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ANALYZING THE USE OF B35 BIODIESEL ON THE DISTANCE AND FUEL FILTERS LIFETIMES FOR LOCOMOTIVES CC201 AND CC203

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ABSTRACT (10 PT)

Blends of biodiesel, like B35, are becoming more and more popular as the demand for cleaner energy sources grows. The purpose of this study is to determine the fuel filter's level of contamination at particular mileage intervals, assess how well the filter works with biodiesel blends, and calculate the fuel filter's lifespan when using B35 biodiesel. The authors have conducted an experimental study involving a testing apparatus to measure the flow rate at the filter. Real-time data on fuel flow rate and filter clogging rate will be collected and analyzed to determine the impact of filter efficiency on fuel changes. The experimental data will be compared and contrasted to draw meaningful conclusions about the correlation between filter clogging and fuel flow rate. The data shows that the CC201 filter experiences less contamination compared to the CC203 filter. Firstly, it was found that the level of contamination experienced by the CC201 fuel filter was superior to that of the CC203 filter. Secondly, the relationship between fuel filter life and locomotive mileage is illustrated by a scatter plot graph showing a decreasing trend line. Thirdly, the performance of the fuel filter decreased at a percentage of 10% and 13% on each locomotive.

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1. INTRODUCTION

Diesel locomotives use diesel engines as their power source. This diesel engine is used to turn a generator to produce electrical energy, which is then used to drive a large traction motor. While diesel engines are known for being powerful and resilient, they also face some problems. One of the most common problems is the clogging of the fuel filter. Although small, these filters are very important for keeping diesel engines healthy.

A clogged fuel filter can cause fuel efficiency, vehicle mileage, and engine power to decrease so that the incoming diesel supply is not optimal and the engine stutters. The most severe consequence of a clogged fuel filter can cause the engine to be difficult to start. If the fuel filter is not replaced regularly, the accumulated dirt can cause serious damage to several engine components such as the fuel pump which works harder to push diesel through the clogged filter and carries dirt that can clog the injectors resulting in uneven diesel flow.

Fuel type is one of the causal factors closely associated with filter clogging, for example in the implementation of B20. The implementation of B20 is related to the problem of fuel filter clogging, due to the presence of some glyceride impurities in biodiesel. To address this, the deposits formed in B20 fuel should be tested using different fuel filter pore sizes [16]. In addition, the amount of sediment and residue affects the clogging time of the fuel filter. The clogging time of the fuel filter is also influenced by the distance traveled by the vehicle. The longer the distance traveled, the more dirt is filtered by the filter [15].

Several research publications served as the foundation for the investigation in this study. This talks about how fuel filters can be used while using biodiesel fuel. There are parallels and divergences between the author's research title and earlier studies. This research has similarities with previous research, namely discussing the ability to filter fuel filters on the use of biodiesel fuel. However, the difference is in the type of fuel and type of fuel filter used and the topic discussed. The previous study discussed the effect of using B20 fuel on the fuel filter and the factors that cause clogging that occurs in the filter, while this study discusses the effect of using B35 biodiesel on the performance of the fuel filter, causing fuel filtration to not be optimal. This study was conducted to determine what is the effect of B35 fuel on the level of fuel filter soiling in terms of mileage (kilometers), how do fuel changes affect filter performance efficiency and how to determine the performance of the fuel filter on the locomotive with the use of B35 fuel.

2. RESEARCH METHOD

2.1 Data Collection Tools

The *flow rate* test equipment used to collect data is designed by adjusting the fuel flow system on the locomotive. Tools consisting of several components such as diesel pumps, *flow* meter measuring instruments, *pressure gauges* to other supporting components are made to resemble the system on the locomotive. *Flow rate* testing is carried out to determine the measurement of fluid passing through the filter in a system per unit time.

Figure 1 *Flow Rate* Test Equipment

2.2 Data Collection Methods

Data collection is carried out by means of field observations at the Madiun Locomotive Depot and discussions to add insight to better understand the problems and solutions to the research to obtain primary data. literature study method as an approach to collecting references from journals and books from research sites needed in understanding the topic of fuel filter life. Primary data in the research include *flow rate* testing on filters and fuel and contaminant parameters in fuel, secondary data obtained include Locomotive kilometers traveled and research journal

After the data is collected, the next step is to determine the variables that will be used in the test. These variables serve to group the objects to be tested. Here are some of the variables used in the study.

a. The independent variables in the research conducted are locomotive mileage data during service to determine the fuel filter usage limit and periodic maintenance such as P1, P3, and P6.
b. The dependent variable, in this study in the form of data on the results of *flow rate* testing on used locomotive fuel filters
c. The control variable, in this study, is the *flow rate* test data on the new filter.

2.3 Data Processing Method

Data from the test results of the tool in the form of numbers arranged in the table are interpreted to analyze the variants used to obtain optimal results between different pressures and flow times using IBM SPSS Statistics software. Determination of the data analysis method is to use a comparison of the fuel filter flow. Data from the *flow* test results with the influence of filter variations were grouped and a series of classical assumption tests were carried out, including.

a. *Kolmogorov-smirnov* normality test to determine whether the data obtained in this study is normally distributed or not.
b. The linearity test uses a *Scatter* plot graph to determine whether the new filter flow and the old filter flow have a significantly linear relationship or not.
c. Multicollinearity test by looking at the Tolerance and VIF values to determine the correlation between independent variables. In this test there should be no correlation between the independent variables.
d. Heteroscedasticity test (*Glejser*) to test the data whether there is an inequality of variation from the residual value of one observation to another. If the variation of the residual value is fixed, it is called homoscedasticity, otherwise if it is different it is called heteroscedasticity. A good regression should not have heteroscedasticity symptoms.
e. Autocorrelation test with *Durbin Watson*, this test is carried out specifically on time series data.

3. RESULTS AND DISCUSSION (10 PT)

3.1 New Filter Observation Results

Data obtained from observations of initial conditions on new filters before use generally have a light beige color on the filter paper which indicates a new and uncontaminated filter, the filter paper used to filter out corrosions in the filter is still sturdy and not torn.

3.2 Testing Results Fuel Filters Locomotive CC201

Table 1 CC201 Flow Velocity and Discharge Testing Results

NO	New filters	P1 CC201	P3 CC201	P6 CC201
	Debit	Debit	Debit	Debit
1	0,80	0,76	0,79	0,74
2	0,81	0,77	0,78	0,71
3	0,82	0,77	0,75	0,70
4	0,79	0,79	0,75	0,70
5	0,83	0,76	0,75	0,71
6	0,79	0,77	0,74	0,70
7	0,82	0,77	0,73	0,71
8	0,79	0,83	0,76	0,71
9	0,81	0,77	0,76	0,71
10	0,81	0,78	0,76	0,70
11	0,80	0,76	0,76	0,71
12	0,80	0,76	0,76	0,70
13	0,81	0,76	0,77	0,70
14	0,80	0,77	0,77	0,70
15	0,79	0,77	0,76	0,70
16	0,80	0,77	0,75	0,70
17	0,80	0,76	0,77	0,70
18	0,79	0,78	0,78	0,70
19	0,79	0,76	0,74	0,70
20	0,81	0,76	0,77	0,75
AVG	0,80	0,77	0,76	0,71

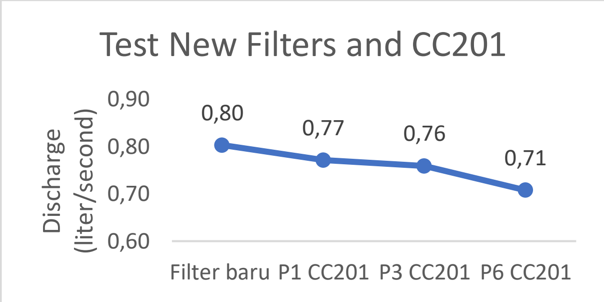

Figure 2 CC201 Filter Graph

Graph of the average fuel flow discharge on the use of CC201 used filters. In the new filter graph, the resulting debit flow is 0.80 liters / second, these results are used as a benchmark for maximum discharge, where a fuel filter is still in a safe and feasible condition to use. In the P1 graph, the debit flow result is 0.77 liters / second. In the P3 graph, the debit flow result is 0.76 liters / second. In P6, the debit flow result is 0.71 liters / second. So it can be concluded that the fuel flow test on the CC201 used filter has decreased flow. This shows that the used filter has dirt.

3.3 Testing Results Fuel Filters Locomotive CC203

Table 2 CC201 Flow Velocity and Discharge Testing Results

NO	New filters	P1 CC203	P3 CC203	P6 CC203
	Debit	Debit	Debit	Debit
1	0,80	0,78	0,76	0,74
2	0,81	0,80	0,78	0,71
3	0,82	0,79	0,75	0,73
4	0,79	0,78	0,69	0,70
5	0,83	0,77	0,85	0,71
6	0,79	0,78	0,76	0,71
7	0,82	0,77	0,78	0,71
8	0,79	0,76	0,79	0,69
9	0,81	0,76	0,75	0,69
10	0,81	0,76	0,78	0,71
11	0,80	0,76	0,72	0,70
12	0,80	0,76	0,74	0,69
13	0,81	0,76	0,75	0,68
14	0,80	0,72	0,74	0,69
15	0,79	0,76	0,68	0,69
16	0,80	0,76	0,87	0,68
17	0,80	0,77	0,78	0,68
18	0,79	0,77	0,78	0,68
19	0,79	0,77	0,79	0,68
20	0,81	0,77	0,79	0,68
AVG	0,80	0,77	0,76	0,70

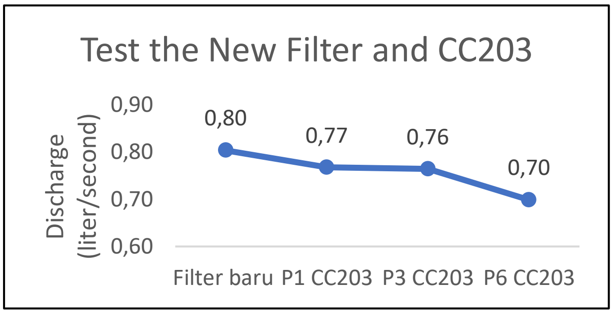

Figure 3 CC203 Filter Graph

Graph of the average fuel flow discharge on the use of CC203 used filters. In the new filter graph, the resulting debit flow is 0.80 liters / second, these results are used as a benchmark for maximum discharge, where a fuel filter is still in a safe and feasible condition to use. In the P1 graph, the debit flow result is 0.77 liters / second. In the P3 graph, the debit flow result is 0.76 liters / second. At P6, the debit flow result is 0.70 liters / second. So it can be concluded that the fuel flow test on the CC203 used filter has decreased flow. This shows that the used filter has dirt.

3.4 Average Filter Testing Results

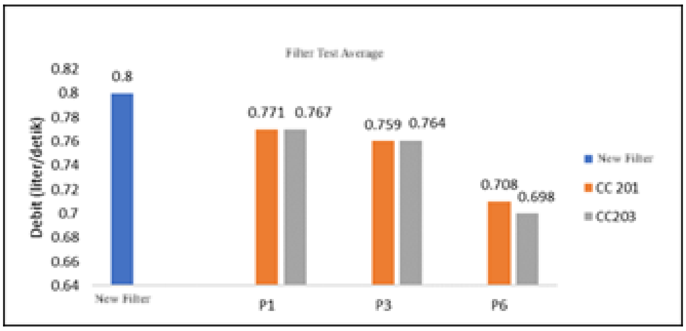

Figure 4 Average Fuel Filter Test Data

From the average calculation in the graph above, it is obtained that the decrease in discharge from the new filter at CC201 for each P1 treatment is 0.029 l/s, for P3 treatment is 0.041 l/s, and for P6 treatment is 0.092 l/s. While at CC203 the decrease in discharge on P1 treatment is 0.033 l/s, for P3 treatment is 0.036 l/s, and for P6 treatment is 0.102 l/s.

3.5 Influence with Distance

The test results on the used filter P1 and used filter P3 both show results of 0.77 and 0.76, so a filter change can be made. If analyzed with locomotive mileage which is carried out monthly maintenance.

Table 3 Kilometer Data

Locomotive Series	The Year 2024 1	2	3	4	Average
CC 2018307	21.217	10.059	8.237	24.914	
CC 2018905	9.676	21.470	21.231	21.923	
CC 2018906	736	15.210	21.595	8.956	
CC 2018907	20.345	18.905	25.012	17.862	
CC 2018908	17.743	23.069	17.890	19.993	
CC 2018909	22.849	23.697	16.691	11.986	
Total	92.567	112.410	110.656	105.633	
Average	15.428	18.735	18.443	17.606	17.553
CC 2039511	14.321	29.801	18.389	14.528	
CC 2039818	20.992	20.339	18.588	8.087	
CC 2030105	22.531	23.017	22.600	15.220	
CC 2030204	20.869	20.059	22.150	13.847	
Total	78.713	93.215	81.728	51.681	
Average	19.678	23.304	20.432	12.920	19.084

From the table data above, an analysis can be drawn for CC201 filter replacement at a distance of about 17,553 kilometers. While CC203 can be done at a distance of about 19,084 kilometers before the filter change can be done. From the above results the filter change on CC201 must be done faster than CC203.

3.6 Analysis and Discussion

From the results of the above research, it can be analyzed regarding the life of the filter based on the distance traveled by a locomotive. Using a *scatter plot* regression graph on SPSS software:

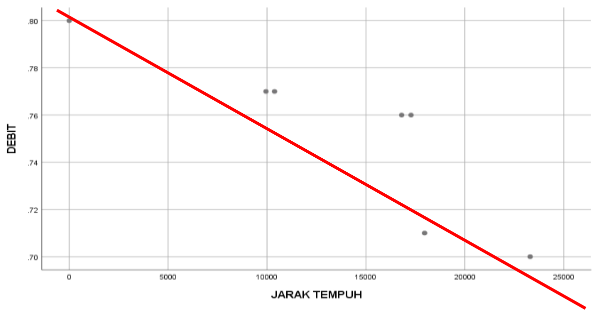

Figure 5 *Scatter plots of* discharge versus distance traveled

From the *scatter plot* graph above, it can be seen that the distribution of points occurs from the top left down to the bottom right. It can be concluded that the relationship between distance and filter life is negative. The representation is that the longer the distance traveled by a locomotive will reduce the quality of the filter. The quality can be seen from the percentage calculation of each treatment on the filter.

For the CC201 filter, it must be replaced in P1 maintenance with a discharge of 0.771 l/s at a mileage of 9,945 km with a filter quality percentage of 96%. In P3 maintenance with a discharge of 0.759 l / s at a distance of 16,804 km with a percentage of filter quality is 94%. And in P6 treatment with a discharge of 0.708 at a mileage of 17,964 km with filter quality is 88%.

For the CC203 filter, it must be replaced in P1 maintenance with a discharge of 0.767 l/s at a mileage of 10,380 km with a filter quality percentage of 95%. In P3 maintenance with a discharge of 0.764 l / s at a mileage of 17,280 km with a percentage of filter quality is 95%. And in P6 treatment with a discharge of 0.698 at a distance of 23,301 km with filter quality is 87%.

4. CONCLUSION

Based on the results of the research and analysis above, it can be concluded as follows:

1. The effect of B35 fuel in terms of mileage is that the level of soiling that occurs in the CC203 locomotive fuel filter is better than the use of fuel filters on CC201 locomotives.
2. Fuel changes affect the efficiency of filter performance, this is shown by the scatter plot graph which shows a decreasing line. This means that the longer the mileage of a locomotive, the quality of the fuel filter will also decrease.
3. The performance of the fuel filter with the use of B35 fuel can be seen to decrease in performance by 12% and 13% before replacing the fuel filter on each locomotive to avoid damage to diesel engine components.

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