

The effect of HVO ratio for ignition timing

Ryosei Takeda ¹⁾ Ryoma Ohnishi ¹⁾ Takafumi Kato ¹⁾

Kensei Kurita ¹⁾ Kanta Kasugai ¹⁾ Yoshiaki Nishijima ¹⁾

*1) GRADUATE SCHOOL OF AICHI INSTITUTE OF TECHNOLOGY
1247 Yachigusa, Yakusacho, Toyotashi, Aichi 470-0392, Japan*

KEY WORDS: Heat engine, Compression ignition engine, combustion analysis, Hydrotreated Vegetable Oil (A1)

The use of biodiesel fuel (BDF) has attracted considerable attention as a means of improving the exhaust emissions performance of diesel engines. Among these fuels, hydrotreated vegetable oil (HVO) is a bio-derived diesel fuel produced by hydrotreating vegetable oils through a process similar to that used in petroleum refining. Compared with JIS No. 2 diesel fuel, HVO contains almost no aromatic compounds and consists mainly of paraffinic hydrocarbons. Therefore, HVO, which has a low aromatic content and a high hydrogen-to-carbon ratio (H/C ratio), is expected to suppress smoke emissions by promoting carbon oxidation during combustion.

Fuel injected into the combustion chamber mixes with air and subsequently undergoes pyrolysis and oxidation reactions as the temperature increases, eventually leading to ignition. During this process, OH radicals are considered to be generated through reactions between hydrogen produced by fuel pyrolysis and oxygen, and their chemiluminescence is closely associated with the ignition process. Since HVO has a higher H/C ratio than JIS No. 2 diesel fuel, OH radical formation may occur earlier, potentially affecting the ignition start timing.

In this study, combustion experiments were conducted using JIS No. 2 diesel fuel and HVO under identical fuel injection pressure, input energy, and combustion chamber conditions. A Rapid Compression Machine (RCM) was used, and OH radical chemiluminescence during combustion was observed using a high-speed camera. The time at which OH radical emission was first detected was defined as the ignition start timing. In addition, blended fuels of JIS No. 2 diesel fuel and HVO were tested to investigate the effect of the HVO blending ratio on the ignition start timing. The objective of this study was to clarify the relationship between the earlier formation of OH radicals and the potential improvement in exhaust emissions performance associated with the use of HVO.

The test fuels were JIS No. 2 diesel fuel without HVO100 (HVO) blending and HVO100. In addition, two blended fuels, HVO25 and HVO50, were prepared by mixing JIS No. 2 diesel fuel with HVO100. The mixing ratios of JIS No. 2 diesel fuel to HVO100 were 3:1 for HVO25 and 1:1 for HVO50, respectively.

The following results were obtained:

1. The ignition start timing of HVO was earlier than that of JIS No. 2 diesel fuel.
2. The ignition start timing became earlier as the HVO blending ratio increased.
3. The ignition start timing of HVO50 was close to that of HVO100, whereas that of HVO25 was between those of JIS No. 2 diesel fuel and HVO100.
4. The ignition start timing became earlier with increasing fuel injection pressure.

These results confirmed that the use of HVO advances the ignition start timing compared with JIS No. 2 diesel fuel. Furthermore, the ignition start timing tended to become earlier as the HVO blending ratio increased. These results suggest that HVO affects the chemical reaction characteristics during the early stage of combustion and may contribute to improvements in combustion characteristics and exhaust emissions performance, including smoke reduction, in diesel engines.

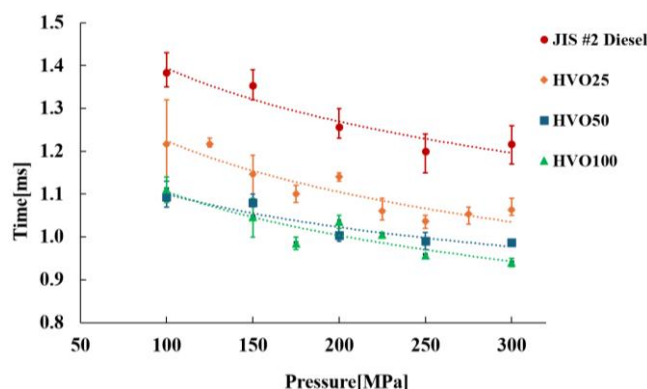


Fig.1 Comparison of ignition timing on OH radical