ENCLOSURE (B)6

STUDIES ON THE METALLIC MATERIALS IN THE MANUFACTURING, STORING, AND TRANSPORTING OF THE HYDROGEN PEROXIDE SOLUTION

by

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Research Period: 1944-1945

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

December 1945

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SUMMARY

Suitable metallic materials for the manufacturing apparatus, storing-tank, and transporting-vessel of hydrogen peroxide solution were investigated and the following results were obtained.

1. For the manufacturing apparatus of hydrogen peroxide, tin and stainless steel may be used.

2. It is satisfactory to use tin for the transporting-vessels.

3. It is satisfactory to use tin for the storing-tank.

I. INTRODUCTION

A. History of Project

It is known that glass, porcelein, paraffin, etc., are good materials in regard to non-corrosion and non-decomposition of hydrogen peroxide, but it is difficult to use them practically because of their low strength and plasticity. We were obliged to investigate metallic materials for the above purpose.

B. Key Research Personnel Working on Project

Chem. Eng. Lieut. M. OKAZAKI
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Date of the beginning: August 1944
Date of the finish: July 1945

II. DETAILED DESCRIPTION

A. Description of Test Apparatus

For the test apparatus a water-bath, controlled to hold a constant temperature at 60°C, was used. In this bath were placed many glass bottles in which the corrosivity of liquid H_2O_2 to various metallic test pieces and the decomposition of hydrogen peroxide were tested.

B. Test Procedure

1. All test pieces of various metals made to have the same form of about 30mm in length, 15mm in width, and 1-2mm in thickness, were polished with various polishing-powders until they became glassy, then partially immersed in the bottles full of hydrogen peroxide solution.

The temperature of liquid was held at 60°C in the water-bath and the initial concentration of H_2O_2 solution was 80%.

The term of the test was always 10 days. During the experiment, the initial concentration of hydrogen peroxide in the 80% solution was measured by titration with potassium permanganate solution and each test piece was weighed. The degree of decomposition of hydrogen peroxide (Table I(B)6) and the corrosion of the metallic test pieces (Table II(B)6) were calculated and recorded.

At the same time, the surfaces of the test pieces and the liquid were examined for evidences of corrosion. Observations are recorded in Table III(B)6.

Some non-metallic materials were tested by the same method but only for comparative purposes.

2. To examine the materials for the storing-tank and transporting vessel, some vessels were produced by way of experiment, each 20 liters in capacity, and after pouring in 15 liters of the liquid, initial concentration of 80%. The vessels were kept for 20 days at 40°C to observe the existence of something unusual on the surface of the vessel and liquid (Table IV(B)6). Also, for the examination of transporting, some of the vessels were carried for about 12 hours at room temperature on a truck (Figure 1(B)6).

C. Experimental Results

The results of the experiments are tabulated in the following tables. The results of the test for transporting were very good. That is, none of them showed anything unusual on the wall of vessel and in the liquid.

The kinds of materials or the structure of vessels used for the test were as follows: Aluminium vessel with one outlet, steel vessel lined with tin plate, and glass bottle, 20 liters in capacity. Details of the vessels used in practice are shown in Figure 1(B)6 and Figure 2(B)6.

III. CONCLUSION

The conclusions from the tests are as follows:

A. For the material in the manufacturing apparatus of hydrogen peroxide solution, porcelain is suitable; but it is hard to use practically because of its mechanical strength and plasticity. If metallic materials are to be used for the purpose, stainless steel containing chromium and nickel, tin, and pure aluminium, are suitable for practical use. From the viewpoint of ease of obtaining a large amount in practice, tin is the most suitable and stainless steel is the next.

B. For the transporting vessel and storage tank, it is better to use tin plate for the lining material. This is better than using a steel vessel.

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Table I(B)6
DEGREE OF DECOMPOSITION OF HYDROGEN PEROXIDE

No	Name of Materials	Surface Area (cm^2)	Vol. of Liquid in the bottle (cc)	Number of Testing Days	Temp. of Liquid (°C)	Concentration of H_2O_2 (%)		Degree of Decomposition of H_2O_2 (%/cm^2/day)
						Initial	Final	
1	18-8-Ni-Cr Stainless steel	10.2	50	10	60	80.0	65.0	0.15
2	13-Cr Stainless steel	10.0	50	10	60	80.0	55.0	0.25
3	Tin (99%)	10.0	50	10	60	80.0	74.0	0.06
4	Aluminium (99.99%)	10.3	50	10	60	80.0	74.0	0.06
5	Aluminium (99.8%)	10.3	50	10	60	80.0	70.0	0.10
6	Paraffin	10.0	50	10	60	80.0	75.0	0.05
7	Smoked sheet	10.0	50	10	60	80.0	75.0	0.05
8	Rubber	10.0	50	10	60	80.0	74.5	0.055
9	Blank Det'n		50	10	60	80	76	0.04

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Table II(B)6
CORROSION VALUE OF METALS

No.	Name of Materials	Surface Area (cm^2)	Vol. of the Liquid in the Bottle (cc)	Number of Testing Days	Temp. of Liquid (°C)	Weight of Test Piece (gr) Initial	Weight of Test Piece (gr) Final	Corrosion Value ($\%/cm^2$/day)
1	18-8-Ni-Cr Stainless steel	10.2	50	10	60	14.0230	14.0228	$2X10^{-6}$
2	13-Cr Stainless steel	10.0	50	10	60	13.9524	13.9515	$9X10^{-6}$
3	Tin (99%)	10.0	50	10	60	13.3552	13.3545	$7X10^{-6}$
4	Aluminium (99.99%)	10.3	50	10	60	4.8240	4.8238	$2X10^{-6}$
5	Aluminium (99.8%)	10.3	50	10	60	4.8155	4.8165	$10X10^{-6}$
6	Paraffin	10.0	50	10	60	1.7432		
7	Smoked sheet	10.0	50	10	60	1.6531		
8	Rubber	10.0	50	10	60	1.6772		

Table III(B)6
APPEARANCE

No.	Name of Materials	Ap. of Liquid	Ap. of Surface of Test Pieces
1	18-8-Ni-Cr Stainless steel	Usual	Vapor-exposed surface-slight violet tarnish
2	13-Cr Stainless steel	Usual	Vapor-exposed surface-slight violet tarnish
3	Tin (99%)	Usual	Usual
4	Aluminium (99.99%)	Usual	Usual
5	Aluminium (99.8%)	White turbidity	White substance on the entire surface
6	Paraffin	Usual	Usual
7	Smoked sheet	Slightly cloudy	Bleached in liquid phase
8	Rubber	Decomposed rubber	Bleached in liquid phase

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Table IV(B)6
STORAGE FOR 20 DAYS AT 40°C

No.	Name of material of vessel	Concentration of H_2O_2 (%)		Degree of decomposition of H_2O_2	Observation of liquid	Observation of vessel
		initial	final	(%/10 days)		
1	Aluminium (99.99%)	80.0	79.0	0.5	Usual	Usual
2	Aluminium (99.8%)	80.0	75.0	2.5	White sub. in bottom	White sub. on the wall of vessel
3	Tin-lined steel	80.0	79.5	0.025	Usual	Usual
4	Paraffin lined steel	80.0			Excessive decomp.	There may be crack or pinhole in paraffin layer
5	Rubber lined steel	80.0	79.8	0.01	White slight sub.	Rubber layer is bleached and corroded.
6	Glass bottle	80.0	80.0	0.0	Usual	Usual

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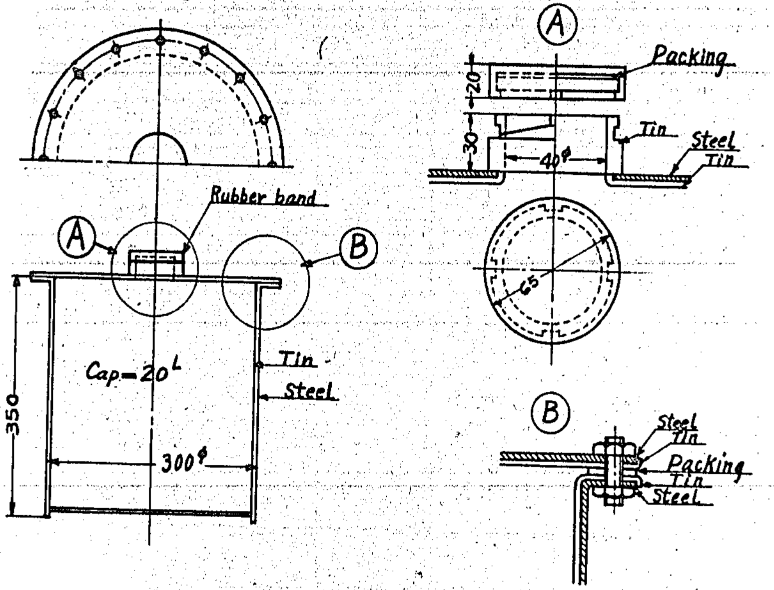

Figure 1 (B)6
H_2O_2 METAL SHIPPING CONTAINER

This vessel, produced by way of experiment, was used in the transporting test and storing test described above.

The vessel is made of steel, lined with tin, and the cover is also the same and fixed with bolts to the vessel.

The stopper is fixed with a rubber band which is at the same time a safety valve for the expansion of gas.

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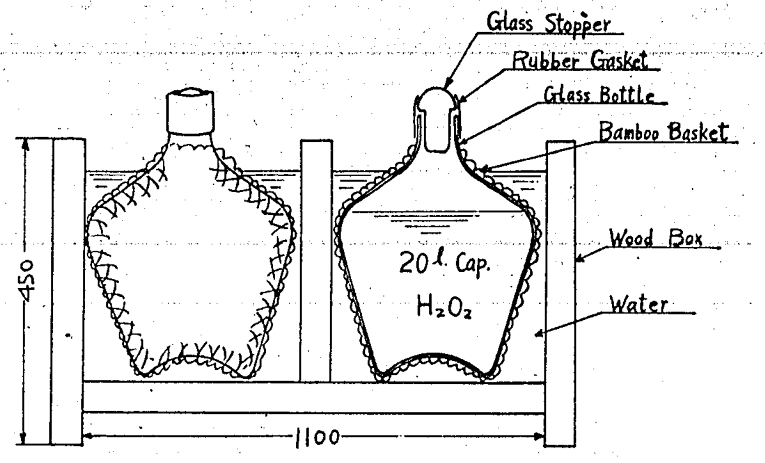

Figure 2 (B)6
H_2O_2 GLASS SHIPPING CONTAINER

Two bottles, made of glass and covered with bamboo basket, are placed in each box, separated into two parts.

The stopper, made of glass, is fixed by a rubber gasket which is at the same time a safety valve for the expansion of gas and occasional explosion.

The water in the box is used to dilute the H_2O_2, overflowing due to vibration of box or by destruction.

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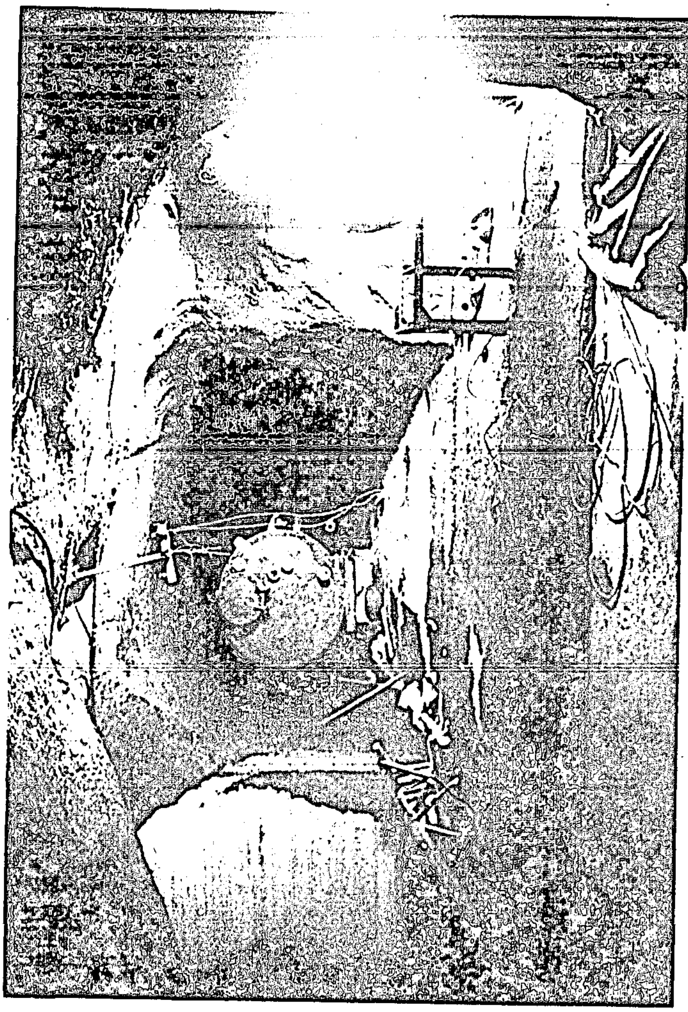

Figure 3 (B)6
UNDERGROUND STORAGE OF HYDROGEN PEROXIDE