A SIMPLE METHOD FOR VAPOR DENSITY DETERMINATIONS

PART XI.[1]—THE DEHYDRATION OF COPPER-SULPHATE PENTAHYDRATE

BY PHILIP BLACKMAN

The bulbs were heated in a thermostat, wax being the heating medium, but no protective outer jacket was employed. The results of the experiments here detailed would seem to show that the evolution of water from the $CuSO_4.5H_2O$ was a function of the temperature and pressure and does not take place in the evolution of only whole molecules, and consequently the dehydration is comparable to the removal of water from an ordinary aqueous solution of a substance, or to the decomposition by heat of other molecular compounds such as acetaldehyde, ammonia, phosphorus, pentachloride, ammonium chloride, chloral hydrate, etc.

The weight of water w given off at any temperature is calculated from the formula

$$w = \frac{dp\mathrm{VL}(\mathrm{L}_c - l)}{31068\, l\, \mathrm{L}_c(273 + t_1)}$$

(where d = the vapor density of water = 9), and the corresponding internal pressure (atmospheres) π of the bulb from the formula

$$\pi = \frac{p\mathrm{L}\,(273 + t_2)}{760\, l(273 + t_1)}.$$

The molecular weight of $CuSO_4.5H_2O = x = 249.66$; the molecular weight of $5H_2O = y = 90$; hence the proportion of water in weight c of copper sulphate $= cy/x$; therefore the proportion, h, of water evolved from the hydrate $= xw/cy$, and consequently the corresponding number of molecules is $5\,h$.

[1] Continued from the Journal of Physical Chemistry, 13, 431 (1909); Chemical News, 100, 174 (1909); Zeitschrift für physikalische Chemie, 65, 552 (1909).

EXPERIMENT I

c = 0.0582 gram; L = 194 mm; L_c = 212 mm; p = 765 mm; t_1 = 10.5° C; V = 22.4 cc

t_2°	l mm	w gram	π atmospheres	h	5 h
85	177	0.0032	1.39	0.15	0.7
90	172	0.0037	1.45	0.18	0.9
95	158	0.0055	1.60	0.26	1.3
100	145	0.0074	1.77	0.35	1.7
105	136	0.0089	1.91	0.43	2.1
110	130	0.0101	2.03	0.48	2.4

EXPERIMENT II

c = 0.0448 gram; L = 187 mm; L_c = 206 mm; p = 765 mm; t_1 = 10.5° C; V = 33.7 cc

t_2	l	w	π	h	5 h
85	176	0.0036	1.10	0.22	1.1
90	171	0.0043	1.44	0.26	1.3
95	159	0.0062	1.53	0.38	1.9
100	150	0.0076	1.64	0.50	2.5
105	139	0.0100	1.80	0.62	3.1
110	135	0.0110	1.88	0.68	3.4

EXPERIMENT III

c = 0.0418 gram; L = 179 mm; L_c = 203 mm; t_1 = 13.5° C; p = 767 mm; V = 30.3 cc

t_2	l	w	π	h	5 h
80	169	0.004168	1.31	0.28	1.3
85	167	0.004466	1.35	0.29	1.4
90	157	0.00607	1.46	0.40	2.0
95	144	0.00849	1.61	0.56	2.8
100	139	0.00954	1.69	0.63	3.1
105	135	0.01043	1.77	0.69	3.4
110	133	0.01090	1.82	0.72	3.6
115	131	0.01138	1.87	0.75	3.7

EXPERIMENT IV

c = 0.0613 gram; L = 192 mm; L_c = 211 mm; t_1 = 13.5° C; p = 767 mm; V = 20.5 cc

t_2	l	w	π	h	5 h
80	179	0.00261	1.33	0.12	0.59
85	177	0.00280	1.37	0.13	0.63
90	163	0.00430	1.51	0.19	0.97
95	153	0.00553	1.63	0.25	1.25
100	145	0.00665	1.74	0.30	1.50
105	132	0.00874	1.94	0.39	1.97
110	126	0.00985	2.056	0.44	2.22
115	120	0.01107	2.187	0.50	2.50

EXPERIMENT V

c = 0.1034 gram; L = 244 mm; L_c = 262 mm; p = 755 mm; t_1 = 12.5° C; V = 40.5 cc

t_2	l	w	π	h	5 h
80	225	0.0047	1.13	0.13	0.6
90	214	0.0064	1.44	0.18	0.9
100	196	0.0097	1.61	0.26	1.3
110	177	0.0138	1.83	0.37	1.8
120	154	0.0202	2.16	0.54	2.7
130	135	0.0272	2.53	0.72	3.6
140	130	0.0293	2.69	0.78	3.9

Hackney Technical Institute, London,
December, 1909