

Effect of Biofuels on Soot emission Focusing on Hydrogen Content

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Diesel engines are widely used in various applications, including commercial and passenger vehicles, due to their high thermal efficiency and good fuel economy. However, diesel engine exhaust gas contains particulate matter (PM), and soot, one of the major components of PM, is a concern because of its adverse effects on human health and air pollution. Therefore, increasingly stringent emission regulations, including Euro 7, require further improvements in diesel engine exhaust performance.

In recent years, alternative fuels for diesel engines have attracted attention as a means of reducing environmental impact. Among these fuels, hydrotreated vegetable oil (HVO) is a biofuel produced from feedstocks such as vegetable oils and waste cooking oils through hydrogenation. Compared with JIS No. 2 diesel fuel (hereinafter referred to as JIS2), HVO contains fewer aromatic components and has a higher hydrogen content. A higher hydrogen content is expected to contribute to soot reduction by promoting the oxidation of carbon during combustion.

Therefore, this study investigated the effect of fuel hydrogen content on soot emissions. Three fuels with different hydrogen contents, JIS2, HVO50, and HVO (hereinafter referred to as HVO100), were used to systematically vary the hydrogen content. HVO50 was prepared by mixing JIS2 and HVO100 at a volume ratio of 1:1. Combustion tests were conducted using a single-cylinder diesel engine. To isolate the effect of hydrogen content, the oxygen input and energy input to the engine were maintained constant, and the relationship between fuel hydrogen content and soot emissions was evaluated based on measured exhaust gas emissions.

Combustion tests were conducted at an engine speed of 1,500 rpm. The oxygen input was maintained at 1.71 g/s, and the energy input was adjusted to be equivalent for each fuel according to its lower heating value.

The following result from the experiments.

1. Combustion tests were conducted using JIS2, HVO50, and HVO100 to vary the hydrogen content of the fuel.
2. The relationship between fuel hydrogen content and Smoke emissions was evaluated under conditions of constant oxygen input and energy input.
3. NO_x emissions were approximately equivalent regardless of the fuel type, whereas Smoke emissions decreased with increasing hydrogen content. Compared with JIS2, Smoke emissions were reduced by 39.7% with HVO50 and by 50.9% with HVO100.

These results confirmed that increasing the hydrogen content of the fuel contributes to the reduction of Smoke emissions under conditions of constant oxygen input and energy input.

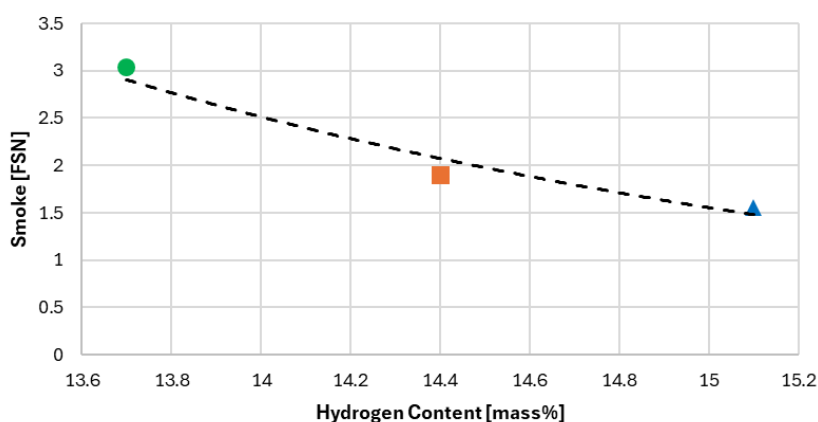


Fig.1 Smoke emissions