Study Comparative Of Fuel Use Of Lpg, Pertalite , And Pertamax On Engine Erformance Armfield Cm 11 Mk II

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Abstract. This study aims to compare the value engine performance of airfield cm 11. Testing engine performance for compared torque and power by mixed fuel pertalite and pertamax, 100% pertamax plus and 100% LPG. The method used is experimental with parameters rpm 1500, 3000 and 4500. The value of machine performance test describes the character of the machine with variable of fuel usage. The use of emerald software is used as an airfield control system, parameter values are operated through emerald software as well as a defined fuel selection classification. The value of the character engine performance of airfield cm 11 machine. The optimal torque of pertamax fuel usage with mixture of 25% and 50% pertalite both has a value of torque of 6.1 Nm and 7.2 Nm at 4500 rpm and a power of 1.2 Kw, 1.6 Kw. LPG fuel torque and power value of 4.2 Nm and 0.5 Kw at rpm 3000, optimum use of fuel pertamax plus torque of 8.3 Nm, 1.9 Kw of power at rpm 3000.
Keywords: LPG, Torque, Fuel, Power.

1. Introduction

The population growth of oil-fueled vehicles is increasing every year. The Central Statistics Agency said the number of motorized vehicles by type in Indonesia reached more than 100 million units in the 2013 survey. This number includes 11 million more passenger car units, 2 million more bus units, 5 million more truck car units, and 84 million more units type of motorcycle. The increase in the number of vehicles is inversely proportional to the availability of oil fuel that continues to decrease. The use of fuel oil has a negative effect on two main things. First, the effect on fuel availability. Secondly, the effect on increasing exhaust emissions which have an impact on global warming [1].

One alternative energy that can be used as a substitute for fuel oil for vehicles is gas fuel [2]. Some types of Gas Fuels include Liquid Petroleum Gas, Compression Natural Gas, Liquid Natural Gas and hydrogen gas. The development of conversion of Oil Fuel to Gas Fuel in Indonesia has become one of the government's main programs through PT. Pertamina, which has begun to be implemented, one of them is in Bali Province. Major infrastructure such as gas refueling stations are available in 3 locations in Bali Province, although this number is still insufficient compared to the number of motorized vehicles in the province [3].

Until now, several experiments and research on LPG as a vehicle fuel in Indonesia, both cars and motorbikes developed through the use of LPG, the availability of LPG can be used as a logical solution as consumption of gasoline motor fuel. Information about LPG as a fuel for gasoline motor

vehicles has been widely found, but in reality the application has not been widely seen. The use of LPG as a fuel for gasoline cars uses generally using converter kits [4]. Either using conventional type or squinal type. In conventional converter kits that work based on the intake manifold vacuum level, LPG in the gas phase is channeled to the inlet (air induction system) with a diffuser. In squastic type converter kits that work based on the control of the ECU (Electronic Control Unit), LPG is injected into the intake manifold with a solenoid valve. The object used in this study is the Armfield CM 11 MK II Machine (Figure 1a). By looking at the performance characteristics of the Armfield CM11 MK II engine using LPG fuel, Pertalite - Pertamax and Pertamax Plus mixtures. The purpose of this study was to determine the performance characteristics of ARMFIELD CM11 MK II engines with different fuels either by loading or without load and knowing the fuel consumption more efficiently and optimal performance of various fuel variations. Then software using EMERALD SOFT for compare of result running test engine by variety fuel consumption (Figure 1b). The purpose of this study was to determine the performance characteristics of ARMFIELD CM11 MK II engines with variations of fuel

Figure 1a. Armfield Machine

Figure 1b. Armfield Machine

In general, armfield machines in the state-of-the-art politkenik automotive engine laboratory are used for basic knowledge to students about engine performance, in this activity information is provided with armfield props to measure engine performance, how to use props, how to read tables, take test samples, store results test and analyze test results. test results can be stored in the form of numeric files with statistical data. This machine has a 3 cylinder with a vertical system with a cylinder capacity of 1198 centimeter cubic, water cooled statically, maximum torque capability of 10.8N.m at 3250 rpm and power 4.8 at 4200 rpm.

2. Method

The main objective in analyzing performance is to improve the workability and reliability of the machine. Testing of a fuel motor is to determine the performance of the combustion motor itself. The parameters that will be discussed to determine the performance of the engine in a four-stroke motor are : *Torque* (N.m), Power (HP), *Fuel Consumption* (kg / hp.hr) (Figure 2). Torque is a rotary force produced by the engine shaft. The size of the Torque can be measured using a dynamometer. The amount of Torque can be formulated as follows :

$$T = I.\alpha \quad (1)$$

By :

T = Moment (N.m)

I = ½ M.r^2 = inersia roller (N/m^2)

α = angular acceleration (rad/sec^2)

Figure 2. Test bench Armfield

The method used in this study is an experimental method, namely the method used to test the ARMFIELD CM11 MK II engine with a variety of fuels including LPG, Pertalite RON 90 Mixing and Pertamax RON 92, and only Pertamax Plus RON 95 (table 1). Figure 3, shown block chart for using ARMFIELD Engine. In this test using the application ARMFIELD CM11 MK II, itscEMERALD software to control and see the characteristics of the machine, and use the Emerald software application to see the ECU MAPING conditions and the characteristics of the Dynamometer that has been integrated in the Armfield CM11 MK II engine unit. The ARMFIELD CM II MK II engine used in the study with the following specifications (Table 3):

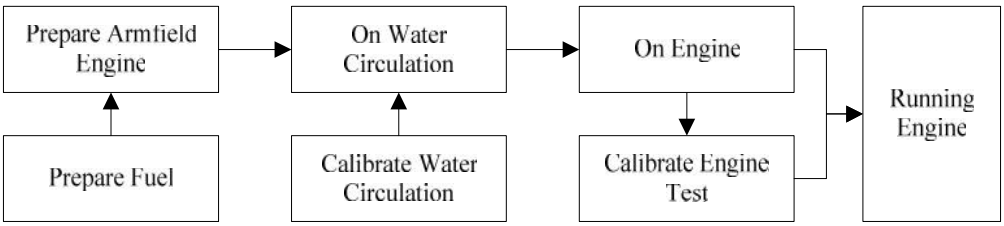

Figure 3. Block flow chart operated

The steps taken in the testing are : first step; Refueling Refueling is done in 2 integrated stages, namely; Pertalite refueling in 25 liters of ARMFIELD CM11 MK II Engine tank, and LPG installation. Next check the condition of the mechanical and electrical systems using analog and digital equipment by looking at the condition of the unit completeness of the ARMFIELD CM11 MK II component, and seeing the program application system can be used for data execution or not. Installation of ECU EMERLARD USB cable, machine USB cable Look at the condition of the engine whether it is integrated with the software application through the Device Manager or see whether USB COM is connected between the mechanical system and the software applied to the ARMFIELD CM11 MK II and EMERLAD applications. Testing begins with selecting the subpoint to be tested through the ARMFIELD CM11 application by selecting the Fuel Engine Cosumption, and choosing the fuel used as the initial test. Turn on the engine using the ARMFIELD Software application and EMERALD software application. Processing of data by viewing data on ARMFIELD CM11 and EMERALD applications, data storage can be done after testing is complete (Table 2).

Gasoline engine fuel, is generally used based on engine specifications to meet fuel usage standards and a minimum standard compression ratio on the engine so that the engine is able to work optimally. Generally unsuitable octane use can reduce engine performance in certain rotations, on the contrary if using fuel with excessive octane results in a loss of performance in certain rotations, combustion efficiency, decreased material function. Table 1 shows the characteristics of the compression ratio and the type of fuel based on Pertamina [5].

Table 1. Fuel based on compretion ratio

Fuel	RON	Engine Compretion Rasio
Premium	88	9 : 1
Pertalite	90	10 : 1
Pertamax	92	11 : 1
Pertamax Plus/Turbo	98	11 : 1
Pertamax Racing	100	13 : 1

Table 2. Speificatios Armfield CM11 MKII

Manufacture	: Volkswagen
Identification	: EA 111 R3
Capacity	: 1198 cm³
Cylinders	: 3
Bore	: 76.50 mm
Stroke	: 86.90 mm
Compression Ratio	: 10.3 : 1
Nominal Output	: 4.8 kW @ 4200 rpm
Max Torque	: 10.8 Nm @ 3250 rpm
Fuel	: 95 RON
Control System	: Emerald
Spark Plugs	: W8DTC
Oil Capacity	: 3.35 litters
Coolant Capacity	: 4.2 litters

In this study the highest value of torque and power using pertamax plus fuel, the highest torque value is obtained by using the highest octane value at 3000 rpm with a torque value of 8.3 Nm and power 1.9 HP. this value corresponds to the specifications and character of the armfield engine with a minimum octane value of the fuel used 95. Table 3. Shown performance of Armfield engine base on fuel consumtion.

Table 3. Character engine performance Armfield CM 11 MKII.

Performance		Torque (Nm)	Power (HP)	Torque (Nm)	Power (HP)	Torque (Nm)	Power (HP)
Rpm		1500		3000		4500	
Fuel	LPG (100%)	2.3	0.2	4.2	0.5	3.8	0.42
	Pertamax (25%) + Pertalite (75%)	3.5	0.32	4.6	0.8	6.1	1.2
	Pertamax (50%) + Pertalite	3.45	0.3	5.1	1.2	7.2	1.6

	(50%)						
	Pertamax Plus (100%)	4.5	1.1	8.3	1.9	8	1.75

Figure 4. Shown used variety of fuel depend on mixture and kind of fuel. The value of torque x 10, power also x 10 and Rpm x 100. Fuel of pertamax plus more than higher 13% therefore mixture pertamax 1:1, and also power more than higher 11.8% therefore mixture pertamax 1:1. LPG fuel consumtion for this engine give low torque and low power betwen liquid fuel consumtion.

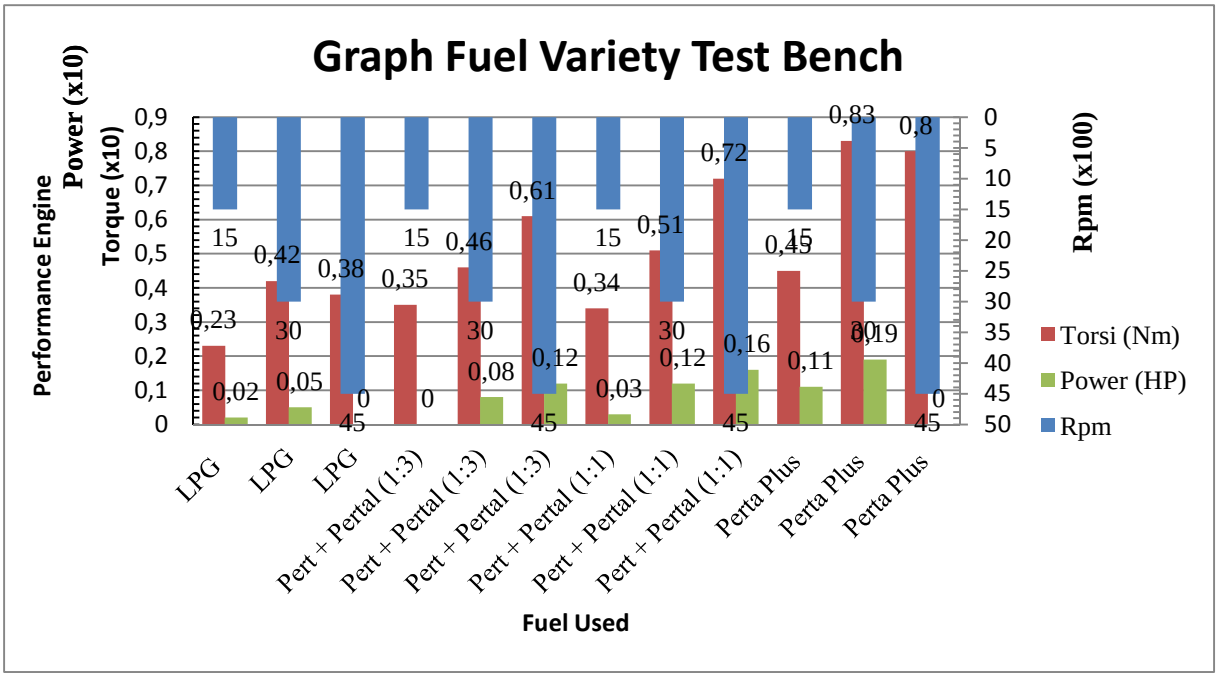

Figure 4. Fuel Variety Consumption For Engine Test Bench Armfield

ARMFIELD engine measurement characteristics, measure the value of volumetric efficiency and air time (kg / s). The value of increasing efficiency is also accompanied by the amount of air entering. This is influenced by the need for the fuel mixture when combustion at a particular engine speed. Table 4. Shows the results of the measurement of efficiency and the period of air measured during testing. Figure 5. Shows a graph of test results from table 4.

Table 4. Characteristic Measurement

Characteristic Measurement		Volumetric Efficiency (%)	Air Mass Flow (Kg/s)	Volumetric Efficiency (%)	Air Mass Flow (Kg/s)	Volumetric Efficiency (%)	Air Mass Flow (Kg/s)
Rpm		1500		3000		4500	
Fuel	LPG (100%)	16,32	0,0032	17,42	0,0039	16	0,0038
	Pertamax (25%) + Pertalite (75%)	19	0,0041	19,5	0,0044	18,4	0,0043
	Pertamax (50%) + Pertalite (50%)	18,3	0,0044	19,2	0,0045	18	0,0043
	Pertamax Plus (100%)	21,2	0,0052	22,1	0,0054	21,9	0,0053

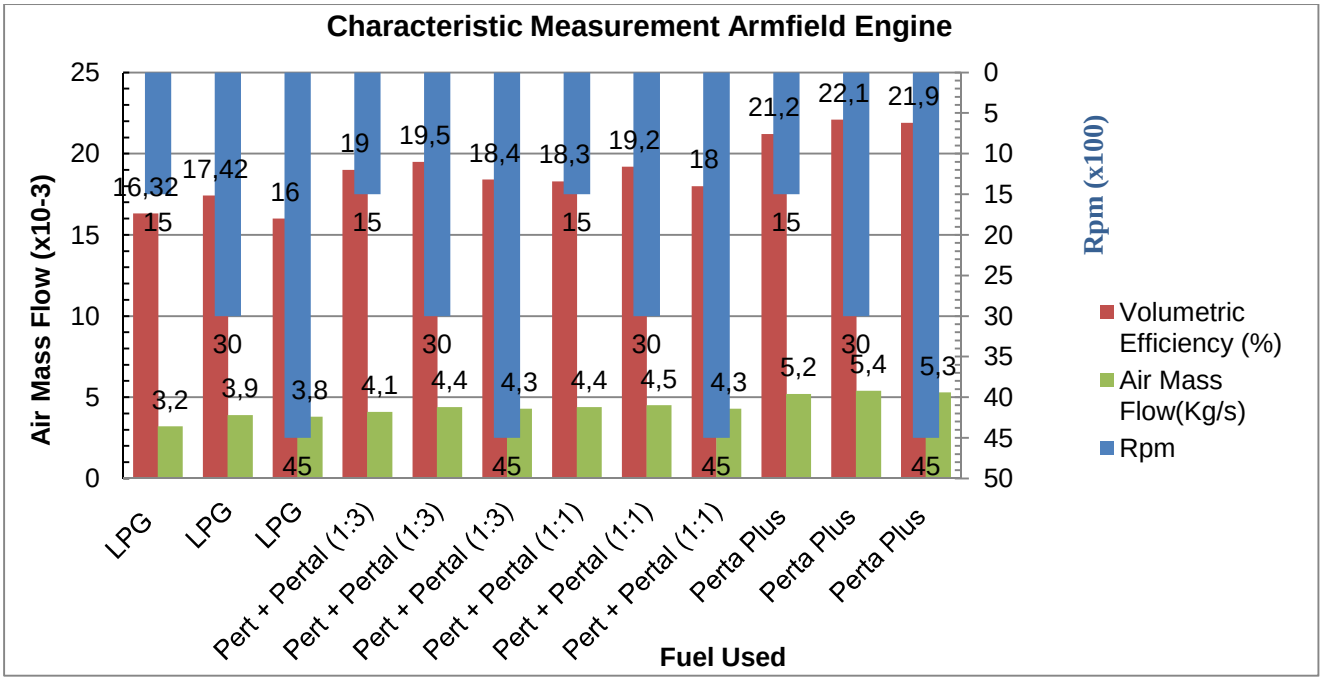

Figure 5. Characteristic Volumetric Efficiency (%) and Air Mass Flow (Kg/s)

3. Conclusion

The conclusion in this research is the highest value of torque and power using pertamax plus fuel, the highest torque value is obtained by using the highest octane value at 3000 rpm with a torque value of 8.3 Nm and power 1.9 HP. this value corresponds to the specifications and character of the armfield engine with a minimum octane value of the fuel used 95. The value of Volumetric Efficiensy on 3000rpm Pertamax Plus Fuel is 22,1 %, and AMF 5,4 x 10^{-3}.

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