12	4.39	2.54	"	25	63.17	12.70	8.07	B + C
-24.0	38.33	5.00	2.92	A + ice	30	63.19	12.71	8.08	"
-28.2	40.25	5.40	3.17	B + ice	35	63.33	12.77	8.13	"
-8.8	42.92	6.00	3.54	B	40	63.41	12.81	8.16	"
0	44.26	6.31	3.74	"	45	63.56	12.89	8.21	"
10	46.83	6.95	4.14	"	50	63.80	13.00	8.30	C
20	49.62	7.71	4.63	"	60	64.08	13.14	8.40	"
25	51.42	8.23	4.98	"	-7.7	43.85	6.21	3.67	A
30	53.08	8.75	5.32	"	0	47.62	7.16	4.28	"
35	55.43	9.54	5.85	"	5.0	49.80	7.76	4.67	"
40	57.51	10.30	6.37	"	8.8	52.23	8.43	5.15	"
					12.3	57.72	10.00	6.43	

^a The mol/kg H_2O values were calculated by the compiler.

^b The solid phases are: A = $K_3PO_4 \cdot 9H_2O$; B = $K_3PO_4 \cdot 7H_2O$; C = $K_3PO_4 \cdot 3H_2O$.

^c Metastable equilibrium.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. The solubility was determined by evaporating the saturated solutions and drying to constant weight. Cooling curves were determined for some of the mixtures.	The material used is reported as having been submitted by Berg. The compiler assumes the material is the same as that used in (1).
	ESTIMATED ERROR:
	No information is given.
	REFERENCES:
	1. Berg, L.G. Izv. AN SSSR. ser. Khim. 1938, 150.

COMPONENTS:

- (1) Tripotassium phosphate; K_3PO_4 ; [7778-53-2]
 (2) Ammonia; NH_3 ; [7664-41-7]
 (3) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Jänecke, E.
Z. Phys. Chem. 1927, 127, 71-92.

EXPERIMENTAL VALUES cont'd:

Part 2. Composition of solutions existing in equilibrium with $K_3PO_4 \cdot 8H_2O$.

$t/^\circ C.$	layer	K_3PO_4		NH_3		H_2O		
		mass%	conc ^a	mol/kg ^b	mass%	conc ^a	mol/kg ^b	mass%
0	upper	3.2	13.85	0.04	19.9	86.15	3.52	76.9
	lower	39.1	95.7	1.27	1.8	4.3	0.71	59.1
15	upper	2.5	9.0	0.05	25.5	91.0	5.83	72.0
	lower	45.5	94.8	1.99	2.5	5.2	1.36	52.0
25	upper	4.2	14.6	0.09	24.5	85.4	6.52	71.3
	lower	50.0	97.3	2.47	1.4	2.7	0.86	48.6

^aThe concentration unit is: g/100 g of ($K_3PO_4 + NH_3$).

^bThe mol/kg H_2O values were calculated by the compiler.

Part 3. Temperatures of the miscibility gap in some solutions of the

$K_3PO_4 - NH_3 - H_2O$ system.

gram	K_3PO_4 mass% ^a	mol/kg ^a	gram	NH_3 mass% ^a	mol/kg ^a	gram	H_2O mass% ^a	$t/^\circ C.$ ^b
93.55	35.57	1.03	6.45	2.45	0.88	183	61.98	0
89.5	29.98	0.71	10.5	3.52	1.04	198.5	66.50	0
84.3	26.55	0.58	15.7	4.94	1.34	217.5	68.50	0.3
78.5	23.21	0.46	21.5	6.36	1.57	238.2	70.43	6.9
66.5	19.76	0.39	33.2	9.82	2.42	238.1	70.42	46.05
56.3	15.50	0.28	43.5	11.94	2.66	264.4	72.56	45.75
42.8	11.08	0.18	56.1	14.16	2.81	296.2	74.76	39.6
25.0	5.77	0.08	75.0	17.32	3.06	333	76.90	14.2
93.6	37.71	1.20	6.4	2.58	1.02	148.2	59.71	37.7
91.0	37.07	1.20	9.0	3.67	1.48	145.5	59.27	57.2
85.0	32.32	0.93	15.0	5.70	2.06	163	61.98	70.2
78.5	27.84	0.72	21.5	7.62	2.46	182	64.54	69.4
71.1	23.66	0.56	28.9	9.62	2.82	200.5	66.72	52.4
60.5	18.85	0.40	39.5	12.30	3.28	221	68.85	44.6
50.8	14.74	0.28	49.2	14.28	3.43	244.6	70.98	35.95
29.2	7.10	0.11	70.8	17.20	3.25	311.5	75.70	13

^aThese values were calculated by the compiler.

^bWhen the temperature is raised, this is the temperature at which two layers are first observed.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tripotassium phosphate; K_3PO_4 ; [7778-53-2] (2) Dipotassium sulfate; K_2SO_4 ; [10233-01-9] (3) Water; H_2O ; [7732-18-5]	Rustamov, K.A.; Rza-Zade, P.F.; Abdurragimova, R.A. Issled. Obl. Neorg. Fiz. Khim. 1971, 167-9. (Proceedings of the Institute of Inorganic and Physical Chemistry, Academy of Sciences of the Adzerbeidzhan SSR)
VARIABLES:	PREPARED BY:
Composition at 70°C.	J. Eyssettová

EXPERIMENTAL VALUES:
Solubility isotherm for the K_3PO_4 - K_2SO_4 - H_2O system at 70°C.

P_2O_5 mass%	K_3PO_4 mass%	SO_3 mass%	K_2SO_4 mass%	H_2O mass%	solid phase ^b
mol/kg ^a			mol/kg ^a		
---	---	7.5906	16.5095	1.13	A
0.6889	2.0599	0.11	6.9682	15.1558	"
1.3413	4.0042	0.22	6.1820	13.4459	A + B
1.4378	4.2932	0.24	5.4722	11.9020	B
2.0000	5.9718	0.33	5.5432	9.8815	"
3.5883	10.7143	0.61	3.2616	7.0941	"
4.6607	13.9164	0.81	2.7395	5.9584	"
6.8621	20.4895	1.27	1.6339	3.5537	"
8.1070	24.2020	1.56	1.3371	2.9081	"
8.8433	26.4033	1.71	0.5414	1.1835	"
10.7585	32.1239	2.29	0.8320	1.8098	B + C
11.9900	35.8011	2.65	0.2833	0.6163	C
13.7434	41.0365	3.30	0.1879	0.4087	"
17.3498	51.8049	5.08	0.0926	0.2014	"
21.4349	64.0026	8.37	-----	-----	"
					35.9974

^aThe mol/kg H_2O values were calculated by the compiler.

^bThe solid phases are: A = K_2SO_4 ; B = $K_2SO_4 \cdot K_3PO_4 \cdot 9H_2O$; C = $K_3PO_4 \cdot 7H_2O$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The potassium phosphate was added to saturated solutions of potassium sulfate and the mixtures were equilibrated in vessels of Mo-glass placed in a water thermostat. Equilibrium was checked by repeated experiments. The P_2O_5 and SO_3 contents were determined photometrically. The solid phases were analyzed only occasionally.	Pure" and "chemically pure" K_2SO_4 and K_3PO_4 were used.
ESTIMATED ERROR:	No details are given.
REFERENCES:	

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tripotassium phosphate; K_3PO_4 ; [7778-53-2]	Protsenko, P.I.; Ivleva, T.I.; Rubleva, V.V.; Berdyukova, V.A.; Edush, T.V.
(2) Potassium nitrite; KNO_2 ; [7758-09-0]	Zh. Prikl. Khim. (Leningrad) 1975, 48, 1055-9.
(3) Water; H_2O ; [7732-18-5]	

VARIABLES:	PREPARED BY:
Composition at 25°C.	J. Eysseltová

EXPERIMENTAL VALUES: Solubility in the K_3PO_4 - KNO_2 - H_2O system at 25°C.

	$K_3PO_4^a$		KNO_2^a		H_2O		
mass%	concn	mol/kg ^b	mass%	concn	mol/kg ^b	mass%	solid phase
50.71	87.24	4.85	0.00	0.00	0.00	49.29	$K_3PO_4 \cdot 7H_2O$
49.50	86.41	4.80	1.93	8.40	0.47	48.57	"
43.50	82.28	4.57	11.68	55.10	3.06	44.82	"
43.39	83.58	4.64	12.59	60.48	3.36	44.02	"
40.65	80.86	4.49	16.72	82.92	4.61	42.63	"
38.70	80.62	4.48	20.60	107.02	5.96	40.70	"
36.39	83.15	4.62	24.67	134.00	7.44	38.94	"
33.43	76.39	4.24	29.46	167.87	9.33	37.11	"
31.19	73.57	4.09	32.87	193.41	10.75	35.94	$K_3PO_4 \cdot 7H_2O + KNO_2$
31.09	73.23	4.07	32.90	192.77	10.71	36.01	"
31.08	73.28	4.07	32.96	194.11	10.78	35.96	"
31.08	73.34	4.07	33.00	194.43	10.80	35.92	"
28.62	69.07	3.84	36.25	218.23	12.12	35.13	KNO_2
24.93	62.00	3.44	40.99	254.37	14.13	34.08	"
20.37	52.69	2.93	46.85	303.97	16.89	32.78	"
16.32	44.70	2.48	51.20	333.68	18.54	32.48	"
12.63	35.03	1.95	56.81	393.15	21.84	30.56	"
8.10	24.26	1.35	63.55	474.09	26.34	28.35	"
4.98	15.81	0.88	68.32	541.08	30.06	26.70	"
-----	-----	-----	75.92	666.81	37.05	24.08	"

^aThe concentration unit is: mol/1000 mol water.

^bThe mol/kg H_2O values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The isothermal method was used. Ten to twelve hours were allowed for equilibration. The nitrite ion content was determined by the iodometric back titration of excess permanganate. The phosphate ion content was determined gravimetrically as $Mg_2P_2O_7$.	The $K_3PO_4 \cdot 7H_2O$ was recrystallized. It had a purity of 99.56%.
	The KNO_2 was synthesized by the reaction of $Ba(NO_2)_2$ with K_2SO_4 . It had a purity of 99.65%.
	ESTIMATED ERROR: The temperature was controlled to within $\pm 0.1^\circ C$. The compiler estimates the reproducibility of the solubility values to be about $\pm 0.3\%$.

REFERENCES:

Tripotassium Phosphate

COMPONENTS:				ORIGINAL MEASUREMENTS:				
(1) Tripotassium phosphate; K_3PO_4 ; [7778-53-2]				Beremzhanov, B.A.; Voronina, L.V.; Savich, R.F.				
(2) Potassium borate; KBO_2 ; [13709-94-9]				<i>Khim. Khim. Tekhnol. (Alma Ata)</i> 1978, 29-36.				
(3) Water; H_2O ; [7732-18-5]								
VARIABLES:				PREPARED BY:				
Composition at 25°C.				J. Eysseltova				

EXPERIMENTAL VALUES: Solubility in the $KBO_2-K_3PO_4-H_2O$ system at 25°C.

mass% ^a	K_3PO_4		KBO_2		refr. index	pH	solid phase ^b
	mol%	mol/kg ^a	mass% ^a	mol%			
---	---	---	0.368	0.081	0.045	1.441	13.95 A
97.4	77.5	180	---	---	---	1.450	13.80 B
87.6	37.38	33.4	0.054	0.054	0.054	1.445	13.90 C
79.2	24.29	18.0	0.061	0.046	0.036	1.445	13.81 "
72.0	17.53	12.1	0.063	0.035	0.028	1.445	13.48 "
68.4	15.45	10.2	0.117	0.067	0.046	1.444	13.21 "
61.4	11.66	7.5	0.126	0.062	0.040	1.445	12.97 "
57.0	9.77	6.3	0.173	0.079	0.050	1.443	12.88 "
56.4	8.08	6.1	0.176	0.086	0.050	1.441	12.88 A + B
54.6	9.06	5.7	0.171	0.072	0.047	1.440	12.70 A
53.4	8.86	5.4	0.164	0.070	0.044	1.435	12.65 "
47.8	7.07	4.3	0.159	0.061	0.038	1.434	12.50 "
23.4	2.89	1.4	0.187	0.052	0.030	1.430	12.46 "
20.4	2.00	1.2	0.211	0.055	0.033	1.425	12.41 "
10.2	0.79	0.5	0.298	0.069	0.041	1.420	12.35 "
6.6	0.57	0.3	0.328	0.076	0.044	1.410	12.22 "

^a These values were calculated by the compiler.

^b The solid phases are: A = KBO_2 ; B = K_3PO_4 ; C = $K_3PO_4 \cdot 8H_2O$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal method was used but no further details are given.

SOURCE AND PURITY OF MATERIALS:

No information is given.

ESTIMATED ERROR:

No information is given.

REFERENCES:

COMPONENTS:		ORIGINAL MEASUREMENTS: Gasanova, Kh.G.; Abduragimova, R.A. <i>Ukr. Khim. Zh.</i> <u>1978</u> , 44, 158-63.											
(1) Tripotassium phosphate; K_3PO_4 ; [7778-53-2]													
(2) Dipotassium sulfate; K_2SO_4 ; [10233-01-9]													
(3) Potassium vanadate; KVO_3 ; [13769-43-2]													
(4) Water; H_2O ; [7732-18-5]													
VARIABLES:		PREPARED BY:											
Composition at 35° and 60°C.		J. Eysseltova											
EXPERIMENTAL VALUES:													
Invariant points in the K_3PO_4 - K_2SO_4 - KVO_3 - H_2O system.													
K_3PO_4 mass%	K_3PO_4 mol/kg ^a	KVO_3 mass%	KVO_3 mol/kg ^a	K_2SO_4 mass%	K_2SO_4 mol/kg ^a	H_2O mass%	solid phase ^b						
temp. = 35°C.													
0.00	0.00	12.83	1.06	0.00	0.00	87.17	A						
0.00	0.00	0.00	0.00	12.23	0.79	87.77	B						
52.90	5.29	0.00	0.00	0.00	0.00	47.10	C						
0.00	0.00	1.88	0.15	10.28	0.67	87.84	A + C						
21.97	1.43	6.01	0.60	0.00	0.00	72.02	C + D						
2.49	0.13	10.58	0.88	0.00	0.00	86.93	A + D						
4.89	0.26	2.28	0.18	5.90	0.38	86.93	A + D + E						
1.85	0.09	0.00	0.00	10.51	0.68	87.54	B + F						
2.79	0.15	0.46	0.03	10.48	0.69	86.27	B + E + F						
4.97	0.25	1.03	0.08	2.58	0.16	91.42	D + E + F						
17.54	1.07	2.98	0.28	2.88	0.21	76.60	C + D + F						
24.21	1.58	0.00	0.00	3.84	0.30	71.95	C + F						
2.29	0.12	0.72	0.06	10.14	0.66	86.85	A + B + E						
temp. = 60°C.													
0.00	0.00	22.46	2.09	0.00	0.00	77.54	A						
0.00	0.00	0.00	0.00	15.38	1.04	84.62	B						
61.55	7.54	0.00	0.00	0.00	0.00	38.45	G						
0.00	0.00	3.37	0.29	13.84	0.95	82.79	A + G						
4.32	0.26	18.11	1.69	0.00	0.00	77.57	A + H						
24.93	1.78	9.12	1.00	0.00	0.00	65.95	G + H						
(continued next page)													
AUXILIARY INFORMATION													
METHOD/APPARATUS/PROCEDURE:		SOURCE AND PURITY OF MATERIALS:											
The method of invariant points was used. The third component was added to binary systems. No further details are given.		No information is given.											
		ESTIMATED ERROR:											
		Nothing is stated.											
		REFERENCES:											

Tripotassium Phosphate

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Tripotassium phosphate; K_3PO_4 ; [7778-53-2]	Gasanova, KH.G.; Abduragimova, R.A. <i>Ukr. Khim. Zh.</i> 1978, 44, 158-63.
(2) Dipotassium sulfate; K_2SO_4 ; [10233-01-9]	
(3) Potassium vanadate; KVO_3 ; [13769-43-2]	
(4) Water; H_2O ; [7732-18-5]	

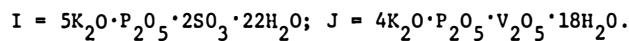
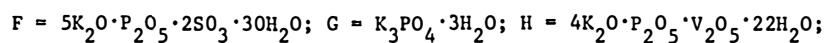
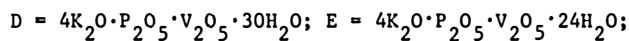
EXPERIMENTAL VALUES cont'd:

Invariant points in the $K_3PO_4-K_2SO_4-KVO_3-H_2O$ system.

K_3PO_4 mass%	K_3PO_4 mol/kg ^a	KVO_3 mass%	KVO_3 mol/kg ^a	K_2SO_4 mass%	K_2SO_4 mol/kg ^a	H_2O mass%	solid phase ^b
temp. = 60°C.							
28.42	2.01	0.00	0.00	5.21	0.45	66.37	G + I
5.14	0.29	0.00	0.00	12.22	0.84	82.64	B + I
5.93	0.34	6.11	0.54	6.58	0.46	81.38	A + H + J
0.74	0.04	2.21	0.18	12.09	0.81	84.96	A + B + J
15.09	0.91	4.00	0.37	3.17	0.23	77.74	G + H + I
3.00	0.15	1.21	0.09	7.20	0.46	88.59	H + I + J
1.39	0.07	0.45	0.03	12.11	0.80	86.05	B + I + J

^a The mol/kg H_2O values were calculated by the compiler.

^b The solid phases are: A = $KVO_3 \cdot 3H_2O$; B = K_2SO_4 ; C = $K_3PO_4 \cdot 7H_2O$;



COMPONENTS:

- (1) Rubidium dihydrogen phosphate; RbH_2PO_4 ; [13774-16-8]
 (2) Water; H_2O ; [7732-18-5]

EVALUATOR:

J. Eyseltová
 Charles University
 Prague, Czechoslovakia

December, 1983

CRITICAL EVALUATION:

Qualitative solubility studies were made of three rubidium orthophosphates (1): $\text{Rb}_3\text{PO}_4 \cdot 4\text{H}_2\text{O}$ [101056-52-4]; $\text{Rb}_2\text{HPO}_4 \cdot \text{H}_2\text{O}$ [79832-54-5]; and RbH_2PO_4 [13774-16-8]. It was estimated that all these compounds are highly soluble. There is also a reference to $\text{Rb}_3\text{PO}_4 \cdot 3\text{H}_2\text{O}$ [10156-51-3] but no solubility data are reported (2). When it was discovered that the crystals of rubidium dihydrogen phosphate had some desirable electrical characteristics, further solubility studies were made.

The binary system $\text{RbH}_2\text{PO}_4 - \text{H}_2\text{O}$ was studied by Bykova, et al. (3). All other solubility studies (4, 5) were for ternary systems. The solubility values were determined by a direct analytical method in all the studies, but some of the analytical procedures are questionable. One group (4) used a potentiometric titration with aqueous KOH and report an accuracy of ± 0.2 mass%. The others (3, 5) used gravimetric procedures. Bykova, et al. (3) weighed rubidium as the tetraphenylborate and discuss the problem of analyzing for phosphorus in the presence of rubidium. Literature data for the solubility of rubidium phosphomolybdate (6, 7) are cited ($8.1 \times 10^{-6} \text{ mol dm}^{-3}$ in $0.1 \text{ mol dm}^{-3} \text{ HNO}_3$ at 293 K) and the possible formation of RbMgPO_4 is discussed (8). Because of these facts the gravimetric determination of phosphorus in systems containing rubidium must be carried out under carefully defined and controlled conditions. Zvorykin, et al. (5) precipitated phosphorus as $(\text{NH}_4)_3\text{PMO}_{12}\text{O}_{40}$, reprecipitated it as NH_4MgPO_4 and then calcined the latter to form $\text{Mg}_2\text{P}_2\text{O}_7$. They made no comment about the consistency of their determinations of NH_3 , Rb and P. The compiler found these values to be inconsistent with each other.

THE BINARY SYSTEM

The solubility of RbH_2PO_4 in water has been determined over the temperature range of 273 to 353 K (3). The temperature coefficient of solubility was also determined and the authors split the temperature interval in two parts: 273-313 and 323-353 K. The evaluator treated these data by the linear regression method. The results are summarized in Table I where the coefficients for equation [1] are given for concentrations expressed as mass% and as mol/kg. The results in Table I suggest that there is no

$$c_{\text{RbH}_2\text{PO}_4} = a(T-273) + b \quad [1]$$

need to split the temperature interval.

Table I. Coefficients for equation [1]

temp. range	a	b	R
c as mass%			
273 - 313 K	0.52 ± 0.01	30.4 ± 0.4	0.9988
273 - 323 K	0.50 ± 0.01	30.6 ± 0.5	0.9983
273 - 333 K	0.47 ± 0.02	31.2 ± 0.9	0.9939
273 - 353 K	0.40 ± 0.03	32.9 ± 1.7	0.9788
c as mol/kg			
273 - 313 K	0.082 ± 0.002	2.33 ± 0.06	0.9990
273 - 323 K	0.087 ± 0.003	2.28 ± 0.10	0.9974
273 - 333 K	0.087 ± 0.002	2.28 ± 0.08	0.9983
273 - 353 K	0.084 ± 0.002	2.3 ± 0.1	0.9981

MULTICOMPONENT SYSTEMS

The solubility of RbH_2PO_4 has been measured in three ternary systems.

1. The $\text{RbH}_2\text{PO}_4 - \text{RbCl} - \text{H}_2\text{O}$ system. The solubility in this system was measured only at 298 K (3). The system is an eutonic one with the invariant solution having a composition of 4.34 mass% (0.47 mol/kg) RbH_2PO_4 and 45.12 mass% (7.41 mol/kg) RbCl .

(continued next page)

COMPONENTS: (1) Rubidium dihydrogen phosphate; RbH_2PO_4 ; [13774-16-8] (2) Water; H_2O ; [7732-18-5]	EVALUATOR: J. Eysseltová Charles University Prague, Czechoslovakia December, 1983
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CRITICAL EVALUATION: (continued)

2. The $\text{RbH}_2\text{PO}_4-\text{NH}_4\text{H}_2\text{PO}_4-\text{H}_2\text{O}$ system. The solubility in this system has been measured only at 298 K (5). There are legitimate questions about the analytical procedures used in this work and the results must be considered to be questionable. There is considerable scatter in the data, which are plotted on Figure 1. It appears that one series of solid solutions is formed. Figure 1 shows that they belong to Type I in the Roozeboom classification (9).

3. The $\text{RbH}_2\text{PO}_4-\text{Rb}_2\text{O}-\text{H}_3\text{PO}_4-\text{H}_2\text{O}$ system. Solubilities in this system have been measured at 298 and 323 K (4). The authors considered it as the ternary system $\text{Rb}_2\text{O}-\text{P}_2\text{O}_5-\text{H}_2\text{O}$. The compiler transformed the values to those for the quaternary system, Figure 2. In the $\text{RbH}_2\text{PO}_4-\text{Rb}_2\text{O}-\text{H}_2\text{O}$ part of the system the solubility of RbH_2PO_4 is only slightly affected by change in concentration of the solutions, especially at 323 K. However, in the $\text{RbH}_2\text{PO}_4-\text{H}_3\text{PO}_4-\text{H}_2\text{O}$ part of the system the solubility of the rubidium dihydrogenphosphate increases with increasing H_3PO_4 content until the invariant point is reached. Beyond this, the acid salt $\text{RbH}_5(\text{PO}_4)_2$ appears in the solid phase. Such acid phosphates are reported for most systems involving the alkaline metals (10-14).

The solubility of RbH_2PO_4 in aqueous H_3PO_4 may be described by equation [2] where c is the concentration expressed as

$$c_{\text{RbH}_2\text{PO}_4} = a \cdot c_{\text{H}_3\text{PO}_4} + b \quad [2]$$

mass% or as mol/kg. The value of the coefficients, calculated by linear regression, are given in Table II.

Table II. Values of coefficients for equation [2].

T/K	c as mass%			c as mol/kg		
	a	b	R	a	b	R
298	0.55 ± 0.02	44.1 ± 0.3	0.9950	0.93 ± 0.02	4.38 ± 0.07	0.9991
323	0.280 ± 0.007	54.8 ± 0.1	0.9979	0.983 ± 0.004	6.65 ± 0.03	1.0000

The authors (4) also linearized their data using equation [3].

$$w_{\text{Rb}_2\text{O}} = a + b \cdot w_{\text{P}_2\text{O}_5} \quad [3]$$

However, they gave no details for the method they used. The compiler recalculated their values to give the following results:

for $\text{P}/\text{Rb} > 1$

$T = 298 \text{ K}$ $a = 17.6 \pm 0.7 \text{ mass\%}$; $b = 0.30 \pm 0.02$; $R = 0.9825$

$T = 323 \text{ K}$ $a = 25.2 \pm 0.5 \text{ mass\%}$; $b = 0.15 \pm 0.02$; $R = 0.9647$

for $\text{P}/\text{Rb} < 1$

$T = 298 \text{ K}$ $a = -41 \pm 5 \text{ mass\%}$; $b = 3.9 \pm 0.3$; $R = 0.9832$

$T = 323 \text{ K}$ $a = -132 \pm 35 \text{ mass\%}$; $b = 7.7 \pm 1.7$; $R = 0.8688$.

CONCLUSIONS

The results of two studies (3, 4) agree well with each other. Therefore, the tentative solubility values for RbH_2PO_4 in water in the temperature range 273-353 K can be described by equation [1]. There are insufficient data to use the method that was described in the Critical Evaluation for the solubility of NaH_2PO_4 (chap. 3).

More work is needed to describe the solubility of other rubidium phosphates.

References

1. von Berg, E. *Ber.* 1901, 34, 4182.
2. Lauffenburger, R. *Thesis*, Strasbourg 1932.
3. Bykova, I.N.; Kuznetsova, G.P.; Kolotilova, V.Ya.; Stepin, B.D. *Zh. Neorg. Khim.* 1968, 13, 540.
4. Rashkovich, L.N.; Momtaz, R.Sh. *Zh. Neorg. Khim.* 1978, 23, 1349.

(continued next page)

COMPONENTS:	EVALUATOR:
(1) Rubidium dihydrogen phosphate; RbH_2PO_4 ; [13774-16-8]	J. Eyseltová Charles University Prague, Czechoslovakia
(2) Water; H_2O ; [7732-18-5]	December, 1983

CRITICAL EVALUATION:

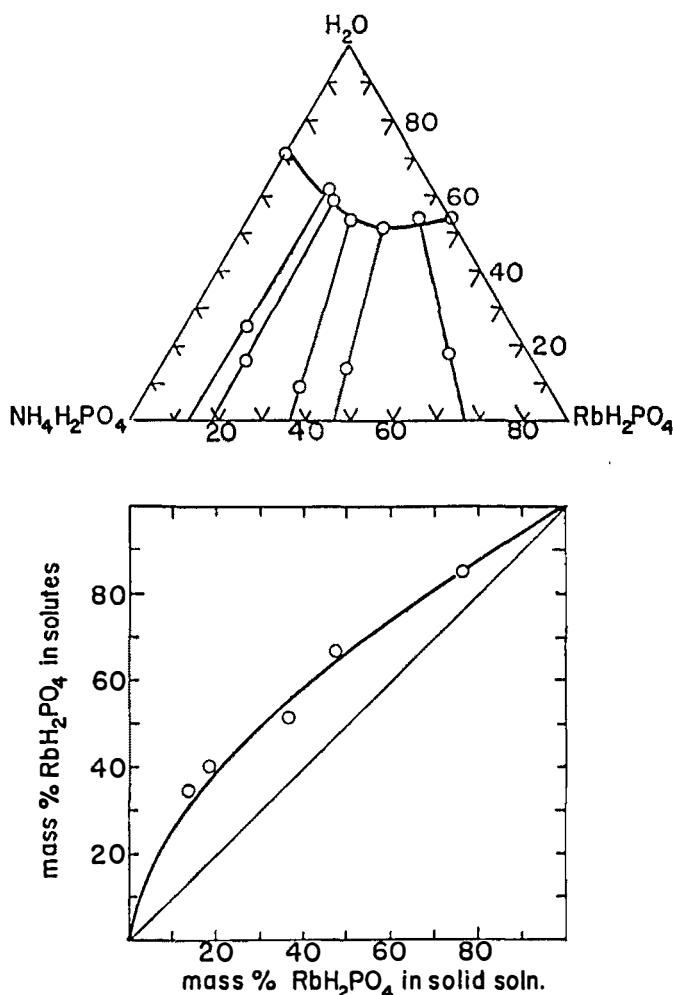


Figure 1. Phase diagram and distribution curve for the $\text{RbH}_2\text{PO}_4-\text{NH}_4\text{H}_2\text{PO}_4-\text{H}_2\text{O}$ system at 298 K.
The data are from ref. (5). The distribution curve was constructed by the evaluator.

COMPONENTS:

- (1) Rubidium dihydrogen phosphate; RbH_2PO_4 ; [13774-16-8]
 (2) Water; H_2O ; [7732-18-5]

EVALUATOR:

J. Eyseltová
 Charles University
 Prague, Czechoslovakia

December, 1983

CRITICAL EVALUATION:

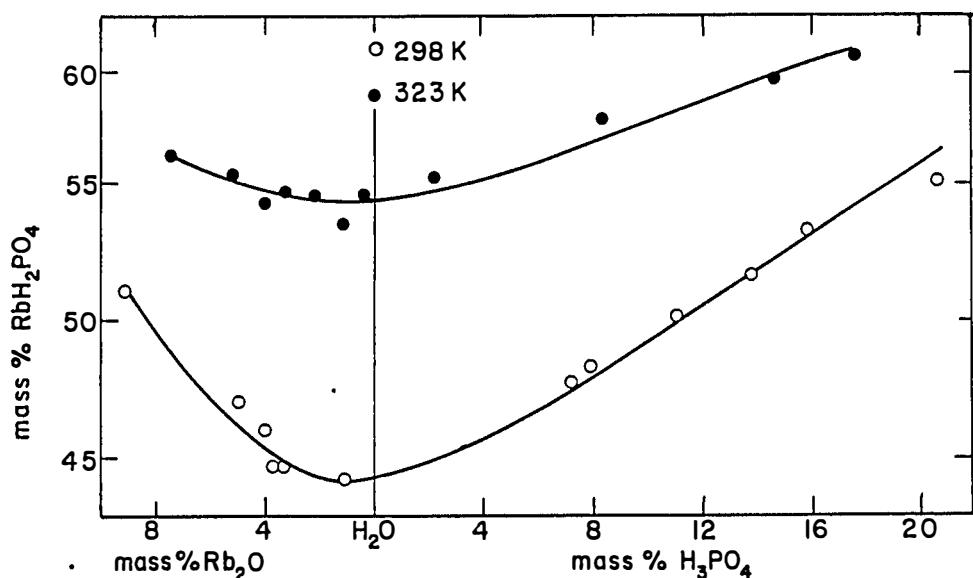


Figure 2. Solubility in the $\text{Rb}_2\text{O}-\text{P}_2\text{O}_5-\text{H}_2\text{O}$ system. The data have been recalculated from ref. (4) by the compiler.

COMPONENTS:	EVALUATOR:
(1) Rubidium dihydrogen phosphate; RbH ₂ PO ₄ ; [13774-16-8] (2) Water; H ₂ O; [7732-18-5]	J. Eysseltová Charles University Prague, Czechoslovakia December, 1983

CRITICAL EVALUATION: (continued)

5. Zvorykin, A.Ya.; Vetrkina, L.S. *Zh. Neorg. Khim.* 1961, 6, 2572.
6. Broadbank, R.W.C.; Dhabanandana, S.; Harding, R.D. *J. Inorg. Nucl. Chem.* 1961, 23, 311.
7. Nikitina, E.A.; Sokolova, O.N. *Zh. Obshch. Chim.* 1954, 24, 1123.
8. Erdmann, H.; Kotheuer, P. *Ann. Chem.* 1897, 294, 72.
9. Roozeboom, B. *Z. Physik. Chem.* 1891, 8, 521.
10. Muromtsev, B.A.; Nazarova, L.A. *Izv. AN SSSR (section of mathematics and natural sciences)* 1938, 1, 177.
11. Flatt, R.; Brunisholz, G.; Chapuis-Goitreux, S. *Helv. Chim. Acta* 1951, 34, 884.
12. Berg, L.G. *Izv. AN SSSR (section of mathematics and natural sciences)* 1938, 1, 147.
13. Barkova, L.V.; Lopeshkov, I.N. *Zh. Neorg. Khim.* 1968, 13, 1432.
14. Rashkovich, L.N.: Meteva, K.B.; Schevchik, J.E. *Zh. Neorg. Khim.* 1977, 22, 1982.

Rubidium Dihydrogenphosphate

COMPONENTS: (1) Rubidium dihydrogenphosphate; RbH_2PO_4 ; [13774-16-8] (2) Water; H_2O ; [7732-18-5]		ORIGINAL MEASUREMENTS: Bykova, I.N.; Kuznetsova, G.P.; Kolotilova, V.Ya.; Stepin, B.D. <i>Zh. Neorg. Khim.</i> <u>1968</u> , 13, 540-4.	
VARIABLES: Temperature.		PREPARED BY: J. Eysseltova	
EXPERIMENTAL VALUES:			
Solubility of RbH_2PO_4 in water.			
<i>t</i> /°C	g/100 g H_2O	mass% ^a	mol/kg ^a
0	43.2	30.16	2.37
25	78.7	44.04	4.31
40	103.7	50.91	5.68
50	123.6	55.27	6.77
60	137.1	57.82	7.51
80	162.9	61.96	8.93
^a These values were calculated by the compiler.			
COMMENTS and ADDITIONAL DATA: The temperature coefficient of the solubility is reported to be constant in the temperature ranges 0 to 40°C and 50 to 80°C. The values are:			
range/°C.		$dm_1/dT/\text{mol kg}^{-1} \text{K}^{-1}$	
0 - 40		0.0803	
50 - 80		0.070	
AUXILIARY INFORMATION			
METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS: RbH_2PO_4 was synthesized from reagent grade H_3PO_4 and Rb_2CO_3 . The Rb_2CO_3 was obtained by calcining $\text{Rb}_2(\text{COO})_2$. The maximum amount of impurity in the RbH_2PO_4 was 0.05 mass%.		
The mixtures were equilibrated isothermally for 15 days. The apparatus has been described elsewhere (1). The rubidium content was determined gravimetrically as the tetraphenylborate. The temperature coefficient of the solubility was determined graphically.	ESTIMATED ERROR: The temperature was controlled to within ± 0.1 K. No other information is given.		
	REFERENCES: 1. Kuznetsova, G.P.; Stepin, B.D. <i>Zh. Neorg. Khim.</i> <u>1965</u> , 10, 472.		

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Rubidium dihydrogenphosphate; RbH_2PO_4 ; [13774-16-8]	Zvorykin, A.Ya.; Vetskina, L.S. <i>Zh. Neorg. Khim.</i> , <u>1961</u> , 6, 2572-5.
(2) Ammonium dihydrogenphosphate; $\text{NH}_4\text{H}_2\text{PO}_4$; [7722-76-1]	
(3) Water; H_2O ; [7732-18-5]	
VARIABLES:	PREPARED BY:
Composition at 25°C.	J. Eysseltova

EXPERIMENTAL VALUES:

Composition of saturated solutions in the
 $\text{RbH}_2\text{PO}_4-\text{NH}_4\text{H}_2\text{PO}_4-\text{H}_2\text{O}$ system at 25°C.

Rb mass%	NH ₃ mass%	P mass%	RbH_2PO_4 mass% mol/kg ^a	$\text{NH}_4\text{H}_2\text{PO}_4$ mass% mol/kg ^a	solid phase
21.37	----	7.92	46.12	4.69	RbH_2PO_4
18.35	1.07	8.36	39.17	4.01	solid soln
15.94	2.43	7.53	32.05	4.41	"
11.26	3.48	9.40	24.03	2.51	"
8.32	2.89	6.52	17.72	1.62	"
8.05	3.14	6.84	17.19	1.61	"
7.3	2.97	8.06	15.58	1.40	"
6.78	3.47	7.61	14.48	1.28	"
----	4.36	7.85	----	29.31	$\text{NH}_4\text{H}_2\text{PO}_4$
				3.60	

^aThe mol/kg H_2O values were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:															
The components were mixed, dissolved in water at 65°C, cooled rapidly to 25°C and equilibrated by shaking for several days. P_2O_5 was determined gravimetrically as $\text{Mg}_2\text{P}_2\text{O}_7$, rubidium was weighed as RbClO_4 , and ammonia was determined by the Kjeldahl method.	RbH_2PO_4 and $\text{NH}_4\text{H}_2\text{PO}_4$ were synthesized from chemically pure H_3PO_4 and Rb_2CO_3 or NH_3 . The analyses were: <table> <thead> <tr> <th></th> <th>found</th> <th>calcd.</th> </tr> </thead> <tbody> <tr> <td>RbH_2PO_4</td> <td>46.16% Rb</td> <td>46.85% Rb</td> </tr> <tr> <td>"</td> <td>16.66% P</td> <td>16.98% P</td> </tr> <tr> <td>$\text{NH}_4\text{H}_2\text{PO}_4$</td> <td>14.4% N</td> <td>14.78% N</td> </tr> <tr> <td>"</td> <td>26.62% P</td> <td>26.95% P</td> </tr> </tbody> </table>		found	calcd.	RbH_2PO_4	46.16% Rb	46.85% Rb	"	16.66% P	16.98% P	$\text{NH}_4\text{H}_2\text{PO}_4$	14.4% N	14.78% N	"	26.62% P	26.95% P
	found	calcd.														
RbH_2PO_4	46.16% Rb	46.85% Rb														
"	16.66% P	16.98% P														
$\text{NH}_4\text{H}_2\text{PO}_4$	14.4% N	14.78% N														
"	26.62% P	26.95% P														
ESTIMATED ERROR:	No information is given.															
REFERENCES:																

COMPONENTS:		ORIGINAL MEASUREMENTS:			
(1) Rubidium dihydrogenphosphate; RbH_2PO_4 ; [13774-16-8]		Bykova, I.N.; Kuznetsova, G.P.; Kolotilova, V.Ya.; Stepin, B.D.			
(2) Rubidium chloride; RbCl ; [7791-11-9]		<i>Zh. Neorg. Khim.</i> 1968, 13, 540-4.			
(3) Water; H_2O ; [7732-18-5]					
VARIABLES:		PREPARED BY:			
Composition at 25°C.		J. Eysseltova			
EXPERIMENTAL VALUES:					
Solubility in the RbH_2PO_4 - RbCl - H_2O system at 25°C.					
RbH_2PO_4		RbCl			
mass%	mol/kg ^a	mass%	mol/kg ^a		
44.05	4.32	----	----		
36.51	3.47	5.86	0.84		
27.78	2.57	12.87	1.79		
13.76	1.29	27.62	3.90		
8.07	0.77	34.62	4.99		
6.72	0.67	38.09	5.71		
4.50	0.46	42.01	6.49		
4.34	0.47	45.12	7.41		
3.44	0.37	46.06	7.54		
2.90	0.33	46.48	7.59		
0.74	0.078	47.29	7.53		
-----	-----	48.29	7.72		
^a The mol/kg H_2O values were calculated by the compiler.					
AUXILIARY INFORMATION					
METHOD/APPARATUS/PROCEDURE:		SOURCE AND PURITY OF MATERIALS:			
The mixtures were equilibrated isothermally for 15 days in an apparatus described earlier (1). The rubidium and chloride contents were determined gravimetrically, Rb as the tetraphenylborate and Cl as AgCl. The composition of the solid phases was determined by the wet-residue method.		Chemically pure RbCl was heated to 400°C, recrystallized and dried at 120°C. RbH_2PO_4 was synthesized from H_3PO_4 and Rb_2CO_3 . The latter was obtained by calcining $\text{Rb}_2(\text{COO})_2$. The impurities in the RbH_2PO_4 were less than 0.05 mass%.			
ESTIMATED ERROR:					
The temperature was controlled to within ± 0.1 K. No other details are given.					
REFERENCES:					
1. Kuznetsova, G.P.; Stepin, B.D. <i>Zh. Neorg. Khim.</i> 1965, 10, 472.					

COMPONENTS:

- (1) Rubidium dihydrogenphosphate; RbH_2PO_4 ; [13774-16-8]
 (2) Rubidium oxide; Rb_2O ; [18088-11-4]
 (3) Phosphoric acid; H_3PO_4 ; [7664-38-2]
 (4) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rashkovich, L.N.; Momtaz, R.Sh.
Zh. Neorg. Khim. 1978, 23, 1349-55.

EXPERIMENTAL VALUES cont'd:

authors' data		compiler's recalculated values					
Rb_2O mass%	P_2O_5 mass%	Rb_2O mass%	H_3PO_4 mol%	H_3PO_4 mass%	RbH_2PO_4 mass%	RbH_2PO_4 mol%	solid phase
temp. = 50°C.							
36.2	21.8	7.49	1.10	----	56.0	8.42	RbH_2PO_4
33.5	21.5	5.18	0.70	----	55.3	7.66	"
31.8	21.1	4.01	0.51	----	54.2	7.12	"
31.3	21.3	3.25	0.41	----	54.7	7.14	"
30.1	21.2	2.18	0.27	----	54.5	6.89	"
28.6	20.8	1.21	0.14	----	53.5	6.46	"
28.3	21.2	0.38	0.05	----	54.5	6.61	"
28.5	23.2	----	----	2.17	0.52	55.3	7.14
29.5	28.4	----	----	8.29	2.46	57.3	9.12
30.3	33.6	----	----	14.6	5.63	58.8	12.2
30.7	36.0	----	----	17.5	7.82	59.6	14.3
31.3	39.6	----	----	21.9	12.8	60.8	19.2
31.4	39.5	----	----	21.6	12.7	61.0	19.2
30.9	41.7	----	----	25.2	17.3	60.0	22.2
							$\text{RbH}_5(\text{PO}_4)_2$

The authors linearized their data in the form:

$$w_{\text{Rb}_2\text{O}} = a + b w_{\text{P}_2\text{O}_5}$$

In the region where $\text{P}/\text{Rb} > 1$ the constants have the following values:

for $t = 25^\circ\text{C}$: $a = 17.5 \pm 0.4$ mass% and $b = 0.30 \pm 0.01 \pm \sigma = 0.1$

for $t = 50^\circ\text{C}$: $a = 24.6 \pm 0.1$ mass% and $b = 0.172 \pm 0.004 \pm \sigma = 0.06$

In the region where Rb_2O is in excess

for $t = 25^\circ\text{C}$: $a = -40 \pm 5$ mass% and $b = 3.8 \pm 0.3 \pm \sigma = 0.6$

for $t = 50^\circ\text{C}$: $a = -124 \pm 23$ mass% and $b = 7.3 \pm 1.1 \pm \sigma = 0.8$

COMPONENTS: (1) Cesium dihydrogenphosphate; CsH_2PO_4 ; [18649-05-3] (2) Water; H_2O ; [7732-18-5]	EVALUATOR: J. Eysseletová Charles University Prague, Czechoslovakia December, 1983
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CRITICAL EVALUATION:

Three cesium orthophosphates are reported in the literature (1, 2): tricesium phosphate, pentahydrate, $\text{Cs}_3\text{PO}_4 \cdot 5\text{H}_2\text{O}$, [101056-43-3]; dicesium hydrogenphosphate, monohydrate, $\text{Cs}_2\text{HPO}_4 \cdot \text{H}_2\text{O}$, [50292-03-0]; and cesium dihydrogenphosphate, CsH_2PO_4 , [18649-05-3]. No quantitative solubility data are available for the tricesium phosphate or the dicesium hydrogenphosphate. The solubility of the cesium dihydrogenphosphate was studied because its crystals had certain desirable electrical characteristics.

Bykova, et al. (3) report the solubility of cesium dihydrogenphosphate in the binary system while all the other reports of solubility data (3-6) are for ternary systems. A direct analytical solubility method was used in all the solubility studies. However, there is some disagreement about the validity of the experimental methods. In one study a potentiometric titration with aqueous KOH was used (4) and the results are reported to have an accuracy of ± 0.2 mass%. Gravimetric procedures were used in the other studies, phosphorus being weighed as $\text{Mg}_2\text{P}_2\text{O}_7$. In two of the studies (5, 6) phosphorus was precipitated as $(\text{NH}_4)_3\text{PMo}_{12}\text{O}_{40}$ and then reprecipitated and transformed to $\text{NH}_4\text{MgPO}_4 \cdot 6\text{H}_2\text{O}$. Nothing is said about the accuracy or the precision of the results. In the other study (3), phosphorus was precipitated directly as $\text{NH}_4\text{MgPO}_4 \cdot 6\text{H}_2\text{O}$ under precisely defined and carefully controlled conditions. A thorough discussion of this analytical procedure is given. Literature data are presented for the co-precipitation of cesium phosphomolybdate (7, 8) and/or cesium magnesium phosphate (1, 9). The solubility of the cesium phosphomolybdate is reported to be $4.2 \times 10^{-6} \text{ mol dm}^{-3}$ in $0.1 \text{ mol dm}^{-3} \text{ HNO}_3$ at 293 K. Because of this, Bykova, et al. (3) recommend that NH_4MgPO_4 be precipitated from solutions containing less than 0.3 g H_2PO_4^- per 100 cm³, and that the amount of $\text{Mg}_2\text{P}_2\text{O}_7$ produced be no greater than 0.06 g. They criticized the analytical procedures used by the other investigators (4-6). As a matter of fact, the results of Bykova, et al. (3) do agree with those obtained by potentiometric titration (4), but they are significantly lower than those reported by others (5, 6).

THE BINARY SYSTEM

Bykova, et al. (3) measured solubilities in the 273-353 K temperature range, and the temperature coefficient of molal solubility in the 273-333 K range was also determined. A recalculation of the results by the Evaluator, using linear regression, gives equation [1].

$$c_{\text{CsH}_2\text{PO}_4} = a \cdot (T - 273) + b \quad [1]$$

When c is expressed as mass%, the coefficients are:

a = 0.25 ± 0.01 and b = 52.2 ± 0.6 with R = 0.9916. When c is expressed as mol/kg the coefficients are: a = 0.0681 ± 0.0007 and b = 4.64 ± 0.03 with R = 0.9991.

MULTICOMPONENT SYSTEMS

Cesium dihydrogenphosphate was chosen as a component in four ternary systems. These systems are discussed individually.

1. The $\text{CsH}_2\text{PO}_4\text{-CsCl-H}_2\text{O}$ system. Solubilities in this system have been measured at 298 K (3). The system is reported to be of the eutonic type and a saturated solution in equilibrium with both CsH_2PO_4 and CsCl has the composition 0.58 mol/kg CsH_2PO_4 and 10.5 mol/kg CsCl.
2. The $\text{CsH}_2\text{PO}_4\text{-MH}_2\text{PO}_4\text{-H}_2\text{O}$ system where M is K^+ or NH_4^+ . Solubility in the $\text{CsH}_2\text{PO}_4\text{-NH}_4\text{H}_2\text{PO}_4\text{-H}_2\text{O}$ system was measured at 298 K (5) and solubility in the $\text{CsH}_2\text{PO}_4\text{-KH}_2\text{PO}_4\text{-H}_2\text{O}$ system was also measured at 298 K (6). In both studies the analysis of phosphorus was made by precipitating it as $(\text{NH}_4)_3\text{PMo}_{12}\text{O}_{40}$ and this is the method that has been criticized (3). Therefore, the solubilities reported in these studies may be incorrect. This is especially true in the system containing $\text{NH}_4\text{H}_2\text{PO}_4$ where the solubility of pure CsH_2PO_4 was reported to be significantly larger than other reported results. Besides this, there is a discrepancy between tabular and graphical data in the article (5). The tabular data have been replotted, Figure 1, and there are intersections of some tie lines that make no physical sense. Therefore, these results (5) are not reliable and must be rejected.

(continued next page)

COMPONENTS:

- (1) Cesium dihydrogenphosphate; CsH_2PO_4 ; [18649-05-3]
(2) Water; H_2O ; [7732-18-5]

EVALUATOR:

J. Eyseltová
Charles University
Prague, Czechoslovakia

December, 1983

CRITICAL EVALUATION:

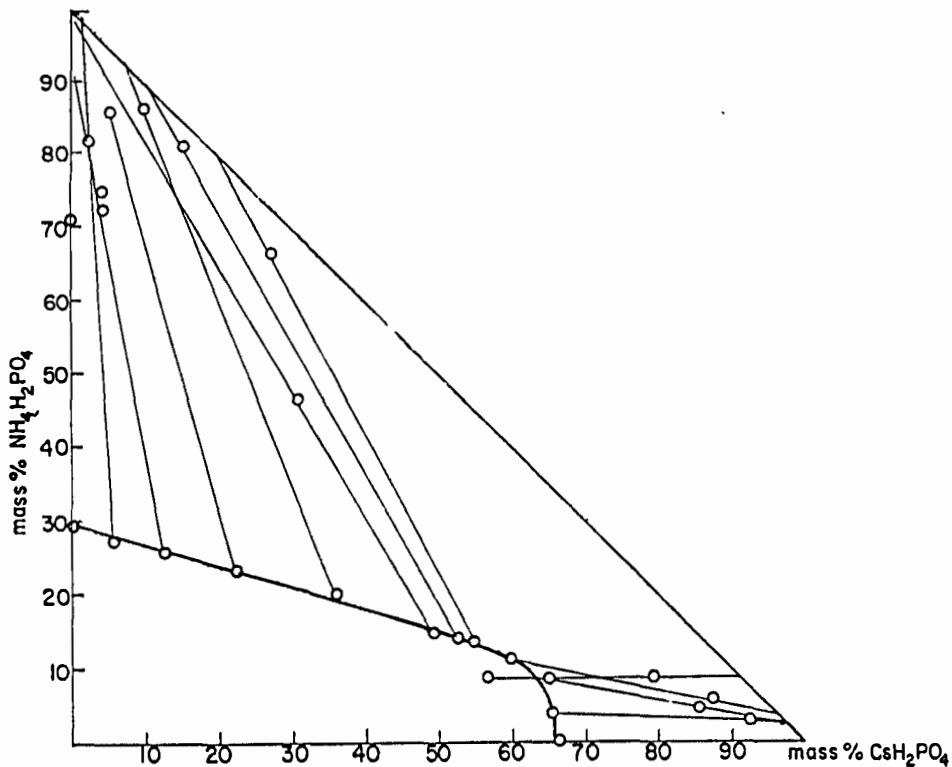


Figure 1. Phase diagram for the CsH_2PO_4 - $\text{NH}_4\text{H}_2\text{PO}_4$ - H_2O system
at 298 K, ref. (5).

COMPONENTS:	EVALUATOR:
(1) Cesium dihydrogenphosphate; CsH_2PO_4 ; [18649-05-3] (2) Water; H_2O ; [7732-18-5]	J. Eysseľtová Charles University Prague, Czechoslovakia December, 1983

CRITICAL EVALUATION: (continued)

Although there is a question about the solubilities reported for these systems, the formation of solid solutions in these systems has been established. In the system containing KH_2PO_4 there are 3 crystallization fields. Solid KH_2PO_4 exists in equilibrium with solutions containing 1.32 to 1.55 mol/kg KH_2PO_4 and 0 to 0.71 mol/kg CsH_2PO_4 . Solid CsH_2PO_4 exists in equilibrium with solutions containing 0 to 1.98 mol/kg KH_2PO_4 and 4.86 to 6.37 mol/kg CsH_2PO_4 . Solid solutions are the equilibrium solid phases between these 2 crystallization fields. The data are given on Figure 2. It is impossible to place this system into one of Roozeboom's categories (10) because of the limited solid solubility.

For the system containing $\text{NH}_4\text{H}_2\text{PO}_4$ there is, in addition to the uncertainty discussed earlier, an uncertainty about the composition of the invariant solution. The data of Zvorykin, et al. (5) are plotted on Figure 3 and, again, because of the limited amount of data, this system cannot definitely be placed in one of Roozeboom's classifications (10).

3. The $\text{Cs}_2\text{O}-\text{P}_2\text{O}_5-\text{H}_2\text{O}$ system. Rashkovich, et al. (4) measured solubilities in solutions in equilibrium with solid CsH_2PO_4 and $\text{CsH}_5(\text{PO}_4)_2$ at 298 and 323 K along with a few solutions at 306.2, 312 and 317.7 K. They expressed their data in terms of Cs_2O and P_2O_5 . The compiler converted their data to that of the quaternary system $\text{CsH}_2\text{PO}_4-\text{Cs}_2\text{O}-\text{H}_3\text{PO}_4-\text{H}_2\text{O}$. These values are given on Figure 4. In the $\text{CsH}_2\text{PO}_4-\text{Cs}_2\text{O}-\text{H}_3\text{PO}_4-\text{H}_2\text{O}$ part of the system, the solubility of cesium dihydrogenphosphate is affected only slightly by changes in solution composition. However, on the $\text{CsH}_2\text{PO}_4-\text{H}_3\text{PO}_4-\text{H}_2\text{O}$ side of the diagram, the solubility of cesium dihydrogenphosphate increases with increasing phosphoric acid content until the invariant point is reached. Beyond this, the solid phase may be $\text{CsH}_5(\text{PO}_4)_2$ but this has not been confirmed experimentally. In the 323 K isotherm the data points in the phosphoric acid region do not lie on a smooth line as do those on the 298 K isotherm. Therefore, it is possible that a new crystallization field comes into existence here. A similar situation exists with ammonium phosphates where the formation of $3\text{NH}_4\text{H}_2\text{PO}_4 \cdot \text{H}_3\text{PO}_4$ has been suggested (11).

The evaluator has used a linear regression method to treat the experimental data in ref. (4). The results for the 298 K isotherm, Figure 4, can be expressed by equation [2].

$$c_{\text{CsH}_2\text{PO}_4} = a \cdot c_{\text{H}_3\text{PO}_4} + b \quad [2]$$

When c is expressed as mass%, $a = 0.56 \pm 0.02$, $b = 58.3 \pm 0.2$ and $R = 0.9923$. When c is expressed as mol/kg, $a = 1.17 \pm 0.02$, $b = 6.11 \pm 0.06$ and $R = 0.9990$. The authors (4) also linearized their results but they gave no details about the method that was used. Later (12) they linearized the results in the region where $P/\text{Cs} < 1$. However, the compiler's method of linear regression gave negative correlation coefficients for these results.

CONCLUSIONS

The reliability of the solubility data for cesium dihydrogenphosphate depends on the analytical method that was used. This matter was discussed by Bykova, et al. (3) and they were careful in their experimental work. Their data agree fairly well with those obtained by extrapolation of solubility isotherms measured by others (4). Therefore, the data of Bykova, et al., (3) as well as their equation for the temperature dependence of the solubility of cesium dihydrogenphosphate are recommended values. The solubility data published by others (5, 6) are rejected because of analytical uncertainties. The only information that can be considered to be proved is the occurrence of solid solutions in the $\text{CsH}_2\text{PO}_4-\text{NH}_4\text{H}_2\text{PO}_4-\text{H}_2\text{O}$ and $\text{CsH}_2\text{PO}_4-\text{KH}_2\text{PO}_4-\text{H}_2\text{O}$ systems at 298 K.

References

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2. Lauffenburger, R. Thesis, Strasbourg 1932.
3. Bykova, I.N.; Kuznetsova, G.P.; Kolotilova, V.Ya.; Stepin, B.D. *Zh. Neorg. Khim.* 1968, 13, 540.

(continued next page)

COMPONENTS:	EVALUATOR:
(1) Cesium dihydrogenphosphate; CsH_2PO_4 ; [18649-05-3]	J. Eyseltová Charles University Prague, Czechoslovakia
(2) Water; H_2O ; [7732-18-5]	December, 1983

CRITICAL EVALUATION:

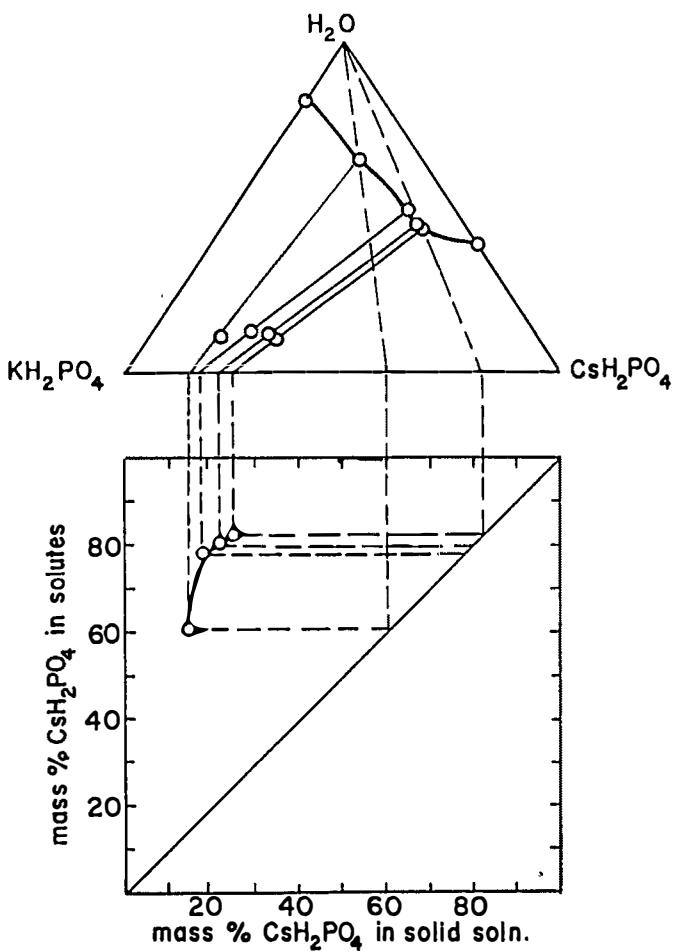


Figure 2. Phase diagram and distribution curve for the $\text{CsH}_2\text{PO}_4-\text{KH}_2\text{PO}_4-\text{H}_2\text{O}$ system at 298 K.
The data are from ref. (6).

Cesium Dihydrogenphosphate

COMPONENTS:

- (1) Cesium dihydrogenphosphate; CsH_2PO_4 ; [18649-05-3]
 (2) Water; H_2O ; [7732-18-5]

EVALUATOR:

J. Eyseltová
 Charles University
 Prague, Czechoslovakia
 December, 1983

CRITICAL EVALUATION:

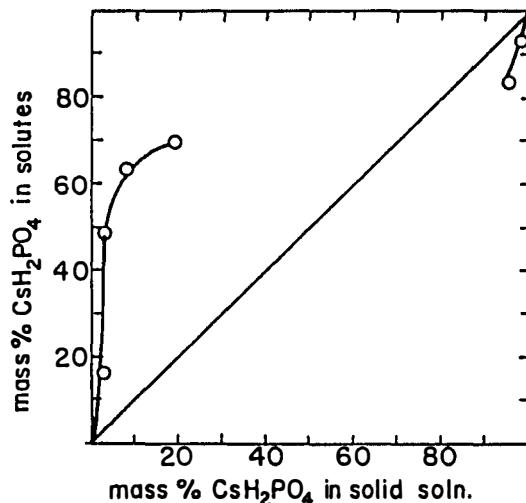
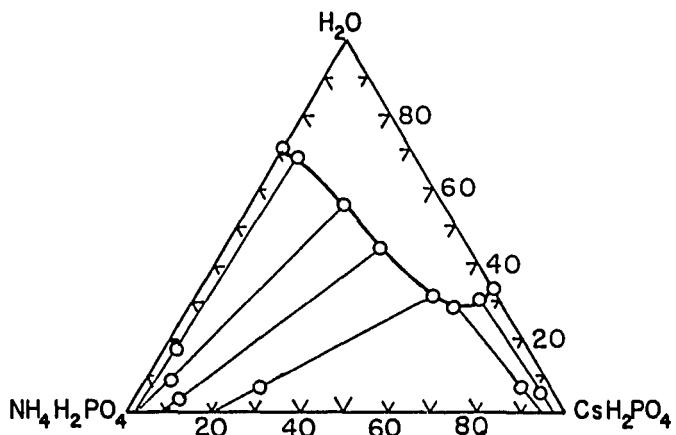


Figure 3. Phase diagram and distribution curve for the $\text{CsH}_2\text{PO}_4-\text{NH}_4\text{H}_2\text{PO}_4-\text{H}_2\text{O}$ system at 298 K, ref. (5).

COMPONENTS:

- (1) Cesium dihydrogenphosphate; CsH_2PO_4 ; [18649-05-3]
 (2) Water; H_2O ; [7732-18-5]

EVALUATOR:

J. Eyseltová
 Charles University
 Prague, Czechoslovakia

December, 1983

CRITICAL EVALUATION:

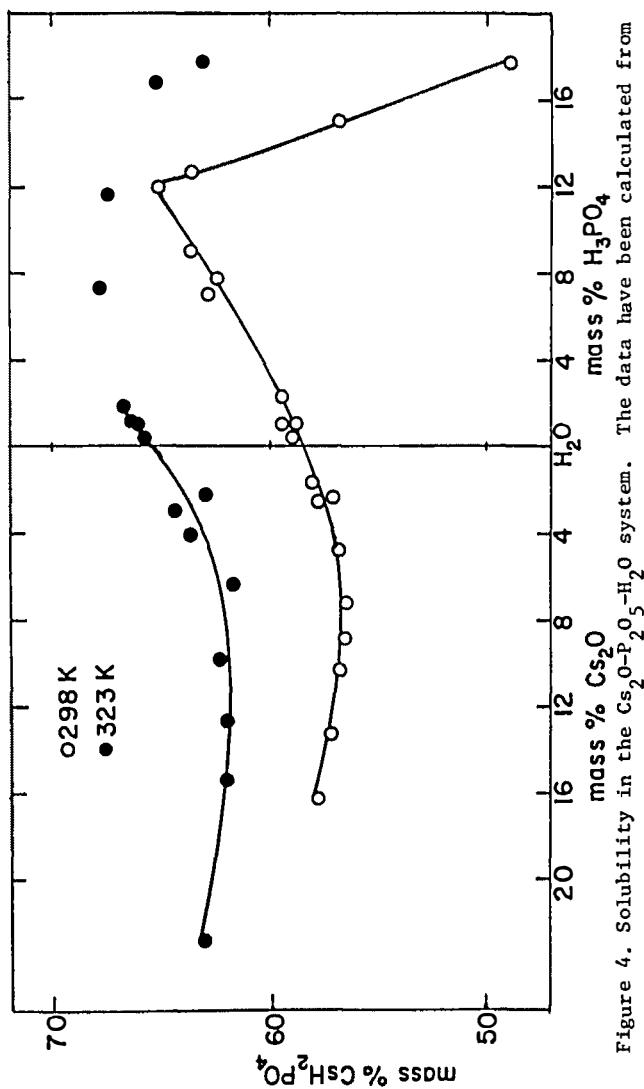


Figure 4. Solubility in the $\text{Cs}_2\text{O}-\text{P}_2\text{O}_5-\text{H}_2\text{O}$ system. The data have been calculated from ref. (4) by the compiler.

Cesium Dihydrogenphosphate

COMPONENTS: (1) Cesium dihydrogenphosphate; CsH ₂ PO ₄ ; [18649-05-3] (2) Water; H ₂ O; [7732-18-5]	EVALUATOR: J. Eysseletová Charles University Prague, Czechoslovakia December, 1983
CRITICAL EVALUATION: (continued)	
<p>4. Rashkovich, L.N.; Meteva, K.B.; Shevchik, J.E. <i>Zh. Neorg. Khim.</i> <u>1977</u>, <u>22</u>, 1982. 5. Zvorykin, A.Ya.; Ratnikova, V.D. <i>Zh. Neorg. Khim.</i> <u>1963</u>, <u>8</u>, 1018. 6. Sayamyan, E.A.; Bashugyan, D.P.; Karapetyan, T.I.; Grigoryan, K.G.; Kohachikyan, A.V. <i>Zh. Neorg. Khim.</i> <u>1977</u>, <u>22</u>, 1119. 7. Broadbank, R.W.C.; Dhabanandana, S.; Harding, R.D. <i>J. Inorg. Nucl. Chem.</i> <u>1961</u>, <u>23</u>, 311. 8. Nikitina, E.A.; Sokolova, O.N. <i>Zh. Obshch. Chim.</i> <u>1954</u>, <u>24</u>, 1123. 9. Erdmann, H.; Kothner, P. <i>Ann Chem.</i> <u>1897</u>, <u>274</u>, 72. 10. Roozeboom, B. <i>Z. Physik. Chem.</i> <u>1891</u>, <u>8</u>, 521. 11. Flatt, R.; Brunisholz, G.; Chapuis-Goitreux, S. <i>Helv. Chim. Acta</i> <u>1951</u>, <u>34</u>, 884. 12. Rashkovich, L.N.; Momtaz, R.Sh. <i>Zh. Neorg. Khim.</i> <u>1978</u>, <u>23</u>, 1349.</p>	

COMPONENTS: (1) Cesium dihydrogenphosphate; CsH_2PO_4 ; [18649-05-3] (2) Water; H_2O ; [7732-18-5]	ORIGINAL MEASUREMENTS: Bykova, I.N.; Kuznetsova, G.P.; Kolotilova, V.Ya.; Stepin, B.D. <i>Zh. Neorg. Khim.</i> <u>1968</u> , 13, 540-4.
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VARIABLES: Temperature.	PREPARED BY: J. Eysseltová
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EXPERIMENTAL VALUES: Solubility of CsH_2PO_4 in water.			
$t/^\circ\text{C}.$	g/100 g H_2O	mass% ^a	mol/kg ^a
0	106.0	51.43	4.61
25	146.97	59.5	6.39
40	169.4	62.88	7.37
50	185.3	64.96	8.06
60	199.7	66.63	8.69
80	258.0	72.07	11.2

^aThese values were calculated by the compiler.

The temperature coefficient of solubility is reported to be constant in the temperature range that was studied. The value is

$$\frac{dm}{dT} = 0.0683 \text{ mol kg}^{-1} \text{ K}^{-1}.$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: The mixtures were equilibrated isothermally for 15 days. The apparatus and procedure are described elsewhere (1). The solubility was determined by a gravimetric analysis for phosphorus. The phosphorus was weighed as $\text{Mg}_2\text{P}_2\text{O}_7$. The temperature coefficient of the solubility was determined graphically.	SOURCE AND PURITY OF MATERIALS: CsH_2PO_4 was synthesized by reacting H_3PO_4 with Cs_2CO_3 . The latter was obtained by calcining $\text{Cs}_2(\text{COO})_2$. The amount of impurities was no more than 0.05 mass%.
	ESTIMATED ERROR: The temperature was controlled to within $\pm 0.1 \text{ K}$. No other information is given.
	REFERENCES: 1. Kuznetsova, G.P.; Stepin, B.D. <i>Zh. Neorg. Khim.</i> <u>1965</u> , 10, 472.

Cesium Dihydrogenphosphate

COMPONENTS:		ORIGINAL MEASUREMENTS:																																																																										
(1) Cesium dihydrogenphosphate; CsH_2PO_4 ; [18649-05-3]		Zvorykin, A.Ya.; Ratnikova, V.D. <i>Zh. Neorg. Khim.</i> 1963, 8, 1018-9.																																																																										
(2) Ammonium dihydrogenphosphate; $\text{NH}_4\text{H}_2\text{PO}_4$; [7722-76-1]																																																																												
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Composition at 25°C.		J. Eyseltová																																																																										
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<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">CsH_2PO_4</th> <th style="text-align: center;">$\text{NH}_4\text{H}_2\text{PO}_4$</th> <th style="text-align: center;">solid phase</th> <th></th> </tr> <tr> <th style="text-align: center;">mass%</th> <th style="text-align: center;">mol/kg^a</th> <th style="text-align: center;">mass%</th> <th style="text-align: center;">mol/kg^a</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">66.26</td> <td style="text-align: center;">8.55</td> <td style="text-align: center;">----</td> <td style="text-align: center;">----</td> <td style="text-align: right;">CsH_2PO_4</td> </tr> <tr> <td style="text-align: center;">65.29</td> <td style="text-align: center;">9.15</td> <td style="text-align: center;">3.65</td> <td style="text-align: center;">7.86</td> <td style="text-align: right;">solid soln A</td> </tr> <tr> <td style="text-align: center;">59.73</td> <td style="text-align: center;">8.91</td> <td style="text-align: center;">11.09</td> <td style="text-align: center;">25.3</td> <td style="text-align: right;">"</td> </tr> <tr> <td style="text-align: center;">64.85</td> <td style="text-align: center;">10.7</td> <td style="text-align: center;">8.72</td> <td style="text-align: center;">22.0</td> <td style="text-align: right;">"</td> </tr> <tr> <td style="text-align: center;">56.76</td> <td style="text-align: center;">7.18</td> <td style="text-align: center;">8.85</td> <td style="text-align: center;">17.1</td> <td style="text-align: right;">solid soln A + solid soln B</td> </tr> <tr> <td style="text-align: center;">49.12</td> <td style="text-align: center;">5.92</td> <td style="text-align: center;">14.77</td> <td style="text-align: center;">27.2</td> <td style="text-align: right;">solid soln B</td> </tr> <tr> <td style="text-align: center;">52.79</td> <td style="text-align: center;">6.93</td> <td style="text-align: center;">14.07</td> <td style="text-align: center;">28.3</td> <td style="text-align: right;">"</td> </tr> <tr> <td style="text-align: center;">54.83</td> <td style="text-align: center;">7.61</td> <td style="text-align: center;">13.80</td> <td style="text-align: center;">29.3</td> <td style="text-align: right;">"</td> </tr> <tr> <td style="text-align: center;">35.91</td> <td style="text-align: center;">3.56</td> <td style="text-align: center;">20.16</td> <td style="text-align: center;">30.6</td> <td style="text-align: right;">"</td> </tr> <tr> <td style="text-align: center;">22.50</td> <td style="text-align: center;">1.80</td> <td style="text-align: center;">23.14</td> <td style="text-align: center;">28.3</td> <td style="text-align: right;">"</td> </tr> <tr> <td style="text-align: center;">12.88</td> <td style="text-align: center;">0.91</td> <td style="text-align: center;">25.57</td> <td style="text-align: center;">27.7</td> <td style="text-align: right;">"</td> </tr> <tr> <td style="text-align: center;">5.42</td> <td style="text-align: center;">0.35</td> <td style="text-align: center;">27.20</td> <td style="text-align: center;">26.9</td> <td style="text-align: right;">"</td> </tr> <tr> <td style="text-align: center;">-----</td><td style="text-align: center;">-----</td><td style="text-align: center;">29.31</td><td style="text-align: center;">27.6</td><td style="text-align: right;">$\text{NH}_4\text{H}_2\text{PO}_4$</td> </tr> </tbody> </table>				CsH_2PO_4	$\text{NH}_4\text{H}_2\text{PO}_4$	solid phase		mass%	mol/kg ^a	mass%	mol/kg ^a	66.26	8.55	----	----	CsH_2PO_4	65.29	9.15	3.65	7.86	solid soln A	59.73	8.91	11.09	25.3	"	64.85	10.7	8.72	22.0	"	56.76	7.18	8.85	17.1	solid soln A + solid soln B	49.12	5.92	14.77	27.2	solid soln B	52.79	6.93	14.07	28.3	"	54.83	7.61	13.80	29.3	"	35.91	3.56	20.16	30.6	"	22.50	1.80	23.14	28.3	"	12.88	0.91	25.57	27.7	"	5.42	0.35	27.20	26.9	"	-----	-----	29.31	27.6	$\text{NH}_4\text{H}_2\text{PO}_4$
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METHOD/APPARATUS/PROCEDURE:		SOURCE AND PURITY OF MATERIALS:																																																																										
<p>The samples were dissolved at 65°C and equilibrated in a water bath by shaking for several days. P_2O_5 was determined gravimetrically as $\text{Mg}_2\text{P}_2\text{O}_7$. Ammonia was determined by the Kjeldahl method. The composition of the solid phases was determined by the wet-residue method.</p>		<p>Both phosphates were prepared by reacting H_3PO_4 with Cs_2CO_3 or with NH_3.</p> <p>Analysis: found CsH_2PO_4 13.40% P $\text{NH}_4\text{H}_2\text{PO}_4$ 26.62% P and 14.4% NH_3</p> <p>calculated CsH_2PO_4 13.48% P $\text{NH}_4\text{H}_2\text{PO}_4$ 26.7% P and 15.5% NH_3.</p>																																																																										
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ESTIMATED ERROR: The temperature was controlled to within ± 0.1 K. No other details are given.																																																																
REFERENCES: 1. Kuznetsova, G.P.; Stepin, B.D. <i>Zh. Neorg. Khim.</i> 1965, 10, 472.																																																																

Cesium Dihydrogenphosphate

COMPONENTS:		ORIGINAL MEASUREMENTS:																																																															
(1) Cesium dihydrogenphosphate; CsH_2PO_4 ; [18649-05-3]		Sayamyan, E.A.; Bashugyan, D.P.; Karapetyan, T.I.; Grigoryan, K.G.; Khachikyan, A.V.																																																															
(2) Potassium dihydrogenphosphate; KH_2PO_4 ; [7778-77-0]		Zh. Neorg. Khim. 1977, 22, 1119-23.																																																															
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VARIABLES:																																																																	
Composition at 25°C.		PREPARED BY:																																																															
J. Eysseltová																																																																	
EXPERIMENTAL VALUES:																																																																	
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Saturated solutions of both phosphates were mixed at 50°C and the mixtures were thermostated at 25°C for a week. P_2O_5 was determined gravimetrically as $\text{Mg}_2\text{P}_2\text{O}_7$. Potassium content was determined by flame photometry. The composition of the solid phases was determined by the wet-residue method.		Both salts were of a "chemically pure" grade.																																																															
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COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Cesium dihydrogenphosphate; CsH_2PO_4 ; [18649-05-3]	Rashkovich, L.N.; Meteva, K.B.; Shevchik, J.E. <i>Zh. Neorg. Khim.</i> <u>1977</u> , 22, 1982-8.
(2) Cesium oxide; Cs_2O ; [20281-00-9]	
(3) Phosphoric acid; H_3PO_4 ; [7664-38-2]	
(4) Water; H_2O ; [7732-18-5]	
VARIABLES:	PREPARED BY:
Temperature and composition.	J. Eyseltová

EXPERIMENTAL VALUES:Composition of saturated solutions in the $\text{Cs}_2\text{O}-\text{P}_2\text{O}_5-\text{H}_2\text{O}$ system.

Nr	pH	Cs_2O		P_2O_5		solid phase
		mass%	mol%	mass%	mol%	
temp. = 25°C.						
1	7.7	51.6	9.12	17.8	6.24	CsH_2PO_4
2	7.2	48.2	7.80	17.6	5.65	"
3	6.65	45.0	6.76	17.5	5.20	"
4	6.4	43.4	6.29	17.4	5.00	"
5	6.05	41.8	5.85	17.4	4.83	"
6	5.6	39.5	5.28	17.5	4.64	"
7	5.1	37.9	4.95	17.8	4.61	"
8	5.0	37.3	4.80	17.6	4.49	"
9	5.0	37.2	4.81	17.9	4.61	"
10	4.1	36.1	4.61	18.5	4.69	"
11	3.9	36.0	4.61	18.9	4.81	"
12	3.6	36.4	4.80	20.0	5.23	"
13	2.85	38.5	5.77	24.5	7.31	"
14	2.7	38.2	5.73	24.8	7.39	"
15	2.6	38.9	6.09	26.2	8.14	"
16	2.2	39.9	6.82	28.8	9.77	"
17	2.1	38.9	6.48	28.8	9.52	$\text{CsH}_5(\text{PO}_4)_2$
18	1.7	34.8	5.23	28.4	8.47	"
19	1.3	29.9	3.98	27.9	7.34	"

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The mixtures were equilibrated isothermally by shaking twice daily for 10-15 days. They were thermostated for a month. Analysis was done by a potentiometric titration using KOH and H_3PO_4 solutions. The solid phases were identified crystallographically.	The Cs_2CO_3 and H_3PO_4 were used as received. The amount of impurities was less than 0.05 mass%.
ESTIMATED ERROR:	
	The temperature was controlled to within ± 0.05 K. The precision of the analyses for Cs_2O and P_2O_5 was ± 0.2 mass%
REFERENCES:	

COMPONENTS:

- (1) Cesium dihydrogenphosphate; CsH_2PO_4 ; [18649-05-3]
- (2) Cesium oxide; Cs_2O ; [20281-00-9]
- (3) Phosphoric acid; H_3PO_4 ; [7664-38-2]
- (4) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rashkovich, L.N.; Meteva, K.B. Shevchik, J.E.
Zh. Neorg. Khim. 1977, 22, 1982-8.

EXPERIMENTAL VALUES, cont'd:

Composition of saturated solutions in the $\text{Cs}_2\text{O}-\text{P}_2\text{O}_5-\text{H}_2\text{O}$ system.

Nr	$t/\text{^{\circ}C.}$	Cs_2O		P_2O_5		solid phase
		mass%	mol%	mass%	mol%	
20	33.2	42.2	6.00	17.8	5.03	CsH_2PO_4
21	33.2	37.2	4.89	19.0	4.96	"
22	33.2	31.6	4.52	29.5	8.38	$\text{CsH}_5(\text{PO}_4)_2$
23	39.0	42.8	6.22	18.3	5.28	CsH_2PO_4
24	39.0	38.2	5.16	19.4	5.21	"
25	39.0	32.4	4.82	30.6	9.04	$\text{CsH}_5(\text{PO}_4)_2$
26	44.7	43.5	6.47	18.7	5.53	CsH_2PO_4
27	44.7	39.0	5.41	19.9	5.48	"
28	44.7	33.4	5.20	31.7	9.80	$\text{CsH}_5(\text{PO}_4)_2$
29	50	61.1	151	19.4	95.2	CsH_2PO_4
30	50	53.3	102	19.1	72.3	"
31	50	50.6	89.8	19.1	67.2	"
32	50	47.9	79.8	19.2	63.5	"
33	50	44.0	66.6	19.0	57.1	"
34	50	43.0	64.5	19.6	58.3	"
35	50	42.3	62.8	19.8	58.5	"
36	50	40.7	57.9	19.4	54.8	"
37	50	40.2	57.8	20.5	58.5	"
38	50	40.4	59.0	21.1	61.2	"
39	50	40.6	59.8	21.3	62.3	"
40	50	40.8	61.0	21.9	65.0	"
41	50	41.5	69.3	26.2	86.9 ^a	"
42	50	41.3	76.1	29.2	10.5 ^a	"
43	50	39.9	74.0	32.3	11.9 ^a	$\text{CsH}_5(\text{PO}_4)_2$
44	50	38.6	69.6	32.4	11.6	"

^aFor the 50°C isotherm, these values are correct. All the other mol% values for Cs_2O and P_2O_5 are too large by a factor of ten.

The compiler has recalculated the above values to convert them to the following values for the $\text{CsH}_2\text{PO}_4-\text{Cs}_2\text{O}-\text{H}_2\text{O}$ system.

Nr	Cs_2O		H_3PO_4		CsH_2PO_4	
	mass%	mol%	mass%	mol%	mass%	mol%
1	16.3	2.22	-----	-----	57.7	9.63
2	13.3	1.59	-----	-----	57.0	8.35
3	10.3	1.10	-----	-----	56.7	7.47
4	8.88	0.91	-----	-----	56.4	7.06
5	7.28	0.71	-----	-----	56.4	6.75
6	4.78	0.44	-----	-----	56.7	6.40
7	2.58	0.23	-----	-----	57.7	6.31
8	2.38	0.21	-----	-----	57.0	6.11
9	1.67	0.15	-----	-----	58.0	6.26
10	-----	-----	0.40	0.19	58.9	6.29
11	-----	-----	1.02	0.26	58.7	6.35
12	-----	-----	2.27	0.60	59.4	6.74
13	-----	-----	7.01	2.37	62.8	9.06
14	-----	-----	7.64	2.60	62.3	9.03
15	-----	-----	9.08	3.38	63.5	10.1
16	-----	-----	12.0	5.33	65.1	12.3
17	-----	-----	12.7	5.42	63.5	11.6
18	-----	-----	15.0	5.41	56.8	8.74
19	-----	-----	17.7	5.39	48.8	4.87

(continued next page)

COMPONENTS:

- (1) Cesium dihydrogenphosphate; CsH_2PO_4 ; [18649-05-3]
 (2) Cesium oxide; Cs_2O ; [20281-00-9]
 (3) Phosphoric acid; H_3PO_4 ; [7664-38-2]
 (4) Water; H_2O ; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rashkovich, L.N.; Meteva, K.B.; Shevchik, J.E.
Zh. Neorg. Khim. 1977, 22, 1982-8.

EXPERIMENTAL VALUES cont'd:

Nr	Cs_2O		H_3PO_4		CsH_2PO_4	
	mass%	mol%	mass%	mol%	mass%	mol%
20	6.88	0.69	----	----	57.7	7.08
21	----	----	0.33	0.09	60.7	6.77
22	----	----	18.7	6.43	51.6	7.55
23	6.49	0.67	----	----	59.3	7.54
24	----	----	0.33	0.05	62.3	7.23
25	----	----	19.7	7.31	52.9	8.37
26	6.40	0.69	----	----	60.7	7.98
27	----	----	0.32	0.09	63.6	7.68
28	----	----	20.5	8.37	52.9	8.37
29	22.9	5.71	----	----	62.9	19.2
30	15.4	2.41	----	----	61.9	11.8
31	12.7	1.77	----	----	61.9	10.6
32	9.81	1.24	----	----	62.2	9.67
33	6.30	0.70	----	----	61.6	8.33
34	4.11	0.45	----	----	63.5	8.53
35	3.02	0.33	----	----	64.2	8.50
36	2.21	0.22	----	----	62.9	7.83
37	----	----	0.31	0.09	65.6	8.37
38	----	----	1.00	0.30	65.9	8.67
39	----	----	1.14	0.36	66.2	8.83
40	----	----	1.83	0.59	66.6	9.16
41	----	----	7.27	2.96	67.7	11.8
42	----	----	11.6	5.59	67.4	13.9
43	----	----	16.8	9.47	65.1	15.6
44	----	----	17.8	9.50	63.0	14.3

The authors linearized the data for the region containing H_3PO_4 and give the following equation

$$w_{\text{Cs}_2\text{O}} = a + b w_{\text{P}_2\text{O}_5}.$$

At 25°C: $a = 28.8 \pm 0.4$ mass% and $b = 0.39 \pm 0.02$ $\pm \sigma = 0.2$.

At 50°C: $a = 36.6 \pm 0.4$ mass% and $b = 0.19 \pm 0.02$ $\pm \sigma = 0.1$.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Cesium dideuteriumphosphate; CsD_2PO_4 ; [28090-46-2]	Rashkovich, L.N.; Meteva, K.B.; Shevchik, J.E.
(2) Cesium oxide; Cs_2O ; [20281-00-9]	Zh. Neorg. Khim. 1977, 22, 1982-8.
(3) Deuterium phosphate; D_3PO_4 ; [14335-33-2]	
(4) Water-d ₂ ; D_2O ; [7789-20-0]	
VARIABLES:	PREPARED BY:
Temperature and composition.	J. Eysseltová

EXPERIMENTAL VALUES:

The original experimental data are expressed for the $\text{Cs}_2\text{O}-\text{P}_2\text{O}_5-\text{H}_2\text{O}$ system. These data are in the four left hand columns below. The compiler has converted these data to values for the $\text{CsD}_2\text{PO}_4-\text{D}_3\text{PO}_4-\text{D}_2\text{O}$ system. These values are in columns 5 to 10 below.

a u t h o r s ' d a t a				c o m p i l e r ' s c a l c u l a t i o n s							
Cs_2O mass%	P_2O_5 mass%	CsD_2PO_4 mass%	D_3PO_4 mass%	Cs_2O mass%	Cs_2O mol%	CsD_2PO_4 solid phase	temp. = 25°C.				
46.2	7.81	17.6	5.91	57.5	7.95	---	---	11.3	1.29	CsD_2PO_4	
39.7	5.87	17.6	5.17	57.5	6.58	---	---	4.78	0.45	"	
38.3	5.54	17.9	5.14	58.5	6.52	---	---	2.79	0.26	"	
36.8	5.45	20.8	6.11	60.6	7.21	3.22	0.88	---	---	"	
37.6	5.86	22.7	7.02	61.9	8.15	5.35	1.62	---	---	"	
37.7	5.97	23.5	7.39	62.0	8.48	6.42	2.02	---	---	"	
37.9	6.05	23.7	7.52	62.4	8.66	6.56	2.10	---	---	"	
38.0	6.14	24.2	7.77	62.5	8.93	7.20	2.37	---	---	"	
37.9	6.13	24.3	7.80	62.4	8.90	7.42	2.43	---	---	"	
38.6	6.53	25.8	8.66	63.5	9.98	9.04	3.26	---	---	"	
36.8	6.29	28.3	9.61	60.6	10.2	13.9	5.40	---	---	$\text{CsD}_5(\text{PO}_4)_2$	

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The mixtures were equilibrated isothermally in sealed vessels. They were shaken twice daily for 10-15 days and were thermostated for a month. The solutions were analyzed by means of a potentiometric titration using solutions of KOH and of H_3PO_4 . No details are given. The content of deuterium in the saturated solutions was determined by a method described elsewhere (1).	Cs_2CO_3 and D_3PO_4 were used as received. The amount of impurities in each was less than 0.05%. The extent of deuteration was 96% for D_3PO_4 , 99.7% for D_2O , and 98 ±1% for the saturated solutions.
	ESTIMATED ERROR: The temperature was controlled to within ± 0.05°C. The analyses for Cs_2O and P_2O_5 had a precision of ± 0.2 mass%.
	REFERENCES: 1. Volkova, E.N.; Podshivalov, J.S.; Rashkovich, L.N.; Strukov, B.A. Izv. AN SSSR, ser. fiz. 1975, 39, 288.

COMPONENTS:

- (1) Cesium dideuteriumphosphate; CsD_2PO_4 ; [28090-46-2]
 (2) Cesium oxide; Cs_2O ; [20281-00-9]
 (3) Deuterium phosphate; D_3PO_4 ; [14335-33-2]
 (4) Water-d₂; D_2O ; [7789-20-0]

ORIGINAL MEASUREMENTS:

Rashkovich, L.N.; Meteva, K.B.; Shevchik, J.E.

Zh. Neorg. Khim. 1977, 22, 1982-8.

EXPERIMENTAL VALUES cont'd:

a u t h o r s ' d a t a				c o m p i l e r ' s c a l c u l a t i o n s							
Cs_2O		P_2O_5		CsD_2PO_4		D_3PO_4		Cs_2O		solid phase	
mass%	mol%	mass%	mol%	mass%	mol%	mass%	mol%	mass%	mol%		
temp. = 50°C.											
42.2	6.75	19.1	6.06	62.4	8.08	----	----	4.32	0.46	CsD_2PO_4	
40.0	6.17	19.6	6.00	64.0	7.91	----	----	1.11	0.11	"	
39.5	6.27	21.8	6.87	65.0	8.67	2.71	0.84	----	----	"	
39.6	6.33	21.9	6.95	65.2	8.78	2.73	0.86	----	----	"	
39.5	6.39	22.6	7.26	65.0	9.00	3.05	1.23	----	----	"	
40.3	6.89	24.5	8.32	66.3	10.3	5.98	1.15	----	----	"	
40.5	7.03	25.0	8.61	66.7	10.7	6.55	2.43	----	----	"	
40.4	7.01	25.1	8.65	66.5	10.7	6.76	2.51	----	----	"	
40.8	7.35	26.4	9.44	67.1	11.8	8.33	3.37	----	----	"	
38.0	7.20	31.7	11.9	62.5	13.8	17.9	9.04	----	----	$\text{CsD}_5(\text{PO}_4)_2$	

The authors linearized the data in the region where P/Cs>1 as follows

$$w_{\text{Cs}_2\text{O}} = a + b w_{\text{P}_2\text{O}_5}.$$

At 25°C., a = 29.7 ± 0.6 and b = 0.34 ± 0.02 ±σ = 0.1

At 50°C., a = 32.9 ± 0.8 and b = 0.30 ± 0.03 ±σ = 0.1

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