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Experimental Investigation of Hydrogen Addition in the Intake Air of Compressed Engines Running on Biodiesel Blend

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Abstract : This study investigates experimentally the effects of hydrogen addition in the intake manifold of a diesel generator operating with a 7% biodiesel-diesel oil blend (B7). An experimental apparatus setup was used to conduct performance and emissions tests in a single cylinder, air cooled diesel engine. This setup consisted of a generator set connected to a wirewound resistor load bank that was used to vary engine load. In addition, a flowmeter was used to determine hydrogen volumetric flowrate and a digital anemometer coupled with an air box to measure air flowrate. Furthermore, a digital precision electronic scale was used to measure engine fuel consumption and a gas analyzer was used to determine exhaust gas composition and exhaust gas temperature. A thermopar was installed near the exhaust collection to measure cylinder temperature. In-cylinder pressure was measured using an AVL Indumicro data acquisition system with a piezoelectric pressure sensor. An AVL optical encoder was installed in the crankshaft and synchronized with in-cylinder pressure in real time. The experimental procedure consisted of injecting hydrogen into the engine intake manifold at different mass concentrations of 2,6,8 and 10% of total fuel mass (B7 + hydrogen), which represented energy fractions of 5,15, 20 and 24% of total fuel energy respectively. Due to hydrogen addition, the total amount of fuel energy introduced increased and the generators fuel injection governor prevented any increases of engine speed. Several conclusions can be stated from the test results. A reduction in specific fuel consumption as a function of hydrogen concentration increase was noted. Likewise, carbon dioxide emissions (CO2), carbon monoxide (CO) and unburned hydrocarbons (HC) decreased as hydrogen concentration increased. On the other hand, nitrogen oxides emissions (NOx) increased due to average temperatures inside the cylinder being higher. There was also an increase in peak cylinder pressure and heat release rate inside the cylinder, since the fuel ignition delay was smaller due to hydrogen content increase. All this indicates that hydrogen promotes faster combustion and higher heat release rates and can be an important additive to all kind of fuels used in diesel generators.

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