

On the Compounds of Urea and Benzoic Acid

By

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Dessaigues obtained a compound of urea and benzoic acid of the composition, $2\text{CO}(\text{NH}_2)_2 \cdot \text{C}_6\text{H}_5\text{CO}_2\text{H}$, from their solution in absolute alcohol as leafy crystals.¹ Suggested by this, the equilibrium of the system of urea, benzoic acid and ethyl alcohol was studied to see whether there was no other compound could be obtained from them.

Ethyl alcohol was purified by distilling commercial absolute alcohol over calcium oxide. It was 99.50 per cent. by weight pure. Benzoic acid was purified by recrystallisation from water and urea by recrystallisation from alcohol.

The materials were put in an Erlenmeyer flask of ca. 20 cc. capacity, well stoppered with a cork and covered with a sheet of oil-paper. It was made to rotate in a thermostat at 25° for at least two days and nights. When equilibrium was attained, the solution and the residue² were analysed separately. Benzoic acid was determined by titration with N/10-baryta water, and urea by Kjeldahl's method, the ammonia formed being absorbed in a given amount of N/5-hydrochloric acid and then titrated back with N/10-baryta water. In the calculation the alcohol was assumed to be anhydrous.

The results are given in Tables 1 and 2. In Table 1 the com-

¹ Beilstein, II, p. 1136, from Jahrb. Fortschr. d. Chem., 1857, 545.

² The residue was not completely freed from the mother liquor.

positions of the solutions and the residues are denoted in gram percentages and in Table 2 they are represented by the formula :

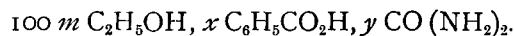
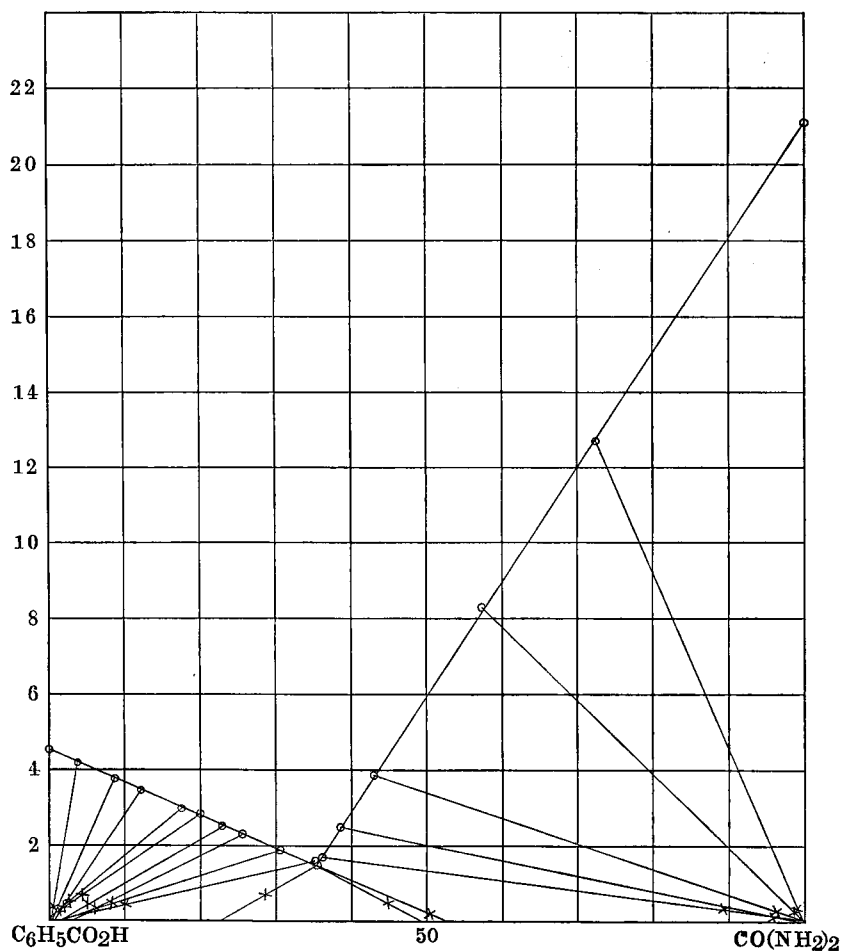


Table 1.

No.	Solution.			Residue.		
	$C_6H_5CO_2H$	$CO(NH_2)_2$	C_2H_5OH	$C_6H_5CO_2H$	$CO(NH_2)_2$	C_2H_5OH
1	36.92	—	63.08	—	—	—
2	37.64	0.72	61.64	86.56	0.33	13.11
3	38.55	1.81	59.64	86.99	0.47	12.54
4	39.38	2.64	57.98	86.93	0.86	12.21
5	40.75	4.22	55.03	83.99	1.12	14.89
6	41.56	5.10	53.34	77.44	1.78	20.78
7	42.31	6.11	51.58	81.77	2.21	16.02
8	42.90	7.09	50.01	85.73	2.71	11.56
9	44.68	9.67	45.65	81.30	3.59	15.11
10	45.55	12.12	42.33	80.73	4.43	14.84
11	46.24	12.48	41.28	62.35	12.27	25.38
12	46.23	12.50	41.27	57.01	23.34	19.65
13	46.20	12.56	41.24	62.17	31.24	6.59
14	43.78	12.15	44.07	15.67	67.76	16.57
15	35.06	12.76	54.18	7.19	81.51	11.30
16	25.38	9.41	65.21	5.94	79.07	14.99
17	11.22	7.39	81.39	2.30	79.54	18.16
18	5.06	6.59	88.35	1.38	79.58	19.04
19	—	5.82	94.18	—	—	—

Table 2.

No.	Solution.			Residue.		
	$C_6H_5CO_2H$	$CO(NH_2)_2$	C_2H_5OH	$C_6H_5CO_2H$	$CO(NH_2)_2$	C_2H_5OH
1	100.00	0	4.53	—	—	—
2	96.26	3.74	4.18	99.23	0.77	0.40
3	91.29	8.71	3.75	98.91	1.09	0.38
4	88.03	11.97	3.43	98.03	1.97	0.36
5	82.61	17.39	2.96	97.36	2.64	0.45
6	80.03	19.97	2.85	95.53	4.47	0.68
7	77.30	22.70	2.50	94.79	5.21	0.49
8	74.42	25.58	2.30	93.96	6.04	0.34
9	69.45	30.55	1.88	91.76	8.24	0.45
10	64.90	35.10	1.60	89.96	10.04	0.44
11	64.57	35.43	1.53	71.43	28.57	0.77
12	64.53	35.47	1.53	55.14	44.86	0.49
13	64.41	35.59	1.52	49.47	50.53	0.14
14	63.93	36.07	1.70	10.22	89.78	0.29
15	61.58	38.42	2.52	4.16	95.84	0.17
16	57.02	42.98	3.88	3.56	96.44	0.24
17	42.76	57.24	8.22	1.40	98.60	0.29
18	27.43	72.57	12.68	0.85	99.15	0.31
19	0	100.00	21.11	—	—	—



With the data in Table 2, Fig. 1 was obtained. As may be seen, there is no evidence of the existence of any compound between benzoic acid and urea. The presence of 0.5 per cent. of water might be the cause of the non-formation of the compound, but whether Dessaignes worked with perfectly dry alcohol or not is unknown, as the original paper was not accessible to us.

A few solubility determinations were carried out at other temperatures, 0° and 40° , but the result was practically the same.

Then some qualitative experiments were tried under different conditions. The two solid components were once completely dissolved in alcohol by warming and allowed to crystallise on cooling. This was repeated in a sealed tube with alcohol dried over anhydrous

copper sulphate. Again they were dissolved in much alcohol and the solvent was driven off by passing a current of dry air through it until some crystals separated out. But all our efforts were in vain.

Summary.

A system of urea, benzoic acid and ethyl alcohol was studied at 25°. No evidence of the existence of any compound was noticed. It was so also at 0° and 40°.
