

ON THE OXIDATION OF STANNOUS HYDROXIDE IN SODIUM CARBONATE SOLUTION BY MEANS OF AIR.

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Received November 26, 1927. Published February 28, 1928.

Introduction. As was described in the previous paper,⁽¹⁾ the oxidation velocity of stannous hydroxide by means of air increases with the increase of the concentration of sodium hydroxide until it attains the dissolution velocity of air into the solution. The increase may be due to the formation of sodium stannite, which dissolves in the solution. The oxidation velocity of stannous hydroxide in sodium carbonate solution can be expected to be very small, as it is almost insoluble in sodium carbonate solution. The present research was carried out to ascertain this idea and as an example of heterogeneous reaction.

Experimental. The experimental procedure was quite the same as that described in the previous paper.⁽²⁾ In the following tables, v is the volume of sodium thiosulphate solution of 0.0996 normal, which is equivalent to the quantity of stannous hydroxide; k was calculated by $k = \frac{1}{t} (v_0 - v)$, v_0 being the value of v at $t = 0$ and $v_{calc.}$ was obtained by $v_{calc.} = v_0 - kt$, using the mean value of k .

TABLE 1.
Temp. = 20° C. Air = 7.78 litres per hour.

$C_{Na_2CO_3}$ normal.	t min.	v c.c.	$v_{calc.}$ c.c.	k
0.0155	0	9.52	—	—
	120	8.93	8.80	0.00492
	0	12.23	—	—
	150	11.36	12.33	0.00580
	0	12.84	—	—
	120	12.11	12.12	0.00608
	160	11.98	11.88	0.00538
	0	19.27	—	—
	120	18.43	18.55	0.00700
	160	18.19	18.31	0.00675
	0	19.35	—	—
	150	18.44	18.45	0.00607
				mean: 0.00600

(1) S. Miyamoto, this journal, 2 (1927), 155; *Scientific Papers of the Institute of Physical and Chemical Research*, 7 (1927), 189.

(2) Ibid.

TABLE 1. (Continued.)

$C_{Na_2CO_3}$ normal.	t min.	v c.c.	$v_{calc.}$ c.c.	k
0.0905	0	10.76	—	—
	120	9.91	9.93	0.00708
	160	9.68	9.66	0.00675
	0	11.52	—	—
	120	10.74	10.69	0.00650
	0	12.23	—	—
	150	11.27	11.19	0.00640
	0	18.00	—	—
	120	17.09	17.13	0.00758
	160	16.87	16.90	0.00706
				mean: 0.00690
0.1655	0	9.43	—	—
	120	8.44	8.51	0.00825
	160	8.21	8.20	0.00763
	0	12.05	—	—
	150	11.01	10.90	0.00693
	0	12.52	—	—
	120	11.61	11.60	0.00758
	160	11.23	11.29	0.00806
	0	17.78	—	—
	120	16.80	16.86	0.00817
	160	16.66	16.55	0.00700
				mean: 0.00766
0.2780	0	11.93	—	—
	120	11.00	11.10	0.00775
	160	10.82	10.82	0.00694
	0	12.31	—	—
	150	11.37	11.27	0.00627
	0	12.87	—	—
	100	12.13	12.18	0.00740
	0	18.14	—	—
	120	17.41	17.31	0.00608
	160	17.02	17.03	0.00700
				mean: 0.00691
0.4655	0	10.02	—	—
	120	9.30	9.19	0.00600
	0	11.52	—	—
	150	10.45	10.49	0.00713
	0	13.19	—	—
	120	12.30	12.36	0.00742
	160	12.04	12.09	0.00719
	0	18.66	—	—
	120	17.78	17.83	0.00733
	160	17.65	17.56	0.00631
				mean: 0.00689

TABLE 1. (Continued.)

$C_{Na_2CO_3}$ normal.	t min.	v c.c.	$v_{calc.}$ c.c.	k
0.8405	0	10.51	—	—
	120	9.69	9.72	0.00683
	160	9.50	9.45	0.00631
	0	13.14	—	—
	120	12.46	12.35	0.00567
	0	14.30	—	—
	120	13.50	13.51	0.00667
	160	13.18	13.24	0.00700
	0	19.75	—	—
	120	18.87	18.96	0.00733
	160	18.73	18.69	0.00638
				mean: 0.00660
	0	10.15	—	—
	120	9.40	9.45	0.00625
	160	9.15	9.21	0.00625
1.216	0	13.40	—	—
	120	12.64	12.70	0.00633
	160	12.48	12.46	0.00575
	0	18.32	—	—
	120	17.68	17.62	0.00533
	160	17.49	17.38	0.00519
				mean: 0.00585

As is seen in Table 1, the oxidation velocity of stannous hydroxide is independent of the quantity of stannous hydroxide in sodium carbonate solution approximately, and the effect of the concentration of sodium carbonate on the oxidation velocity is small. The result shows that the oxidation of stannous hydroxide principally takes place in the liquid phase and not on the surface of the solid phase, as in the case of the oxidation of ferrous hydroxide suspended in sodium hydroxide solution by means of air.⁽¹⁾ We see also from the results that stannous hydroxide oxidizes very slowly in the air, and that the rapid increase of the oxidation velocity of stannous hydroxide with the increase of the concentration of sodium hydroxide⁽²⁾ is due to the formation of sodium stannite which is soluble in the solution.

The Effect of Temperature. The oxidation velocities observed at 30°C. and 40°C. are given in Table 2. The effect of temperature was very small.

(1) S. Miyamoto, this journal, 2 (1927), 40; *Scientific Papers of the Institute of Physical and Chemical Research*; 7 (1927), 35.

(2) S. Miyamoto, this journal, 2 (1927) 158; *Scientific Papers of the Institute of Physical and Chemical Research*, 7 (1927), 192.

TABLE 2.

Air = 7.78 litres per hour.

Temp.	C _{N₂O} normal.	<i>t</i> min.	<i>v</i> c.c.	<i>v</i> _{calc.} c.c.	<i>k</i>
30° C.	0.0155	0	10.26	—	—
		120	9.29	9.37	0.00808
		160	9.11	9.08	0.00719
		0	12.92	—	—
		120	12.09	12.03	0.00692
		160	11.95	11.74	0.00606
		0	19.32	—	—
		120	18.24	18.43	0.00900
		160	18.18	18.14	0.00713
					mean: 0.00740
30° C.	0.0905	0	10.12	—	—
		120	8.97	9.09	0.00958
		160	8.91	8.75	0.00756
		0	13.07	—	—
		120	12.09	12.04	0.00817
		160	11.87	11.70	0.00750
		0	18.88	—	—
		120	17.66	17.85	0.01017
		160	17.55	17.51	0.00831
					mean: 0.00855
40° C.	0.0155	0	9.75	—	—
		90	9.07	9.03	0.00756
		150	8.74	8.55	0.00673
		0	12.19	—	—
		90	11.49	11.47	0.00778
		160	11.05	10.91	0.00713
		0	17.84	—	—
		90	16.96	17.12	0.00978
		150	16.50	16.64	0.00893
					mean: 0.00799
40° C.	0.0905	0	9.81	—	—
		120	8.80	8.78	0.00842
		160	8.59	8.43	0.00763
		0	12.31	—	—
		120	11.27	11.28	0.00867
		160	11.15	10.93	0.00725
		0	18.39	—	—
		120	17.16	17.36	0.01025
		160	16.87	17.01	0.00950
					mean: 0.00862

$$\frac{k_{30^{\circ}}}{k_{20^{\circ}}} = \frac{0.00740}{0.00600} = 1.23 \quad \frac{k_{40^{\circ}}}{k_{30^{\circ}}} = \frac{0.00799}{0.00740} = 1.08, \text{ when } C_{Na_2CO_3} = 0.0155 \text{ normal}$$

$$\frac{k_{30^{\circ}}}{k_{20^{\circ}}} = \frac{0.00855}{0.00690} = 1.24 \quad \frac{k_{40^{\circ}}}{k_{30^{\circ}}} = \frac{0.00862}{0.00855} = 1.01, \text{ when } C_{Na_2CO_3} = 0.0905' \text{ normal}$$

The oxidation velocity of stannous hydroxide in sodium carbonate solution is thus very small and it was not studied thoroughly. More complete study will be carried out in later occasion.

Summary.

1. The oxidation velocity of stannous hydroxide suspended in sodium carbonate solution of various concentrations by means of air was studied. The oxidation velocity was independent of the quantity of stannous hydroxide.

2. The effect of the concentration of sodium carbonate on the reaction velocity was small.

3. It was ascertained that sodium stannite is oxidized rapidly, while stannous hydroxide is oxidized very slowly by means of air.

4. The effect of temperature on the reaction was small.

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