NAPHTHALENE AND AQUEOUS ACETONE

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At the suggestion of Prof. Bancroft I have made a partial investigation of the system naphthalene, acetone, and water. The acetone used was purified by drying with calcium chlorid and fractionating. The naphthalene was recrystallized from alcohol. The mixtures of acetone and water were made up so as to contain approximately 10, 20, 30, 40, 50, 60 and 70 percent of acetone by weight. Naphthalene in excess was added to each solution and the temperatures determined at which a second liquid phase first appeared. In order to determine the composition of the liquid phase at this point, the following method was adopted: A weighed quantity of naphthalene was added to a known weight of the mixed liquids, the amount being just sufficient to cause the formation of two liquid phases. The consolute temperature of the system was then determined, and the experiment repeated several times with different amounts of naphthalene. If the results are plotted using the weights of naphthalene in a constant quantity of the mixed liquids as abscissas and the temperatures as ordinates, we shall get a series of curves. The composition of the liquid phase at the moment when the system passes from solid, solution and vapor to solid, two solutions and vapor is given by the point at which the prolongation of the curve for that particular mixture of acetone and water cuts the ordinate for the temperature at which the change takes place. This method requires no analyses and is of advantage in this case where ordinary quantitative analysis would be very difficult. The method involves but one assumption, that the field for two liquid phases and vapor lies within the boundary curve. Preliminary experiments showed that this was the case for no unsaturated solution of naphthalene, acetone and water

could be found which formed two liquid layers upon heating.

Considerable difficulty was experienced in determining the consolute temperatures. Owing to the volatility of the acetone the solutions could not be heated in corked test-tubes. Pressure flasks were tried but proved unsatisfactory for, sooner or later, they would leak and perhaps spoil a series of determinations. It was finally found necessary to seal each mixture of aqueous acetone and naphthalene in a glass tube. This was, of course, a laborious process since separate tubes had to be made for each determination.

The experimental data are given in Tables I-III. In Table I are given the percentage acetone in the aqueous acetone, the amounts of naphthalene added to one hundred grams of the aqueous acetone and the corresponding consolute temperatures for the resulting solutions. In Table II are the temperatures at which different solutions begin to separate into two layers in presence of solid naphthalene and the compositions of these solutions. In Table III are the data for portions of various isotherms, obtained by interpolation from the figures in Table I.

Table I

Percentage acetone.		Naphthalene in 100 grams solvent. Consolute temperatures.				
10.01	0.109	78°	0.125	85°	0.127	90°
19.94	0.368	83	0.433	92	0.447	94
30.04	0.585	61.1	0.674	68	0.801	74
41.20	1.038	41	1.587	67.4	3.745	100.5
49.99	2.790	39.2	4.019	58	4.960	74
60.33	7.082	39.3	7.383	43.2	7.901	49.8
70.12	16.067	28.2	17.978	49		

Table II

Acetone	Water	Naphthalene	Temperature
10.00	89.92	0.08	65.5°
19.91	80.00	0.09	55.3
29.92	69.67	0.41	45.0
40.81	58.22	0.97	38.0
48.67	48.68	2.65	32.2
57.43	36.64	5.93	28.5
60.43	25.75	13.82	28.2

Table III

(CH ₃) ₂ CO	70°	10.01	19.88	29.84	40.53	47.73
H ₂ O		89.90	79.89	69.46	57.82	47.76
C ₁₀ H ₈		0.09	0.23	0.70	1.65	4.51
(CH ₃) ₂ CO	60°	19.93	29.87	40.62	47.97	56.04
H ₂ O		79.95	69.56	57.96	48.02	35.75
C ₁₀ H ₈		0.12	0.57	1.42	4.01	8.21
(CH ₃) ₂ CO	50°	29.91	40.72	48.23	56.55	
H ₂ O		69.63	58.08	48.28	36.08	
C ₁₀ H ₈		0.46	1.20	3.49	7.37	
(CH ₃) ₂ CO	40°	40.79	48.43	56.99	59.65	
H ₂ O		58.20	48.49	36.34	25.31	
C ₁₀ H ₈		1.01	3.18	6.67	15.04	
(CH ₃) ₂ CO	30°	57.36	60.35			
H ₂ O		36.58	25.70			
C ₁₀ H ₈		6.06	13.95			

The addition of a very small quantity of naphthalene raises the consolute temperature so much that, if isotherms 10° apart be plotted on triangular coordinate paper, the curves lie so close together as to be indistinguishable for the greater part of their course. For this reason it was not deemed advisable to represent the results graphically. In the solid diagram with the temperature measured along the vertical axis, the surface for two solutions and vapor would rise almost perpendicularly from the boundary curve.

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