
An Investigation of the Effects of Injection Strategies of DME-Propane, EGR and Boosting on Dual Fuel HCCI Engine for Extending Operating Ranges

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This study has been investigated the potential extension of operating range of homogeneous charge compression ignition (HCCI) engine utilizing dual fuel di-methyl ether (DME) and propane over exhaust gas recirculation (EGR) and boosting. The experiments were conducted in a single-cylinder diesel engine (498cc displacement) with a compression ratio of 19.5. DME was injected directly in the cylinder while propane was injected in intake port and their injection timing strategies were studied to clarify the optimal performance with higher power and lower emissions. A numerical analysis was conducted through the detailed chemical kinetics using CHEMKIN-PRO for newly developed mixing model of DME/propane to clarify the underlying mechanism of autoignition, while considering the gas mixture heat loss to the cylinder wall to compare with the experiment. It was resulted that increasing amount of propane retards the combustion phasing by the means of reducing low temperature heat release which suppresses autoignition reactivity. Numerical results were agreed with experiment that the weakened low temperature oxidation by the increase of propane amount. Advancing the injection timings of DME and propane were shown the higher engine output from homogeneous mixtures. Consequently, maximum pressure rise rate was tended to increase. Also, NO_x emissions were raised from increased in-cylinder pressure and temperature. Therefore, EGR and boosting were utilized to reduce NO_x emissions while obtaining the same power output. In finally, it was considered from the engine output power and emissions that DME/propane dual fuel has the potential to extend the operating range of HCCI engines.