An experimental evaluation of TiO_2 nanoadditive for HCCI engines running on ABE fuel

Abstract

There is a demand for improved combustion processes to enhance engine efficiency and reduce pollutant emissions. Homogenous charge compression ignition (HCCI) engine is a combustion mode characterized by a lean burn, which results in excellent thermal efficiency and low NOx and soot emissions compared to diesel engines. However, it has limitations, such as misfiring and knocking at low and high load conditions. For this reason, adding titanium oxide (TiO2) nanoparticle additive could enhance the combustion characteristics and expand the operational capacity of HCCI engines. The mixed fuels formed with %40 Acetone-butanol-ethanol (ABE) and %60 n-heptane as a reference fuel, and the TiO2 nanoparticles additives at concentrations of 50, 100, and 150 ppm were used. The findings show that using TiO2 nanoparticle additives in HCCI combustion significantly controls the combustion phase and reduces HC and CO emissions, surpassing the reductions achieved with the reference fuel. The optimal operating range was obtained with ABE40 + 150 TiO2. Furthermore, the indicated mean effective pressure, in-cylinder pressure, heat release rate, maximum pressure rise rate, and indicated thermal efficiency all increased with TiO2. Meanwhile, the start of combustion and the CA50 location were shifted to earlier crank angles, while the combustion duration was reduced.

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