Engine Performance by Eucalyptus Oil Blended Fuel

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1. Introduction

The engine perfomance tests were conducted for the fuels of various gasoline-eucalyptus oil blend ratio. The objectives of the study was :

1) To find the engine output characterisics for the eucalyptus oil blended fuels.
2) To find the appropriate ignition time for the eucalyptus oil blended fuels.
3) To examine the antiknock quality of the eucalyptus oil blended fuels.

(1) The burning process and the cylinder pressure change

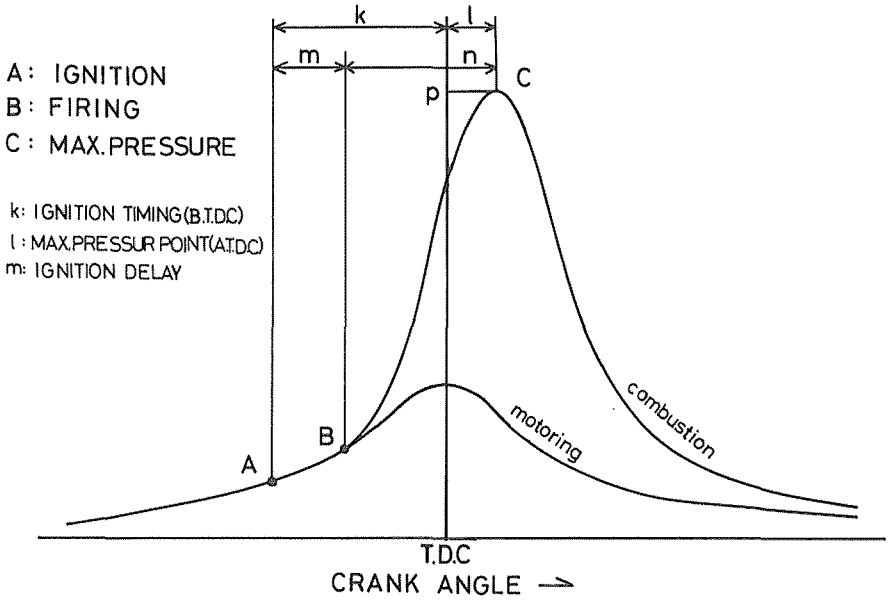

Fig. 1 indicator diagram

Fig.1 shows a typical indicator diagram (P-T diagram). The compressed air-fuel mixture is ignited at point A and fired at point B, then the maximum pressure is reached at point C. At the top dead point (T. D. C.) the displacement of combustion chamber become minimum and thereafter the expansion stroke is begun. The combustion however is not yet completed at the T. D. C. the maximum pressure is obtained at the certain degrees of the crank angle from the T. D. C. Therefore the point C is determined mainly by the piston stroke and the burning velocity of the mixture.

The flame propagation velocity of the eucalyptus oil blended fuels is not well known and left for the future research.

(2) Ignition Timing

As above mentioned the combustion process can be categorized into two, that is

Ignition delay time : The time between the spark and the flame propagation to be started. During this time formation of the core necessary for flame propagation is made.

Main combustion : The flame propagation is actually started and the abrupt pressure rise by combustion is

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caused.

A certain time for the crank angle to proceed is necessary before the maximum pressure at point C is reached. Consequently, the ignition time must be set a certain earlier time. To obtain optimum engine efficiency the point C is set around 12° after T.D.C.(1). The ignition time is also determined by considering flame propagation velocity of the mixture.

The time from point A to B (Fig.1) is assumed to be almost constant regardless engine revolution.

The time from point B to C is considered to be increased with the increase engine revolution. The crank angle (m+n) in Fig.1 is increased in general with the increase of engine revolution.

2. Measuring Instrumentation and Method.

The engine used for the tests was four cycle and air cooled. The rated horse power was 4.5ps/3000rpm. The engine specifications are shown in Table 1. The engine performance was measured by an electrical dynamometer. The cylinder pressure was measured by a pressure pick-up installed on the cylinder head. Pressure -time diagram was obtained on an oscilloscope and taken by a camera (Fig.2)

Table. 1 Specifications of the engine used

Model	Shibaura GE-25A
Kind of fuel	Gasoline
Cooling system	Air cooled
Cycle	4
Number of cylinder	1
Bore×Storke	70×65(m/m)
Capacity	250(c c)
Compressin ratio	6.0
Ignition timing	23°(Before T.D.C)
Rated horse power	4.5ps/3000rpm
Maximum horse power	6.5ps/3800rpm
Maximnm torque	1.33Kgm/2800rpm

Table. 2 Blend fuels used in the test

Blend fuel No.	Gasoline (%)	Eucalyptus oil (%)	Octane number
1	100	0	85.0
2	75	25	88.75
3	50	50	92.5
4	25	75	96.25

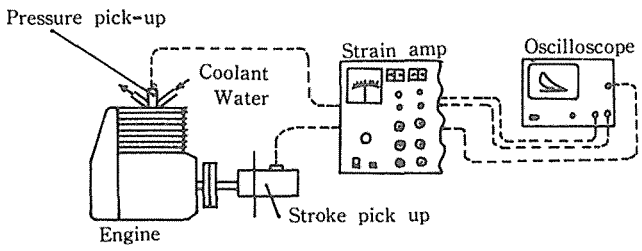

Fig. 2 Indicater diagram recording system

Gasoline with 85 octane number and eucalyptus oil were blended in a different ratios. Four types of blend fuels used in the test are shown in Table 2.

Tests were conducted with the throttle fully open. The engine revolution was changed from 3600rpm to the speed to cause knocking, applying loads by the dynamometer. At the same time pressure -time diagram was recorded on the film by a camera. Ignition time was adjusted to 20°, 23° and 28° before top dead center (B.T.D.C.).

3. Results and discussion

(1) Output Performance

The engine performance curves obtained for the 100% gasoline and the blend fuels of 25%, 50% and 75% eucalyptus oil were shown in Figs. 3, 4, 5 and 6. In each figure three curves were drawn for the ignition time of 20°, 23° and 28° B.T.D.C.

The curves for the torque and the specific fuel consumption were shown together.

The general trend was that for the blend fuels larger output and torque were obtained at the ignition time of 20° B.T.D.C. which was later than the normal ignition time of 20° B.T.D.C. But for the 100% gasoline larger output was obtained at the ignition time of 23° B.T.D.C. in the case of high revolution range. This is understood that the engine was originally set for the gasoline to produce the maximum output under the rated revolution.

It was noted that the blend fuels of higher ratio of eucalyptus oil always gave higher output at the later

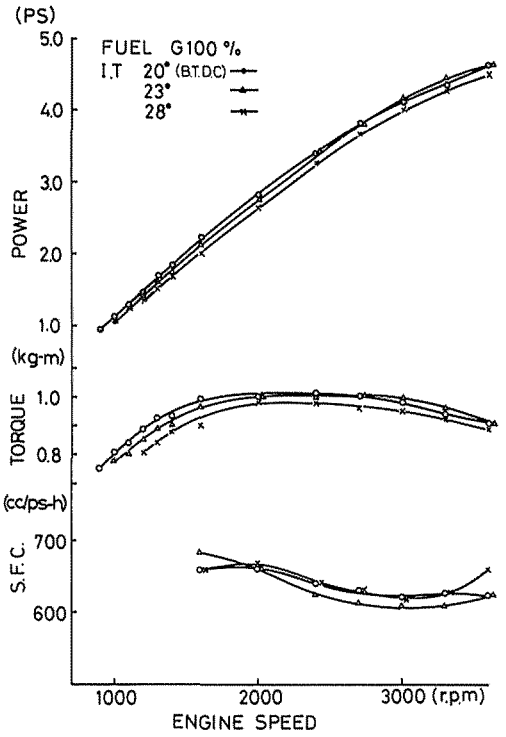

Fig. 3 Engine performance curves for 100 % gasoline

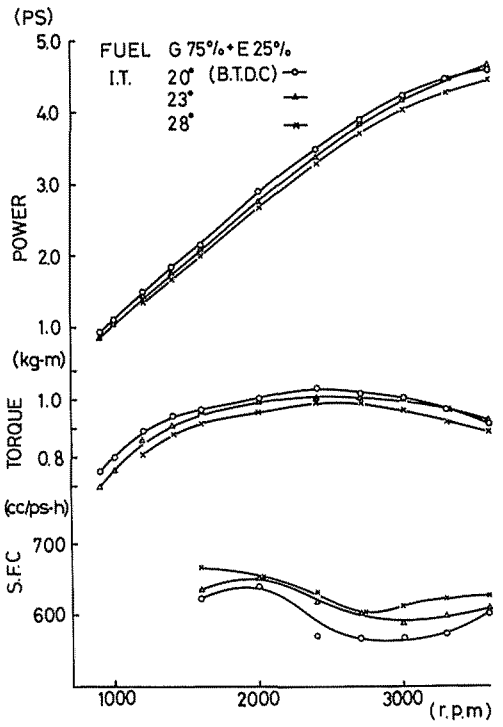

Fig. 4 Engine perfomance curves for 25 % eucalyptus oil blend fuel

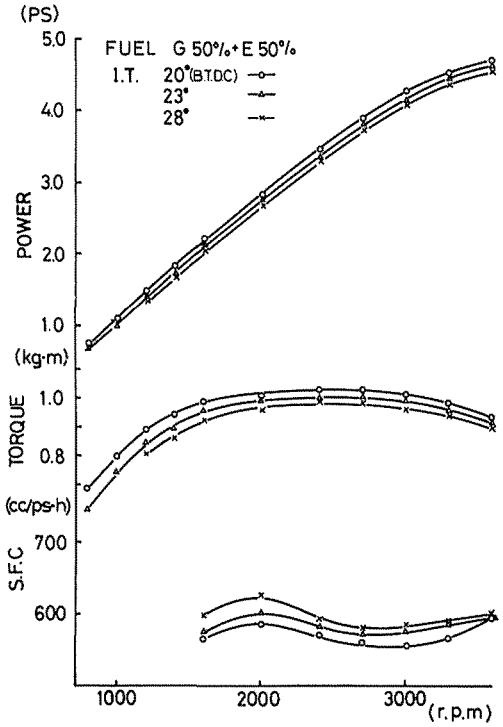

Fig. 5 Engine performance curves for 50 % eucalyptus oil blend fuel

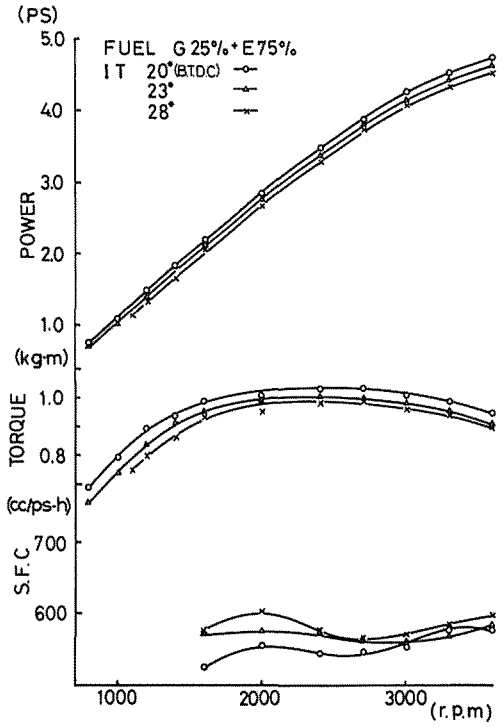

Fig. 6 Engine performance curves for 75 % eucaliptus oil blend fuel

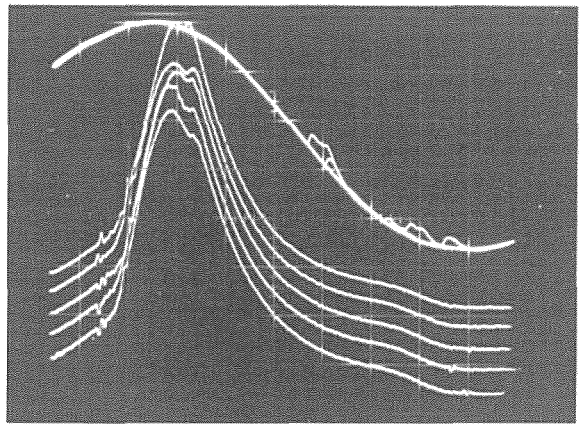

Fig. 7 Pressure-time diagram for 100 % gasoline at 1000 rpm (5 measurements were recorded on one picture)

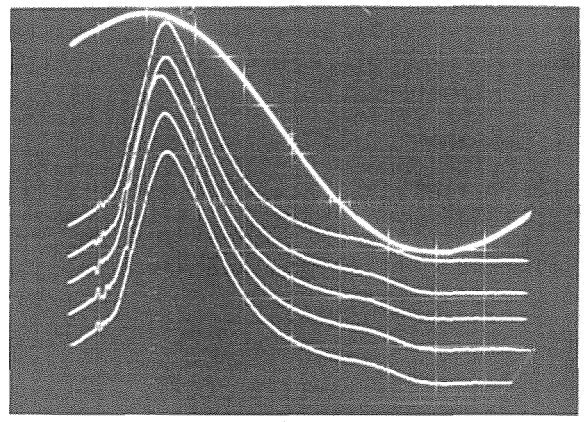

Fig. 8 Pressure-time diagram for 75 % eucalyptus oil blend fuel at 1000 rpm (5 measurements were recorded on one picture)

ignition time of 20° B.T.D.C.

(2) Knocking

The knocking or detonation was usually caused when the engine was operating at low speed with wide-open throttle. The knocking was noticed by an unpleasant, sharp, clicking sound. This was clearly detected on the pressure-time diagram as an irregular curve appeared a little after the maximum pressure was performed in the cylinder. The engine revolution to cause detonation was found to be considerably different depending upon the blend ratio of the eucalyptus oil to gasoline as shown in Figs. 7 and 8. The antiknock quality of the blend fuels was improved with the increase of the eucalyptus oil blend ratio. The knocking which occurred at 1000rpm for 100% gasoline (Fig.7) was not occurred for 75% eucalyptus oil blended fuel (Fig.8). The knocking did not occur until at 700rpm for the 75% eucalyptus oil blended fuels.

4. Conclusions

1. The engine output produced by the eucalyptus oil blended fuels were almost the same with gasoline. No distinct difference was observed on the indicator diagram between the blend fuel and gasoline.

2. For the eucalyptus oil blended fuels better output performance was obtained by retarding the ignition time slightly. This may be due to the increase of flame propagation velocity.
3. The eucalyptus oil blended fuels had better anti-knocking quality due to the higher octane number compared with gasoline.

References

1. HATTA, K. et. al. Handbook of Internal Combustion Engines, 1960 (in Japanese).
2. NAGAO, F. Lecture of Internal Combustion Engines. Yokendo Co., Ltd. 1964 (in Japanese).

摘　　要

ユーカリ油混合燃料によるエンジン性能試験

法貴　誠・竹田策三・伊藤信孝・矢沢啓男

ガソリンとユーカリ油の混合燃料について火花点火機関への応用のための性能試験を実施した。得られた結果を以下に要約する。

1) ユーカリ油の割合を25%，50%および70%とした混合燃料によるエンジン出力はガソリン100%の場合とほとんど変わらなかった。またガソリンと混合燃料との間には指圧線図においても著しい相違は見られなかった。

2) ユーカリ油混合燃料においては点火時期を標準の上死点前23°より少し遅らせ上死点前20°としたときの方が出力特性が良好であった。これはユーカリ油混合燃料の火炎伝播速度がガソリンより大きいためではないかと考えられる。

3) ユーカリ油混合燃料はガソリンよりアンチノック性が良くなることが指圧線図より確認された。すなわちガソリン100%では1000rpmで発生したノックはユーカリ油75%混合の場合には全くなく700rpm で初めてノックが生じた。これはユーカリ油混合燃料のオクタン価が高いことによると考えられる。