

Development of LPG Motorcycle for Rural Village in Indonesia

A. A. P. Susastriawan
Department of Mechanical Engineering
Institut Sains & Teknologi AKPRIND
Yogyakarta, Indonesia

Joko Waluyo
Department of Mechanical Engineering
Institut Sains & Teknologi AKPRIND
Yogyakarta, Indonesia

Khairul Muhajir
Department of Mechanical Engineering
Institut Sains & Teknologi AKPRIND
Yogyakarta, Indonesia

Abstract— In this work, 112 cc single cylinder four stroke gasoline engine motorcycle is converted to LPG fuelled motorcycle. Three model gas converter kits are developed and tested on LPG motorcycle. The models of gas converter kit are tested over a wide range of engine speed. LPG fuelled motorcycle performances in terms of torque and power as well as fuel efficiency are measured and the results are compared with gasoline fuelled motorcycle. The results show that converter kit model II has better performance than converter kit model I and III. Model II can produce higher torque and brake horse power. Engine torque and brake horse power of LPG fuelled motorcycle is lower than gasoline fuelled motorcycle. However, LPG fuelled motorcycle offers a solution for alternative energy utilization due to economically benefit.

Keywords: Optimization, converter kit, performances, fuel efficiency

I. INTRODUCTION

It has been concern worldwide not only the depletion of gasoline fuel for transportation, but also global warming effect of exhaust gas emission. To encounter these problems, many alternative fuels have been investigated for transportation sector. These alternative fuels were used additional fuel on gasoline as well as for substitution fuel for gasoline. For example ethanol has been added on gasoline [1], [2] or application of bio-fuels alone for internal combustion engine [3]. Many researchers have also been worked on utilization of Liquefied Petroleum Gas (LPG) for Internal Combustion engine. Engine performances decrease on LPG fuel [4], [5]. In order to increase LPG engine performances, some efforts have been investigated. Ignition timing at 11° before Top Dead Centre (TDC) of LPG four stroke engine give better performance, almost close to gasoline engine [5]. LPG engine performance is affected by operational condition of the engine. Yamin, et al. [6] have predicted an effect of combustion duration on performance and emission characteristic of LPG engine. Combustion duration has significant effect on engine performance and emission characteristic. Besides engine performances,

exhaust gas emission have to be considered. LPG engine give reduction of CO and HC in exhaust gas emissions compared to gasoline engine [7]. LPG is blended with biogas to reduce pollutant from LPG Engine [8]. LPG fuel is not only utilized for SI engine, but also for CI engine. The combustion of LPG fuel in Stratified and Homogenous Charge CI engine was investigated by Yeom and Bae [9]. HC emission was lower in Stratified CI engine, but CO and NO_x emission were slightly higher. The start of the combustion timing was advanced in stratified engine

II. METHODOLOGY

In this work, three model LPG converter kits are designed and manufactured prior to retrofit on 112 cc single cylinder motorcycle. The main body of LPG converter kit is made from Aluminum alloys. The models of converter kit are shown in Figure 1. Model I has a hollow cylinder sliding valve, Model II and III have a cone sliding valve. Model III also has two outlet ports.

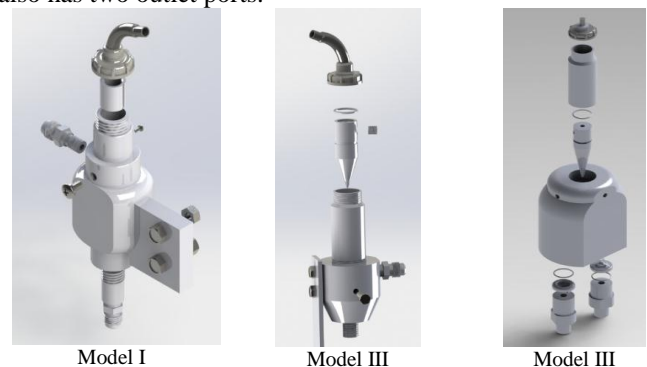


Figure 1. Exploded view of converter kit model

Converting gasoline fuel system to LPG fuel system requires modification of carburetor and throttling mechanism. Gasoline carburetor is modified for LPG in such a way that main pilot jet as a passage during high engine speed and pilot air as a passage during low engine speed. Throttling

mechanism is made from three wires that connect the main throttle to converter kit, vacuum terminal, and carburetor.

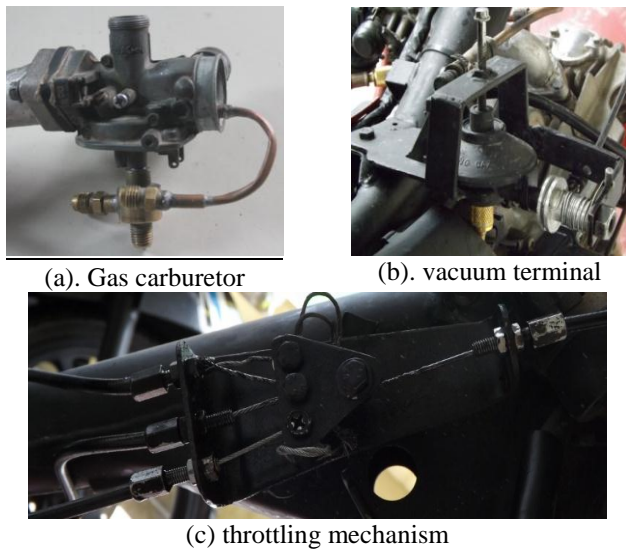


Figure 2. Fuel system of LPG motorcycle



Figure 3. LPG fuelled 112 cc single cylinder four stroke motorcycle

The performance of each converter kit model is evaluated in term of torque, brake horse power, and fuel efficiency. The torque, brake horse power, and fuel efficiency for both LPG fuelled motorcycle and gasoline fuel motorcycle is compared at different engine speed. The torque and brake horse power is measured with Dynamometer, and fuel efficiency is investigated on the road testing by measuring the distance can be travelled by the motorcycle for particular amount of fuel.

III. RESULTS & DISCUSSION

Figure 4 to figure 6 show the performance evaluation of LPG fuelled motorcycle for with three different models of converter kit and gasoline fuelled motorcycle. Figure 4 shows engine torque at variation engine speed. The graph shows that converter kit model II produces higher torque than Model I and II at for wide range engine speed. Converter kit model II can produce higher torque because of no leakage of LPG converter kit. Meanwhile, Figure 5 shows engine brake horse power at variation engine speed. The graph indicates that converter kit model II can produces more power than model I and III. Figure 4 and 5 also indicate that engine torque and brake horsepower of LPG motorcycle is lower than gasoline fuelled motorcycle.

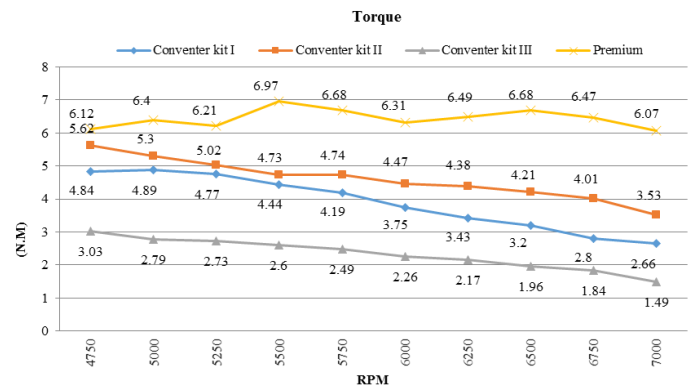


Figure 4. Torque at variation engine speed

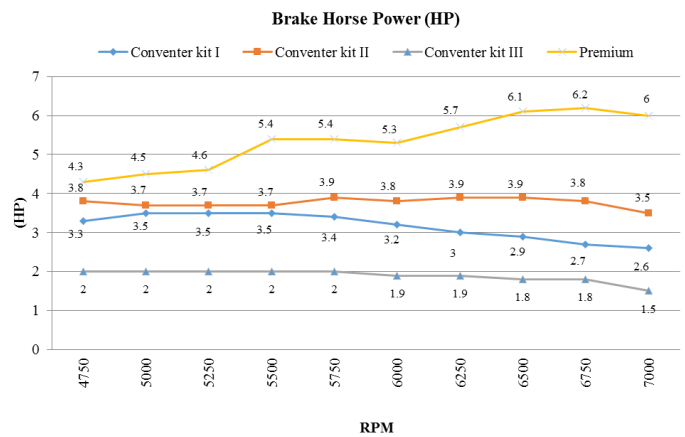


Figure 5. Engine brake horse power at variation engine speed

Fuel efficiency is evaluated by measuring the maximum distance can be travelled for same amount (in term of fuel cost) of LPG and gasoline. The LPG motorcycle cover more distance than gasoline motorcycle for same fuel cost of Rp. 17.000,-. Converter kit model II has better fuel efficiency than model I and II. It is due to good performance of sliding mechanism that prevent leakage of LPG in converter kit model II

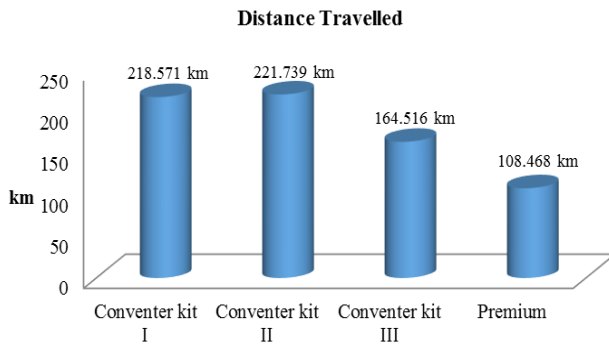


Figure 6. Fuel efficiency

IV. CONCLUSION

The different model of homemade LPG converter kit are successfully manufactured and tested on 112 cc single cylinder motorcycle. Converter kit model II has better performance than converter kit model I and III. Model II produce higher torque and brake horse power. However, engine torque and brake horse power of LPG fuelled motorcycle is lower than gasoline fuelled motorcycle, but LPG fuelled motorcycle offers a solution for alternative energy utilization due to economically benefit.

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