ABSTRACT

Biodiesel is regarded as a feasible substitute in areas where conventional diesel fuel is not easily accessible. To enhance the efficiency of the diesel engine under these conditions, the combustion components were coated with a layer of partly stabilized zirconia using plasma coating technology. The coating had a thickness of 500 µm. This project focuses on enhancing the efficiency and minimizing the NOx emissions of a direct injection (DI) diesel engine that runs on a blend of biodiesel and diesel. To achieve this objective, a standard direct injection (DI) diesel engine is operated in a low heat rejection (LHR) mode, which restricts heat dissipation in order to enhance the engine's thermal efficiency. The biodiesel-diesel blend analyzed in this research is JME20, including 20% Jatropha methyl ester (JME) and 80% diesel, measured by volume. At first, the engine is operated using diesel and JME20 in order to collect first data for comparison. The PSZ coated piston-fitted engine, when compared to the uncoated piston-fitted engine running on JME20, exhibits a 1.8% increase in peak cylinder pressure and a 2.2% increase in heat release rate. The Brake Thermal Efficiency (BTE) had an almost 7% increase, while the Brake Specific Fuel Consumption (BSFC) reduced by 5.3% during the full load operation of the LHR engine using JME20 fuel. The JME20-fueled LHR engine experiences a reduction of approximately 11.5% in HC emissions, 7.2% in CO emissions, and 4.7% in smoke opacity when operating at full load. The emission of nitric oxide (NO) is enhanced by 11.2% at full load conditions for the low heat rejection (LHR) diesel engine when fueled with JME20. The analysis of the experimental findings indicates that the engine performance of the LHR diesel engine is enhanced, leading to a reduction in emissions of HC, CO, and smoke. However, there is an increase in NO emission due to the elevated cylinder temperature and the presence of oxygen in the test fuel (JME20).