[CONTRIBUTION FROM THE SCHOOL OF CHEMISTRY, RUTGERS UNIVERSITY]

The Systems Ag_2SO_4–$BeSO_4$–H_2O and Ag_2SO_4–$MgSO_4$–H_2O at 35°

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The systems silver sulfate–beryllium sulfate–water and silver sulfate–magnesium sulfate–water have been studied at 35°· The only solid phases observed were the pure salts silver sulfate, beryllium sulfate tetrahydrate and magnesium sulfate heptahydrate.

In two previous papers[1] the equilibrium relations in aqueous systems involving silver sulfate and the alkali sulfates have been reported. The solubility measurements here described have been made as an extension of this study to include the soluble sulfates of Group II.

Materials.—C.P. grade silver sulfate was further purified by recrystallization from concentrated sulfuric acid.[2] C.P. grade beryllium sulfate tetrahydrate was dehydrated to the anhydrous salt by heating for an hour and a half at 400–420°. C.P. grade magnesium sulfate heptahydrate was recrystallized[3] and dehydrated to the monohydrate by heating for 24 hours at 130–140°. All salts were stored in glass-stoppered weighing bottles in a calcium chloride desiccator.

Solubility Determinations.—Complexes of known composition were made up by weight in stoppered test-tubes which were then tumbled end over end for several days in a constant temperature water-bath at 34.95 ± 0.05°. To prevent photochemical decomposition of the silver sulfate, the solubility tubes were wrapped in aluminum foil. Samples for analysis were taken in the usual way by means of pipets fitted with filter paper tips.

In all cases two analytical samples were taken. The silver sulfate concentration was determined in one by titration with ammonium thiocyanate, using the Volhard indicator. In the beryllium sulfate system, the silver ion was precipitated from the second sample with hydrochloric acid, and a gravimetric sulfate determination run on the filtrate. To avoid contamination of the barium sulfate with nitrate the silver chloride precipitate was washed with 0.01 *M* hydrochloric acid instead of nitric acid. In the magnesium sulfate system, the second sample was evaporated to dryness by heating overnight at 110° followed by 24 hours at 130–140°. The resulting solid was a mixture of silver sulfate and magnesium sulfate monohydrate.

Results.—The data (in weight per cent.) are shown in Table I. Both systems are simple, the only solid phases being the pure salts, silver sulfate, beryllium sulfate tetrahydrate and magnesium sulfate heptahydrate, as determined by the algebraic extrapolation[4] of the tie lines through the original complexes. The extrapolation errors averaged 0.21 and 0.27% for the beryllium and magnesium systems, respectively. The compositions of the hydrates were determined by direct analysis after they had been filtered and freed from saturated solution by washing with petroleum ether.

TABLE I

SYSTEMS Ag_2SO_4–H_2O AND $BeSO_4$ OR $MgSO_4$ AT 35°

Liquid solution		Original complex		
Wt. % Ag_2SO_4	Wt. % $BeSO_4$	Wt. % Ag_2SO_4	Wt. % $BeSO_4$	Solid phase[a]
		(1) $BeSO_4$		
0.929				A
.892	2.48	9.63	2.26	A
.935	6.17	9.57	5.63	A
.945	11.05	9.83	10.08	A
.900	16.95	10.00	15.38	A
.792	22.25	9.95	20.14	A
.661	27.31	9.98	24.77	A
.601	29.91	9.84	29.49	A + B
.596	30.00	7.30	32.58	A + B
.600	29.95	5.08	35.21	A + B
.601	29.87	0.53	35.25	A + B
.599	29.93	Average		A + B
.247	30.02	Unknown		B
	30.15			B
		(2) $MgSO_4$		
	Wt. % $MgSO_4$		Wt. % $MgSO_4$	
0.929				A
.906	.320	14.03	2.75	A
.952	5.44	15.38	4.70	A
1.050	11.64	14.97	9.93	A
1.065	14.50	14.68	12.46	A
1.052	18.63	14.86	16.05	A
0.99	24.06	14.99	20.66	A
.837	29.35	7.42	32.53	A + C
.840	29.33	5.02	35.07	A + C
.842	29.31	2.98	37.02	A + C
.840	29.33	Average		A + C
.633	29.35	0.54	35.00	C
	29.77			C

[a] A = Ag_2SO_4, B = $BeSO_4 \cdot 4H_2O$, C = $MgSO_4 \cdot 7H_2O$.

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(1) E. L. Simons and J. E. Ricci, THIS JOURNAL, **68**, 2194 (1946); W. C. von Dohlen and E. L. Simons, *ibid.*, **73**, 461 (1951).

(2) E. H. Archibald, "The Preparation of Pure Inorganic Substances," John Wiley and Sons, Inc., New York, N. Y., 1941, p. 66.

(3) Ref. 2, p. 91.

(4) A. E. Hill and J. E. Ricci, THIS JOURNAL, **53**, 4306 (1931).