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Design Optimization of Gas Converter Kit for Three Wheelers Motorcycle

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***Abstract*—In this work, 150 cc three wheelers LPG fueled motorcycle are developed. Gasoline fueled system are replaced with LPG fueled system. This modification requires gas converter kit system. Three gas converter kits (Model I, Model II, and Model III) are fabricated and tested. All three models are successfully used in LPG three wheelers motorcycle. The result shows that converter kit model III gives the best performance in term of engine's torque, brake power, and brake specific fuel consumption rate. The torque and brake power of LPG three wheelers motorcycle using gas converter kit model III are 11,56 Nm and 13.7 HP, respectively. Meanwhile, brake specific fuel consumption rate is 0.094 kg/hp.hour when using gas converter kit model III.**

Keywords*— *Design; optimization, converter; kit.

I. INTRODUCTION

Depletion and global warming effect of fossil fuel initiate a utilization of alternative fuel for transportation. One of the alternative fuel has been used for transportation is LPG fuel. In order to use LPG for gasoline engine, it requires gas converter kit. Many researchers have investigated LPG for motorcycle. Performance of engine decreases for LPG fuel [1], however, the performance can be increased with advancing ignition timing 11^0 before top dead center (BTDC) as performed by Yunianto [2] and also can be done by utilization a better fuel injection system [3]. Performance of LPG engine was also studied with simulation. Jehad [4] simulated performance and exhaust gas emission of LPG engine. The study showed that duration of combustion in combustion chamber is a key factor on engine performance.

Utilization of LPG fuel for transportation can reduce exhaust gas emission. Yousufuddin [5] reported that CO and HC is lesser in exhaust gas for LPG if compared with gasoline. Exhaust gas from LPG direct injection engine is measured with gas analyzer [6]. CO, CO_2, and HC in exhaust gas from LPG engine is lesser than from gasoline engine, but NOx is higher from LPG engine. CO and HC in exhaust gas can be affected by ignition timing [7]. CO and HC are low for ignition timing of 7^0 BTDC, and increase for ignition timing of 130 BTDC.

Performance of internal combustion engine can be characterized with engine torque, power output, dan specific fuel consumption. Torque is measured with dynamometer or calculated with equation [8]

$$T = Fxb \qquad \text{(Nm)} \qquad (1)$$

Power output of the engine is calculated with

$$P = 2\pi NT \qquad \text{(kW)} \qquad (2)$$

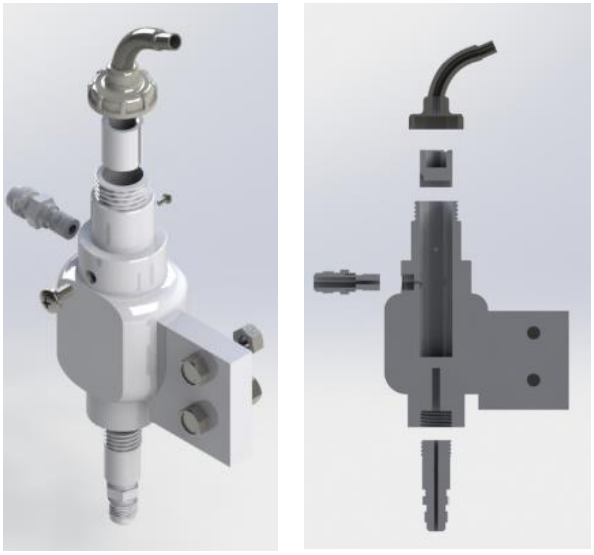
and Specific fuel consumption rate can be calculated with [8]

$$SFC = \frac{3600x\left(\rho_f xv_f\right)}{BHPxt/1000}\left(\frac{kg}{hp.jam}\right) \qquad (3)$$

In this work, three models of gas converter kit developed by [9] are experimentally investigated to obtained the optimum design of converter kit for three wheelers LPG motorcycle. Optimum design of converter kit is defined in term of engine performance (brake horse power, torque, and specific fuel consumption rate) of 150 cc three wheeler motorcycle VIAR

II. METHODOLOGY

All three models of converter kit are made from Aluminum. Model I without O-ring, and both model II and III have O-ring. Model III is also has one way valve and sliding valve. Figure 1 shows the converter kit models.



Model I

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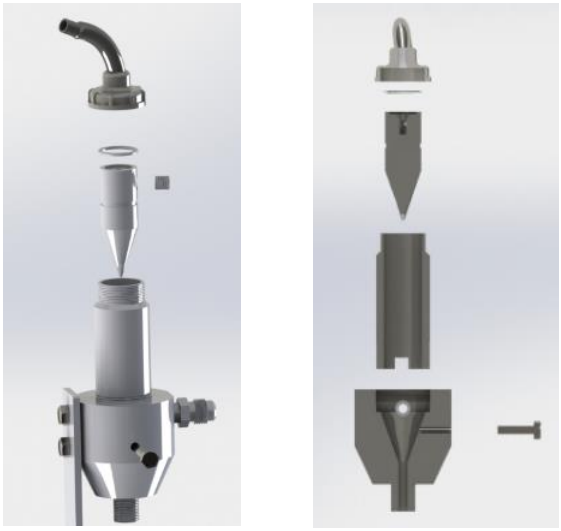
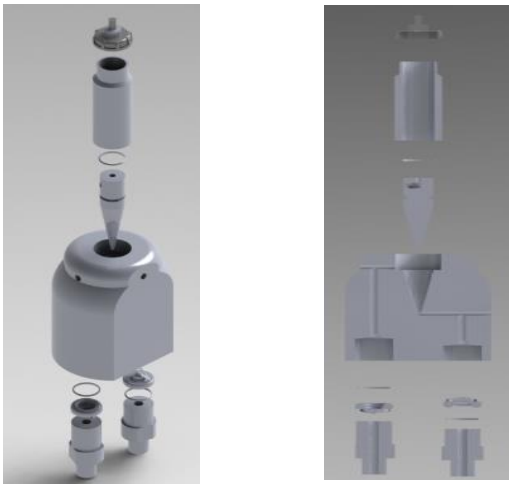


Model II



Model III

Figure 1. The three model of gas converter kit

Prior to installation, gasoline carburetor is modified to gas carburetor. Each of converter kit is installed on three wheelers motorcycle and its performance are investigated in terms of engine brake power, engine torque, and specific fuel consumption rate. Dynamometer is used for power and torque measurement and gas analyzer for exhaust gas measurement.

Figure 2. LPG three wheelers motorcycle

III. RESULTS & DISCUSSION

Figure 3 show an effect of converter kit model on engine torque at different engine speed. The torque from LPG fueled engine is compared with gasoline fuel engine.

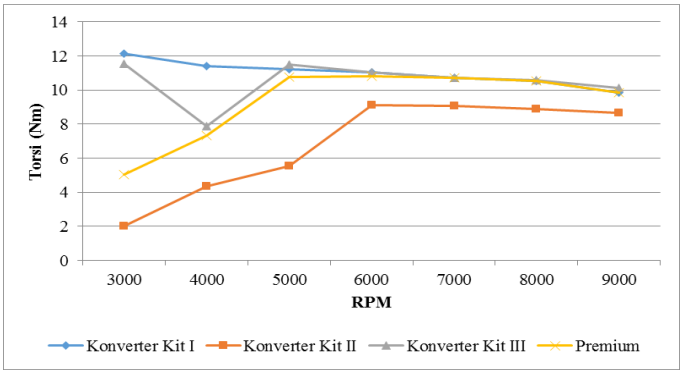


Figure 3. Torque vs engine speed

As shown in Figure 3, torque increases from engine speed 3000 rpm-6000 rpm for model II and model III. Engine torque using model II and III have similar trend at engine speed 6000 rpm to 9000 rpm. Model III give an engine torque of 11, 56 N.m.

Engine power output with LPG fuel and different converter gas kit model is shown in Figure 4. The graph shows that LPG engine with converter gas kit model III has a maximum power of 13.7 HP, higher than using model I and II. This may due to model III has O-ring, one way valve with sliding guide valve. O-ring seal and one way valve can prevent LPG leakage during flowing through converter kit which enhance volumetric efficiency.

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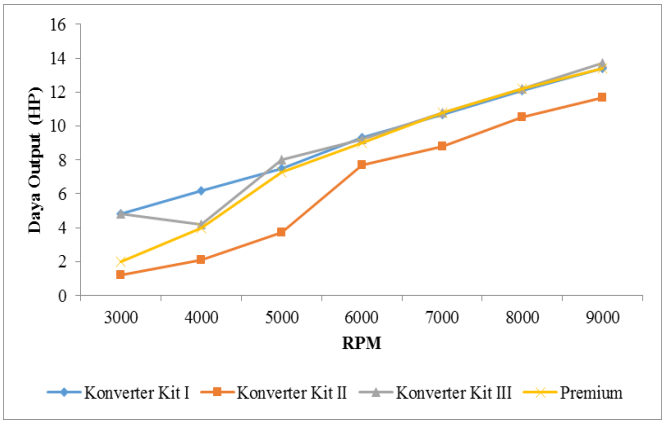

Figure 4. Engine power output vs engine speed

Brake specific fuel consumption (bsfc) for LPG engine with converter kit model II and III have almost similar trend at engine speed from 6000 to 9000 rpm. Bsfc using converter kit model II is slightly lower than bsfc using converter kit model III

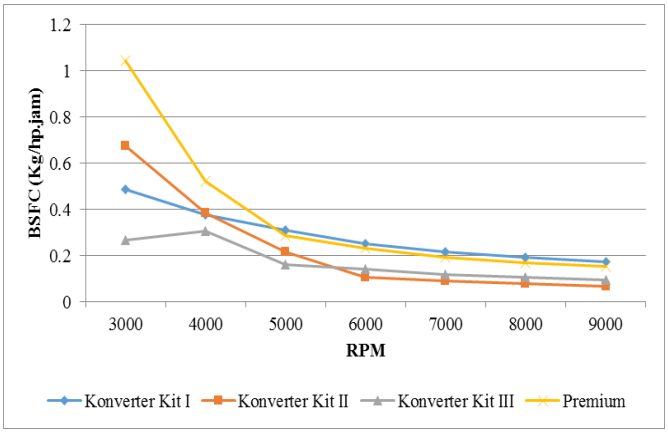

Figure 5. Bsfc vs engine speed

IV. CONCLUSION

From experimental work has been performed, it can be concluded that all converter kit model (I, II, and III) work properly for three wheeler LPG motorcycle. Converter kit model III has optimum design in this work. The model give the engine torque, engine brake power, and brake specific fuel consumption rate of 11. 56 Nm, 13.7 HP, and 0.094 kg/hp.hour, respectively.

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