Department of Mechanical Engineering	Key words	Heat engines, environmental load reduction technology, energy utilization, combustion

Doctor of Engineering / Professor

Haruyoshi Ida

Education

Graduate School of Engineering, Fukui University of Technology (Doctoral Program Credits Completed)

Professional Background

Associate professor at Fukui University of Technology

Consultations, Lectures, and Collaborative Research Themes

Technical consultations concerning performance tests and exhaust gas measurements of small diesel engines. Lectures on engine performance and the mechanics of automobiles.

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Main research themes and their characteristics

「Exhaust gas reduction in diesel engines using bio fuel」

The combustion process and fuel used in diesel engines influence the generation of toxic substances such as PM (particulate matter) and NOx (nitrogen oxides). BDF (bio diesel fuel), which has recently drawn attention as an alternative fuel containing a lot of oxygen, promotes diesel engine combustion, thus promising improvements in thermal efficiency. However, minute atomization is not formed easily with BDF because of its high kinematic viscosity, so that PM emission tends to increase compared to the use of gas oil (Tab.1).

This study examines the relations between exhaust gas characteristics and combustion characteristics in performance tests of a small diesel engine (Tab.2) with a common rail fuel injection system, which changes fuel injection pressure by using gas oil and BDF. Results clarified that thermal efficiency improved when BDF was injected at high pressure (Fig.1). Furthermore, previous research has found that using fuel with a mix of gas oil and BDF improves the exhaust gas characteristics of diesel engines, compared to using BDF alone.

Elsewhere, EGR is widely used to reduce the NOx concentration in diesel engines, but it tends to increase PM emissions.

Therefore, the purpose of this study is to grasp the effects of mixed gas oil and BDF fuel on the exhaust gas characteristics of diesel engines with EGR. To this end, engine performance testing using mixed gas oil and BDF fuels with different oxygen content ratios was performed. The results showed that excellent exhaust gas characteristics can be obtained by using BDF appropriately mixed with gas oil when the EGR rate is increased within the range where normal operation can be maintained (Fig.2, Fig.3).

Tab.1 Properties of gas oil and BDF used as experimental fuel

Fuel	Gas oil	BDF
Specific gravity	0.82	0.88
Kinematic viscosity (303K) [m²/s]	3.95×10^{-6}	6.52×10^{-6}
Ignition point [K]	507	522
Oxygen content [wt%]	0.10	10.7
Gross calorific value [kJ/kg]	45.6×10^{3}	39.5×10^{3}

Tab.2 Specifications of diesel engine used in performance testing

Engine type	Horizontal, water cooled, 4 stroke
Combustion chamber	Direct injection (troydal type)
Cylinder ／ Bore and stroke [mm]	Single ／ 102 × 105
Displacement [cm³]	857
Maximum power [kW] {PS} ／ Engine speed [min⁻¹]	12.5 {17.0} ／ 2400
Compression ratio	17.8
Air charging	Naturally aspirated

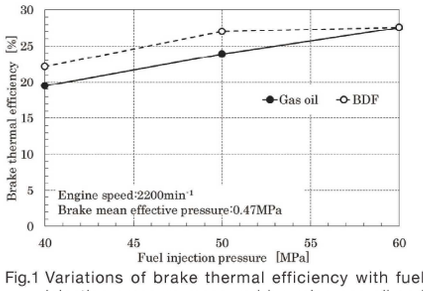

Fig.1 Variations of brake thermal efficiency with fuel injection pressure measured by using gas oil and BDF at brake mean effective pressure 0.47MPa

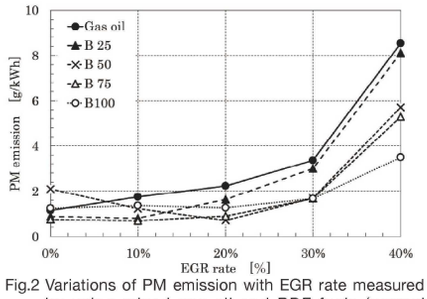

Fig.2 Variations of PM emission with EGR rate measured by using mixed gas oil and BDF fuels (normal operating range within EGR rate 30%)

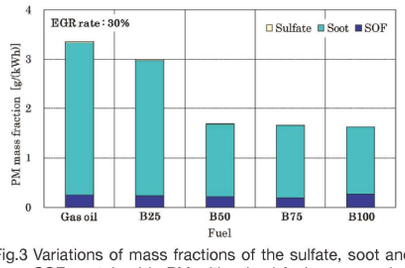

Fig.3 Variations of mass fractions of the sulfate, soot and SOF contained in PM with mixed fuels measured at EGR rate 30%

Major academic publications

H.Ida, and K.Khiriwan, “Effects of Mixed Gas Oil and BDF Fuel on Exhaust Gas Characteristics of Diesel Engines with EGR”, MEMOIRS OF FUKUI UNIVERSITY OF TECHNOLOGY, No.49(2019), pp.27-32.