Analysis of Blended Fuel Properties and Engine Cyclic Variations with Ethanol Additive

Obed M. Ali[a], Rizalman Mamat[a], Nik R. Abdullah[b], Abdul Adam Abdullah[a]
[a]Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
[b]Faculty of Mechanical Engineering, Universiti Teknologi MARA (UiTM), 40450 Shah Alam, Selangor, Malaysia

ABSTRACT

The challenge of addressing increasing energy demand due to modern social development requirements, together with the crises of mineral oil depletion, make renewable energy sources promising alternatives for energy production. Currently, diesel fuel is mainly used in the industrial and transportation sectors. Though blended biodiesel-diesel fuel can replace diesel satisfactorily at low blending ratios up to 20%, fuel property problems may persist and worsen at high blending ratios. Hence, the feasibility of the blended biodiesel-diesel fuel B30 was investigated in the present study with respect to its property and engine cyclic variations when using ethanol as an additive. The blended fuel and ethanol additive were tested experimentally in a diesel engine. The in-cylinder pressure data were collected and analysed using the coefficient of variation and wavelet power spectrum. The fuel property test results showed slight improvement in density and acid value with a significant reduction in viscosity when increasing the ethanol additive. Furthermore, the blended fuel pour point was reduced to –7 °C at 8% ethanol additive. However, the fuel energy content was slightly affected with increasing ethanol additive ratio in the blend. From the wavelet analysis results, the short-period oscillations appear intermittently in blended fuel, while the long and intermediate-term periodicities tend to appear with increasing additive ratio in the blend. Furthermore, the spectral power increased with an increase in the additive ratio, indicating that the additive has a noticeable effect on increasing the engine cycle to cycle variations. This behaviour validates the coefficient of variation of the indicated mean effective pressure time series, which reveals that the blended fuel B30 has the lowest engine cyclic variations. However, the engine cycle variation increases with increasing additive ratio and become comparable to that of diesel fuel up to 4% ethanol additive.

KEYWORDS: Additives; Blended Fuel; Cyclic Variations; Ethanol; Fuel Properties

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