Behaviour of Gas Emissions on Mixtures of Diesel & Olive Seed Oil in Relation to Different Temperatures

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Abstract: - Fuel quality has very strongly influences in diesel engine emissions like HC, CO, NOx and particulate emissions. This is due to the fact that fuel emissions depend on the formation and the combustion of the mixture. At the present paper will be examined the behavior of gas emissions in a four stroke engine when changes the temperature of fuel. The temperatures of fuel that has been used for the experiment were 10^{o}C, 20^{o}C, 30^{o}C, 40^{o}C, 50^{o}C and 60^{o}C. In addition, it has been used the following mixtures of fuels: diesel-5% olive seed oil, diesel-10% olive seed oil, diesel-20% olive seed oil, diesel-30% olive seed oil, diesel-40% olive seed oil, diesel-50% olive seed oil. For the above temperatures, it has been measured the gas emissions of carbon monoxide (CO), hydrocarbons (HC), nitrogen monoxide (NO), mainly emissions (smoke) and also it has been examined the fuel consumption.

1.INTRODUCTION

Air pollution is any gas or particulate that originates from both natural and anthropogenic sources. Anthropogenic sources mostly related to burning different kinds of fuel for energy. Moreover, the exhaust from burning fuels in automobiles, homes and industries. Natural sources related to dust from natural source, usually large areas of land with little or no vegetation, the smoke and carbon monoxide from wildfires, volcanic activity etc. The main causes by air pollution related deaths include aggravated asthma, bronchitis, emphysema, lung and heart diseases to human beings. There are several many types of air pollutant [1,2]. These include smog, acid rain, the greenhouse effect and holes in the ozone layer. The atmospheric conditions such as the wind, rain, stability affect the transportation of the air pollutant [3,4]. Furthermore, depending on the geographical location temperature, wind and weather factors, pollution is dispersed differently [5.6]. For instance, the wind and rain may effectively dilute pollution to relatively safe concentrations despite a fairly high rate of emissions. In contrast when atmospheric conditions are stable relatively low emissions can cause buildup of pollution to hazardous levels. The quality of fuel affects diesel engine emissions (HC, CO, NOx and particulate emissions) very strongly. The fuel that is used in diesel engines is a mixture of hydrocarbons and its boiling temperature is approximately 170 ^{o}C to 360^{o}C [4]. Diesel fuel emissions composition and characteristics depend on mixture formation and combustion. In order to compare the quality of fuels the following criteria are tested: ketene rating, density, viscosity, boiling characteristics, aromatics content and sylph content. For environmental compatibility, the fuel must have low density, low content of aromatic compounds, low sylph content and high ketene rating [6,7,8]. The question that arises is how a four-stroke diesel engine behaves on the side of pollutants and operation, when it uses diesel –olive seed oil mixtures as fuel in different temperatures.

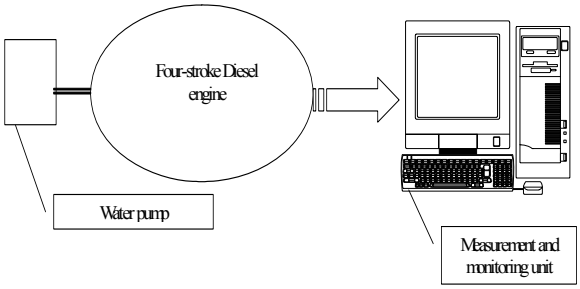
2.EXPERIMENTAL SET-UP

Specifically it has been used fuel mixture: diesel-5% olive seed oil (Pyrin5%), diesel-10% olive seed oil (Pyrin10%), diesel-20% olive seed oil (Pyrin20%), diesel-30% olive seed oil (Pyrin30%), diesel-40% olive seed oil (Pyrin40%), diesel-50% olive seed oil (Pyrin50%), at different temperatures: 10^{o}C, 20^{o}C, 30^{o}C, 40^{o}C, 50^{o}C and 60^{o}C in a four-stroke diesel engine named Ruggerini type RD-80, volume 377cc, and power 8.2hp/3000rpm, who was connected with a pump of

water centrifugal. Measurements were made when the engine was function on 1000, 1500, and 2000rpm.

During the experiments, it has been counted:

- The percent of (%) (CO)
- To ppm(parts per million) HC
- To ppm(parts per million) NO
- The percent of smoke
- Fuel consumption



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. The NO emissions were measured by a Single GAS Analyser SGA92-NO.

3.EXPERIMENTAL RESULTS

The experimental results are shown at the following figures:

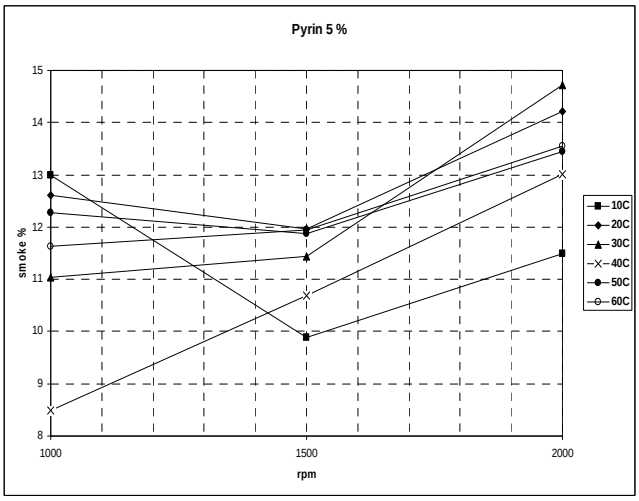


Figure 1. The %smoke average value variation on different rpm regarding to the fuel temperature about the diesel-5%seed oil mixture.

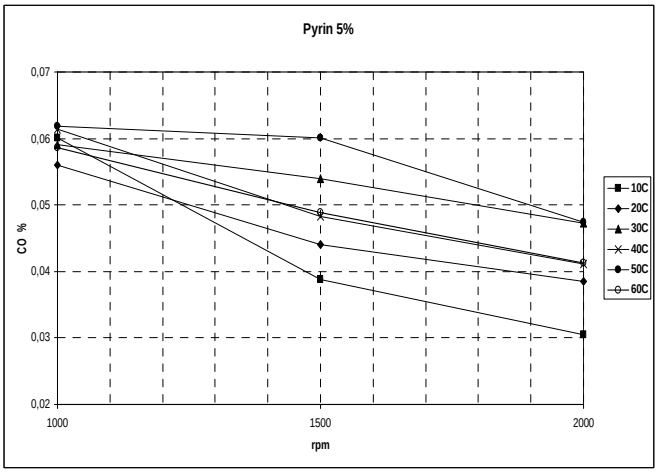


Figure 2. The CO average value variation on different rpm regarding to the fuel temperature about the diesel-5%seed oil mixture.

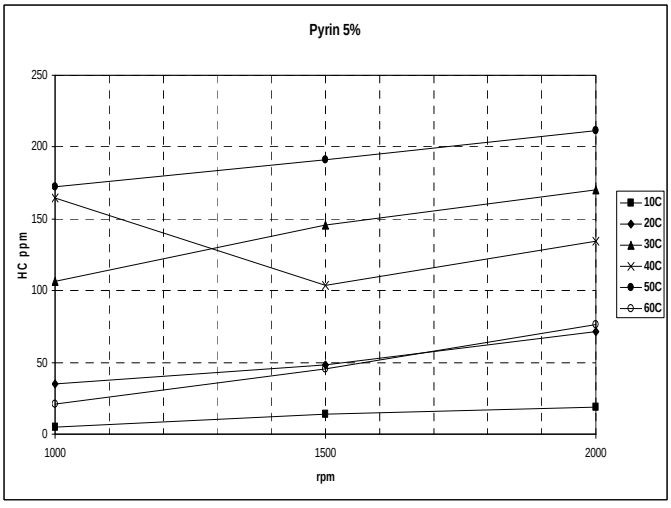


Figure 3. The HC average value variation on different rpm regarding to the fuel temperature about the diesel-5%seed oil mixture.

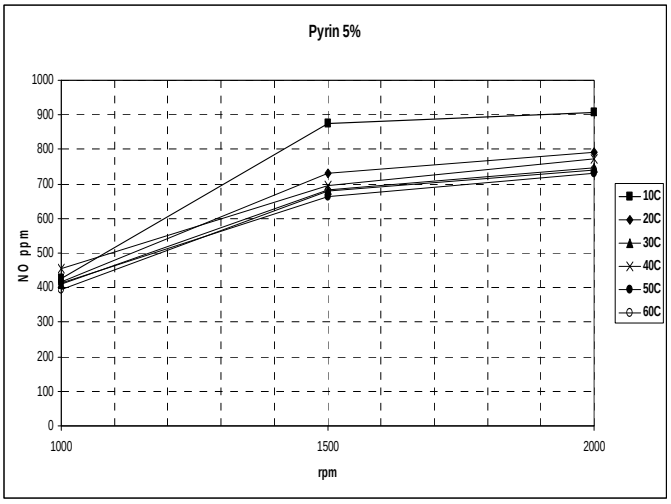


Figure 4. The NO average value variation on different rpm regarding to the fuel temperature about the diesel-5%seed oil mixture.

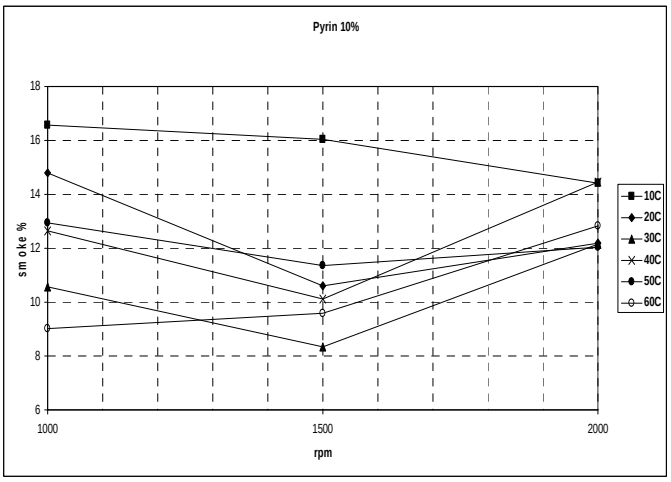


Figure 5. The %smoke average value variation on different rpm regarding to the fuel temperature about the diesel-10%seed oil mixture.

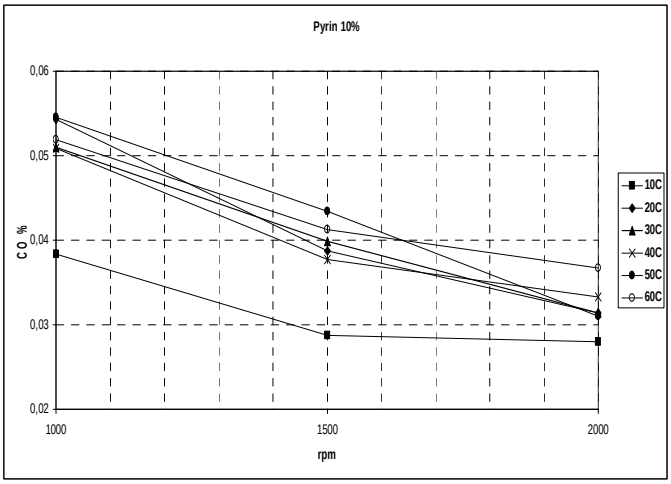


Figure 6. The CO average value variation on different rpm regarding to the fuel temperature about the diesel-10%seed oil mixture.

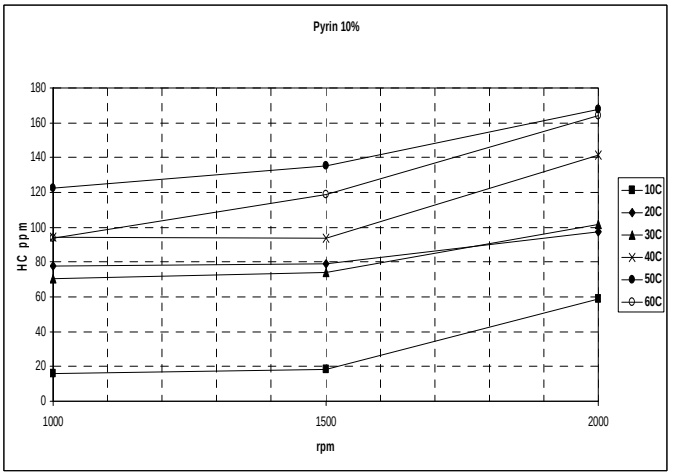


Figure 7. The HC average value variation on different rpm regarding to the fuel temperature about the diesel-10%seed oil mixture.

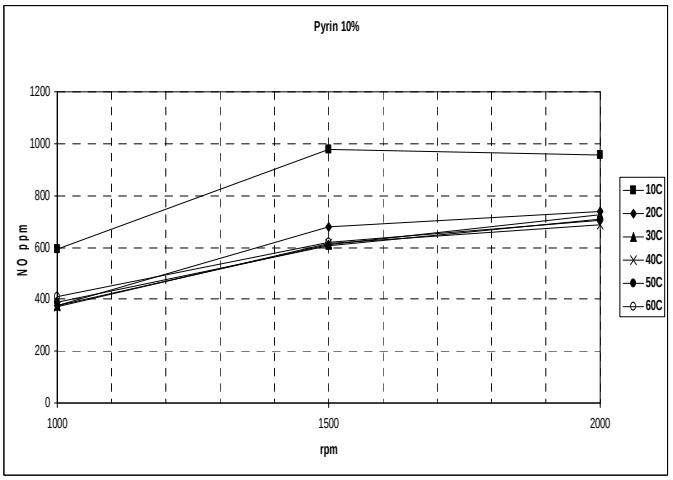


Figure 8. The NO average value variation on different rpm regarding to the fuel temperature about the diesel-10%seed oil mixture.

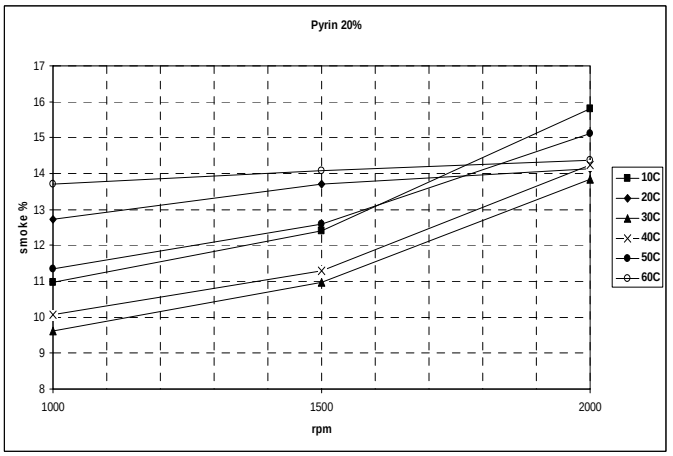


Figure 9. The %smoke average value variation on different rpm regarding to the fuel temperature about the diesel-20%seed oil mixture

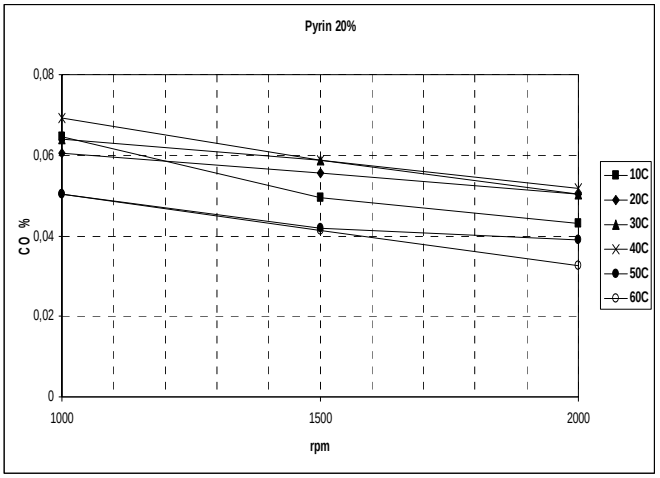


Figure 10. The CO average value variation on different rpm regarding to the fuel temperature about the diesel-20%seed oil mixture

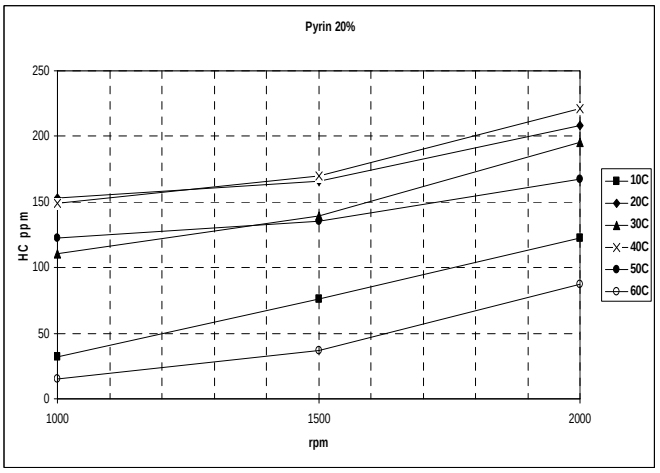


Figure 11. The HC average value variation on different rpm regarding to the fuel temperature about the diesel-20%seed oil mixture

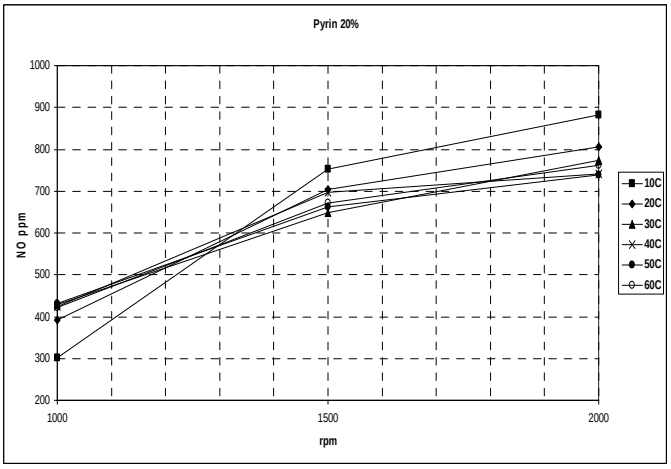


Figure 12. The NO average value variation on different rpm regarding to the fuel temperature about the diesel-20%seed oil mixture

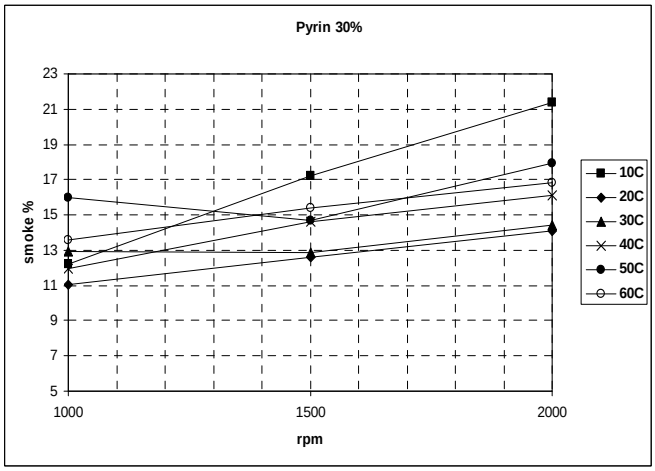


Figure 13. The %smoke average value variation on different rpm regarding to the fuel temperature about the diesel-30%seed oil mixture

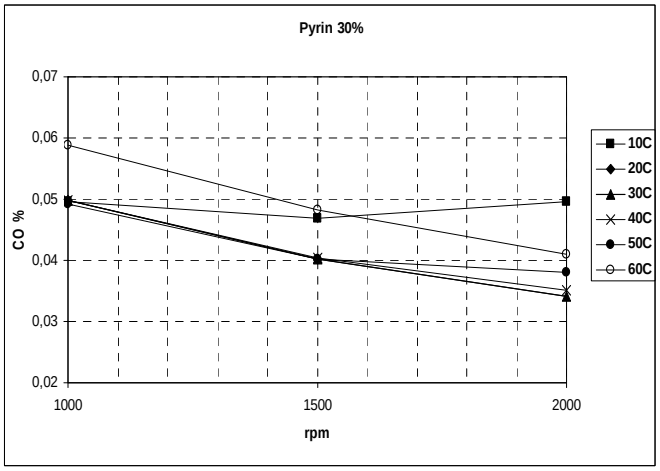


Figure 14. The CO average value variation on different rpm regarding to the fuel temperature about the diesel-30%seed oil mixture

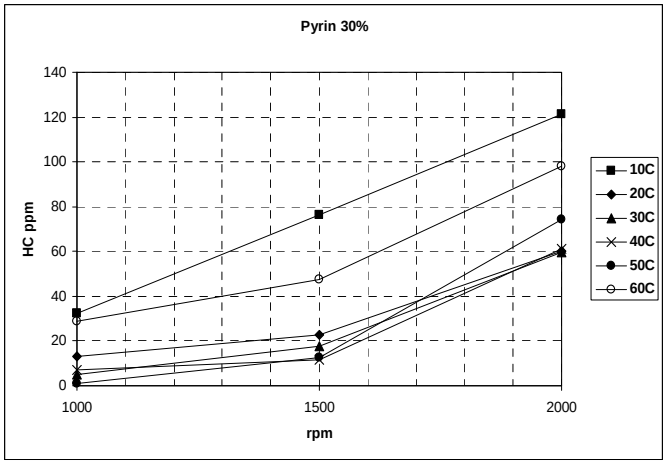


Figure 15. The HC average value variation on different rpm regarding to the fuel temperature about the diesel-30%seed oil mixture

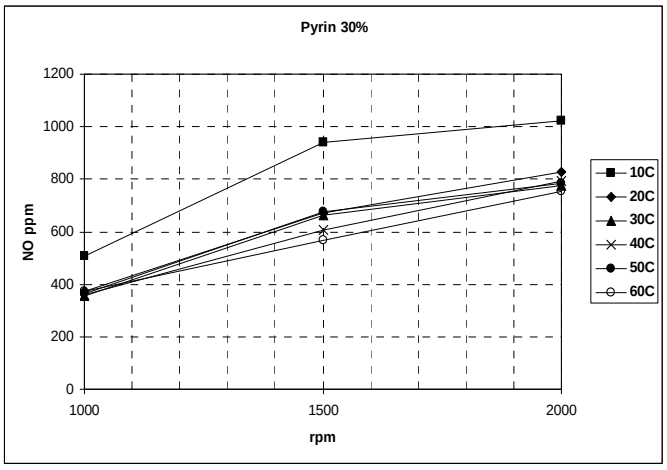


Figure 16. The NO average value variation on different rpm regarding to the fuel temperature about the diesel-30%seed oil mixture

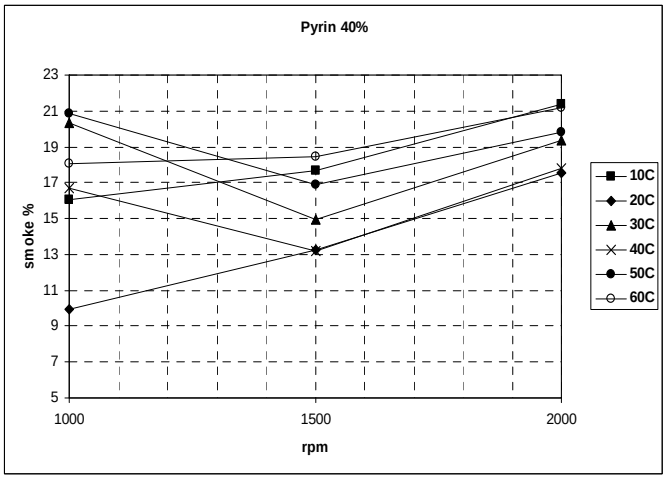


Figure 17. The %smoke average value variation on different rpm regarding to the fuel temperature about the diesel-40%seed oil mixture

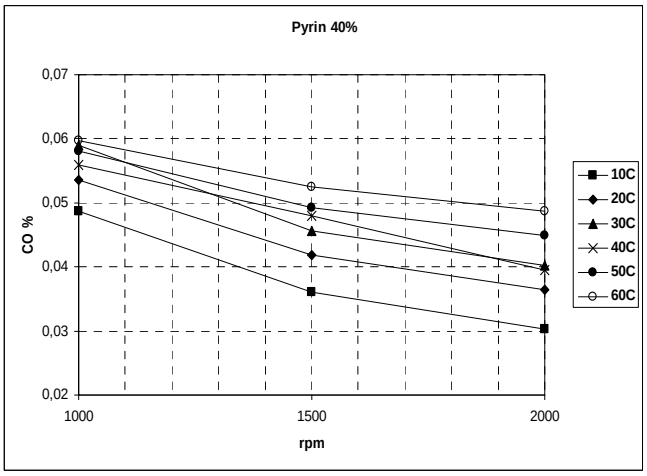


Figure 18. The CO average value variation on different rpm regarding to the fuel temperature about the diesel-40%seed oil mixture

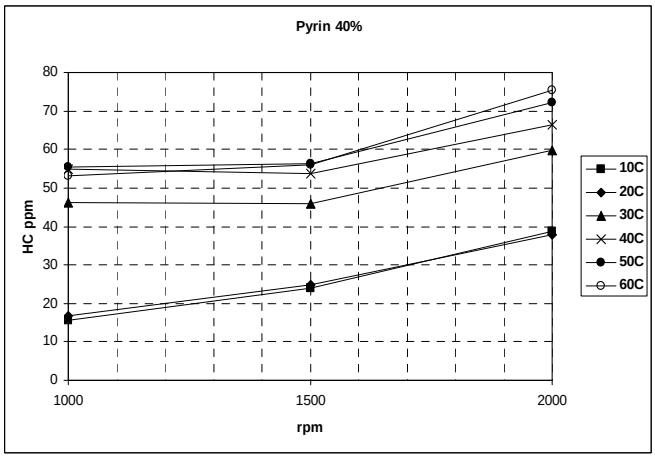


Figure 19. The HC average value variation on different rpm regarding to the fuel temperature about the diesel-40%seed oil mixture

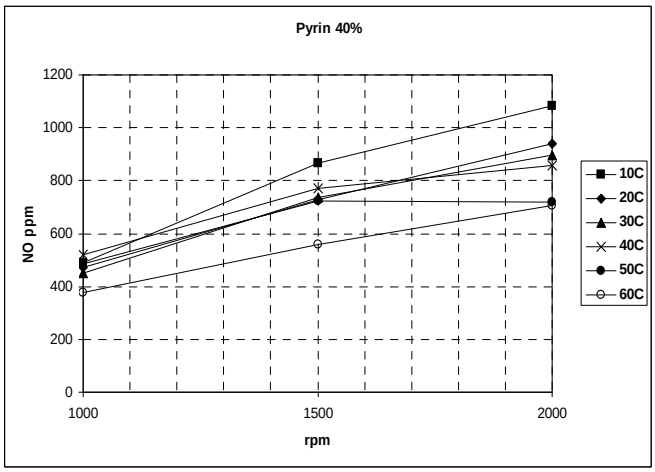


Figure 20. The NO average value variation on different rpm regarding to the fuel temperature about the diesel-40%seed oil mixture

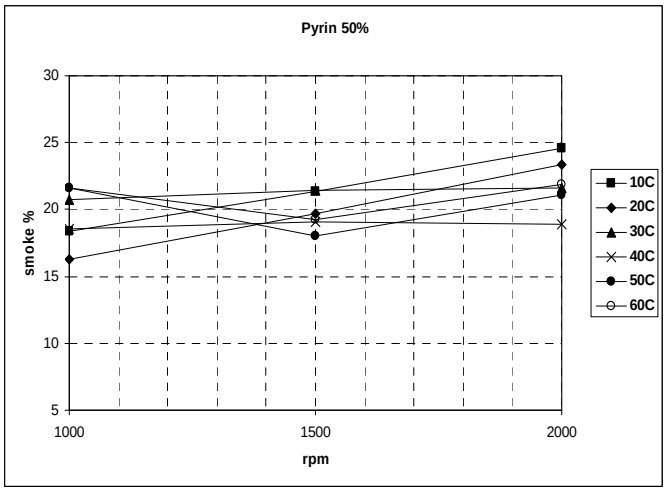


Figure 21. The % smoke average value variation on different rpm regarding to the fuel temperature about the diesel-50%seed oil mixture

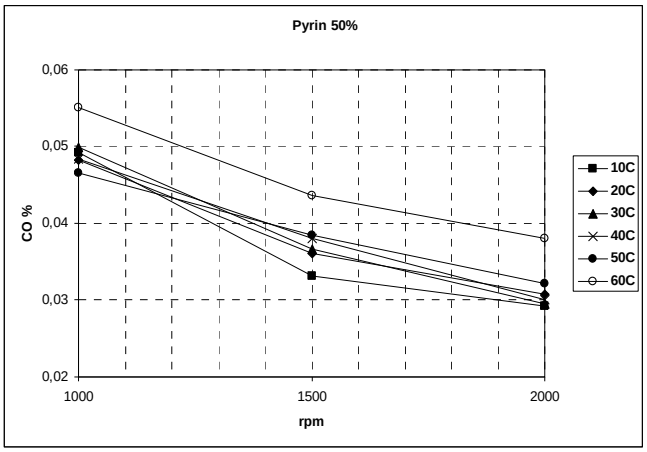


Figure 22. The CO average value variation on different rpm regarding to the fuel temperature about the diesel-50%seed oil mixture

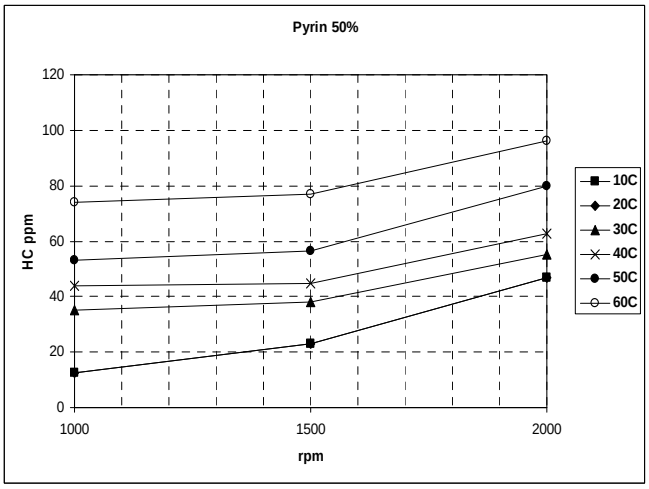


Figure 23. The HC average value variation on different rpm regarding to the fuel temperature about the diesel-50%seed oil mixture

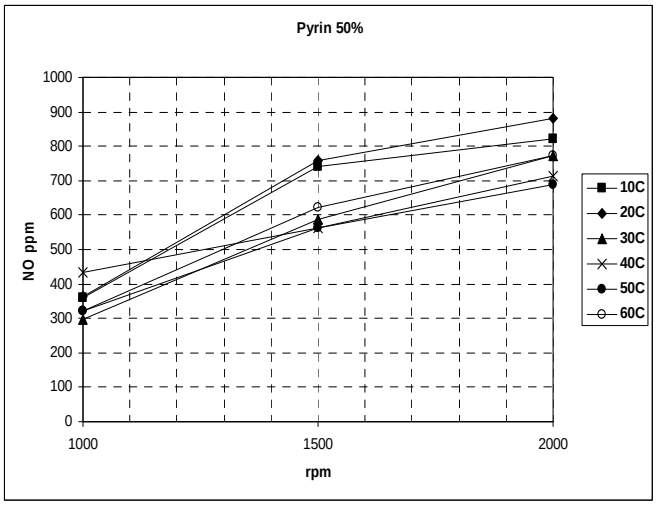


Figure 24. The NO average value variation on different rpm regarding to the fuel temperature about the diesel-50%seed oil mixture

The diesel-seed oil mixtures have different viscosity due to different content of seed oil. If ´´η´´ stands for viscosity, then we have[9]:

$$\eta_{pyrin5\%} < \eta_{pyrin10\%} < \ldots\ldots\ldots\ldots\ldots\ldots < \eta_{pyrin40\%} < \eta_{pyrin50\%}$$

Also, the viscosity varies with the temperature and we have[9]:

$$\eta_{pyrin5\%(10^{o}C)} > \eta_{pyrin5\%(20^{o}C)} > \ldots\ldots\ldots\ldots\ldots\ldots > \eta_{pyrin5\%(60^{o}C)}$$

. .
. .
. .

$$\eta_{pyrin50\%(10^{o}C)} > \eta_{pyrin50\%(20^{o}C)} > \ldots\ldots\ldots\ldots\ldots\ldots > \eta_{pyrin50\%(60^{o}C)}$$

Regarding the consumption small changes they were observed with the change of temperature, and because the small difference they do not require mentioning.

The change of temperature of fuel in the various mixtures, it has the following results:

Smoke:

- Pyrin 5%: is observed the better behavior in the cases 1500rpm/30^{o}C and 2000rpm/30^{o}C. While the bad behavior it is observed in the case of 1000rpm/10oC. This likely it happens because in the case of 1000rpm/30^{o}C the engine is in the start and is cold.

- Pyrin 10%: is observed the better behavior in the cases 1500rpm/10^{o}C and 2000rpm/10^{o}C. While the bad behavior it is observed in the case of 10^{o}C in all rpm.

- Pyrin 20%: is observed the better behavior in the case of 30^{o}C in all rpm. While the bad behavior it is observed in the case of 2000rpm/10^{o}C.

- Pyrin 30%: is observed the better behavior in the case of 20^{o}C in all rpm. While the bad behavior it is observed in the cases 1500rpm/10^{o}C, 2000rpm/10^{o}C.

- Pyrin 40%: is observed the better behavior in the case of 20°C in all rpm. While the bad behavior it is observed in the cases 1500rpm/10°C, 2000rpm/10°C

- Pyrin 50%: is observed the better behavior in the case of 1500rpm/50°C. While the bad behavior it is observed in the cases 1500rpm/10°C, 2000rpm/10°C

CO:

- Pyrin 5%: is observed the better behavior in the cases 1500rpm/10°C and 2000rpm/10°C while in the case of 1000rpm/10°C is observed an increase of CO.

- Pyrin 10%: is observed the better behavior in the case of 10°C in all rpm, while in the cases 1000rpm/50°C, 1500rpm/50°C is observed an increase of CO.

- Pyrin 20%: is observed the better behavior in the case of 60°C in all rpm, while in the cases of 40°C in all rpm, is observed the higher increase of CO.

- Pyrin 30%: is observed the better behavior in the case of 30°C in all rpm, while in the case of 1000rpm/60°C, 1500rpm/60°C is observed the higher increase of CO.

- Pyrin 40%: is observed the better behavior in the case of 10°C in all rpm, while in the cases of 60°C in all rpm is observed the higher increase of CO.

- Pyrin 50%: is observed the better behavior in the cases 1500rpm/10°C, 2000rpm/10°C, while in the cases of 60°C in all rpm is observed the higher increase of CO.

HC:

- Pyrin 5%: is observed the better behavior in the case of the temperature of fuel 10°C in all rpm. While the bad behavior is presented in the case where the temperature of fuel is 50°C.

- Pyrin 10%: is observed the better behavior in the case of the temperature of fuel 10°C in all rpm. While the bad behavior is presented in the case where the temperature of fuel is 50°C.

- Pyrin 20%: is observed the better behavior in the case of the temperature of fuel 60°C in all rpm. While the bad behavior is presented in the case where the temperature of fuel is 40°C.

- Pyrin 30%: is observed the better behavior in the case of the temperature of fuel 50°C in all rpm. While the bad behavior is presented in the case where the temperature of fuel is 10°C.

- Pyrin 40%: is observed the better behavior in the case of the temperature of fuel 30°C in all rpm. While the bad behavior is presented in the cases 1500rpm/ 60°C and 2000rpm/ 60°C.

- Pyrin 50%: is observed the better behavior in the case of the temperature of fuel 10°C in all rpm. While the bad behavior is presented in the cases 1500rpm/ 20°C and 2000rpm/ 20°C.

NO:

- Pyrin 5%: is observed the better behavior in the case of the temperature of fuel 60°C in all rpm. While the bad behavior is presented in the cases 1500rpm/10°C and 2000rpm/10°C .

- Pyrin 10%: is observed the better behavior in the case of the temperature of fuel 40°C in all rpm. While the bad behavior is presented in the case of 10°C in all rpm.

- Pyrin 20%: is observed the better behavior in the cases 1000rpm/10°C, 1500rpm/30°C, 2000 rpm/30°C. While the bad behavior is presented in the cases 1500rpm/10°C, 2000rpm/10°C .

- Pyrin 30%: is observed the better behavior in the case of the temperature of fuel 60°C in all rpm. While the bad behavior is presented in the case where the temperature of fuel is 10°C.

- Pyrin 40%: is observed the better behavior in the case of the temperature of fuel 30°C in all rpm. While the bad behavior is presented in the case of 2000rpm/60°C.

- Pyrin 50%: is observed the better behavior in the cases 1000rpm/30°C, 2000rpm/50°C . While the bad behavior is presented in the cases 1500rpm/20°C, 2000rpm/20°C.

4.CONCLUSION

From all the above observations, it can be understood that the temperature of fuel influences the viscosity of the fuel and also the gas emissions. Each one however in a different way, without can no one determine that in a specific temperature will observed the same change in all gas emissions (smoke, CO, HC, NO). Also it should be taken into consideration that the fuels that are used are diesel-seed oil mixtures with different contents and different viscosity in the same temperature. In any case, it is important that the temperature of fuel it influences the concentration of gas emissions.

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