Impact of B7 diesel, GTL, and GTLB30 on the emissions and efficiencies of compression ignition engines

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Confidential Report - Public summary

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Public Summary

Global temperatures are increasing at an alarming rate due to global warming. One of the causes for global warming is the emissions by the transportation sector. Around 14% of emissions globally occur from the transportation sector every year. Legislation is in place to combat increasing global temperatures and pollution levels. Despite these efforts, the world is still reliant on fossil fuels for most of its power generation. As a means to stop our reliance on fossil fuels, a global push towards electrification in the transportation is in effect. However, the current battery technologies are sufficient only for the passenger automobile sector. The current-gen battery powered trucks do not have enough range for long-range operations. Furthermore, the availability of rare earth metals to develop batteries is sparse and the costs involved in this process are high. Therefore, research into alternate fuels as means of clean power source for heavy-transportation sector can help reduce emissions and global temperatures.

This project aims to research and analyze alternate fuels such as Shell gas-to-liquids and benchmark these with diesel based on combustion and emission properties. The testing was done on a DAF PACCAR MX-13 engine. A test matrix was devised based on the test matrices provided by Shell and DAF to understand the effects of speed, load, EGR, and intake temperature on the fuels' performance.

The efficiency analysis shows that the engine achieves higher efficiencies on both GTL and GTLB30 fuels when compared to diesel. At most of the high speed and load points, the combustion, thermal and gross indicated efficiency of GTL and GTLB30 fuels were higher than diesel. EGR variations had significant impact on the efficiency of the engine. At high EGR rates, the engine was found to be the least efficient. At high loads and speeds however, the engine achieved higher efficiencies at the temperature sweep points. Similarly, EGR rates had significant impact on the emissions of the three fuels. All the three fuels saw a spike in THC, NO_x, and CO emissions at high EGR rates. On the contrary, soot emissions were reduced at higher EGR rates. Furthermore, similar to efficiencies, GTL and GTLB30 proved to be better at higher speeds and loads as their emissions were lower when compared to diesel. Some injection strategies were also planned as part of this study, however, due to issues with the fuel injector, this was not possible. Based on the test results, recommendations were also made for future research in this topic.