Fuel filter condition monitoring (ffcm) devices innovation on truck diesel engine to prevent filter blocking due to use of biodiesel: b10-b20-b30

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Abstract. Currently, diesel fuel uses with a mixture of plant oil, or animal oil are increasingly stifling. To increase awareness of the dangers of global warming, the government strongly supports the presence of biodiesel. Biodiesel in Indonesia, such as B10, B20, or even B30, has been sold in the market. However, it turns out that the use of this mixture of fuels can cause fuel filters to be clogged faster than pure petroleum fuels. Some users are forced to replace the fuel filter faster than before. This can also cause unexpected blockages from diesel users, so we need a measuring device that can measure the level of the block from a fuel filter. The method in this research is to make a filter connecting bracket from aluminium then attach a pressure sensor to the fuel flow in and out, which is connected to the raspberry-based python programming communication system to be able to display the actual pressure data in each fuel flow leading to the fuel filter, after that the results of the innovation were tested directly on the diesel engine which was applied to the truck. The result of the design strength simulation can withstand a load of 15N with von mises stress on the bolt hole of 4.5 N / mm² or 4.5 MPa the yield strength material applied to the bracket aluminium Alloy 6061 of 55 N / mm² or 55 MPa, develop the system base on raspberry pi using a python program that will be read by the monitor board and will produce a percentage of a filter block right level of accuracy in reading the program that is with the error of 1.2%, after the tool is fabricated, it is tested directly on the truck diesel engine, namely on a new filter or 0 hours using biodiesel fuel B0, the result is a block filter percentage of 40%, biodiesel B20 has a block filter percentage of 41% and using biodiesel fuel B30 gets the filter block yield by 42%.

1. Introduction

The use of biodiesel, especially biodiesel B30, has been determined by the government by issuing Ministerial Decree (Kempen) of ESDM Number 227 K / 10 / MEM / 2019 concerning the Implementation of Testing the Mixing of B30 Biofuels into Diesel Oil as fuel for diesel engines, both for transportation fuel or industrial fuel [1]. Diesel fuel blends can be successfully used as an alternative fuel source for diesel engines. Biodiesel blends (B10, B20, B30, B40, B100, B30 + BHT and B30 + Butanol) were tested in single-cylinder four-stroke direct injection diesel. Machine. The BSFC (Brake Specific Fuel Consumption) value of B30 is 7.3% higher than diesel fuel and BTE (Brake Thermal Efficiency) 4.6% lower than diesel fuel [4]. In total conventional diesel fuel is still the
best, and the mixture can reduce performance when the biodiesel fraction increases [2]. However, with the addition of biodiesel fuel and the mixture, it has better quality than diesel fuel. The use of coconut-blended biodiesel produces BSCO (Brake Specific Carbon Monoxide) and the resulting smokes emissions. A massive 52.4% reduction in opacity was found as fast as possible at 0.86 MPa engine load with B50. For the combustion system, the ignition is built shorter, and the combustion system is longer [2]. In general, blended biodiesel fuels produce a lower peak heat release rate than refined diesel fuel [3]. Transportation companies also need to make operational savings including fuel and maintenance components that are on trucks or buses for that matter[4].

2. Methodology

To achieve the purpose of this research, we propose a methodology in Figure 1, and the methodology consists of the steps how we develop the bracket, system and testing on the truck diesel engine.

![Fig. 1. The Proposed Methodology](image)

In the first step of methodology, we design the devices for FFCM. In this step, the FFCM system will have collaborated with the pressure analyzer system. After creating the FFCM system, the next step is the development of the FFCM Application. This step needs the concept of SCADA and software engineering. The next step is integrating the device and the application into one system. The final step is testing the FFCM System on the truck diesel engine. We will describe all of the stages more clearly in subsection three below.

3. Develop the device

3.1. Design Fuel Filter Condition Monitoring (FFCM) Bracket

The design concept used in this Plug and PlayBracket uses a bracket that can be installed into the system quickly. This Plug and Play Bracket Design concept uses the space around the fuel filter so that it doesn't disturb or change the arrangement of the existing system[5]. The shape will be adjusted to the needs of the block filter control device, and also by using this design concept, it can be used in all types of vehicles using the J08E type filter. For material selection, the design concept uses aluminium.
alloy type 6061 [6]. The choice of material was chosen because it has a low specific gravity of 0.0027 Kg/cm³ [7][8]. Also, aluminium alloy has corrosion-resistant properties, so it is perfect if installed on the bottom of the vehicle.

Fig. 2. Plug and play Designed Bracket FFCM

3.2. Develop the Fuel Filter Condition Monitoring Application
This research design consists of hardware design and software integration and block diagrams of pressure measurement systems using Raspberry pi as the primary process and processing[9]. The pressure sensor is a reader that provides analog signal input, which is then forwarded to the Raspberry pi with the help of an ADC with the ADS 1115 type in converting the analog signal to digital so that it can be read by raspberries; this sensor is placed on a bracket that has been designed to read input and output pressure on the filter as analog data for further processing by Raspberry.

Fig. 3. Use Case Diagram of FFCM Application

This system's design is based on raspberry pi using the python program, which will be read on the monitor board and will produce a percentage of a filter block that aims to determine the lifetime of a filter. This system design has a good reading accuracy with an error of 1.2%. This design can also provide a percentage of the ability of a filter, which will later become a benchmark for replacing the fuel filter.
4. Results and discussion

4.1. Testing Fuel Filter Condition Monitoring (FFCM)

The next process is the process of testing the device. Fuel Filter Condition Monitoring (FFCM) is installed in the fuel system in the filter section. After the test equipment is installed, the connection process to the monitor uses a wifi network.

Fig. 4. Installation FFCM and application on the Truck Engine

Fuel Filter Condition Monitoring (FFCM) will be installed between the pre-filter and the primary filter[10]. Among the FFCM components include two pressure sensors that will detect the flow of fuel before entering the filter and after entering the filter, the data obtained will be sent to raspberry pi 3 b+, which will then be displayed on the LCD, gadget, or laptop using the VNC Viewer program where on the monitor the filter block will appear due to compression of the dirt on the diesel filter, Figure 5 the pressure results from each filter that has been tested.

Fig. 5. Live Monitoring Application system FFCM

4.2. Fuel filter block and effectiveness for the devices testing

This data results from testing a FFCM device using Bio solar B10, B20 and B30 on a vehicle; it can be seen in the filter that has been used for 0, 250, 500,750 hours, the block level on the filter is 41%, and the block level of the filter is 45%. From the results of the testing, it can be concluded that the use of a relatively long filter will affect the more massive the block in the filter.
5. Conclusion

From the Fuel Filter Monitoring Control (FFMC) design that has been developed and the integrated system that has been built to display pressure data when the filter is used with a time-variant that exceeds the standard working time of the fuel filter, it can show more accurate data reporting related to the life of the fuel filter on use of biodiesel by looking at the level of blocking on the fuel filter being tested.

From the test results of using a new filter or 0 hours using biodiesel fuel, B 10 will get a pressure input of -1,475 Psi and a pressure output of -2,435 Psi so that the percentage of the filter block is 40%, then using B20 biodiesel fuel will get the pressure input results - 1,514 Psi and -2,508 Psi output pressure so that the percentage of the filter block is 41% and using B30 biodiesel fuel will get a pressure input of -2,522 Psi and an output pressure of -2,593 Psi so that the percentage of the filter block is 42%.

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