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Influence of a Mixture of Biosolar and Pertamax on Diesel Engine Power and Fuel Consumption

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Abstract: **The subject of fuel consumption and vehicle power is intrinsically interesting and worthy of study particularly in relation to the use of fuel mixtures. This study examined a mixture of 40 litres of Biosolar and 1 litre of Pertamax used to fuel a diesel engine. In this experimental study, the object being researched was an Isuzu Panther car with a 2230cc, four-cylinder indirect injection diesel engine. The engine rotation varied from 1400 rpm to 2900 rpm, with a margin of 300 rpm. The researchers used a dyno tester as a power metre and a measuring tube as a fuel consumption gauge. Data analysis was performed through paired samples t-tests with a significant level of 0.05; calculations were done with the aid of SPSS 22 for Windows. The research results indicated that there was a difference in power of the diesel engine using pure Biosolar; there was a difference in power of the diesel engine using a mixture of Biosolar and Pertamax; there was a difference in fuel consumption of using a mixture of Biosolar and Pertamax; there was a difference in engine power between the use of pure Biosolar and a mixture of Biosolar and Pertamax; there was a difference in fuel consumption between the use of pure Biosolar and a mixture of Biosolar and Pertamax.**

Keywords: Power, Fuel Consumption, Fuel Mixture

I. INTRODUCTION

People's dependence on fuel oil is a severe problem [1]. Given the diminishing supply and increasing cost of fuel oil, many people are seeking alternatives to this energy source [2][3][4]. The type of fuel oil that is efficient and relatively inexpensive to maintain is diesel fuel [5]. One of the motor fuels that is efficient and relatively inexpensive to maintain is diesel [6]. Diesel is a motor fuel for an internal combustion engine using the heat of compression to cause ignition and burn fuel injected into the combustion chamber [7]. Unlike gasoline engines or gas engines, diesel engines do not use spark plugs [8].

There are several ways to improve fuel efficiency. However, not many people know that there is an easy method such as mixing a diesel fuel with Pertamax. Pertamax serves to accelerate the combustion in the combustion chamber, because it has a high thermal efficiency of 32% [9]. During fuel injection or combustion, Pertamax burns faster because the carbon chain in Pertamax is shorter than Biosolar. In this mixture, Pertamax occupies a role like a catalyst which in this case as a combustion accelerator. A ratio of 40:1 is applied to the mixture because Pertamax is only used for accelerating ignition due to its shorter carbon chain.

II. METHODOLOGY

This experimental research involved three types of variables. The independent variables included Biosolar and a mixture of Biosolar and Pertamax. The dependent variables were the engine power and fuel consumption produced by indirect injection diesel engines. The moderator variables included a vehicle engine after getting a tune-up. The engine rotation varied from 1400 rpm to 2900 rpm, and the power measuring device and fuel consumption metre were in good condition. Biosolar and a mixture of Biosolar with Pertamax were used. At the time of data collection, the engine temperature was in working temperature.

The variables were developed into instruments for collecting data. The instruments were validated and consulted to experts before being used. Data analysis was done through paired t test with a 0.05 significance level because this study aimed to test two paired samples having a distinct or distinct mean [10]. Before the statistical tests performed, then first

perform the normality test (normality test) in order to see the population is normally distributed. Calculations were performed with the help of SPSS 22 for Windows [11].

The object being researched was an Isuzu Panther car with a 2230cc, four-cylinder indirect injection diesel engine. The fuel used was Biosolar with a cetane number of 49 and Pertamax with an octane number of 92. The data collection and analysis were carried out in the chemistry laboratory of Universitas Negeri Malang and the automotive laboratory of VEDC.

III. Result and Discussion

The data obtained were described to equate the interpretation of research results. The data presented were data from the experiment conducted on the C223 Isuzu diesel engine at VEDC, Malang. The data including the average power and fuel consumption were recorded at each engine rotation per treatment. The data collected were then inputted into tables to be analysed further.

A. *Data Analysis*

Data were analysed using a paired samples t-test. Here is shown graphs on fuel consumption and power, each shown in Figures 1 and 2.

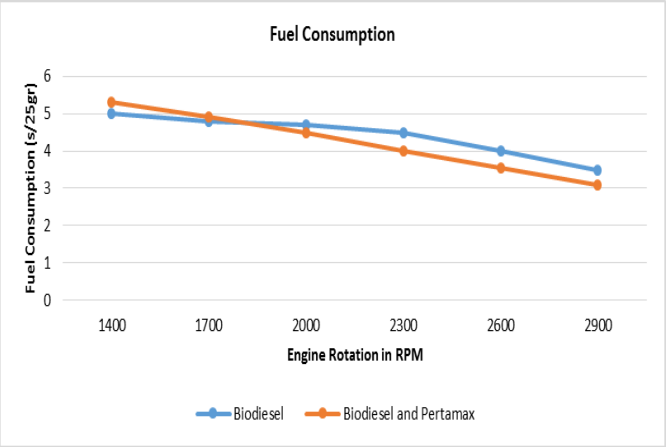

Fig.1. Fuel consumption of Biosolar and the mixture of Biosolar and pertamax with the increase RPM

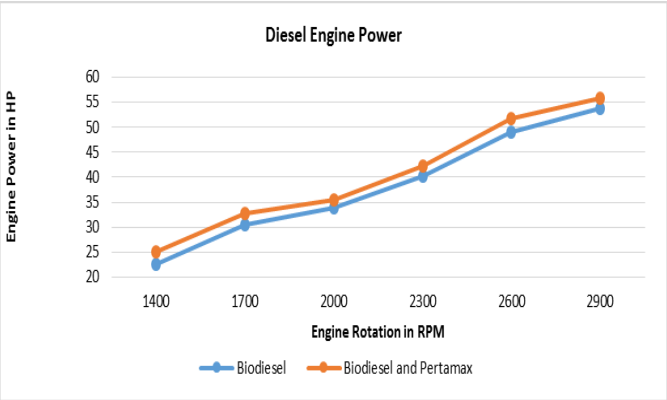

Fig. 2. Diesel engine power of Biosolar and the mixture of Biosolar and pertamax with the increase of RPM

B. *Normality Test using the Kolmogorov-Smirnov Test*

Decision making of the One Sample Kolmogorov Smirnov method is done by simply reading the significance value (Asymp Sig 2-tailed) [12]. A significance value of fewer than 0.05 means that a set of data is not normally distributed, while that of greater than 0.05 indicates a normally distributed data set. In this study, the results of normality test indicate that the data are normally distributed in each variation of treatment or fuel.

TABLE I. Normality Test on Fuel Consumption using Kolmogorov-Smirnov Test

One-Sample Kolmogorov-Smirnov Test

		Fuel Consumption
N		12
Normal Parameters[a,b]	Mean	4,3125
	Std. Deviation	,70971
Most Extreme Differences	Absolute	,188
	Positive	,124
	Negative	-,188
Test Statistic		,188
Asymp. Sig. (2-tailed)		,200[c,d]

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.

TABLE II. Normality Test on Engine Power using Kolmogorov-Smirnov Test

One-Sample Kolmogorov-Smirnov Test

		Engine Power
N		12
Normal Parameters[a,b]	Mean	39,408
	Std. Deviation	11,2140
Most Extreme Differences	Absolute	,137
	Positive	,136
	Negative	-,137
Test Statistic		,137
Asymp. Sig. (2-tailed)		,200[c,d]

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.

The data were normally distributed since the significance value of each treatment was 0.200 (0.200 > 0.05) as shown in Table I and II, and each variation in fuel had the same significance value of 0.200. The normally distributed data were then tested for homogeneity of variances.

C. Test for Homogeneity of Variances

TABLE III. HOMOGENEITY OF VARIANCES ON FUEL CONSUMPTION

Test of Homogeneity of Variances

Fuel Consumption

Levene Statistic	df1	df2	Sig.
1,520	1	10	,246

Table III shows that the significance value (Sig) is 0.246 or greater than 0.05 (0.246> 0.05), indicating that the power generated from the engine using Biosolar and that using a mixture of Biosolar and Pertamax is homogeneous or no difference

TABLE IV. HOMOGENEITY OF VARIANCES ON ENGINE POWER

Test for Homogeneity of Variances

Power

Levene Statistic	df1	df2	Sig.
,000	1	10	.988

Table IV shows that the significance value (Sig) is 0.988 or greater than 0.05 (0.988> 0.05), indicating that the power generated from the engine using Biosolar and that using a mixture of Biosolar and Pertamax is homogeneous or no difference.

The based result on table III and table IV, this has supported the basic assumption and met the prerequisites for conducting a paired samples t-test.

D. T-Test Related Samples

Fuel Consumption

The proposed hypotheses were as follows:

- H_0 is no difference to fuel consumption on pure biosolar usage by using a mixture of biosolar fuel with pertamax.
- H_1 is that there is a difference to fuel consumption on pure biosolar usage by using a mixture of biosolar fuel with pertamax.

TABLE V. PAIRED SAMPLES STATISTICS ON FUEL CONSUMPTION

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Fuel Variations	1,50	12	,522	,151
	Fuel Consumption	4,3125	12	,70971	,20488

TABLE VI. PAIRED SAMPLES CORRELATIONS ON FUEL CONSUMPTION

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Fuel Variations & Fuel Consumption	12	-,166	,607

TABLE VII. PAIRED SAMPLES TEST ON FUEL CONSUMPTION

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Fuel Variations – Fuel Consumption	-2,81250	,94823	,27373	-3,41498	-2,21002	-10,275	11	,000

The value of t count > t table (-10,275 > 2,201) and the significance of 0.05 (0,000 < 0.05) then H_0 is rejected, so it can be concluded that there is a difference in fuel consumption of diesel engines between using pure biodiesel with a mixture of biosolar fuel with pertamax. From the mean (average) can be seen if the average results of fuel consumption of diesel engines that use a mixture of biodiesel with pertamax more than that using pure biosolar. It can be concluded that by using a mixture of biodiesel fuel with pertamax, the diesel engine's fuel consumption is greater than using pure biosolar.

Diesel Engine Power

The proposed hypotheses were as follows:

- H_0 is no difference to diesel engine power on pure biosolar usage by using a mixture of biosolar fuel with pertamax.
- H_1 is that there is a difference to diesel engine power on pure biosolar usage by using a mixture of biosolar fuel with pertamax.

TABLE VIII. PAIRED SAMPLES STATISTICS ON ENGINE POWER

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Fuel Variation	1,50	12	,522	,151
	Engine Power	39,408	12	11,2140	3,2372

TABLE IX. PAIRED SAMPLES CORRELATIONS ON ENGINE POWER

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Fuel Variation & Engine Power	12	,102	,753

TABLE X. PAIRED SAMPLES TEST ON ENGINE POWER

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Fuel Variation – Engine Power	-37,9083	11,1730	3,2254	-45,0073	-30,8094	-11,753	11	,000

Value t count > t table (-11,753 > 2,201) and significance 0,05 (0,000 < 0,05) then H_0 is rejected, so it can be concluded that there is difference of power from diesel engine as above. From the mean (average) can be seen if the average power output of a diesel engine that uses a biosolar mixture with pertamax is greater than that using pure biosolar. It can be concluded that by using a mixture of biodiesel fuel with pertamax, the diesel engine's power is greater than using pure biosolar.

It can be concluded that by using a mixture of Biosolar and Pertamax, the power of a diesel engine is greater than using merely Biosolar. The higher the number of cetanes, the better the combustion. In addition to the properties of each fuel, i.e. having rapid combustion, the injection timing has an impact on the start of combustion [13].

The results also indicate that the higher the power of the vehicle engine, the more fuel is consumed. It is also influenced by increased engine speed due to the increased amount of air mixed into the fuel entering the combustion chamber. Also, faster rotation speeds on rear wheel cause more fuel consumption.

However, at low and medium engine speeds, the engine fuelled with a mixture of Biosolar and Pertamax consumed less fuel than that fuelled with Biosolar only. In fact, low rotation speeds result in less power. Fuel composition also affects fuel consumption, where the flashpoint in pure Biosolar is lower than that in a mixture of Biosolar and Pertamax. Also, a fast opening valve causes more air enters the combustion chamber, resulting in more fuel consumption. The injection timing complies with the standards of peak efficiency, the performance of a diesel motor is in medium loading only (electrical load of 15A), whereas when the loading is high, the engine consumes more fuel [13].

IV. CONCLUSION

Taken together, the findings of this research on the power and fuel consumption of a diesel engine using Biosolar and that using a mixture of Biosolar and Pertamax (40:1) suggest the following conclusions.

- There is a difference to fuel consumption on pure biodolar use by using a mixture of biosolar fuel with pertamax
- In engine rotation in RPM 2000 - 2900, the consumption of biosolar mixed fuel with pertamax is greater than that of pure biosolar
- There is a difference to power on pure biosolar usage by using a mixture of biosolar fuel with pertamax
- The power generated by the use of biosolar mixtures with pertamax is greater than that of pure biosolar.

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