

Thesis Title	A Study of Combustion Characteristics of a Biogas Fueled Engine
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Abstract

Nowadays, the Thai government has supported the use of biogas as fuel in engines, but there is limited research work for spark ignition engines. This thesis studied combustion characteristics, performance, fuel consumption and exhaust gas emissions on spark ignition engines using biogas. In the study, the test engine was a 4 cylinder engine, 1600 C.C. which was modified to operate on 1 cylinder. Biogas used in the test had carbondioxide in the mixture in the ratio of 17-50 percent. The test condition was a steady state at 3,000 rpm and fixed throttle position.

The result shows an equivalence ratio of 1.0, with full open throttle, when the ratio of carbondioxide was increased from 17 percent to 30, 40 and 50 percent accordingly. Power output decreased 4, 8 and 15 percent accordingly. Thermal efficiency decreased 1.7, 5.1 and 10.1 percent accordingly. Unburned hydrocarbon increased from 442 ppm to 464, 490 and 509 ppm accordingly. Carbonmonoxide increased from 0.97 percent to 1.02, 1.11 and 1.23 percent accordingly. Oxides of Nitrogen decreased from 735 ppm to 530, 360 and 158 ppm accordingly. COV of IMEP increased from 1.10 percent to 1.15, 1.58 and 3.00 percent accordingly. COV of Pmax increased from 7.04 percent to 7.25, 8.35 and 10.54 percent accordingly. Flame development period increased from 26.0 degrees crank angle to 30.2, 33.7 and 41.4 degrees crank angle accordingly. Flame propagation period increased from 37.4 degrees crank angle to 39.3, 41.4 and 43.8 degrees crank angle accordingly.

Furthermore, this thesis was studied on the effect of the spark plug type on combustion characteristics using biogas in an SI engine. It was found that, using the biogas with 40 percent carbondioxide, equivalence ratio 1.0, the platinum and iridium central electrode spark plugs did not produce more power output. Moreover, when comparing platinum and Iridium spark plugs with standard spark plug, it was found that COV of IMEP increased from 1.47 to 1.52 and 1.56 percent. COV of Pmax changed from 6.82 to 6.81 and 7.71 percent. Flame development period increased from 31.4 to 32.2 and 33.1 degrees crank angle while flame propagation periods were similar. So it is proof that special spark plugs which expect better erosion resistance have little affect on performance and combustion characteristics.

The comparison between calculation and test results for biogas at equivalence ratio 1.0, found that Pmax in the cylinder from the calculation was higher than that from the test for about 1-4.5 percent depending upon the ratio of carbondioxide in biogas. IMEP and indicated thermal efficiency were 7 and 20 percent higher than the test results, respectively. However, results from the calculation give the same direction with the test.

Overall, when the proportion of carbondioxide in biogas is increased, the mixture is diluted and energy density is decreased and engine power output and thermal efficiency are decreased. The engine requires more advance spark timing since the combustion is slower. Cycle to cycle combustion variations are increased and flame development and flame propagation periods are longer.

Keywords : Alternative Fuel / Spark Ignition Engine / Biogas / Natural Gas / Carbondioxide / Methane / Combustion Characteristics