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GREEN FUEL: 34% REDUCTION OF HYDROCARBONS VIA HYDROGEN (AL+HCL) BLENDED WITH GASOLINE AT MAXIMUM TORQUE FOR MOTORCYCLE OPERATION

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ABSTRACT

The concept of alternative fuel is more towards green technology which is now a necessity in the transport sector. The requirements not only refer to the reduction of hydrocarbon but an increase in engine performance is also an importance part in the research. In this study, the use of aluminum and hydrochloric acid is the basis of the chemical reaction to produce hydrogen. The application of hydrogen as a fuel in the conventional engine is through a mixture of hydrogen and gasoline (G + H_2). The hydrogen supports the combustion in the combustion chamber to reduce hydrocarbon contents in the exhaust gases. The evaluation of hydrocarbon production levels in this study were set at maximum torque when the motorcycle engine is in full throttle. Chassis dynamometer test and load test contamination at L0 , L1 and L2 of the engine (G + H_2) produced a 34% reduction in hydrocarbons. This is better than using the engine (G). During the tests L0 , L1 and L2, the average hydrocarbon gas readings decreased by 58.2%, 27.4% and 16.7% to 46 ppm, 85 ppm and 95 ppm respectively versus 110 ppm, 117 ppm and 114 ppm. This study has shown that generated hydrogen (AL + HCl) is a better alternative in controlling air pollution which has become an increasingly critical aspect for the local and international motoring industry.

Keywords: green technology, aluminium, hydrochloric acid (HCL), hydrogen, emission control, internal combustion engine.

INTRODUCTION

Development of the automotive industry is currently moving towards technological change based on Green Technology [1-6], geared to the concept of environmental protection [1, 7-11], with vehicle types more commonly known as fuel cells and hybrid [12, 13]. Vehicle manufacturers have shown their capability of providing world class technological change with positive impacts on economic growth and the environment in the diversity of green technology vehicle models available in the present global market [14, 15]. Classification of green technology vehicles are divided into two types: vehicles that produce "zero pollution", and vehicles that use alternative fuels and produce "less pollution" as shown in Figure-1. Electric vehicles such as battery-electric and plug-in (rechargeable) are categorized as zero pollution [16]. According to the Prentice Hall dictionary in page 594, the definition of a hybrid vehicle is any transportation mode that depends on the energy supplied by two different energy sources. Currently, proponents of green technology vehicles prefer hybrids especially on the continent of Europe. This is because it is more environmentally friendly and the system uses electrical power to activate the motor to propel the vehicle. It is also cheaper compared to using more expensive fuel cell and spark ignition for internal combustion engine operating on two-stroke cycle and four-stroke [2, 17-19].

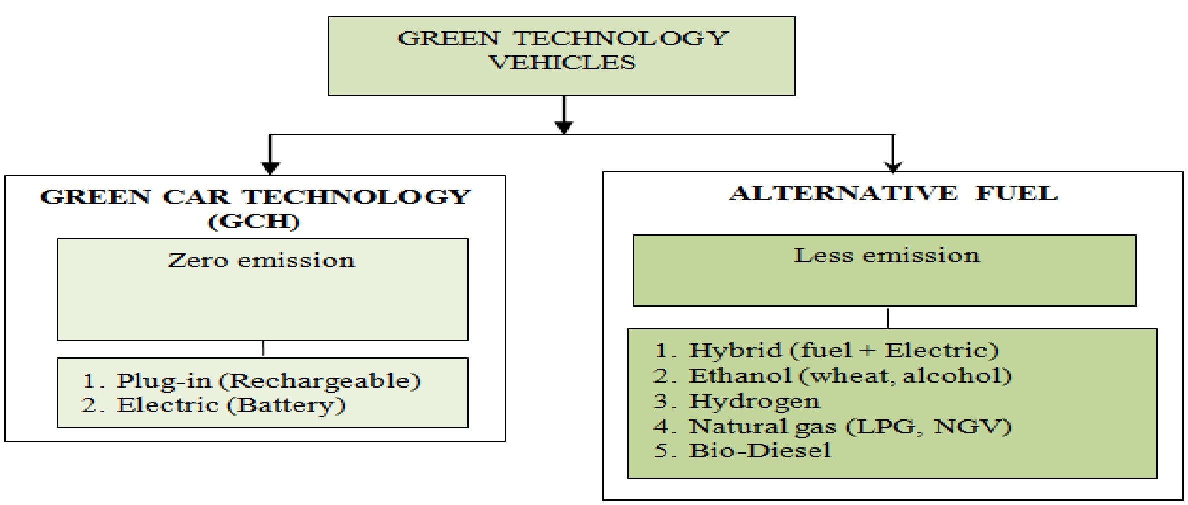

Figure-1. Classification of green vehicles.

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EXPERIMENTAL SETUP AND PROCEDURE

This study discuss the production process of hydrogen via chemical reaction**,** interpretation of reaction rates, the chemical activity via aluminum and hydrochloric acid to produce hydrogen as a fuel, and effect of specific fuel consumption (sfc) for internal combustion engine between G + H_2 and gasoline (G) application regarding chassis dynamometer test, based on load condition (L0), load 1 (L1) and load 2 (L2).

HYDROGEN GENERATION AND INTERNAL COMBUSTION ENGINE APPLICATION

The generation of hydrogen is produced through a combination of aluminum with hydrochloric acid during a chemical reaction. The presence of air (O_2) and water (H_2O) will produce wet hydrogen. The hydrogen gas will be transferred into the cylinder tube and compressed by a vacuum pump before the pressurized hydrogen released into the ICE combustion chamber. Figure-2 illustrates the hydrogen onboard production. It shows how the experiment uses hydrogen generation model via a chemical reaction between acids and metals to produce hydrogen gas as an alternative energy for spark ignition engines (motorcycles). As gasoline is the existing fuel in the fuel system of motorcycles, these models are operated onboard and act as a energy source or alternative fuel by blending hydrogen with gasoline (G + H_2). The selection of fuel-based energy source or blended fuel (G + H_2) is controlled by valve control switch options. As this study's focus is on hydrogen as the source of energy, the system operates with two main switches. The first switch serves to "switch on" the circuit for the magneto ignition system (spark plug), and the second switch is to activate the pressure regulator and vacuum pump. At the same time an aluminum sheet is passed through the catalyst lever either manually or automatically to produce hydrogen.

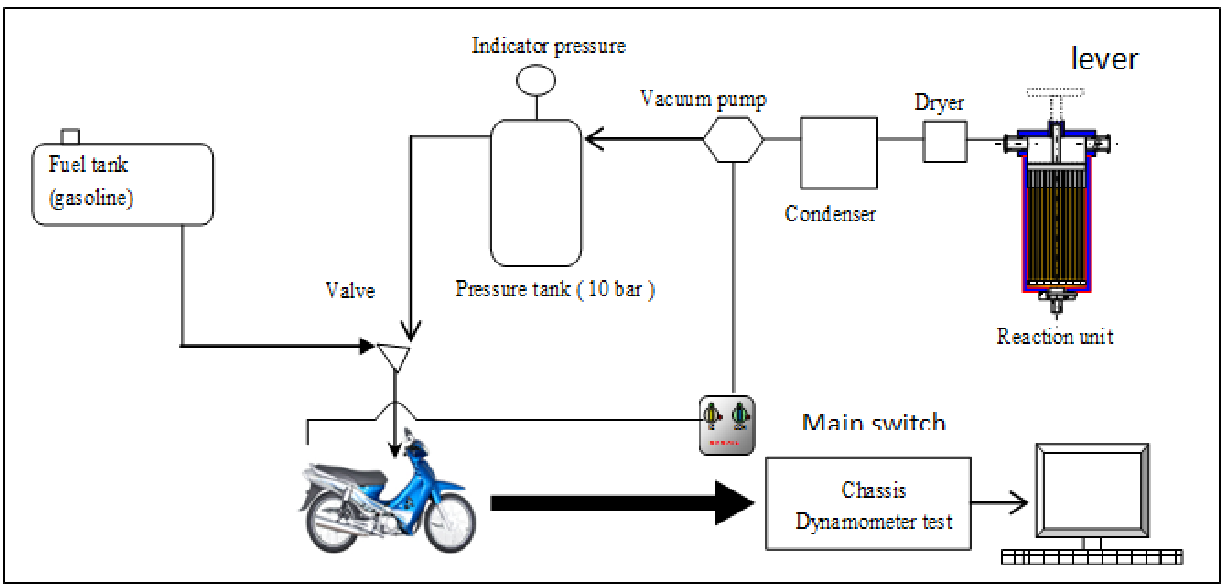

Figure-2. Hydrogen onboard production.

RESULTS AND DISCUSSION

Hydrocarbon

Table-1 and Figure-3 display the difference between the readings of hydrocarbons (ppm) on the test engine using gasoline mixed with hydrogen (G + H_2) compared to just gasoline. The test is conducted in three situations, namely when the engine is in the load L0, L1 and L2 using the load test equipment, chassis dynamometer. The study found the content of HC emission increases as the engine load increases. This is because hydrocarbon gases cannot be completely burned during the power stroke caused by a spark from the spark plug. One of the consequences of this is the occurrence of excessive fuel flow which results in the proper oxidation of the gasoline fuel elements. Therefore, the engine requires full torque (T) and the high engine output (FO) against the burden imposed on it to stay moving. The opening of the throttle valve will force the engine revolutions (Ne) into maximum condition, but at the same time, as the load increase, the torque and output (FO) start to decrease due to the movement of the piston. During the load test engine on L0, when the engine is in a linear motion, the performance of engine (G+H_2) will increase and total of hydrocarbon content in the exhaust fumes reduced up to 58% compared to normal operating engine (G). When the testing of engine increase to load L1 and L2, hydrocarbons content in engine (G+ H_2) is 85ppm compared to 117ppm for engine (G). After the last experiment at L2, a value of 95ppm hydrocarbon is still lower compared to engine (G) with 114ppm. Overall, under the three conditions of

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testing (L0,L1,L2), engine (G + H_2) is able to reduce the hydrocarbon content by 34% compared to gasoline engines. The results show the involvement of hydrogen in the stoichiometric mixture ratio can increase the quality of combustion and reduce the factor of energy losses via technical influence such as friction in cylinder walls, situation of mixture of rich and poor and the failure of ignition (misfire).

Table-1. The differences of produced hydrocarbon in engine (G + H_2) and engine (G) under load test L0, L1 and L2.

Load Test	Hydrocarbon (HC)		
Testing level	Gasoline + H_2 (ppm)	Gasoline (ppm)	Result $\pm$ (%)
L0	46	110	-58
L1	85	117	-27
L2	95	114	-16.7
Average of load testing	75.3	113.6	-33.9

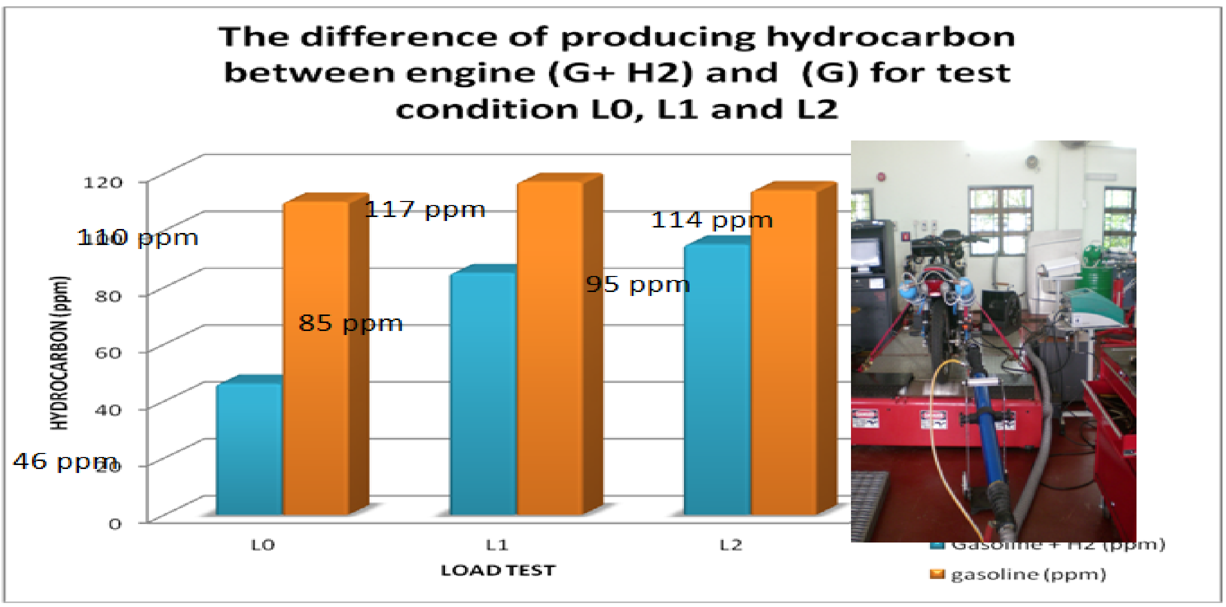

Figure-3. Comparison of produced hydrocarbon between engine (G + H_2) and engine (G) under load test L0, L1 and L2.

CONCLUSIONS

In this study, average hydrocarbon reduction for the three loading conditions L0, L1 and L2 of the engine (G + H_2) is 34% better than using the engine (G).Average hydrocarbon gas readings of engine (G+H_2) during testing L0, L1 and L2 decreased by 58.2%, 27.4% and 16.7% corresponding to readings of 46 ppm, 85 ppm and 95 ppm as compared to engine (G) of 110 ppm, 117 ppm and 114 ppm.

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