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THE THERMOGRAVIMETRIC ANALYSIS OF DIFFERENT BLENDS OF BIODIESEL OF RAPESEED AND PETRODIESEL

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Abstract: *The analysis of a engine with ignition through compression fueled with biodiesel show some properties which recommends this type of fuel for internal combustion engines. We present thermo gravimetric analyses for different blends of biodiesel and petrodiesel. The experimental data shows a high temperature of vaporization when is used blend with high concentration in biodiesel. In experimental researches we use biodiesel of rapeseed and EuroL Diesel.*

Key words: *biodiesel, termogravimatric analysis, petrodiesel;*

1. Introduction

Biodiesel is a renewable biofuel made up of methyl or ethyl esters of long chain fatty acids; if methyl ester is used, it is named FAME (Fatty acid methyl ester).

It is obtained from the chemical reaction between methanol (and bioethanol) with vegetable oils (rapeseed, sunflower, soybeans, and palm).

It doesn't contain sulphur and, with respect to diesel obtained from petroleum, it diminishes greenhouse gas emissions (amongst others CO_2), carbon monoxide (CO), particles (PM) and other polluting products.

2. Thermogravimetric analyses

Thermal analysis represents a sum of methods of investigation in which physical or chemical properties of a substance, a mixture of substances and / or of reaction products or mixtures of reaction products are measured as a function of temperature or time.

To make these determinations technical analysis the product temperature is modified after a well established and well controlled process.

During the temperature change is measured continuously the physical property wanted, the result is usually a graph obtained automatically that contains on the ordinal the modification the physical property and on abscise the modification in temperature.

The thermogravimetric PYRIS Diamond TG / DTA are a device that combines two systems: thermo balance (TGA) and differential thermal analysis (DTA).

Experimental data were processed using Pyris software. It was performed a heating with 10^0C per minute starting of the temperature of the room with a flux of air 150 ml / min in aluminum crucible [3] until 600^0C.

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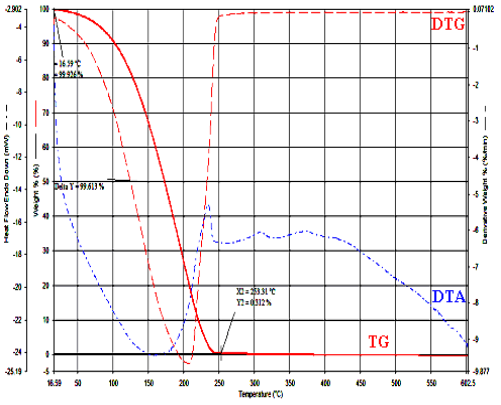

Fig.1. *Thermo diagram for Diesel*

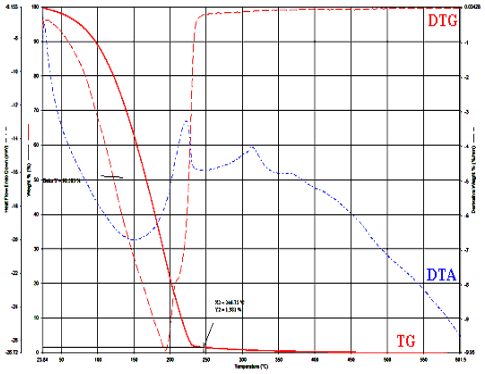

Fig.2. *Thermo diagram for B10*

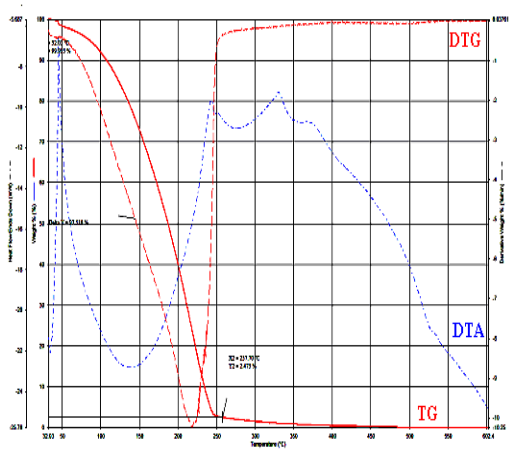

Fig.3. *Thermo diagram for B20*

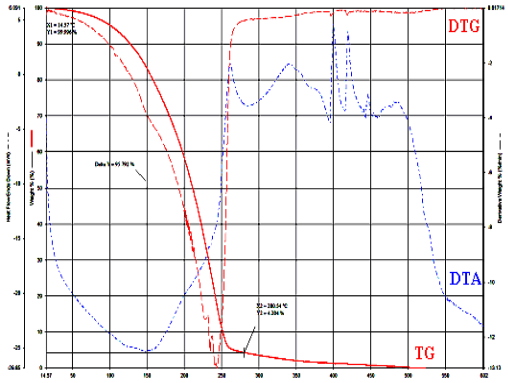

Fig.4. *Thermo diagram for B40*

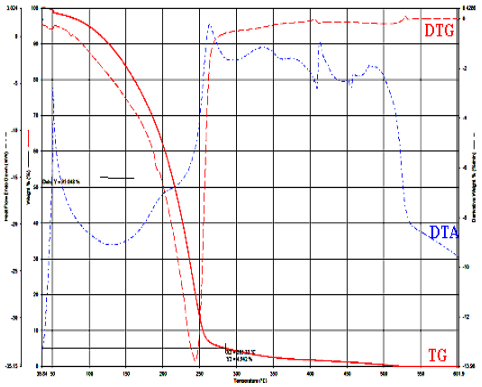

Fig.5. *Thermo diagram for B50*

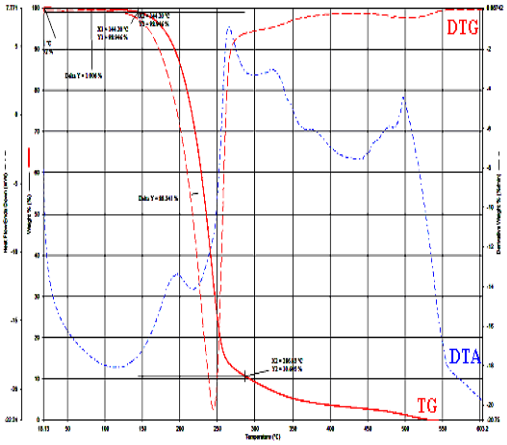

Fig.6. *Thermo diagram for biodiesel of rapeseed*

3. Interpretation and discussion

In the petroleum composition enters hydrocarbons, aromatics and mixed with distillation limits between 200 and 400^{0}C.

In general diesel molecules of different lengths have different properties and different behaviors.

Chains of molecules that are longer have higher boiling points. They come generally from atmospheric distillation of crude oil and consist of mixtures of hydrocarbons that have molecules in them range from 10 to 19 carbon atoms.

Fuels for diesel engines is characterized by properties opposite to the gasoline respectively hydrocarbon components must oxidize easily with the formation of peroxides and other products of incomplete oxidation, for the auto ignition to start easily.

In the TG curve of diesel Figure 1 fuel it is notice a loss of weight up to 16.59° C of 74% and then a rapid weight loss (99,613%) at 16.59° C to 253.31° C. In the DTG curve are observed the speed of mass loss rate with a peak maximum at 210° C.

Fractions containing less carbon evaporate most quickly. It can be seen that petrodiesel is completely evaporated at a temperature of approximately 253° C, of the initial sample remaining 0,312% by weight.

In the DTA curve is observed an endothermic process at 150° C and an exothermic peak at 230° C. At a temperature of 255^{0}C occurs the carbonization of the sample. The weight loss is approximately 99.99%.

The TG curve of B10 Figure 2 shows a level of thermal stability at 300^{0}C with three stages of thermal decomposition. The first takes place in the 30-246,75^{0}C with a weight loss of about 98,585% with the volatilization of methyl esters and light factions of carbon. The second is easier to 246,75^{0}C up to 350^{0}C with a weight loss of about 1% by the decomposition of mono, di and triglycerides and methyl esters of fatty acids with high carbon content. And finally the carbonization of the sample is from 350^{0}C to 470^{0}C with a weight loss of less than 0.1%. The total loss was about 99.99%. On the DTA curve is observed several phenomena: an endothermic process between 30^{0}C and 200^{0}C and two exothermic processes at 225^{0}C and 320^{0}C.

On the DTG curve are observed the maximum speed of weight loss at 185^{0}C. At a temperature of 460^{0}C the sample is carbonized.

The TG curve of B20 Figure 3 shows a level of stability up to32,05^{0}C with three stages of thermal decomposition.

The first takes place between 30,05-257,70^{0}C with a weight loss of about 97,518% with the volatilization of methyl esters and light factions of carbon.

The second is easier to 257,70^{0}C at 430^{0}C with a weight loss of about 2% by the decomposition of mono, di and triglycerides and methyl esters of fatty acids with high carbon content. And finally carbonization of the sample is from 430^{0}C to 510^{0}C with a mass loss below 0.4%.

The total loss of mass was approximately 99.993%. On the DTA curve is observed multiple processes: an endothermic process between 32,05^{0}C and 200^{0}C, and three exothermic processes at 240^{0}C, 330^{0}C and 325^{0}C. On the DTG curve are observed the maximum speed of weight loss at 220^{0}C. At a temperature of 510^{0}C the sample is carbonized.

The TG curve of B40 Figure 4 shows a level of thermal stability at 14,57^{0}C with three stages of thermal decomposition.

The first takes place between 14,57-280,54^{0}C with a weight loss of about 95,792% wit the volatilization of methyl esters and light factions of carbon.

The second is easier to 280,54^{0}C at 450^{0}C with a weight loss of about 4% by the decomposition of mono, di and

triglycerides and methyl esters of fatty acids with high carbon content. And finally the carbonization of the sample is from 450^0C to 510^0C with a mass loss below 0.3%. The total loss was approximately of 99.996%. On the DTA curve is observed multiple processes: an endothermic process between 30^0C and 200^0C and 6 exothermic processes at 260^0C, 340^0C, 400^0C, 420^0C, 440^0C and 480^0C. On the DTG curve are observed the maximum speed of weight loss at 2400C. At a temperature of 510^0C is the carbonization of the sample.

The TG curve of B50 Figure 5 shows a level of thermal stability at 30^0C of three stages of thermal decomposition.

The first takes place in the 30-285,35^{0}C with a weight loss of about 95,058% wit the volatilization of methyl esters and light factions of carbon.

The second is easier to 285,35^{0}C at 450^0C with a weight loss of about 4% by the decomposition of mono, di and triglycerides and methyl esters of fatty acids with high carbon content. And finally carbonization of the sample is from 450^0C to 510^0C with a mass loss below 0.2%. The total loss was approximately 99.996%. On the DTA curve is observed multiple processes: an endothermic process between 30^0C and 200^0C and four exothermic process at 260^0C, 340^0C, 420^0C and 430^0C. On the DTG curve are observed the maximum speed of weight loss at 240^0C. At a temperature of 510^0C the sample is carbonized.

The TG curve of biodiesel from rapeseed Figure 6 shows a level of stability up to 144,20^{0}C with a small mass loss of 1,054% in three stages of thermal decomposition.

The first takes place in the 144,20-286,83^{0}C with a weight loss of about 88,341% with the volatilization of methyl esters.

The second is easier to 286,83^{0}C at 500^0C with a weight loss of about 10% by the decomposition of mono, di and triglycerides and fatty acids with high carbon oleic and linoleic. And finally the carbonization of the sample is from 500^0C to 525^0C with a weight loss of approximately 0.5%. The total loss was approximately 99.946%. On the DTG curve are observed many processes: endothermic to 150^0C and several exothermic processes at 195^0C, 270^0C, 330^0C, 495^0C. On the DTA curve is observed speed loss of mass at 240^0C. At a temperature of 525^{o}C the sample is carbonized.

4. Conclusions

The intervals of distillation conditioned the possibility of vaporization of fuel and complete combustion in the engine.

Compared with petrodiesel the interval of distillation is higher for biodiesel and biodiesel blends which may cause incomplete combustion in the engine with deposit formation.

Biodiesel is safer to handle and store than petrodiesel because of higher temperature of vaporization.

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