Studies of Eucalyptus Oil and Its Application to Spark Ignition Engine (V) : Performance test by use of a blend of Eucalyptus oil and Methanol

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——Performance test by use of a blend of Eucalyptus oil and Methanol——

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1. Preface

The performance of the spark ignition engine was tested using the blended fuel of eucalyptus oil and methanol from the view point of alternative fuel for fossil fuels. It is already wellknown that eucalyptus oil and ethanol can be used as the alternative fuel for the internal combustion engine. The following were measured and analyzed in the experiments: out put horsepower, crank shaft torque, specific fuel consumption and exhaust gas. Tab. 1 shows the physical and chemical properties of fuels. Tab. 2 shows the lower calorific value, theoretical air fuel ratio and the specific gravity of the blended fuels.

2. Testing Method

Two stroke cycle air cooled engine was used in this experiment. (Tab. 3) Fig. 1 shows the diagram of the experimental apparatus. Test was conducted by the measurement of the engine performance, specific fuel consumption rate, emission gas analysis and so on.

Tab. 1. Physical and Chemical Properties of Fuels.

	Gasoline	Eucalyptus Oil	Ethanol	Methanol
Molecular Formula	—	$C_{10}H_{18}O$	C_2H_5OH	CH_3OH
Molecular Weight	—	154	46	32
Specific Gravity	0.731	0.918	0.789	0.791
Octane Number	85	100.1～100.2	106	106
Flash Point (°C)	Less than-40	54	14	16
Low Calorific Value (kcal/kg)	10500	9500	6400	4900
Theoretical Air Fuel (Ratio (kg/kg)	14～15	12.5	9.0	6.4
Calorific Value of Theoretical Mixture (kcal/kg)	677	704	640	662
Evaporative Latent Heat (kcal/kg)	70～85	—	180	290

Received October 30, 1982

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Tab. 2. Low Calorific Value, Theoreitcal Air Fuel Ratio, Specific Gravity of Blencled Fuel.

Fuel	Low Calorific Value (kcal/kg)	Theoretical Air Fuel Ratio (kg/kg)	Specific Gravity (15/4°C)
Gasoline	10500	14.5	0.731
Methanol	6400	6.4	0.791
Eucalyptus Oil	9500	12.5	0.918
E. 90% M. 10%	9100	12.4	0.905
E. 80% M. 20%	8700	12.2	0.893
E. 70% M. 30%	8100	12.0	0.880
E. 60% M. 40%	7800	11.8	0.867
E. 50% M. 50%	7400	11.6	0.855

Tab. 3. Tested Engine.

TEA0660 (SHIBAURA)

Type	Gasoline Engine of Air Cooled and 2 Stroke Cycle Type
Number of Cylinder	1
Bore × Stroke	45 × 38 (mm)
Total Displacement	60 (cc)
Continuous Rated Horsepower	1.8/1.660 (ps/r.p.m.)
Maximum Horsepower	2.8/2.000 (ps/r.p.m.)
Maximum Torque	0.4/1.330 (kg·m/r.p.m.)
Compression Ratio	6.5
Ignition Plug	B-6HS (NGK)
Reduction Gear Ratio	1/3
Standard Main Jet Nozzle Diameter	0.650 (mm)
Lublicating System	Mixed Lublication (Mixture Ratio 25: 1)

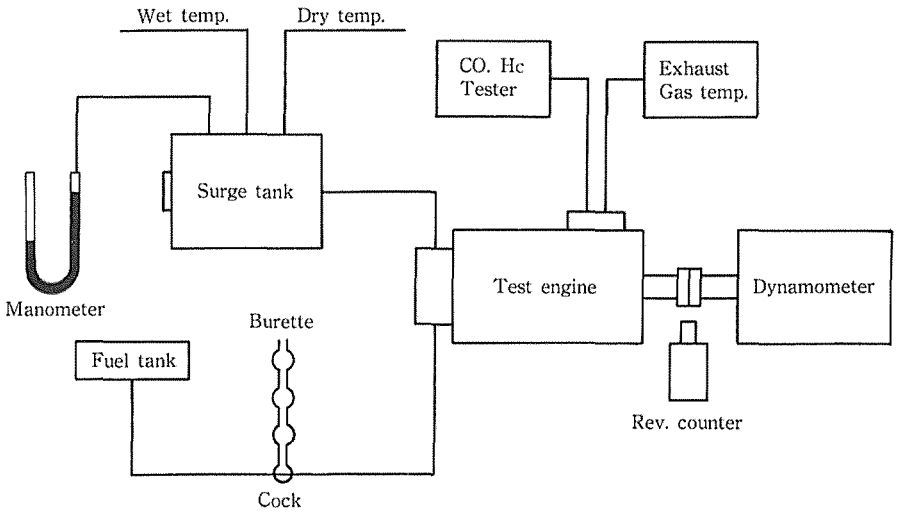

Fig. 1. Diagram of Experimental apparatas.

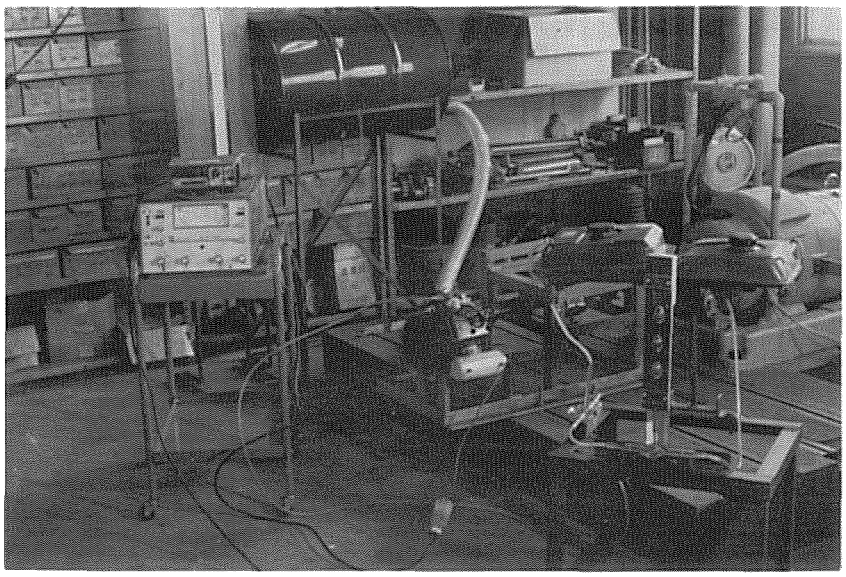

Photo. 1. Whole view of the engine test.

3. Test Results

In this experiments the following kinds of fuels were tested; eucalyptus oil, 30% of methanol blended in eucalyptus oil, and 50% of methanol blended in eucalyptus oil. In case of using the 0.05 m/m over size main jet nozzle was used, the engine performance and specific fuel consumption rate showed almost nearly equal to the case of using the gasoline (Fig. 2).

For use of the eucalyptus oil, the volume of hydrocarbon involved in the emission gas was about 1800 ppm, and also about 3000 ppm of unburned hydrocarbon was recognized for 50% of methanol blended fuel in eucalyptus oil (Fig. 3).

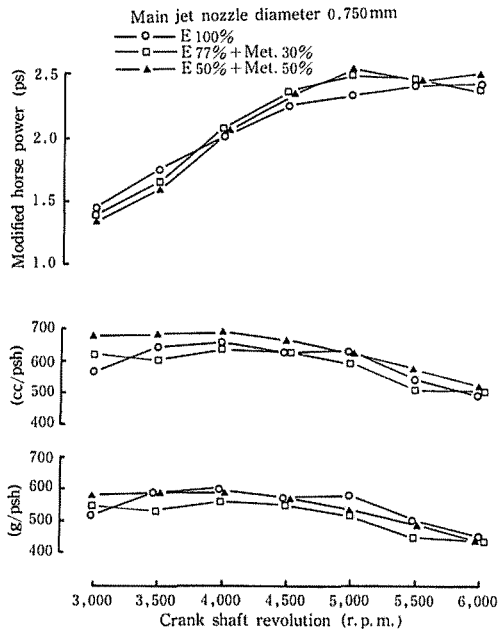

Fig. 2. Engine performance.

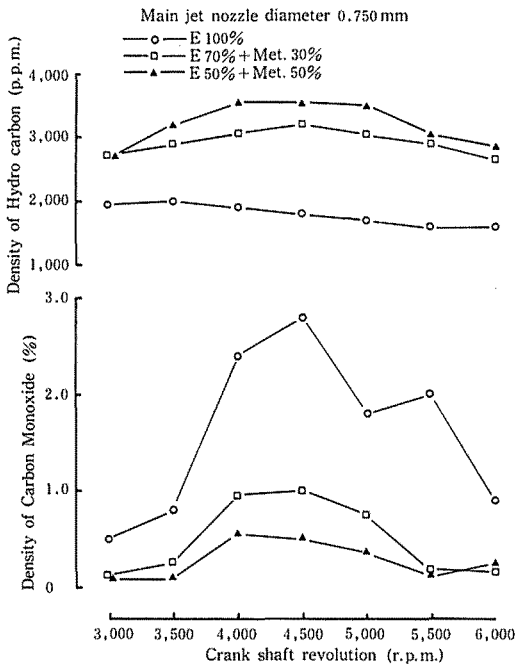

Fig. 3. Amalysis of Exhaust Gas.

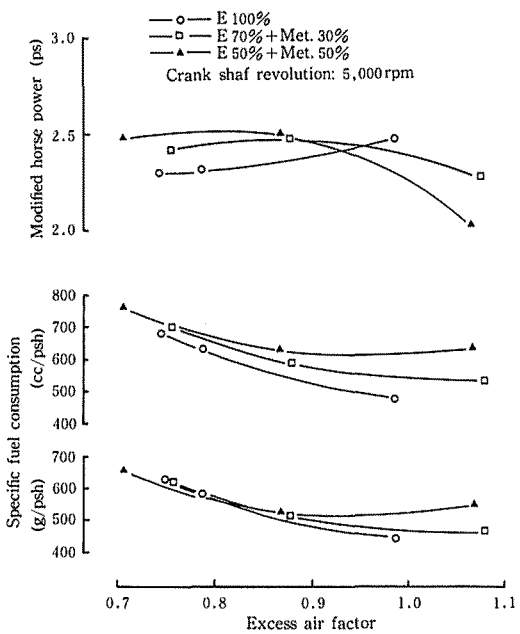

Fig. 4. Engine performance.

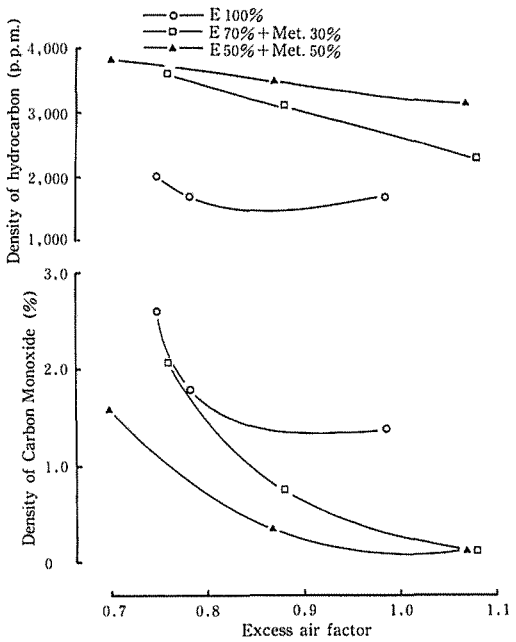

Fig. 5. Analysis of Exhaust Gas.

The content of carbon monoxide was less than 0.5% in case of using 50% methanol blended fuel in eucalyptus oil. Above phenomenon was recognized at every revolutional speed in the engine tested. However in case of using the blended fuel with eucalyptus oil more than 70 to 100% the carbon monoxide was increased almost 2 to 5 times as shown in Fig. 3.

When air fuel ratio was 0.9, the engine performance showed the maximum out put horse power. The minimum value of the fuel consumption rate was obtained in the range of air fuel ratio between 1.0 and 1.1 (Fig. 4).

Hydrocarbon and carbon monoxide in emission gas showed the lowest value when the air fuel ratio was 1.1 and 1.2 (Fig. 5).

Tab. 4 shows relationship between the kinds of fuels and the size of main jet nozzle. The size of the nozzle shown of the larger in proportion to the blend ratio of methanol, It was due to viscosity of the fuels.

Tab. 4. Relationship between fuel and nozzle.

fuel	nozzle diameter
G100	0.650 m/m
E100	0.700
E80+M20	0.700
E60+M40	0.750
E50+M50	0.800

G: Gasoline E: Eucalyptus oil M: Methanol

Conclusion

From the above test results, it can be concluded as follows.

a) At the blending ratio of 50% methanol test was obtained in this experiment.

b) Methanol blended fuels would reduce the carbon monoxide contents in emission gas.

References

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要　　約

ユーカリ油の火花点火機関への応用（第5報）

——2サイクル機関における，ユーカリ油メタノール混合燃料の実験例——

竹田策三・村居完治

第4報において，ユーカリ油，エタノール混合燃料が，2サイクル機関用として優れた性質を備えていることが実証された。第5報では，ユーカリ油，メタノール混合燃料の実験を行なった。使用機関には，空冷単気筒2サイクル農用機関を用いた。ユーカリ油にメタノールを30%，および50%混入したとき，機関出力，燃料消費率は，ガソリンの場合とほぼ同等であった。排気中の未燃焼炭化水素分はユーカリ油100%で約2000 p.p.m であるが，メタノールが混入量の30%のとき約3000 p.p.m, 50%で3500 p.p.m（何れも機関回転数4000～5000 rpm）と増加した。また排気中一酸化炭素分は，メタノール混合により減少した。

機関出力は，ユーカリ油100%，ユーカリ油70%＋メタノール30%，ユーカリ油50%＋メタノール50%，何れの燃料の場合も，空燃比0.9で最高値を示し，燃料消費率は，空燃費1.0～1.1附近で最小であった。出力・燃費率ともメタノールは，エタノールにくらべ発熱量が低いにもかかわらず，ほとんど同じ値を示した。また特筆すべきは，排気の清浄性で，機関定格回転数5000 rpm における HC（未燃焼炭化水素）濃度が，ガソリンの場合約5000 p.p.m に対し，ユーカリ油，メタノール混合燃料では1500～3000 ppm と非常に少なくなった。以上を綜合し，ユーカリ油メタノールの混合燃料は，ユーカリ油，エタノール混合燃料と同様にガソリンの代替として実用化できる。