ENCLOSURE (B)4

STUDIES ON SYNTHESIS OF HYDROGEN PEROXIDE FROM HYDROGEN-OXYGEN MIXTURE BY ELECTRIC ARC DISCHARGE METHOD

by

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Prepared for and Reviewed with Authors
by U. S. Naval Technical Mission to Japan

December 1945

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LIST OF TABLES AND ILLUSTRATIONS

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SUMMARY

When the flow rate of the hydrogen-oxygen mixture (O_2 about 5%) through the electric are exceeded 100 m/sec, the power consumed by the hydrogen peroxide synthesis was about 300 kwh/kg H_2O_2.

To obtain the synthesized hydrogen peroxide, the following three methods were used. Among them, Method 1 was the best.

1. Distilled water at the end of the reaction tube was used to absorb the H_2O_2.

2. Distilled water was allowed to contact the reacted gas directly and absorb the H_2O_2.

3. Synthesized H_2O_2 was condensed directly by cooling.

I. INTRODUCTION

The synthesis of hydrogen peroxide from hydrogen-oxygen mixtures by electric discharge previously had been effected with an ozonizer tube. However, the treated volume per unit in this method, was so small that to improve this point, arc discharge was tried by Lieutenant T. KONOSU from September to December 1944. When the arc discharge was used, the flow speed in the reaction tube was most important, and it was found necessary that the flow speed be above 100 m/sec. To obtain the synthesized products, distilled water was injected at the end of the reaction tube, and the products absorbed.

II. DESCRIPTION

A. Apparatus

The apparatus is shown in Figure 1(B)4

B. Procedure

In Figure 1(B)4, the mixed hydrogen oxygen gases are stored in the gas tank (T) and the O_2 content is maintained at about 5%. By means of the gas recycling pump (P), the gases are forced into the reaction tube (R). Their volume is measured by the flow meter (F_1) and their pressure by the manometer (P_1). In the reaction tube they contact the arc and the cooling water, which is recycled by the recycling pump (I), and flow into the cooling tube (C). Then the cooling water flows into the receiver (E), and residual gases are recycled into the gas tank (T) by the gas recycling pump (P) after their volume is measured by the flow meter (F_2), and their pressure by the manometer (P_2). When the experiment is over, the product is removed and titrated with 1/10 N $KMnO_4$ to determine the concentration of H_2O_2.

C. Results

The results are shown in Table I(B)4

The apparatus in which the cooling water was used so as to contact directly with reacted gases, is shown in Figure 2(B)4, and its results are shown in Table II(B)4.

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The apparatus in which the synthesized H_2O_2 was condensed directly by cooling is shown in Figure 3(B)4, and its results are shown in Table III(B)4.

II. CONCLUSIONS

When the cooling method was used as shown in Figure 1(B)4, the power consumption was about 300 kwh/kg H_2O_2, and the H_2O_2 concentration was about 0.5%. This concentration may be increased by reducing the volume of initial cooling water. In this case, however, the materials of the cooling water recycling pump, which is made of iron and copper, are not suitable. Hence, it will be necessary to select a material that will minimize the decomposition of H_2O_2 synthesized.

It was the object of this research to develop a commercial method of producing H_2O_2 which would eliminate the use of platinum and which could be used as a substitute for the $(NH_4)_2S_2O_8$ method. In this experiment it was hoped that the power consumption would be below 100 kwh/kg H_2O_2 and that the concentration of H_2O_2 produced be at least one percent. Additional experiments will be necessary to develop this method commercially.

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Table I(B)4
RESULTS OF ARC DISCHARGE ON MIXED H_2, O_2 GAS

Gas volumes (F_1) (lit/min)	Pressure (P_1) (mm Hg abs)	Primary		Secondary		Power Factor	Power (watts)	Total H_2O_2 (gm/hr)	Power Consumption (KWH/kgH_2O_2)	H_2O_2 Concentration (%)
		Voltage (volts)	Current (amps)	Voltage (kilo-volts)	Current (milli-amps)					
15	740	45	20	15.6	35	0.6	540	0.19	2,800	0.004
20	740	43	20	11.0	45	0.6	516	0.26	2,000	0.005
30	730	42	19	11.0	42	0.6	480	0.48	1,000	0.01
75	730	44	20	10.5	50	0.6	528	1.42	400	0.3
100	730	45	20	10.6	50	0.6	540	1.56	350	0.4
120	720	50	20	12.0	50	0.6	600	1.98	300	0.5
135	720	50	20	13.3	45	0.6	600	1.86	320	0.4

Table II(B)4
RESULTS OF ARC DISCHARGE ON MIXED H_2, O_2 GAS

Gas volumes (lit/min)	Pressure (mm Hg abs)	Primary		Secondary		Power factor	Power (watts)	Total H_2O_2 (gm/hr)	Power consumption (KWH/kgH_2O_2)	H_2O_2 concentration (%)
		Voltage (volts)	Current (amps)	Voltage (kilovolts)	Current (milliamps)					
75	740	45	20	10.8	50	0.6	540	0.97	550	0.6
100	740	46	20	11.0	50	0.6	552	1.37	400	0.8
120	740	48	20	11.5	50	0.6	576	1.34	420	0.7

Table III(B)4
RESULTS OF ARC DISCHARGE ON MIXED H_2, O_2 GAS

Gas volumes (l/min)	Pressure (mm Hg abs)	Primary		Secondary		Power factor	Power (watts)	Total H_2O_2 (gm/hr)	Power consumption (KWH/kgH_2O_2)	H_2O_2 concentration (%)
		Voltage (volts)	Current (amps)	Voltage (kilovolts)	Current (milliamps)					
75	740	45	20	10.8	50	0.6	540	0.7	700	1.0
100	740	45	20	10.8	50	0.6	540	1.1	500	1.2
120	740	48	20	11.5	50	0.6	576	1.0	550	1.0

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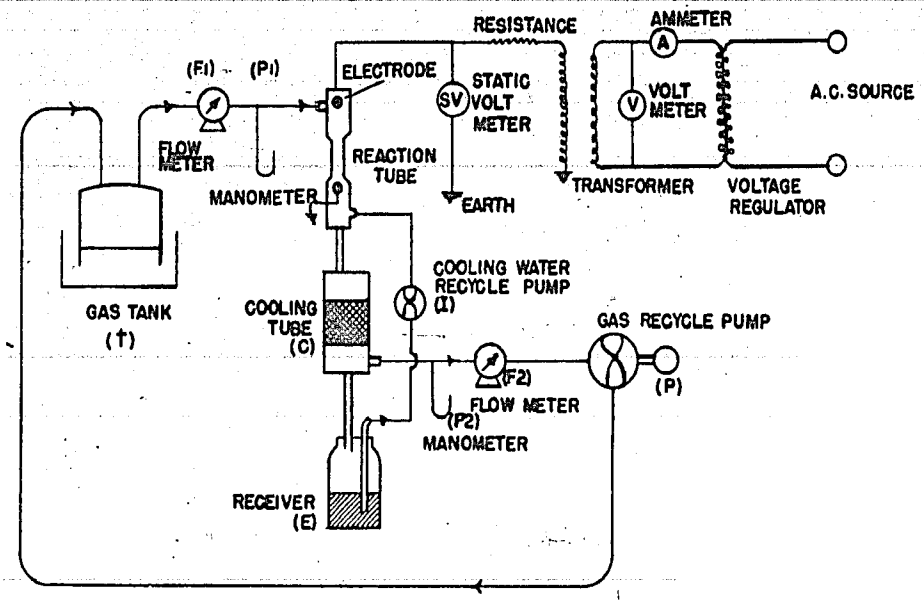

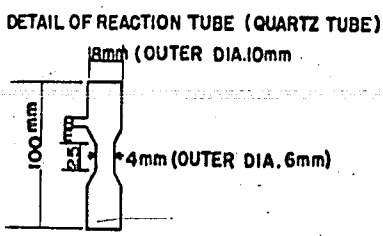

Figure 1 (B)4
APPARATUS FOR H_2O_2 SYNTHESIS BY ARC DISCHARGE

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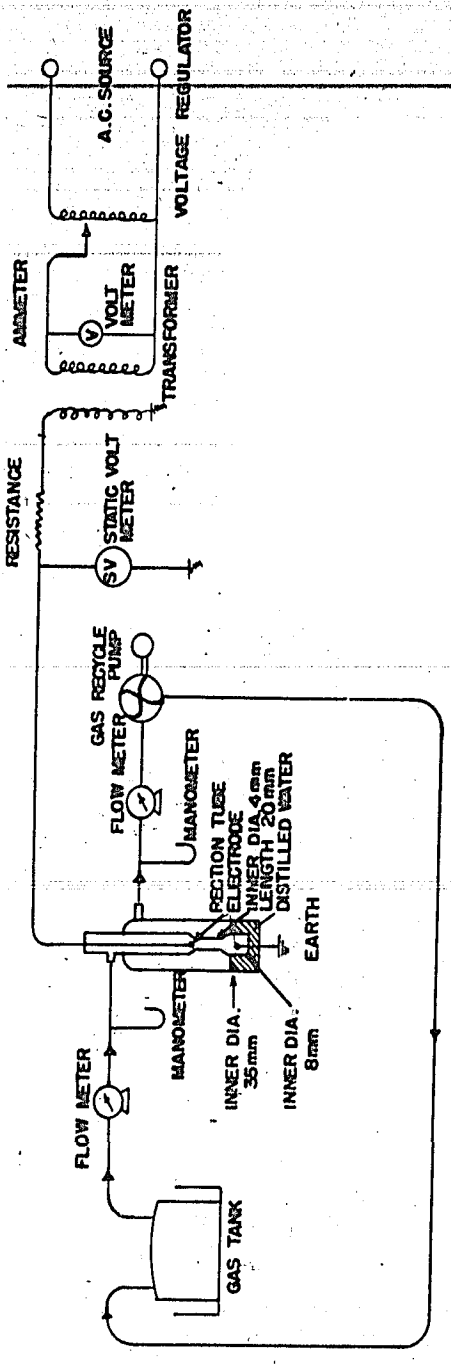

Figure 2 (B)4
APPARATUS FOR H_2O_2 SYNTHESIS BY ARC DISCHARGE

ENCLOSURE (B)4

Figure 3 (B)4
APPARATUS FOR H_2O_2 SYNTHESIS BY ARC DISCHARGE