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PRACTICAL TESTS OF COPRA OILS AS SUBSTITUTE DIESEL FUELS

by

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LIST OF TABLES AND ILLUSTRATIONS

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SUMMARY

It was confirmed that dry distilled copra oil was unsuitable as a fuel for either diesel or semi-diesel engines. It was also confirmed that widely-used, pressed-out copra oil and esterified copra oils were both suitable.

I. INTRODUCTION

To utilize the oily and fatty products of the South Sea Islands for fuel oil, various copra oils were chosen for the purpose of finding a substitute for diesel fuels. Samples were prepared in July 1942, and tests were finished in October 1942. Chief researcher: Assistant Engineer KAJIWARA.

II. DETAILED DESCRIPTION OF PRODUCTS

A. Data on samples are given in Table I(B)7.

B. Data on Testing Engines are given in Table II(B)7.

C. Test Proceedures

At the following loads, 40%, 60%, 80%, and 100% load factor, the fuel consumption, bhp, maximum pressure in cylinder, exhaust gas temperature and composition, smoke condition, cooling water temperature, and various other data required were measured.

The results of tests are compared using Tarakan pitchless heavy oil as standard.

D. Experimental Results

1. Results using 25 hp air-injection diesel engine are given in Table III(B)7.

2. Results using 10 hp solid-injection diesel engine are given in Table IV(B)7.

III. CONCLUSIONS

Each copra oil tested was found to be suitable for starting, and from this standpoint each was better than Tarakan pitchless oil. Nearly smokeless combustion (almost equal to that of Tarakan pitchless oil) can be expected when copra oil is used.

The exhaust temperature was comparatively low, viz. about 230°C for copra oil, about 265°C. for Tarakan oil.

None of the fuel compound was found to be corrosive against engine materials, except dry distilled copra oil.

Each oil exhibited smooth running in engine performance tests.

Carbon deposits on piston head, cylinder cap, etc. were not great, and no ring sticking occurred in any case.

The high freezing point of dry distilled copra oil and pressed-out copra oil prohibits the use of these oils under cold weather conditions.

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Esterified copra oil is believed to be suitable for use in diesel and semi-diesel engines in summer and winter, and there is no need of special caution in connection with its use. It can be utililized therefore, as easily as mineral oils.

Table I(B)7
SAMPLES

Property	Copra oil			Tarakan pitchless oil##
	Dry distilled*	Pressed-out**	Esterified#	
Color	Dark brown	Orange	Orange	Blue brown
Specific gravity	0.9	0.92	0.97	0.93
Calorific value (kcal/kg)	9200	9200-9300	9250	9670
Cetane no.	54	45	54	32
Flash point (°C)	85	180	42	78.5
Freezing point (°C)	+7	+20	-8	-38.5
Yield (%)	60	60	80	

* Distilled from dry and crushed copra at 500°C. Contains acrolein and has sharp odor.
** Pressed-out oil from copra, has aromatic smell.
\# Pressed-out copra oil treated with Methyl alcohol of same volume, under the catalyst HCl (3%) forming methyl laurate.
Shipped from Tokuyama 3rd Naval Fuel Depot after deasphalting with propane.

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Table II(B)7
TESTING ENGINES*

Name of Engine	Type of Engine	Cylinder Diameter (mm)	Dimension			Compression Ratio
			Stroke(mm)	bhp	RPM	
Okiko	4 cycle air-injection	220	300	25	450	14.5
Niigata	4 cycle solid-injection	100	140	10	1800	16.5
Ikegai	semi-diesel	115	120	2	800	8.0

Testing Engines Used (all single cylinder)

Table III(B)7
RESULTS USING 25 hp AIR-INJECTION DIESEL ENGINE

	Copra oil			Tarakan pitchless oil
	Dry distilled	Pressed-out	Esterified	
Power rate	10/10 (Full)	10/10 (Full)	10/10 (Full)	10/10 (Full)
bhp	25	25	25	25
Fuel consumption (gm/hp/hr)	208	220	210	190

Table IV(B)7
RESULTS USING 10 hp SOLID-INJECTION DIESEL ENGINE

	Copra oil			Tarakan pitchless oil
	Dry distilled	Pressed-out	Esterified	
Power rate	10/10 (Full)	10/10 (Full)	10/10 (Full)	10/10 (Full)
bhp	10	10	10	10
Fuel consumption (gm/hp/hr)	300	300	305	230

Table V(B)7
TABLE OF COMPARISON

	Copra Oil											
	Dry Distilled			Pressed Out			Esterified			Tarakan Pitchless Oil (Reference Oil)		
	A	B	C	A	B	C	A	B	C	A	B	C
Maximum pressure in cylinder	49			48			47			56		
Fuel consumption (gr/hp/hr)	208	295		219	290		210	305		187	220	
Exhaust temperature		233			228			232			265	
Cetane no. (C.F.R.)	54			45			54			32		
Starting	easy			easy			easy			slightly difficult		
Smoke (visual)	very slight			very slight			very slight			almost no smoke (best)		
Corrosion (visual) (fuel pump lamger -steel-)	corrosive (red color)			none			slightly corrosive (red color) (due to HCl remaining)			none		
Carbon deposit (pistonhead & crown)	slight			none			none			none		

Remark. A: Chiko 25 hp air injection diesel engine
B: Niigata 10 hp solid injection diesel engine
C: Ikegai 2 hp semi-diesel engine

Table VI(B)7
PROPERTIES OF FUELS TESTED

Name of Fuel	Treatment	Cetane Value	Viscosity (E-1 cc°C)	Density (15/4°C)	Pour Pt. (°C)	Test Engine	Test Condition
Tarakan pitchless oil*	Deasphaltised with propane	32	37	0.93		Okiko 25 hp air injection	Max. speed 450 rpm Compression ratio 14.5
Distilled copra oil**	Distilled at 300°C from dry and crushed copra	54		0.9		Okiko 25 hp air injection	Max. speed 450 rpm Compression ratio 14.5
Pressed out copra oil#	Compressed out oil from copra	45		0.92		Okiko 25 hp air injection	Max. speed 450 rpm Compression ratio 14.5
Esterified copra oil	Treated the pressed out copra oil with methyl alcohol of same volume under the catalyst, HCl (3%), forming methyl laurate	56		0.97		Okiko 25 hp air injection	Max. speed 450 rpm Compression ratio 14.5
Ebd - Kerosene	250 to 370°C	37.0		0.89		Okiko 25 hp air injection	Max. speed 450 rpm Compression ratio 14.5
Sumatra - Kerosene	165 to 260°C	46	32	0.82			
Kotileman Hills	50% topped residue	47.5	31.8	0.8293	-45		
California	200 to 300	43.3	35	0.8574	-40		
Midway	200 to 350	44.5	39.5	0.8634	-26		
Bahrein	200 to 365	39.0	36.5	0.8193	-28		
Tarakan##	200 to 350	35.0	36.5	0.8806	-30	Okiko 25 hp air injection Diesel Engine Niigata 10 hp Diesel Engine	Max. speed 1800 rpm Compression ratio 16
Eureka	200 to 350	39.7	38.4	0.8665	-17		
Izmail, Japan	200 to 300	34.3	36.8	0.8682	-50		
Tarakan§	200 to	29.5	59.0	0.9401	-30		

*Fuel Composition: 190 gm/hp/hr
Advantage or Disadvantage: (+) smooth running
Practical Use: for submarine

**Fuel Composition: 200 to 210 gm/hp/hr
Advantage or Disadvantage: (+) easy starting
(-) corrosive

#Advantage or Disadvantage: (+) easy starting
(-) slight smoke

##Practical Use: for submarine

§Practical Use: for submarine

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