The Soy Oil Behavior on Diesel Engine

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Abstract- **The imported oil has had an enormous impact on so many people, so rapidly in so many ways and in so many places around the world. At the same time we must not forget the need for clean air, clean water, clean fuel and biodegradable, renewable materials. Hazardous pollutants that lead to atmospheric pollution have many sources and automobile's exhaust emission is one of these. Therefore, it needs to be taken into consideration seriously the replacement of fossil fuels with renewable fuels. More affordable and longer lasting, renewable fuels not only resurrect the economy but also save the environment before it's too late. This paper will examine the use of diesel-soy oil mixtures in diesel four-stroke engine. The mixtures that have been used are the following: diesel-5% soy oil, diesel-10% soy oil, diesel-20% soy oil, diesel-30% soy oil, diesel-40% soy oil, diesel-50% soy oil. The fuels were submitted in different temperatures 10^{o}C, 20^{o}C, 30^{o}C, 40^{o}C, 50^{o}C, 60^{o}C. For those mixtures and for every fuel temperature the gas emissions of carbon monoxide (CO), hydrocarbons (HC), nitrogen monoxide (NO) and smoke have been measured. The fuel consumption and the gas emission temperature have also been measured.**

Keywords- Gas Emissions; Soy Oil Fuel; Biofuels; Fuel Temperature

I. INTRODUCTION

Biofuel is attained from living or biological materials that have just died. It is a renewable energy source, unlike other natural resources such as petroleum, coal and nuclear fuels. Biofuel can be distinguished as a gaseous, liquid, or solid fuel and is generally used for vehicles, homes and cooking. Biofuels can replace conventional fossil fuels completely or partially in the internal combustion engines. Example of liquid biofuel is biodiesel, while ethanol represents gaseous type of this alternative energy source. Example of solid fuel is pellets made from wood chips. The strategic goal of biofuel is to supplement or even replace fossil fuels, the amount of which is constantly and rapidly diminishing. The most widely used types of biofuel are ethanol and biodiesel [1, 2, 3].

Ethanol is grain alcohol that is produced from renewable crops such as corn. Moreover, it is produced through the process of fermentation like any other alcohol. Ethanol is a clear, colorless liquid with characteristic odor. Other names of ethanol are ethyl alcohol and grain alcohol. Ethanol has been made since ancient times by the fermentation of sugars and was known as an intoxicating drink. Fermentation is a reaction where simple sugars are changed into ethanol and carbon dioxide with the effect of an enzyme from yeast, zymase. As raw materials for ethanol production can be used grains, wood, brewery waste, potatoes, cheese whey, paper waste, beets, or vegetable wastes. Like ethanol, biodiesel is a renewable clean burning fuel produced from fatly acids or vegetable oil. Biodiesel can be made from a number of crops including soybeans, canola and cotton. It contains no sulphur or aromatics, it is biodegradable and non toxic, it is more oxygenated than regular diesel and produces far less particulates [4, 5, 6, 7].

The wide use of biofuel has positive influence in terms of environment protection. Substitution of conventional gasoline with biodiesel or ethanol in transportation can significantly reduce the emissions of greenhouse gases into the atmosphere. The harmful chemicals that are produced while burning biofuel are much lower in comparison with the emissions during burning fossil fuels. Moreover, plants consume carbon dioxide from atmosphere, while they grow thus compensating its release during burning biofuel. Another advantage of biofuel is that it reduces the demand for importing fossil fuels. Also when the petrol prices are on the rise, the replacement of petroleum with a renewable energy source, it will offer significant savings too. It is also necessary to keep in mind that growing popularity of biodiesel requires more and more land to be used for growing plants as the resource for biofuel. Consequently, the development and wide implementation of any alternative energy source may bring new serious challenges in the economy and the environment [8, 9].

Nowadays there are an increasing number of cars and vehicles which run on gasoline or diesel fuel. This is one of the main factors that cause air pollution. Air pollution is actually harmful substances in the atmosphere, which damages the environment. It results mainly from the incomplete combustion of several fuels, such as coal, petrol and wood. The chief sources of pollution from combustion are furnaces in factories, engines in vehicles and burning of trash. Thus, pollutant gases are mainly introduced into the air due to human activities. Basically, the industrialization of society, the introduction of motorized vehicles and the explosion of the population are factors contributing to the growing air pollution problem. The main causes of air pollution is the carbon dioxide, the combustion of fuels in automobiles, the burning of fossil fuels, the release of harmful gases into the atmosphere from the increased number of power plants and manufacturing units or industries, activities that involve the burning of wood, fumes that are released from aerosol sprays, military activities that involve the use of nuclear weapons etc. There is no doubt that air causes a lot of damage to human and animal health, tropical rainforests, as well as the wider environment. Furthermore, air pollution is responsible for major health effects, as many different chemicals in the air affect the human body in negative ways. Apart from air pollution human health can be affected by water pollution, too [10, 11]. How sick people will get depends on what chemicals they are exposed to, in what concentrations, and for how long. There are many diseases that result from air pollution, such as bronchitis, lung cancer, and heart disease. There are also many diseases from water pollution, such as waterborne diseases, cancer, hormonal problems that can disrupt reproductive and developmental processes, damage the nervous system, liver and kidney, etc. People that are highly vulnerable to diseases induced by air pollution are older people, children and infants. By taking into consideration all these, it can be said that each person is responsible for all the causes of air pollution and the situation that we face today, as each of us look to satisfy our needs without considering the fact that we contribute to the growing of air pollution. Based on a survey that took place in Australia in 2004, engineers demonstrated that the best solution for reducing the greenhouse gas emissions was the use of alternative fuels. Therefore, there is a big need for mainstream alternative, sustainable eco friendly energy resources in order to protect our environment and the possibility of running out of fuel sources [12, 13]. Vegetable soy oil could be used as fuel in diesel engine [14]. The major issue is how a four-stroke diesel engine behaves on the side of pollutants and operation.

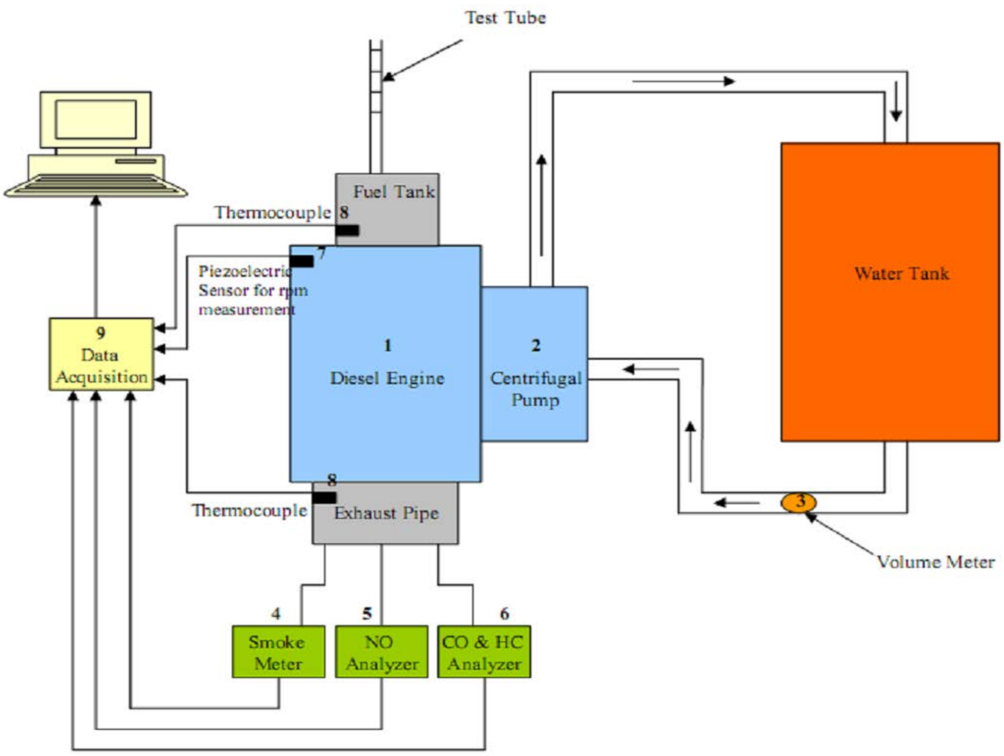
II. INSTRUMENTATION AND EXPERIMENTAL RESULTS

In the experiment stage soy oil in the mixture of diesel has been directly used into a four – stroke Diesel engine in fuel temperatures 10oC, 20oC, 30oC, 40oC, 50oC, 60oC. Specifically it has been used diesel, mixture diesel-5% soy oil (Soya5), diesel-10% soy oil (Soya10), diesel-20% soy oil (Soya20), diesel-30% soy oil (Soya30), diesel-40% soy oil (Soya40), diesel-50% soy oil (Soya50) in a four-stroke diesel engine volume 377cc, and power 8.2hp/3000rpm, who was connected with a pump of water centrifugal. Measurements were made when the engine functioned at 1000, 1500, and 2000rpm.

1) *Experimental Measurements*

During the experiments, it has been measurement:

- The % of CO
- The HC(ppm)
- The NO(ppm)
- The % of smoke



Picture1. Experimental layout

The measurement of rounds/min of the engine was made by a portable tachometer (Digital photo/contact tachometer) named LTLutron DT-2236. Smoke was measured by a specifically measurement device named SMOKE MODULE EXHAUST GAS ANALYSER MOD 9010/M, which has been connected to a PC unit. The CO and HC emissions have been measured by HORIBA

Analyzer MEXA-324 GE (Picture 1). The NO emissions were measured by a Single GAS Analyser SGA92-NO.

2) Experimental Results

The experimental results are shown in the following tables and figures:

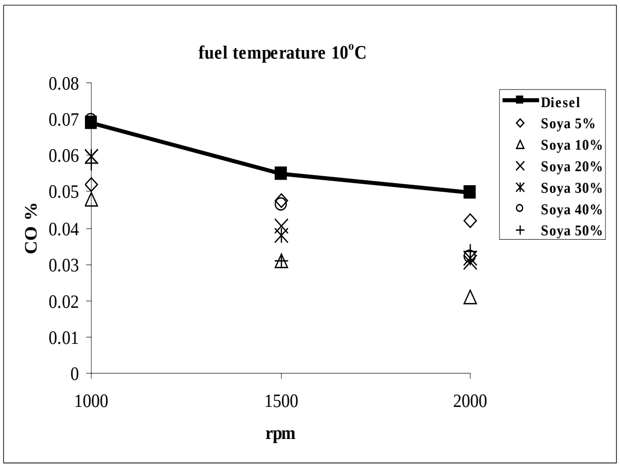


Fig. 1 The CO variation on different rpm regarding to the mixture in 10°C fuel temperature

As far as CO emissions are concerned, the best behavior appeared from the mixture of diesel-10% soy oil at 10 oC, of fuel temperature. On the other hand diesel displayed the highest CO emissions (Fig.1).

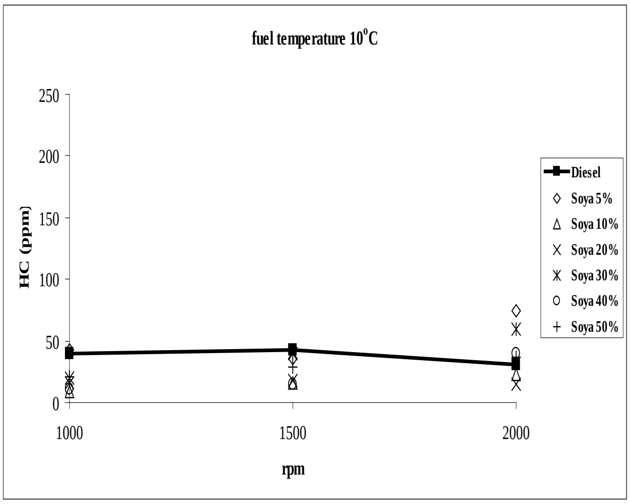


Fig. 2 The HC variation on different rpm regarding the mixture at 10oC fuel temperature

The mixtures of Soya10, Soya20, Soya30 and Soya40 presented reduction of HC emissions, but the mixture of Soya40 didn't keep it in all engine rounds (Fig. 2).

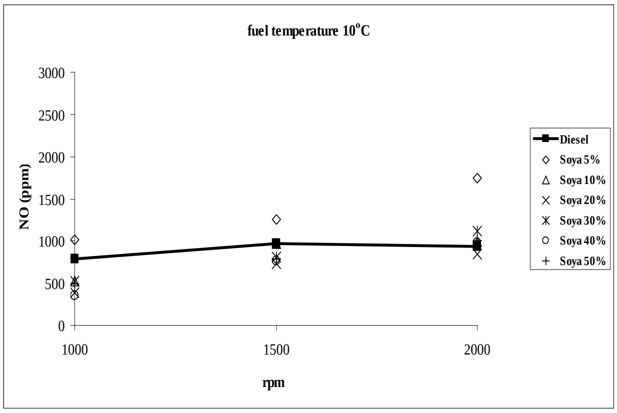


Fig. 3 The NO variation on different rpm regarding the mixture at 10oC fuel temperature

As far as NO emissions are concerned, the best behavior (reduction) appeared in the mixtures of Soya20 and Soya40. On the contrary diesel did not present good behavior. (Fig. 3)

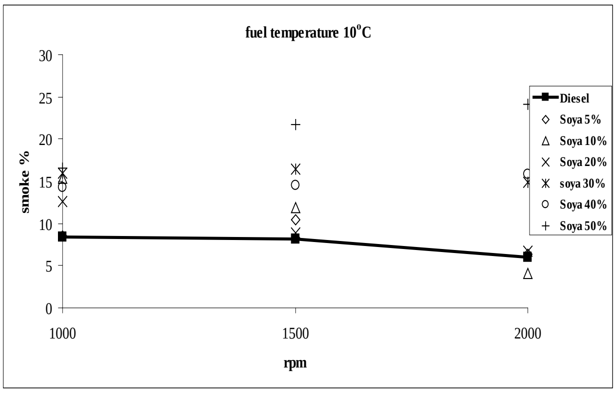


Fig. 4 The smoke variation on different rpm regarding the mixture at 10oC fuel temperature

Diesel presented the best behavior at smoke emissions in regard to the other mixtures. (Fig. 4)

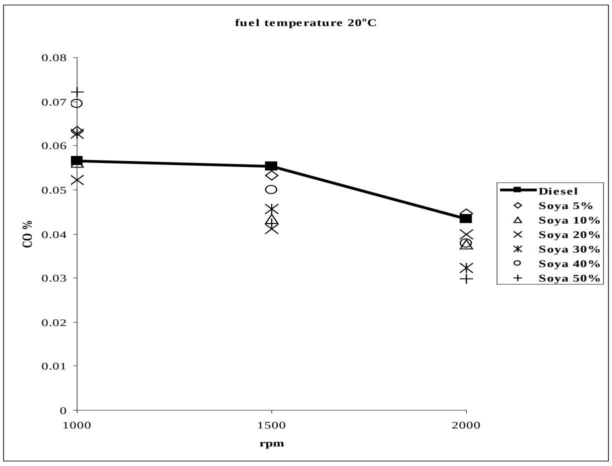


Fig. 5 The CO variation on different rpm regarding the mixture at 20oC fuel temperature

From Figure 5, it can be noticed that until 1500 rpm the best behavior presented in the mixture of Soya20, while at

2000 rpm the best behavior presented in the mixture of Soya50.

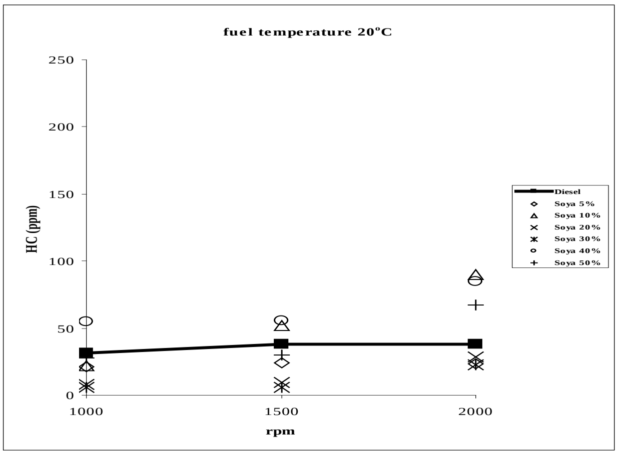


Fig. 6 The HC variation on different rpm regarding the mixture at 20oC fuel temperature

As far as HC emissions are concerned, the best behavior in all engine rounds presented in the mixtures of Soya20 and Soya30. (Fig. 6)

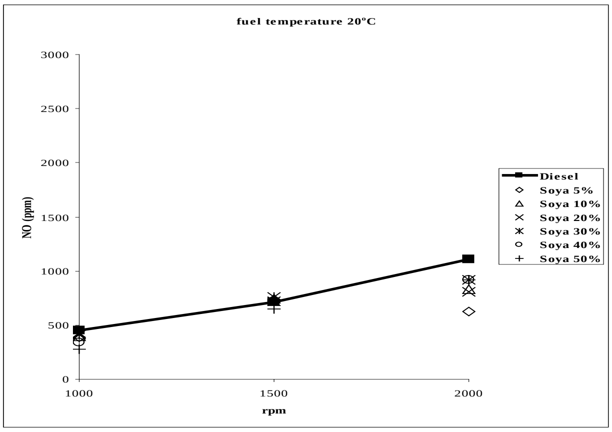


Fig. 7 The NO variation on different rpm regarding the mixture at 20oC fuel temperature

From Figure 7, it can be said that the mixture of Soya50 presented positive behavior (reduction) until 1500 rpm as NO emissions are concerned, as well as the mixture of Soya5.

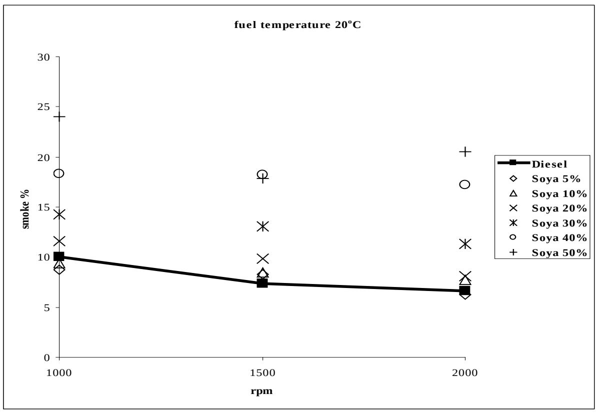


Fig. 8 The smoke variation on different rpm regarding the mixture at 20oC fuel temperature

Diesel showed the least smoke emissions in all engine rounds. (Fig. 8)

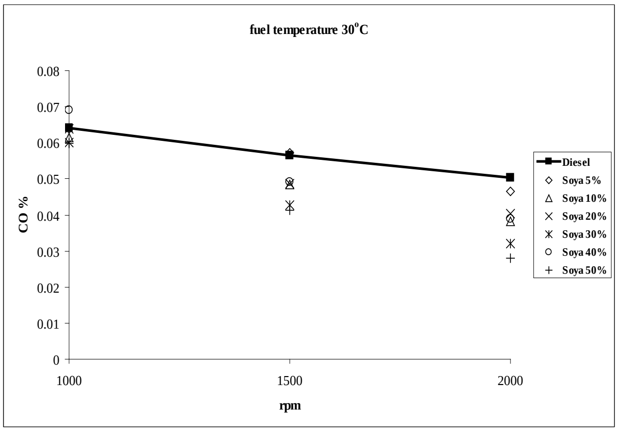


Fig. 9 The CO variation on different rpm regarding the mixture at 30oC fuel temperature

The highest CO emissions presented in diesel, while the least CO emissions presented in the mixtures of Soya30, Soya40 and Soya50. (Fig.9)

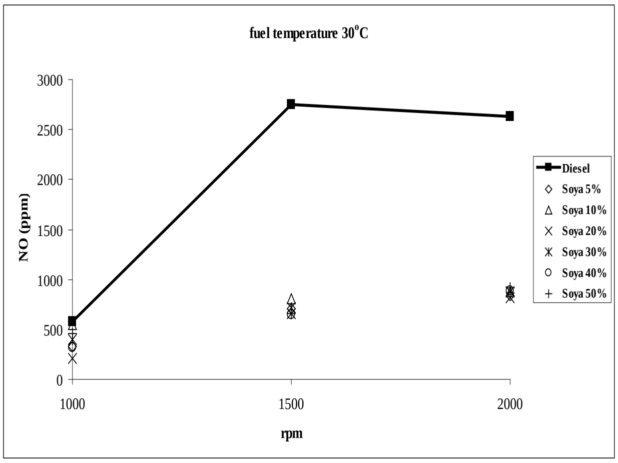


Fig. 10 The HC variation on different rpm regarding the mixture at 30oC fuel temperature

The mixture of Soya20 and Diesel presented better behavior in regards to HC emissions. (Fig. 10)

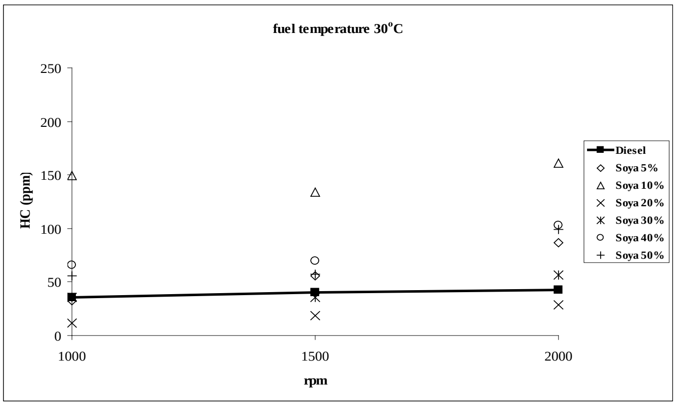


Fig. 11 The NO variation on different rpm regarding the mixture at 30oC fuel temperature

The mixture of Soya20 presented very good behavior (reduction) as far as NO emissions are concerned. (Fig.11)

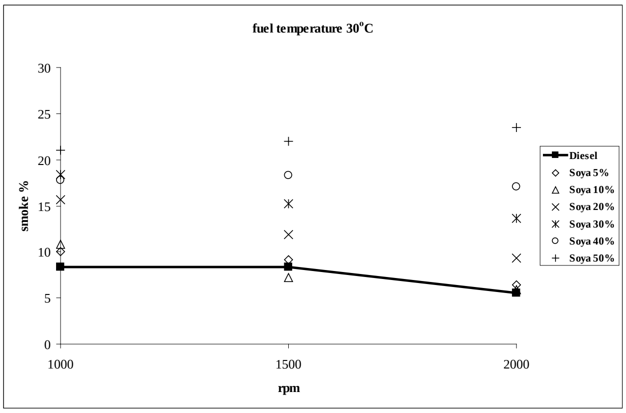


Fig. 12 The smoke variation on different rpm regarding the mixture at 30oC fuel temperature

The least smoke emissions presented in diesel and mixture of Soya10 (Fig. 12)

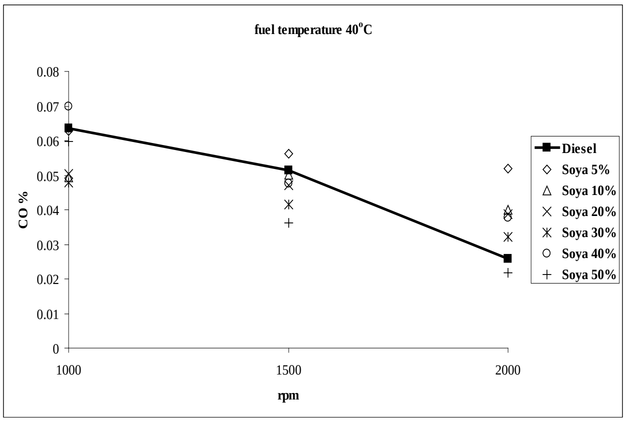


Fig. 13 The CO variation on different rpm regarding the mixture at 40oC fuel temperature

The least CO emissions were in the mixtures of Soya40 and Soya50. Also Diesel had lower CO emissions at 2000 rpm (Fig. 13).

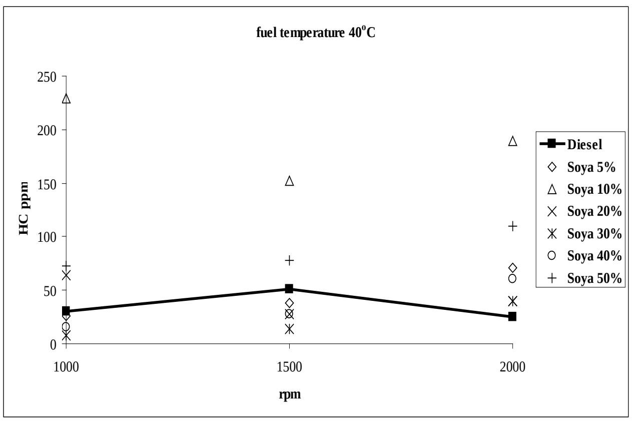


Fig. 14 The HC variation on different rpm regarding the mixture at 40oC fuel temperature

The best behavior regarding HC emissions was found in the mixtures of Soya20, Soya30 and Soya40 (Fig. 14)

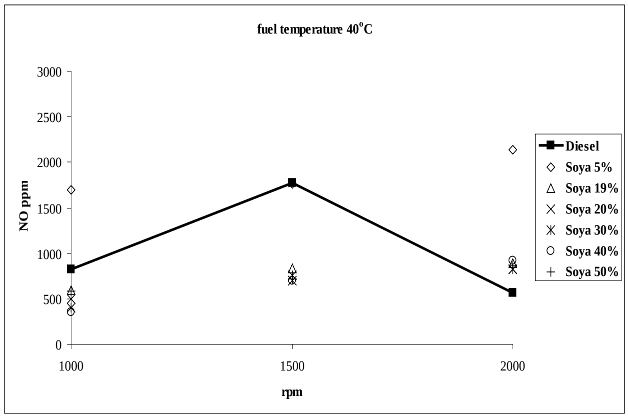


Fig. 15 The NO variation on different rpm regarding the mixture at 40oC fuel temperature

The best behavior regarding NO emissions was found the mixtures of Soya20, Soya30 and Soya40 (Fig. 15).

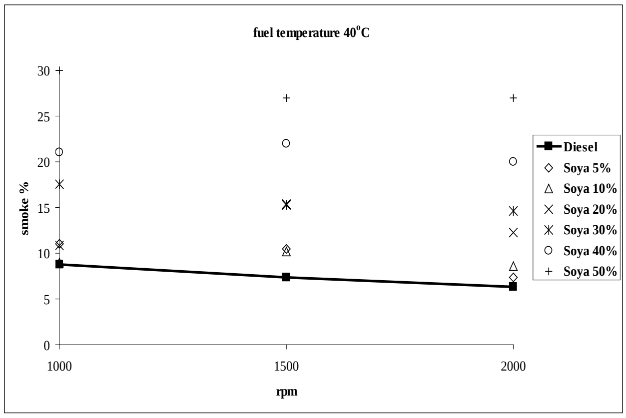


Fig. 16 The smoke variation on different rpm regarding the mixture at 40oC fuel temperature

From figure 16, it can be said that diesel presented the least smoke emissions (Fig. 16).

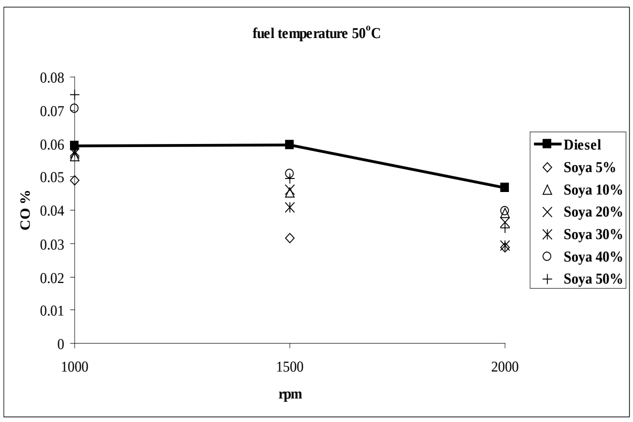


Fig. 17 The CO variation on different rpm regarding the mixture at 50oC fuel temperature

The best behavior was in the mixtures of Soya5, Soya10 and Soya30 in regards to CO emissions, while diesel presented the worst behavior (Fig. 17).

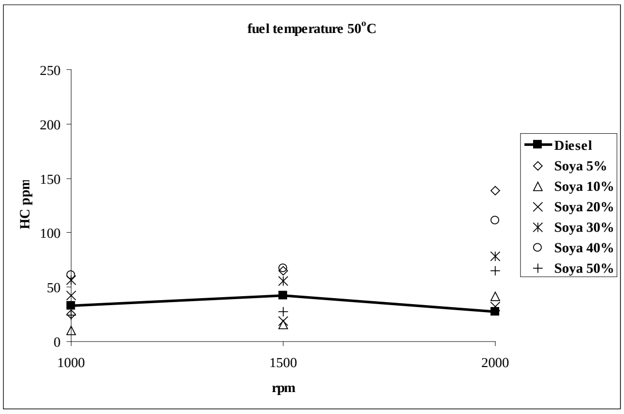


Fig. 18 The HC variation on different rpm regarding the mixture at 50oC fuel temperature

The mixtures of Soya10 and Soya20 presented the least HC emissions. Diesel presented good behavior, too (Fig. 18).

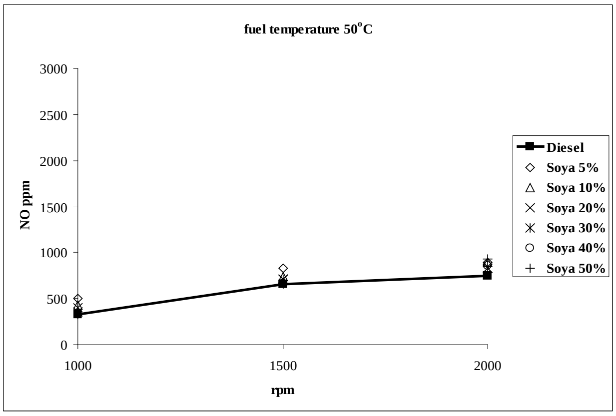


Fig. 19 The NO variation on different rpm regarding the mixture at 50oC fuel temperature

From Figure 19, it can be concluded that diesel presented the best behavior.

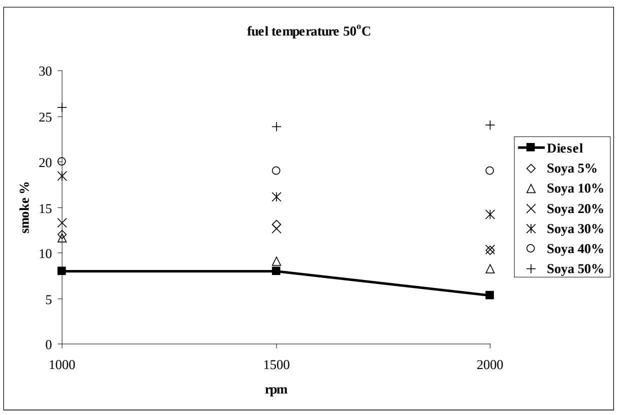


Fig. 20 The smoke variation on different rpm regarding the mixture at 50oC fuel temperature

From Figure 20, it can be said that diesel presented the least smoke emissions.

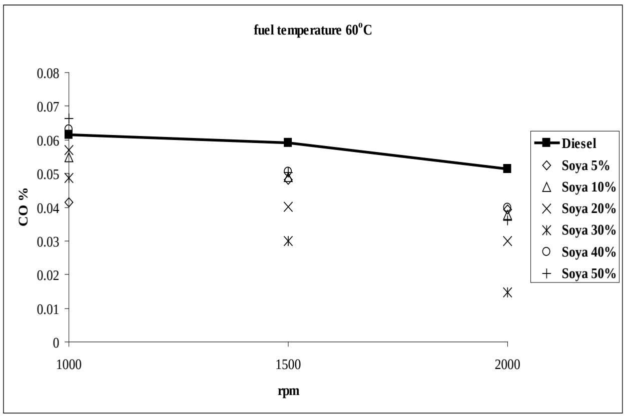


Fig. 21 The CO variation on different rpm regarding the mixture at 60oC fuel temperature

The best behavior regarding CO emissions above all the mixtures had the mixtures of Soya20 and Soya30. Diesel was the one with the worst behavior (Fig. 21).

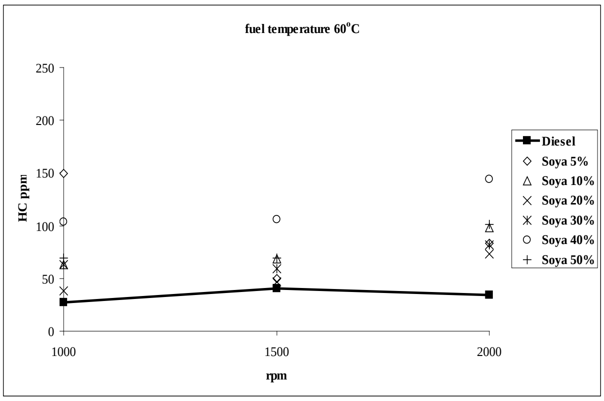


Fig. 22 The HC variation on different rpm regarding the mixture at 60oC fuel temperature

From Figure 22, it can be said that Diesel presented the least HC emissions.

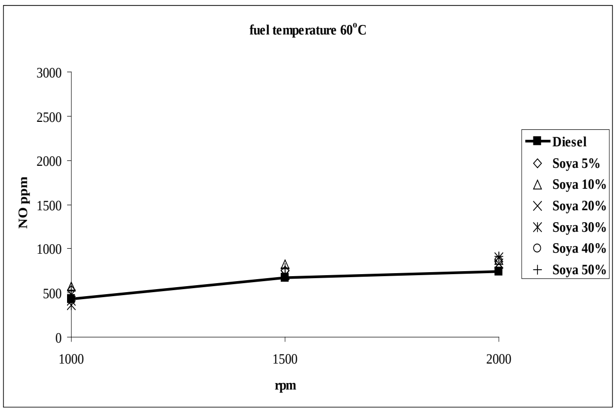


Fig. 23 The NO variation on different rpm regarding the mixture at 60oC fuel temperature

From Figure 23 it can be concluded that diesel presented the least NO emissions.

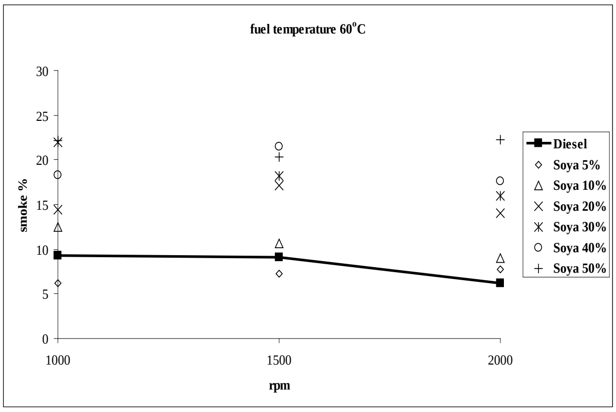


Fig. 24 The smoke variation on different rpm regarding the mixture at 50oC fuel temperature

The least smoke emissions were in the mixtures of Soya5, Soya10, Soya20 and Diesel (Fig. 24).

From the above figures, it can be noticed that the smoke was increased for all the mixtures in relation to diesel. Also it can be seen that the use of different mixtures can constitute changes to CO, HC, NO. It is important to mention that there were no changes in the rounds of the engine, as well as in the supply of water with the use of mixtures. Finally as far as the consumption is concerned, it has not been observed changes with the use of different mixtures.

III. CONCLUSION

Air pollution is something that we cannot really ignore nowadays. This is evident from the moment we step out of our house and are greeted with black colored smoke that hit us directly. This smog is not due to climate but rather due to each and every one of us. The use of mixture of diesel and soy oil didn't cause any changes in the rounds of the engine, in the consumption, as well as in the supply of water. On the other hand it constituted changes to CO, HC, NO and smoke too. CO emissions are reduced when the fuel temperature and the percentage of soy oil in diesel are increased. The HC emissions are increased when the fuel temperature is 60^oC. The NO emissions are influenced by the fuel temperature and the percentage of soy oil in diesel and they get high prices when the fuel temperature is 30^oC. Finally, the exhaust temperature is not affected either by the percentage of soy oil in diesel or by the fuel temperature.

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