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EFFECTS OF BLENDING LINSEED BIODIESEL INTO THE FUEL USED IN A SINGLE CYLINDER DIESEL ENGINE

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Abstract

In many countries around the world, internal combustion engines are still used in transport and other sectors. The search for alternative fuels continues because the environmental damage caused by exhaust emissions increases with the length of time combustion engines are used. On the other hand, the depletion of oil resources and the increase in fuel prices are causing economic problems. In this study, 10% linseed biodiesel was blended with diesel fuel used in a single-cylinder internal combustion diesel engine, and its effects on the engine characteristics were investigated. According to the results obtained from the experiments, it was observed that linseed biodiesel added to diesel caused a slight increase in carbon monoxide, carbon dioxide, and hydrocarbon levels in exhaust emissions, while engine power and fuel consumption remained almost at the same level. It is expected that these results from the experiments will contribute to the evaluation of various studies on biodiesel in the future.

Keywords: energy, internal combustion engine, emissions, biodiesel

INTRODUCTION

Although the interest in diesel engines in the automotive sector has recently declined, many countries in the world still use a large number of diesel engines. The daily depletion of fossil resources, the increase in harmful emissions, and fuel prices have created a worrying situation. Scientific research continues and it is believed that the use of vegetable oils by blending with petroleum-based diesel fuel will reduce these negative effects to some extent [1-2]. Biodiesel blends are an alternative solution to prevent harmful exhaust emissions, greenhouse effect, and global warming caused by the use of standard diesel fuel in internal combustion engines. The increasing use of fossil fuels in transport, agriculture, and other sectors around the world is leading to an increase in harmful exhaust emissions [3]. In the past, the use of biodiesel as an alternative was not much preferred due to environmental regulations and policies, but recently, as economic and environmental issues have gained importance, interest in biodiesel has increased [4]. Despite some favorable properties, biodiesel is more corrosive than standard diesel fuel [5]. This is known to cause deterioration in the structural properties of engine materials and reduce the life of circuit elements used in the fuel system [6-7]. In addition, biodiesel blended with standard diesel fuel, even at low volumes, can cause corrosion of copper parts[8]. There are many methods and vegetable oils that can be used to produce

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biodiesel. Looking at the studies on linseed oil in the literature, in one study linseed oil was blended with diesel fuel at different ratios and the effects on the engine were studied. 10% linseed oil added to the fuel slightly increased the fuel consumption of the engine and caused some reduction in thermal efficiency [9].

In one study, linseed biodiesel was blended with standard diesel fuel at a level of 20-30-40% by volume and its effect on a single-cylinder four-stroke engine was investigated. In this study, it was observed that when 20% linseed biodiesel was added to standard diesel fuel, good performance and exhaust emission values were obtained from the engine[10].

The effect of using biodiesel produced by blending linseed and rubber seed oils in different proportions on engine efficiency and emissions was investigated. Since linseed and rubber seed oils have similar physical properties, 5% of each was blended with 90% standard diesel fuel and tested in a single-cylinder diesel engine. Then 10% linseed oil and 10% rubberseed oil were blended with 80% standard diesel fuel and tested. When the performance and emissions of the engine were examined, it was found that better results were obtained by blending 10% linseed and 10% rubberseed oils with 80% standard diesel fuel[11]. In a new study, the production of biodiesel from linseed oil using a new ultrasonic cavitation reactor with a hybrid approach and its effects on the engine were investigated. It was found to increase brake thermal efficiency by 0.848% and reduce specific fuel consumption by 0.607% compared to standard diesel as engine fuel[12].

There are not many studies in the literature where linseed oil is added to diesel fuel and its effect on the engine is experimentally investigated. In this study, 10% linseed oil was blended with standard diesel fuel to be used in a single-cylinder diesel test engine at the Erin Engine R&D Centre and its effect on engine characteristics was investigated.

EXPOSITION

Standard diesel fuel and 10% linseed biodiesel were mixed with the standard diesel fuel to be used in the test engine and compared. First, 1 liter of standard diesel fuel was used and the engine characteristics were measured. Then a mixture of 10% flaxseed biodiesel and 90% standard diesel fuel was prepared by volume to produce biodiesel blended fuel. Mixing was carried out for 5 minutes to obtain a homogeneous fuel. Before the start of the tests, the engine was run at no load until the radiator water temperature reached 82°C to achieve the ideal engine operating temperature. Once the coolant temperature was reached, the engine was loaded at 25%, 50%, and 75% using a dynamometer, and the power and fuel consumption of the engine were measured for both fuel types. At the same time as these tests, the engine's exhaust emissions were measured under load. From the data obtained from the test engine, graphs of the changes in power, fuel consumption, and exhaust emissions were drawn. The test engine at the Erin Motor R&D Centre is shown in Figure 1.

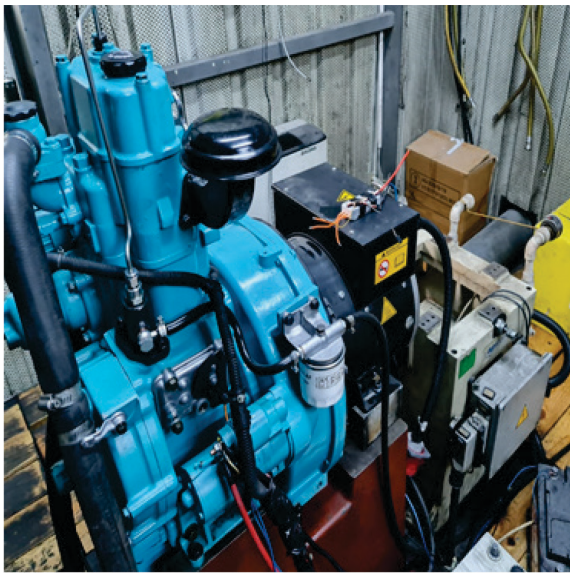

Fig. 1. *Test Engine*

Technical specifications and necessary information of the test engine are given in table 1.

Table 1. *Technical Specifications of The Test Engine*

General Characteristics	**Technical Specifications**
Engine type	Erin Motor Base Model
Number of Valves	4
Continuous Power (kw/rpm)	11.5 / 1500
Bore (mm)	108
Stroke (mm)	127
Combustion System	Direct Injection
Compression Ratio	14.6 : 1
Engine Cooling	Water
Weight (kg)	157

RESULTS

The changes in engine characteristics resulting from the use of standard diesel fuel and 10% linseed biodiesel in the test engine are shown graphically. Firstly, the change in engine power, which is one of the most important characteristics of the engine, is shown in Figure 2.

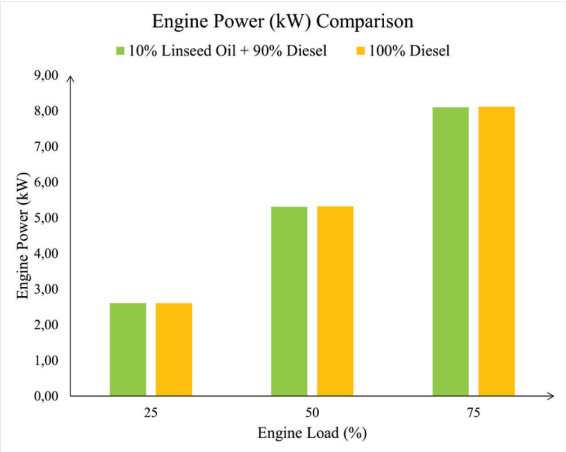

Fig. 2. *Fuel and load-related changes in engine power*

As can be seen in Figure 2, the maximum power output of the engine at the 25-50-75% load applied to the test engine remained almost the same.

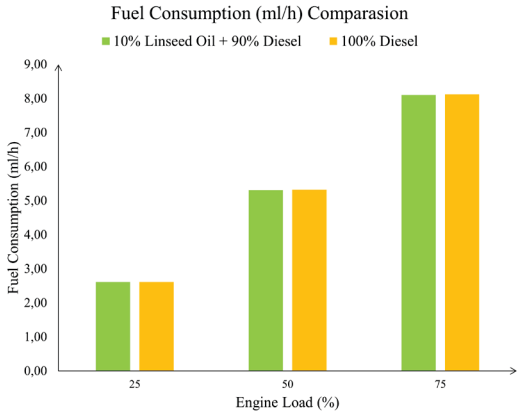

Fig. 3. *Variation in engine fuel consumption according to load and fuel type*

As can be seen in Figure 3, there was no change in fuel consumption at the 25-50-75% load applied to the test engine. Since the same fuel consumption values were obtained with linseed oil mixed with 10% of standard diesel fuel, it was observed that good results were obtained with the use of biodiesel. On the other hand, since linseed oil is a renewable fuel, it is assumed that it can be used when blended with diesel.

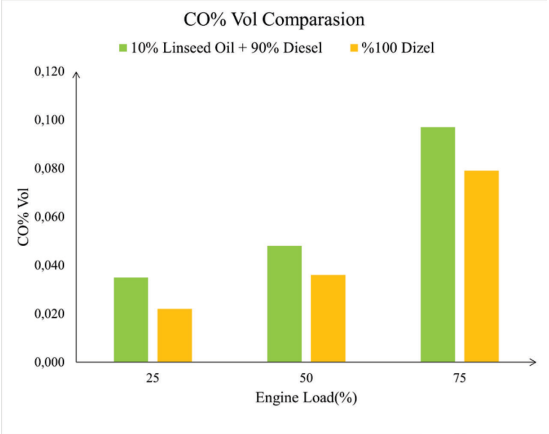

Fig. 4. *Change in CO in engine exhaust emissions according to load and fuel type.*

As can be seen in Figure 4, the level of carbon monoxide (CO), which is the most important harmful gas in exhaust emissions, increased at all engine loads as a result of the use of biodiesel produced by adding 10% linseed oil to standard diesel fuel. Because of the importance of CO in diesel exhaust emissions, it is clear that further experiments and emission tests should be carried out by blending linseed oil at different ratios.

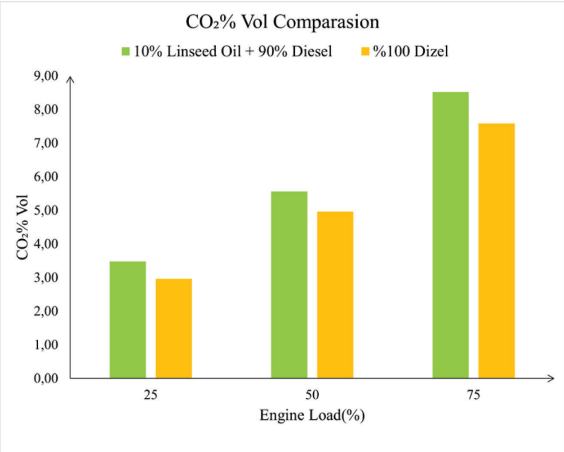

Fig. 5. *Change in CO_2 in engine exhaust emissions according to load and fuel type.*

As shown in Figure 5, the level of carbon dioxide (CO_2), which is a harmful gas in exhaust emissions, increased at all engine loads as a result of the use of biodiesel produced by adding 10% linseed oil to standard diesel fuel. For this reason, since the level of CO_2 in diesel exhaust is important, further experiments and emission tests should be carried out using linseed oil at different ratios in a similar way.

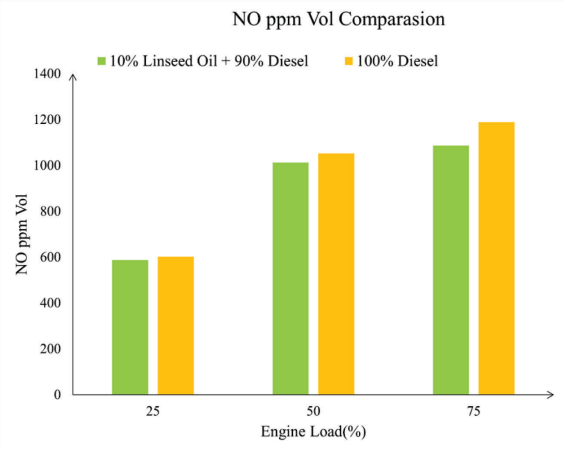

Fig. 6. *Change in NO in engine exhaust emissions according to load and fuel type.*

As can be seen in Figure 6, the level of nitrogen oxide (NO), a harmful gas in exhaust emissions, showed a slight increase at all engine loads as a result of the use of biodiesel produced by adding 10% linseed oil to standard diesel fuel. Although the level of NO in the diesel exhaust is at an acceptable level, it is expected to decrease with further experimentation and emission testing by blending linseed oil in different proportions.

CONCLUSION

In this study, the effect of biodiesel produced by adding 10% volume of linseed oil to standard diesel fuel on engine characteristics was investigated. When the results were examined, it was found that the power and fuel consumption values produced by the engine with the use of standard diesel fuel and 10% linseed oil biodiesel remained at almost the same level, while in terms of emissions, an increase in the levels of carbon dioxide and carbon monoxide in exhaust emissions was observed in all load conditions applied to the engine with the use of linseed oil biodiesel. A slight increase in nitrogen oxides was observed in the exhaust emissions when biodiesel was used compared to standard diesel fuel. In future studies, linseed oil should be blended with standard diesel fuel at different ratios to reduce exhaust emissions, and the ideal blend ratio should be determined by analysing the test results.

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