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ANALYSIS OF COMBUSTION AND NO_X FORMATION IN A SPARK IGNITION (SI) ENGINE FUELED WITH HYDROGEN-HYDROGEN OXYGEN (HHO) ENRICHED BIOGAS

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Abstract

A numerical simulation was conducted to investigate the combustion characteristics and effects of Hydrogen-Hydrogen Oxygen (HHO) addition on performance and NO_x emission of a spark ignition (SI) biogas engine. At a given operating condition, indicative work cycle Wi increases with increase of HHO, CH_4 concentrations and load rate; but it decreases with engine speed increase and reaches peak value as variation of equivalence ratio and advanced ignition timing. Combustion temperature T and NO_x concentration in exhaust gas also increase with increase of HHO, CH_4 concentrations, load rate and advanced ignition timing; but it decreases with engine speed increase, and reaches peak value as variation of equivalence ratio. The increase rate of NO_x concentration with equivalence ratio is much higher than that of Wi and T. When HHO concentration in biogas is lower than 30%, the gain of Wi is advantageous before the increase of NO_x. The addition HHO is more interesting as biogas engine operates with lean mixture. At a given engine speed, optimal ignition timing reduces 6 crankshaft angle degrees as adding 30% HHO to biogas. A compromise between performance and NO_x emission can be obtained by appropriate adjustment of operating conditions of the engine fueled with HHO enriched biogas.

Key words: alternative fuels, biogas, biogas engines, HHO gas, renewable energy

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