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Effects of Fuel Components on Lean and EGR Diluted Combustion in Gasoline Engine

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To correspond with CO_2 reduction from automobile, in conjunction with electrification, improving thermal efficiency of ICE is crucial and lean and EGR diluted combustion are being studied. It is important for improving thermal efficiency to enhance combustion in lean and EGR diluted condition and it is known that the effects of fuel components are significant. The purpose of this study is to evaluate CO_2 reduction potential and effects of fuel base manufactured in the refinery on EGR diluted combustion, and to clarify the factors.

In this study the effects of fuel components on the lean & EGR diluted combustion were examined with inline 4-cylinder engine and Fuel1~3 as test fuels. Fuel1 was produced from light fuel base which is mainly composed of C5 and C6 hydrocarbons, and able to be manufactured in the current refinery processes. For further improvement of combustion speed and Octane number, Fuel2 includes 10vol.% ethanol and Fuel3 includes 20vol.% ethanol with Fuel1. As reference fuels, five-component surrogate fuels, named S5R and S5H which simulate Japanese commercial regular fuel and high-octane fuel were used.

Figure 1 shows maximum thermal efficiency in lean condition, and Figure 2 shows CO_2 emission at maximum thermal efficiency. Maximum thermal efficiency of Fuel1~3 are improved more than the line through points of S5R and S5H. Fuel1, Fuel2 and Fuel3 reduced CO_2 emissions by 7.8%, 9.2%, 10.1% compared to S5R, respectively. This reduction of CO_2 emissions comes from improving maximum thermal efficiency and low carbon content of test fuels. As shown in Figure 3, lean limit of Fuel1 and Fuel3 are expanded compared to S5R and S5H, and EGR limit of them are also expanded. Therefore fuels that have an effect to enhance lean combustion are expected to enhance EGR diluted combustion as well.

It was clarified that test fuels produced from light fuel base have the potetial of reducing CO_2, and enhancing EGR diluted combustion as well as lean combustion. The knowledge obtained in this research is expected to make a contribution to reduce CO_2 emission of future ICE.

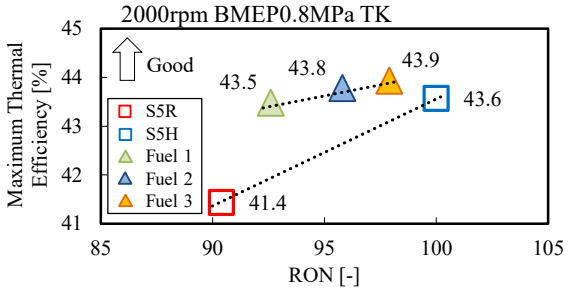

Figure 1 Maximum Thermal Efficiency in Lean Condition.

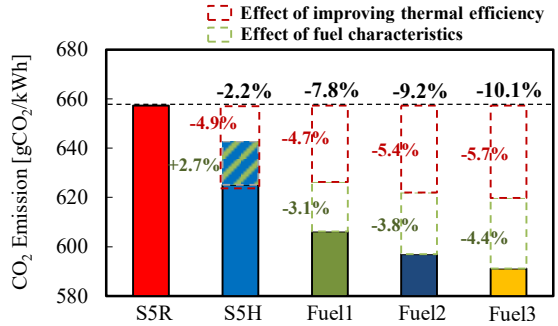

Figure 2 CO_2 Emission at Maximum Thermal Efficiency.

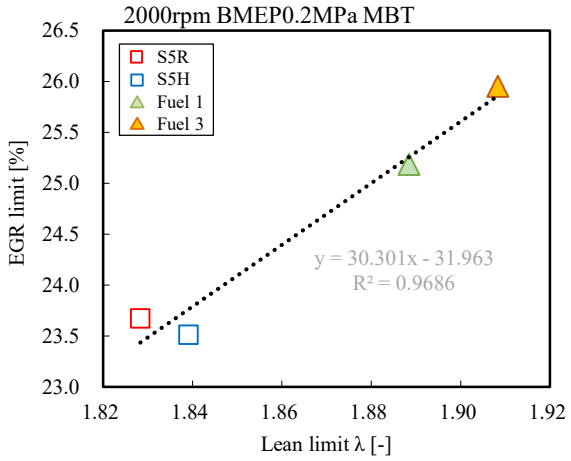

Figure 3 Relationship between Lean limit λ and EGR limit.