عنوان مقاله:

Modification of piston bowl geometry and injection strategy, and investigation of EGR composition for a DME-burning direct injection engine

محل انتشار:

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خلاصه مقاله:

The amount of pollutant gases in the atmosphere has reached a critical state due to an increase in industrial development and the rapid growth of automobile industries that use fossil fuels. The combustion of fossil fuels produces harmful gases such as carbon dioxide, nitrogen monoxide (NO), soot, particulate matter (PM), etc. The use of Dimethyl Ether (DME) biofuel in diesel engines or other combustion processes have been highly regarded by researchers. Studies show that the use of pure DME in automotive engines will be possible in the near future. The present work evaluated the environmental and performance effects of changing the injection strategy (time and temperature), piston bowl geometry, and exhaust gas recirculation (EGR) composition for a DME-burning engine. The modification of piston bowl parameters and engine simulation were numerically performed by using AVL fire CFD code. For model validation, the calculated mean pressure and rate of heat released (RHR) were compared to the experimental data and the results showed a good agreement (under a 70% load and 1200-rpm engine speed). It was found that retarding injection timing (reduction in in-cylinder temperature, consequently) caused a reduction in NO emissions and increased soot formation, reciprocally; this occurred because of a reduction in temperature and a lower soot oxidation in the combustion chamber. It became clear that 3 deg before top dead center (BTDC) was the appropriate injection timing for the DME-burning heavy duty diesel engine running under 1200 rpm. Also, the parametrical modification of the piston bowl geometry and the simultaneous decrease of Tm (piston bowl depth) and R3 (bowl inner radius) lengths were associated with lower exhaust NO emissions. For the perfect utilization of DME fuel in an HD diesel engine, the suggested proper lengths of Tm and R3 were 0.008 and 0.0079 m, respectively. Furthermore, various EGR compositions for the reduction of exhaust NO were investigated. The simulation results showed that a 0.2 EGR composition led to a reduction in the exhaust NO by 37%

کلمات کلیدی:

Piston bowl geometry، Injection strategy، HD diesel engine، EGR، DME fuel