ENCLOSURE (B) 6

PRACTICAL TEST OF SUBSTITUTE DIESEL FUELS

(In Two Parts)

by

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LIST OF TABLES AND ILLUSTRATIONS

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PART I

C R E O S O T E O I L

SUMMARY

It was confirmed that creosote oil was unsuitable for all types of engine operation for periods of long duration due to piston deposits and ring sticking. However, it can be used for a short time except in high speed Diesel engines.

I. INTRODUCTION

The purpose was to acquire another source of Diesel fuels. Hence, the creosote oil which is a by-product of low temperature distillation of coal was investigated. Samples were brought from Showa-Seike Co., Ltd. in MANCHURIA.

There were no key research personnel assisting Lt. HIRABE.

II. DETAILED DESCRIPTION

A. Samples Tested

The samples which were tested are shown in Table I(B)6.

B. Test Engines Used

The test engines which were used are shown in Table II(B)6.

C. Test Procedure

1. The first test series related to states of combustion under various conditions; that is, smoke condition, knocking phenomena, exhaust gas temperature, maximum explosion pressure, etc. Since the details of the experimental data were burned, the following is described from memory. Various injection air pressures were tried, and when the pressure of injection air was near 85 kg/cm^2, combustion was best and satisfactory performance was shown at full load.

2. Then at the following loads - 4/10, 6/10, 8/10, 10/10, and 11/10 of rated power, additional data were acquired; i.e. fuel consumption, revolutions per minute, brake horsepower, exhaust gas temperature and pressure, maximum explosion pressure, lubricant temperature at both inlet and outlet, cooling water temperature, smoke condition, etc.

3. The 10hp small, high speed, Diesel engine was operated in the same way as the 25hp Diesel engine.

At low power rate the smoke was very bad, black, and excessive, and the speed was not smooth.

At high power rates, the engine exhibited good performance, but smoke was rather bad.

On inspection of the cylinder after 20 hours running, there was some scoring, and the piston head and cylinder head were coated with carbon deposits. There were also deposits in the tip of the injection nozzle.

Carbon deposits on the piston head were directly opposite to each nozzle hole.

As a result, the engine had to be cleaned after 20 hours running. The fuel filter was not clogged.

III. CONCLUSIONS

Creosote oil cannot be used as a starting fuel. Starting with this fuel was very difficult even when cranking with the dynamometer; but creosote oil can be used at high power rates quite satisfactorily except for considerable smoking. At low power rates, its running was not smooth and the smoking was excessive. This fuel cannot be used for long time running periods and engine cleaning is required every 20 hours. Care must be taken when using this fuel, as it will burn the skin.

Table I(B)6
PROPERTIES OF SAMPLES TESTED

	Creosote Oil	Tarakan Pitch-less Oil*
Color	black and dark brown	blue brown
Specific weight (15/4°C)	1.078	0.9311
Flash point (°C)	62	78.5
Viscosity (Redwood No.1 at 30°C)	52.6	
Freezing point (°C)	<-20°C	-38.5
Carbon (%)	2.23	
Water (%)	0.06	
Ash (%)	0.027	
Cetane value (calculated)	approximately -3	38
Reaction	acidic	

* Tarakan pitchless oil, prepared at 3rd Naval Fuel Depot by deasphaltizing with propane, was used for comparison.

Table II(B)6
CHARACTERISTICS OF TEST ENGINES USED

	25HP Air Injection Diesel Engine*	10HP Solid Injection Diesel Engine**
Cylinder bore	220mm	100mm
Cylinder stroke	300mm	140mm
B.H.P.	25	10
Speed (RPM)	450	1800
Comp. ratio	14.5	16.5

*Manufactured by Ohiko (Osaka Kikai Kosakusho), 4-cycle, single-cylinder, vertical.
**Manufactured by Niigata, 4-cycle, single-cylinder, vertical, small high speed Diesel engine.

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PART II

S O Y B E A N O I L

SUMMARY

It was found that the soy-bean oil (treated with acid clay) was as suitable for both high speed Diesel engines and low speed Diesel engines as other mineral oils.

I. INTRODUCTION

The purpose was to acquire another source of Diesel fuels. Accordingly, soy-bean oil was investigated, and the results agreed with expectations - in that it was found satisfactory.

II. DETAILED DESCRIPTION

A. Data on Sample

color	sap yellow
specific weight (15/4°C)	0.925
flash point	173
viscosity (Redwood No.1 at 30°C)	176
freezing point (°C)	-15
carbon (%)	0.353
water (%)	28
reaction	neutral

B. Test Engines Used

1. Junkers small, high speed, solid injection, single cylinder vertical Diesel engine. Specifications were:

2 cycle 10hp 1800 RPM

Bore 65mm opposed piston type.

2. OKIKO, 25hp low speed, air injection, verticle single cylinder Diesel engine. Specifications were:

4 cycle 25hp 450RPM

Bore 220mm stroke 300mm

Compression ratio: 14.5

C. Test Procedure

Test procedure was done under the following conditions at the various power rates: 2/10, 4/10, 6/10, 8/10, 10/10 brake horsepower. Data of thermal efficiency, fuel consumption, and maximum explosion pressure was obtained by a "Farns Bore" indicator. At the same time the combustion state was observed by using indicator cards.

A twenty five horsepower low speed Diesel engine was operated in the same way as the 10hp, small, high speed Diesel engine. At every power rate, running state and smoke condition were very good and engine exhibited good performance.

III. CONCLUSION

The soy-bean oil was found suitable for high speed Diesel engines and exhibited satisfactory performance at both low and high power rates. There was also no phenomena of sticking nor engine deposits. The smoke condition was very satisfactory. No starting test was made, cranking being done by the dynamometer.