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Performance and Emission Characteristics of Direct Injection C.I Engine Retrofitted with Mono-CNG System

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Abstract. Diesel engines are widely used in logistics and haulage as vehicular prime movers. In the mechanized and fast-moving forward world of today, the consumption of petroleum products has become an important yardstick of a country's prosperity. This ever-increasing consumption has led the world to face the twin challenge of energy shortage and environmental deterioration. Natural gas has been one of the highly considered alternative fuels for both spark ignition (S.I) and compressed ignition (C.I.) engines. The advantages and benefits of CNG have made it the preferred choice as alternative fuel in the transportation sector. This present study focused on the effects of retrofitted direct injection C.I. engine with mono-CNG system to its performance and exhaust emissions. The engine speed was varied from 850 rpm to 2500 rpm, with load test conditions of 0Nm, 27.12Nm and 53.23Nm, using an engine dynamometer. Results indicated that CNG has the potential to provide better fuel consumption compared to diesel fuel. Meanwhile, the characteristics of exhaust gas emissions such as smoke opacity and CO2 gave promising results compared to CO, HC and NOX, for diesel combustion.

Introduction

The shortage in the hydrocarbon fuel sources and the stringent future emission regulations have been a formidable challenge to the most prominent worldwide automotive industries [1]. Therefore, the alternative sources of fuel are receiving a lot attention in the automotive industry. These are the main reasons for exploring alternatives, which are abundantly available and less polluted in nature. Natural gas or Compressed Natural Gas (CNG) has been one of the highly considered alternative fuels for both S.I and C.I. engines [2]. CNG is the favorite for fossil fuel substitution, which is made up primarily of methane (CH4). Its favorable chemical properties are high hydrogen to carbon ratio (H/C) and high research octane number (RON) than gasoline, which is approximately range from 120 to 130 compare to 93 to 97 for gasoline. CNG is colourless, odorless, non-toxic, and lighter than air and inflammable [3].

There are lots of previous studies [4],[5] on CNG as an alternative fuel, which led to economic fuel consumption for fleet operators. The benefits of using CNG include lower fuel cost and maintenance cost and cleaner exhausts emissions. The operational cost using CNG is one third of vehicle running on gasoline [6]. Therefore, CNG has been identified as a leading contender for transportation application especially for vehicle fleet operators: logistic and haulage companies.

In Malaysia, most of the logistics and haulage companies are using diesel fuel and compression ignition (C.I.) engines to propel their small-duty until up to prime mover vehicles. Therefore, for those companies to gain additional economic benefits, retrofitting their fleets with mono-gas CNG system will be the best option to take. Through retrofitting, the C.I engines to run using CNG, fleet operators will still have beneficial option operating their existing C.I. engines fleet. Therefore, this research is to evaluate and advanced monitoring the CNG fuel, engine speed and test load conditions which is

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