Effects Of the Use of B30 On Coal Mining Operation Dump Truck

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Abstract- B15, B20 and B30 have been used to fuel coal mining operations dump truck. With the same type of dump truck and mileage, the calculation results show that the specific fuel consumption of B15 is 1.42 liters/ton of coal, the specific energy consumption of B20 increases to 1.43 liters/ton of coal and the specific energy consumption of B30 decreases to 1.42 liter/ton of coal. This decrease occurred due to the implementation of an energy management program by implementing smart driving, which is turning off the dump truck engine when it is not running.

Index Terms- Biodiesel, B15, B20, B30, dump truck, specific energy consumption, fuel filter

I. INTRODUCTION

The obstacle in using biodiesel is that the quality is not yet homogeneous and its adjustment for coal mining operations dump truck operations. The biodiesel quality standard refers to SNI 04-7182-2015. Biodiesel has the advantages of cleaner emissions and more optimal combustion. The biodiesel has the disadvantage that replacing the fuel filter will become more frequent and cannot be stored for a long time (Sorates and Bhale 2015). The use of biodiesel will increase the specific consumption of brakes but reduce the pollutant carbon monoxide. Biodiesel has a higher level of lubrication (Knote and Steidly 2005) Biodiesel has corrosive and oxidative properties. Common problems that often occur are fuel pump failure, filter blockage, coking injectors (M.A Fazal 2011). In coal mining exploitation, fuel costs can reach 30% - 40% of coal mining operational costs, so the use of fuel is important to get more attention.

Biodiesel

Biodiesel is a renewable fuel derived from animal and vegetable fats. The process of making biodiesel by transesterification and esterification (Fazal, Haseeb, and Masjuki 2011). Transesterification is used for raw materials in the form of triglycerides and esterification for raw materials in the form of fatty acids (Agarwal 2007). Biodiesel is produced from the transesterification process assisted by homogeneous base catalysts such as NaOH and KOH. The use of homogeneous catalysts facilitates the transesterification reaction (Duarte et al. 2016). Transesterification is influenced by several factors such as the molar ratio of glyceride and alcohol, catalyst, reaction temperature and time, and moisture content (Abbaszaadeh et al. 2012). Transesterification is currently the most superior when compared to other methods (Supriyanto et al. 2021). Biodiesel is environmentally friendly, agriculturally oriented, non-toxic and biodegradable, has a fairly high cetane value, has low sulfur content and volatility (Aregbe 2010).

Biodiesel and Diesel Fuel

Biodiesel has a higher density and viscosity and a lower heating value when compared to diesel (C. S Cheung 2015). The kinematic viscosity of biodiesel is about 10 times higher; its density is about 10% higher and it has about 10% less energy than diesel fuel (Math 2010). Biodiesel has advantages in terms of carbon renewal compared to diesel (Knothe 2010)Biodiesel has a lower vapor pressure than diesel, resulting in a decrease in injection speed and loss of flow efficiency (Som et al. 2010). Biodiesel has a better lubricating ability than diesel fuel due to the presence of lower oxygen atoms than diesel fuel (Knote and Steidly 2005). Brake thermal efficiency (BTE) is defined as the ratio between power output and energy input through fuel injection (Christoper, Hilary,

and Najeem 2011). A comparison of BTE between diesel fuel and biodiesel shows that biodiesel BTE is lower than diesel because biodiesel has lower viscosity, density and higher heating value than diesel (Reddy, Shiva, and Apparao 2010). The higher the biodiesel content in the mixture, the lower the relative calorific value (Barad, Shah, and Shah 2017):

Biodiesel and diesel engine maintenance

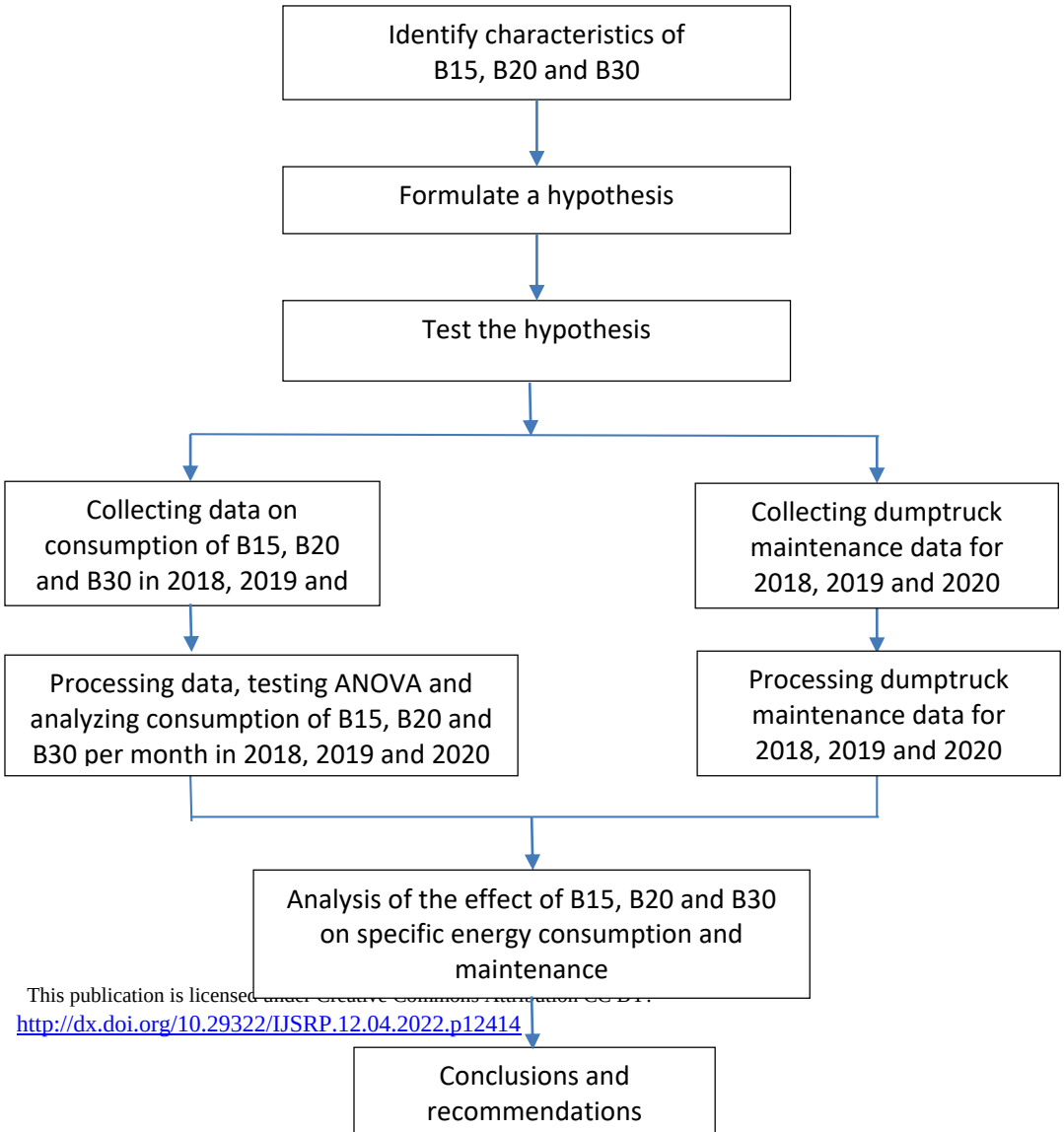
The use of biodiesel for fuel does not cause damage to the cylinder head and has no effect on the viscosity level of the lubricating oil used (Oqut et al. 2006). The effect of the use of sunflower biodiesel on engine performance and exhaust emissions showed that CO was reduced, CO2 and NOx emissions increased, torque and engine power decreased by an average of 5.87% and specific fuel consumption showed an average increase of 9.07 % (Karabektas and Ergen 2006). Comparisons between the use of diesel and various biodiesels show that, if the engine is properly tuned for biodiesel operation, it can produce the same levels of performance (torque and power) as diesel fuel but produce less smoke. This means that if the engine is tuned with precision, it is possible to switch from diesel to biodiesel without compromising engine performance (Joa quim da Costa 2018)

II. METHOD

The research will be conducted at coal mines in the South Kalimantan and Central Kalimantan areas by taking data from the coal transportation process from the Run of Mine (ROM) location to the Coal Processing Plant (CPP) with a distance of 82 km.
In this study, the data used is secondary data consisting of:

- Data on biodiesel consumption of B15 during the 2018 operating year, B20 during the 2019 operating year and B30 during the 2020 operating year. The biodiesel is used for dump truck operations of 111 units, operating from 2018 to 2020.
- Data on the actual amount of coal transported from ROM to CPP every month, during 2018, 2019 and 2020.
- Maintenance data from fuel filter replacement for all these dump truck units during 2018, 2019 and 2019.

The data is collected, then data processing is carried out to obtain the value of biodiesel consumption in liters/hour and specific energy consumption in liters/ton of coal. Furthermore, the results of data processing are stated in a thesis report to draw conclusions



Data collection is carried out in a span of a year, namely 2018, 2019 and 2020. Within a year the condition of the mine site experiences rainy and dry seasons, so that in 2018, 2019 and 2020 it can be assumed that the weather conditions are relatively the same, meaning that rainy and dry conditions can be equated because data collection was carried out from January to December.

III. RESULT

The consumption data of B15, B20 and B30 are presented in the following table:

Biodiesel consumption data per month 2018, 2019 and 2020

	B15 (2018)	B20 (2019)	B30 (2020)
January	1,770,854	2,036,613	1,908,281
Feb	1,763,229	1,903,851	1,924,931
March	1,796,853	2,110,319	2,047,696
April	1,837,272	2,025,456	1,894,412
May	2,133,911	2,134,011	1,706,600
June	1,941,959	1,897,638	1,871,530
July	2,150,388	2,019,170	1,940,979
August	2,015,411	1,943,795	2,093,114
Sep	2,064,465	2,013,433	1,844,135
Oct	2,229,946	2,144,274	1,863,732
Nov	2,059,723	1,809,558	2,014,371
Dec	2,070,694	1,609,326	1,819,905
total	23,834,705.00	23,647,444.00	22,929,686.00

From this data, it can be seen that B15 was only used in 2018, B20 in 2019 and B30 in 2020. The replacement of the biodiesel type is a continuous change with gradual adjustments, then an ANOVA test is carried out to determine the significance of the change. The results of the ANOVA test are as follows:

Descriptives

Biodiesel Consumption

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
B15	12	1986225.42	160621.229	46367.355	1884171.56	2088279.28	1763229	2229946
B20	12	1970620.33	152225.501	43943.717	1873900.86	2067339.80	1609326	2144274
B30	12	1910807.17	105422.321	30432.803	1843825.02	1977789.31	1706600	2093114
Total	36	1955884.31	141318.113	23553.019	1908069.14	2003699.48	1609326	2229946

Test of Homogeneity of Variances

Biodiesel Consumption

Levene Statistic	df1	df2	Sig.
1.713	2	33	.196

ANOVA

Biodiesel Consumption

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	38036183862.389	2	19018091931.194	.950	.397

Within Groups	660942129089.250	33	20028549366.341		
Total	698978312951.639	35			

F value = 0.950; Sig = 0.397 (sig <0.05) means that H0 is accepted and Ha is rejected.
So it can be concluded that there is no difference in biodiesel consumption between B15, B20 and B30

Multiple Comparisons

Dependent Variable: Biodiesel Consumption
Bonferroni

(I) Types of Biodiesel	(J) Types of Biodiesel	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
B15	B20	15605.083	57776.220	1.000	-130118.85	161329.01
	B30	75418.250	57776.220	.602	-70305.68	221142.18
B20	B15	-15605.083	57776.220	1.000	-161329.01	130118.85
	B30	59813.167	57776.220	.924	-85910.76	205537.10
B30	B15	-75418.250	57776.220	.602	-221142.18	70305.68
	B20	-59813.167	57776.220	.924	-205537.10	85910.76

The use of B15 compared to B20, the value of sig 1,000 (p<0.05) means that there is no difference
The use of B15 compared to B30, the sig value of 0.602 (p<0.05) means that there is no difference
The use of B20 compared to B30, the sig value of 0.924 (p<0.05) means that there is no difference
From the results of the ANOVA statistical analysis, it can be concluded that the use of B15, B20 and B30 did not show a significant difference.

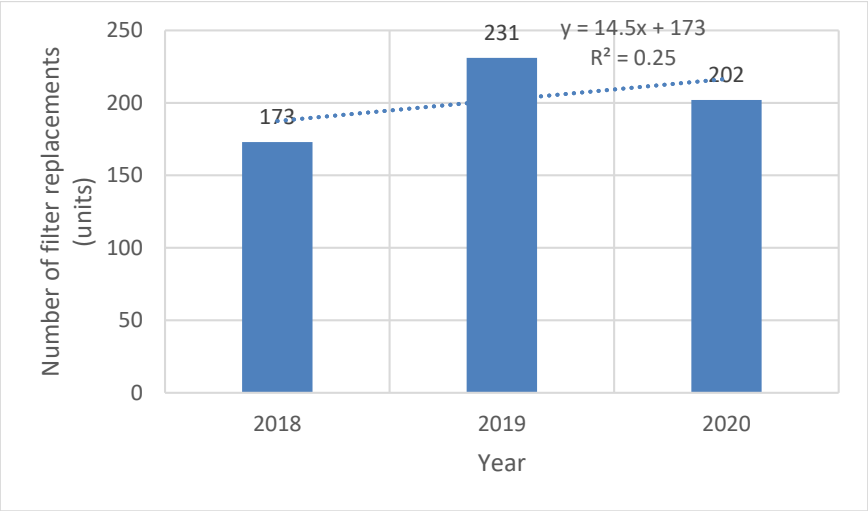
Fuel Filter Replacement

Maintenance data from fuel filter replacement are as follows:

Fuel filter replacement

No	Bulan	Penggantian Fuel Filter		
		2018	2019	2020
1	January	6	20	13
2	February	10	18	7
3	March	4	10	26
4	April	7	12	75
5	May	10	13	1
6	June	7	7	14
7	July	4	14	9
8	August	17	9	8
9	September	17	21	8
10	October	7	92	12
11	November	17	6	12
12	December	67	9	17
Total		173	231	202

From the data above, it can be seen that the filter replacement in 2018 was 173 units, in 2019 was 231 units and in 2020 was 202 units.
Comparison of filter replacement per year is shown in the graph below:



Graph of fuel filter replacement for 2018, 2019, 2020

From the graph above, it can be seen that the filter replacement has an increasing trend along with the biodiesel content in the fuel mixture. The higher the biodiesel content, the filter replacement tends to increase.

During the use of B15 in 2018, the fuel filter was replaced 173 times, the use of B20 in 2019 was replaced with the fuel filter 231 times and the use of B30 in 2020 was replaced by 202 times.

If you look at the fuel filter replacement in 2020, there will be fewer replacements compared to 2019, even though the biodiesel content is higher. This happened because fuel consumption in 2020 decreased compared to 2019

IV. DISCUSSION

Consumption of biodiesel in coal mining operations is influenced by several factors, including:

1. Condition of dump trucks

In this research, the dump trucks used in 2018, 2019 and 2020 are the same and the conditions are relatively the same. So that the condition factor of the vehicle does not really affect fuel consumption.

2. Road conditions

The roads used by dump trucks in this study are the same, the distance traveled is the same. So that the road condition factor does not really affect the difference in fuel consumption in 2018, 2019 and 2020.

3. Type of fuel

The fuel used is B15 in 2018, B20 in 2019 and B30 in 2020. Each type of fuel has a different calorie content. The higher the biodiesel content in the mixture, the lower the calorific value. So, it can be seen in the specific energy consumption that in 2018 it has a specific energy consumption value of 1.42 litters/ton of coal. In 2019, there was an increase in specific energy consumption to 1.43 litters/ton of coal. It can be concluded that the calorific value affects the amount of fuel consumption.

4. Driver behaviours

In 2020 there was a decrease in specific energy consumption from the previous year, which was to 1.42 litters/ton of coal. This happened because of the energy saving program intervention that was carried out in early 2020. The energy saving program was carried out by rearranging the dump truck queuing system, where in 2018 and 2019 when queuing for loading and unloading, the dump truck engine was on, but in 2018 2020 driver must turn off the dump truck engine.

V. CONCLUSION

This study analyzes the use of B15, B20 and B30 fuel on 111 units of dump trucks in coal mining operations. The results of the ANOVA test showed that there was no significant difference in biodiesel consumption between B15, B20 and B30.

The calorific value of fuel is not the only factor that affects fuel consumption. Other influencing factors include vehicle conditions, road conditions, and driver behavior.

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