RESTRICTED

ENCLOSURE (A)

ENCLOSURE (A)

SUMMARY OF DIESEL AND BOILER FUEL RESEARCH AT THE FIRST NAVAL FUEL DEPOT, OFUNA

by

NAVAL ENGINEER
T. ITAKURA, PH.D

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

December 1945

ENCLOSURE (A)

I. INTRODUCTION

Up to 1942, straight run distillates (boiling range 200-340°C and 30-35 cetane rating) of various petroleum crudes (Enc. (B) 3, (B) 5.) from California and Tarakan crudes, had been used in submarine and other diesel engines; chemical studies on diesel fuel had not been attempted to the extent as in the case of aviation gasoline, due to the fact that advanced diesel engines were not required in the Japanese navy.

Since 1942, however, with the progress of submarine engines, it was necessary to use a somewhat higher cetane rating fuel with a high specific gravity for ballasting purposes, (40 cetane and sp. grav. above 0.915 at 15/4°C) and various blending tests (Enc. (B) 3) of high specific gravity fuel with high cetane rating oils, were tried.

Investigation of the manufacture of a high cetane and low pour-point fuel for torpedo boat or aviation diesel engines, was started in 1942. For these purposes, the Edeleanu process (Enc. (B) 1) was applied to various kerosenes, and hydrocracking of vegetable oils (Enc. (B) 2) was also investigated.

With regard to bunker fuel, various attempts (Enc. (B) 12, (B) 13) were made to lower the pour points of waxy topped residues from East Indies and Southern Sumatra crudes.

The next investigations were made to obtain boiler fuel from pine root oil and to prepare heavy oil from shaly coal and lignite which were obtainable throughout Japan, (Enc. (B) 11).

Owing to the shortage of diesel and boiler fuel, various practical engine tests were undertaken to develope substitute diesel or bunker fuels. (Enc. (B) 6, 7, 8, 9, 10, 14).

II. DIESEL OIL

After extensive diesel blending tests of diesel oil, Tarakan heavy oil (sp. grav. 0.94, 15/4°C, cetane value 27-30) and dil. H_2SO_4 treated shale oil from Fushun (sp. grav. 0.82, 15/4°C, cetane value 52, pour pt. 5°C) were chosen for use by the navy in 1943 (Enc. (B) 3, (B) 5) A mixture of Tarakan heavy oil, 70 parts, and treated shale oil, 30 parts, gave a fuel with sp. grav. 0.915 and 38-40 cetane rating, satisfactory for practical use. By treating the shale oil 7 to 8 times with 3-5% H_2SO_4, precipitation or emulsion in the oil mixture during storage was prevented.

On applying the Edeleanu process to Sanga Sanga kerosene in Borneo, a fuel of cetane rating 65-70 and pour-pt. -20 to -30°C, was obtained in 70% yield. (Enc. (B) 1). According to preliminary engine tests, the fuel thus obtained gave peak pressure in the cylinder lower by 10 kg/cm².

The hydrocracking of coconut oil gave 90-95 weight per cent yield of a diesel fuel of 80-100 cetane rating and -20°C pour point. (Enc. (B) 2). Engine tests of ordinary pressed copra oil and esterified copra oil showed that both were suitable for either diesel or semidiesel engines. (Enc. (B) 7). Creosote oil from high temperature carbonization was unsuitable for engine operational periods of long duration due to piston deposits and ring sticking. (Enc. (B) 6, (B) 9).

When soya bean oil was used the running characteristics of the engine were satisfactory. (Enc. (B) 8) Pine root oil was undesirable because the resinous matters gummed the fuel injection system.

ENCLOSURE (A)

All these laboratory developments, however, were not applied in practice, because the advanced diesel engines for torpedo boats and aircrafts were still under design at the end of the war. Details of test equipment used at OFUNA are given in Enc. (B) 9. A description of the method of preparation of α-methyl naphthalene used as a standard fuel, is given in Enc. (B) 10.

III. BOILER FUELS

An investigation of the lowering of heavy oil pour points by thermal cracking, which was conducted on topped residues from SANGA SANGA or PALEMBANG, resulted in actual utilization of Dubbs or Cross Cracking plants for this purpose. By this method, pour-points were lowered to about 15°C from 20-35°C, and the yields of the oil were 60-70% (Enc. (B) 13).

Another investigation related to the mixing of cracked heavy oil, with 1% by weight of Al-stearate to emulsify it. (Refer to Enclosure (B)12.) The addition of Al-stearate gave a 15 to 20 C pour point depression. These cracked heavy oils compounded with the metallic soap, had a pour-point of 0°C and were satisfactory for practical use.

Pine root tar, when distilled in a goose neck retort, gave 50-65% by weight of boiler fuel with specific gravity 1.01 (15/4°C), pour point -15°C, and flash point 85°C. These properties complied with heavy oil specifications of the Japanese Navy.

Shaly oval tar and lignite, which had been manufactured by carbonizing at 300-450°C for 20-30 hours, were distilled in a simple goose neck retort, after dehydration of the tar by holding at a temp. of 80-90°C for 0.5-1.0 hr (Enc. (B)5-(B)11).

The yield of distillate was 50-65% by weight. The oil had a boiling point of 200-340°C, flash point of 75-80°C and pour point of 87°C.

Research on obtaining heavy oil from pine root tar, shaly coal tar and lignite tar was still in progress when the war ended.

Another investigation was made of pitchless briquettes for use as boiler fuel, obtained by mixing caking and anthracite coals (Enc. (B) 15).

Boiler tests showed that copra and copra pressed residue were satisfactory substitutes for coal fuel (Enc. (B) 14).