ENCLOSURE (B) 20

STUDIES ON LUBRICANTS FOR DIESEL ENGINES

by

CHEM. ENG. COMDR. DR. I. KAGEHIRA

CHEM. ENG. LIEUT. M. HIRATA

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LIST OF TABLES AND ILLUSTRATIONS

ENCLOSURE (B) 20

SUMMARY

The object of this project was to obtain an excellent lubricant for diesel engines from crude oil by acid treating or solvent extraction, or by use of additives.

From OHA crude oil was prepared a good cylinder lubricant for diesel engines by vacuum distillation, phenol extraction, dewaxing, topping, and active clay treating. The yield was about 0.3%.

The result of the engine test at Yokosuka Naval Arsenal was satisfactory, but it was not used because of the insufficient amount available.

When a turbine oil was used for the diesel engine, the wear of the cylinder was very great, and this wear could not be sufficiently decreased by using additives; i.e., adding 0.5% of lecithin or 1% of tricresyl phosphate.

When aeroengine oil #80 was used for this engine, the wear of the cylinder was very slight, but the carbon deposit on the surface of the piston and the cylinder wall was great, and use of an additive, i. e., 1% of calcium phenyl stearate, did not decrease the carbon deposit sufficiently.

I. INTRODUCTION

A turbine oil has been mainly used for the marine diesel engine in the Japanese Navy, but this was not satisfactory from the view point of the cylinder wear. To avoid wear of the engine cylinder which occurred in the above case, a viscous oil such as aeroengine oil #80 was used, but hard carbon and piston lacquer were deposited, while the wear of the cylinder was decreased to about one fifth of that in the case of the turbine oil. Therefore, studies were carried from April 1938 to March 1944 to improve the properties of the oil and to manufacture a good diesel engine oil from a crude oil easily obtainable in Japan.

II. DETAILED DESCRIPTION

A. The 250-300°C (at 5mm Hg) fraction of OHA crude oil was extracted with 5 volumes of phenol and its raffinate, after dewaxing by acetone-benzene method, was topped in vacuum and the residue was treated by active clay. The characteristics of this oil were as follows:

Viscosity at 210°F	72 S.U.S.
Viscosity index	99
Conradson's carbon residue	0.05%

The results of the engine test of this oil at Yokosuka Naval Arsenal were satisfactory, using no additive.

B. The results of the engine test of aeroengine oil #80, the properties of which are shown in Table I(B)20, were somewhat the same as in the case of the above-mentioned oil, except in this case much carbon deposit and piston lacquer appeared, and it was desirable to decrease them. Therefore, another engine test was undertaken on the effect of additive in the oil.

ENCLOSURE (B)20

The addition of 1% of calcium phenyl stearate* to this oil decreased carbon deposit and piston lacquer, but not sufficiently to be satisfactory.

C. The use of turbine oil, whose properties are shown in the Table II (B)20, caused much wear of the cylinder of this engine, but practically no carbon or lacquer deposits. To decrease this wear, 0.5% of lecithin or 1% of tricresyl phosphate* was added to this oil, but the results of the engine test showed that these additives were not effective.

D. Results obtained were summarized in the Table III(B)20.

III. CONCLUSIONS

1. The aeroengine oil #80 was not a good diesel engine lubricant from the view point of carbon deposit and piston ring sticking.

2. An excellent diesel engine lubricant was prepared from OHA crude oil by vacuum distillation, phenol extraction, dewaxing, topping, and active clay treating.

3. The use of additives in aeroengine oil #80 (Calcium phenyl stearate) and in turbine oil (Lecithin or tricresyl phosphate) showed insufficient improvement in their characteristics.

4. From these results it may be said that the lubricating oil for marine diesel engines should be a well refined distillate and have the following properties:

Viscosity in S. U. °S. at 210°F ..... 70 - 80
Viscosity index ..... 90 (min)
Conradson's carbon (%) ..... 0.2-0.3 (max)

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*Chem. Eng. Comdr., Dr. I. KAGEHIRA and Chem. Eng. Lieut., M. HIRATA: Studies on the Additives of the Submarine Diesel Engine Lubricant.

Table I(B)20
PROPERTIES OF THE AEROENGINE OIL #80 USED

Density (d_4^{15})	0.8809	Conradson's carbon residue	0.47	Sap. Value	0.12
Flash point (°C)	221.0	Ash	none	Acid Value	0.05
Viscosity (S.U.S.) at 210°F	79.0	Pour point (°C)	-15.0	Stability viscosity ratio	1.47
Viscosity index	99.1			O.C.R. After test	1.53

ENCLOSURE (B)20

Table II(B)20
PROPERTIES OF THE TURBINE OIL USED

Reaction		neutral	Pour point (°C)	-4
Density-d_4^{15}		0.930	Corrosion	none
Flash point (°C)		193	Conradson's carbon residue	0.4
Viscosity R.-I. at	30°C	645	Volatility at 135°C for 6 hr	0.6%
	50°C	181	Sap. Value	0.1
	80°C	61	Acid Value	0.08

Table III(B)20
RESULTS

Name of oil	Source of oil	Compound	Ring sticking	Hard carbon	Cylinder wear
Diesel engine oil prepared by the author	Oha	None	0	least	low
Turbine oil (obtained from the market)	Perhaps Niigata	None	0	least	high
Turbine oil (obtained from the market)	Perhaps Niigata	1% of tricresyl phosphate	0	least	high
Turbine oil (obtained from the market)	Perhaps Niigata	0.5% of lecithin	0	least	high
Aeroengine oil #80	Produced by Texas oil Co. U.S.A.	None	2 (2nd & 3rd rings)	greatest	low
Aeroengine oil #80	Produced by Texas oil Co. U.S.A.	1% of Calcium phenyl stearate	1 (2nd ring)	intermediate	low