

ENCLOSURE (B) 28

STUDIES ON A METHOD OF TESTING
THE STABILITY OF ETHYL FLUID

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ENCLOSURE (B)28

LIST OF TABLES
AND ILLUSTRATIONS

Figure 1(B)28	Diagrammatic View of Stability Tester	Page 357
Figure 2(B)28	Relation between the Amount of Precipitate and Turbidity	
Figure 3(B)28	Relation between the Formation of Turbidity and the Time of Exposure	Page 358
Figure 4(B)28	Relation between the Formation of Turbidity and Temperature of Sample	Page 358

ENCLOSURE (B)28

SUMMARY

Ethyl fluid is liable to decompose during storage, and form an amorphous deposit which not only lowers the antidetonating effect but also impairs the engine operation. Therefore, a method for testing the stability of ethyl fluid was tried. It was based on the determination of the turbidity nephelometrically (using a pair of the selenium photogalvanic cells) after exposing the sample to ultra violet rays having a constant intensity for a definite time. The stability tester was designed and constructed by the Tokyo Electric Co. on the basis of the above principle.

I. INTRODUCTION

Hitherto, many attempts were made to measure the stability of ethyl fluid by gravimetric or volumetric measurement of the precipitate or the gas formed by heat or sunlight. Accurate results were not obtained and the technique was troublesome. In 1941, Chem Eng. Capt., Dr. S. YAMAGUCHI and Nav. Eng. G. ISHIDA devised the above-mentioned method and the tester was constructed in 1943. It was then decided to adopt it as the authorized stability tester for ethyl fluid.

II. DETAILED DESCRIPTIONA. Apparatus and Procedure

The diagrammatic figure of the tester is shown in Figure 1(B)28. At first the intensity of the ultraviolet rays from the mercury lamp was adjusted by a chromium photocell through an iris, a shutter, a sample vessel, a shutter and a filter. The photocurrent of the chromium photocell was amplified and indicated by a microammeter. The sample vessel was made of silica. The filter served to match the characteristics of the mercury lamp and the chromium photocell. The intensity of the mercury lamp was checked by adjusting the rheostat of the electric source, and when the amplified photocurrent indicated 150 microamperes, the ultra violet rays were shut off, and 150cc of 0.1% tetraethyl lead solution in standard gasoline were placed in the silica vessel and exposed for exactly 15 minutes to the ultra violet rays. The turbidity formed in the sample caused by exposure to the ultra violet rays was determined by the absorption of visible rays from the checked standard lamp. A pair of the selenium photogalvanic cells having the same characteristics were used, one of which was directly illuminated and the other was illuminated through the sample. The difference of the two photoelectromotive forces was determined potentiometrically using a galvanometer. The calibration of both selenium cells was carried out using a filter having a 10% absorption of rays, which was inserted in place of the sample vessel. The regulating dial of the potentiometer was set so that the galvanometer indicated 0 when the reading dial was at 10%. The stabilities of the samples were compared by the numbers on the reading dial of the potentiometer.

B. The Various Effects on Determination

1. Relation between the amount of the precipitate and the absorption of visible ray The amount of precipitate formed by exposure to ultra violet rays was measured gravimetrically after measuring the absorption of the visible rays. The result is shown in Figure 2(B)28. The absorption of rays is proportional to the amount of the precipitate within the limit of 10% absorption.

ENCLOSURE (B)28

2. Effect of the temperature of the sample Figure 3(B)28 shows the effect of temperature on the formation of the turbidity. Though the effect of the temperature of the sample was small, it could not be neglected. The data indicates that for the temperature interval between 10°C and 30°C the error caused by the temperature difference was 10% of the determined absorption value.

3. Effect of time of exposure The absorption of rays through the sample was limited to 10%, since this represents the maximum absorption which can be measured. Fifteen minutes exposure of the sample to the ultra violet rays was found to be sufficient, since the final absorption was below 10% even in the case of the most unstable samples. As shown in Figure 4(B)28, 15 minutes exposure was suitable for the formation of the turbidity.

4. Effect of the constitution of the base gasoline A gasoline which is high in aromatics absorbs ultra violet rays more than a paraffine gasoline. A specially prepared standard gasoline "N - 1", was used as the base gasoline for these tests. The properties of "N - 1" gasoline are as follows:

Sp. gr. 15/4 0.7377

A.S.T.M. Distillation Characteristics

I.b.p. °C	.....	38.5
10% p. °C	.....	76.0
50% p. °C	.....	106.0
90% p. °C	.....	135.0
d.p. °C	.....	158.0
t.d. %	.....	98.0

Composition of Hydrocarbons (%)

Olefin	.....	0.32
Aromatic	.....	3.68
Naphthene	.....	42.24
Paraffine	.....	79.68

5. Effect of the change of absorption due to additives in ethyl fluid Ethylene dibromide, the stabilizers and the dyestuffs in ethyl fluid also absorb ultra violet rays and the absorption of visible rays changes on exposure. Though the change was small, the greatest error of this method is caused by this reason.

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Figure 1(B)2B

DIAGRAMMATIC VIEW OF STABILITY TESTER

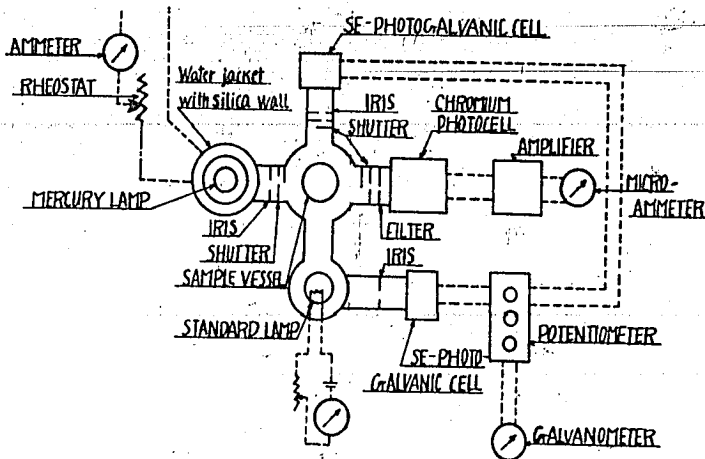
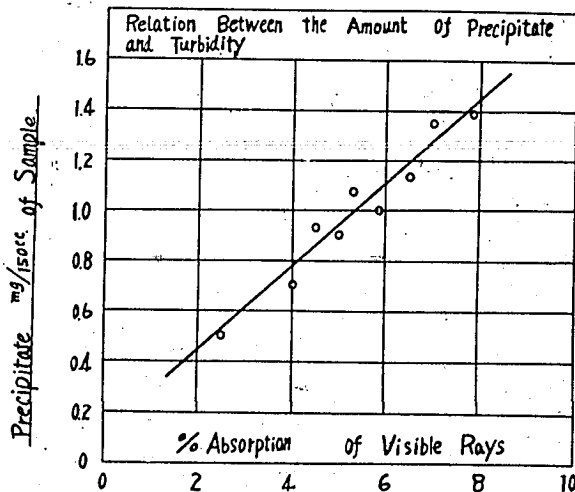


Figure 2(B)2a

RELATION BETWEEN THE AMOUNT OF PRECIPITATE AND TURBIDITY



ENCLOSURE 1B)28

Figure 3(B)2a

RELATION BETWEEN THE FORMATION OF TURBIDITY
AND THE TIME OF EXPOSURE

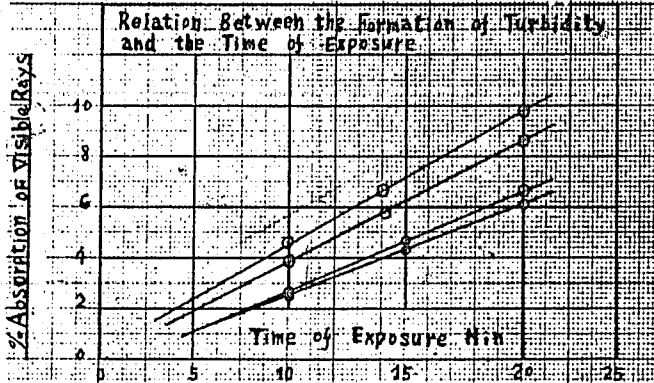


Figure 4(B)2a

RELATION BETWEEN THE FORMATION OF TURBIDITY
AND TEMPERATURE OF SAMPLE

