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OPTIMAL POSSIBILITIES OF USE OF BIODIESEL IN DIESEL ENGINE PASSENGER CARS OLDER THAN 10 YEARS

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ABSTRACT: The main objective of this work is to be based biodiesel synthesized in this study, starting from different raw materials (rape seed oil and waste cooking oil), setup and a mixture of biodiesel / mineral diesel in an iron ratio, which were then used in diesel engines to measure the concentration exhaust gases exiting the exhaust. Especially exhaust gas composition was measured and especially pure mineral diesel. On the basis of these results was carried out using concentrations of exhaust gases from combustion mixtures (biodiesel/mineral diesel) and pure mineral diesel, to show whether and to what extent a mixture of biodiesel / mineral diesel have less impact on environmental pollution during combustion in diesel engines than it is to influence the combustion of pure mineral diesel. This study should demonstrate that the use of biodiesel fuel in diesel engines older more then 10 years, leads to less environmental pollution, and non break rating diesel engine work unlike pure mineral diesel. Since the environmental pollution by using biodiesel as a fuel less, and it all together should confirm the justification of introducing biodiesel in the cycle of exploitation for vehicles older more then 10 years.
KEYWORDS: biodiesel, mineral diesel, environmental, diesel engine, exhaust gases

INTRODUCTION

Due to the scarcity petroleum and increasing environmental burden of exhaust emissions of motor vehicles, actualize the idea of application of biofuels. The European Union Directive 2003/30/EC states that the obligation to 31 December 2005, must provide at least 2% of biofuels and other renewable fuels in the total amount of fuel for transport purposes (calculated on the energy content), and 5.75% by 31 December 2010 year, which will mean increased multi-growing plants that produce biodiesel. [1]

Production of biodiesel is widely available in most European countries, has started in 1991, in Germany. The first modern experiments and investigate the possibility of using vegetable oil to run vehicles, have started 1973rd year during the first oil crisis. Now it is shown that vegetable oils can be successfully used in diesel engines, but there are certain difficulties. The main cause of the problem, high oil viscosity, quickly discovered and resolved by chemists who are simply adjust the oil transesterification. [2]

Chemical modification or by transesterification of vegetable oils and animal fats, is obtained less fuel viscosity of which is termed a general biodiesel. [2]

In this process, the ester bonds in triglycerides are hydrolysed to form free fatty acids, which react with methanol or ethanol to form ethyl or methyl ester. This process occurs less frequently, less viscous and more volatile fuel. A secondary product of this process is glycerin. Because of these esters and rapeseed basis, biodiesel is commonly known as rapeseed oil methyl ester (ROME). [4]

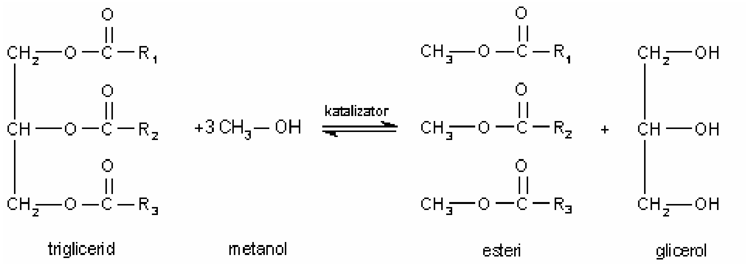

Figure 1. Transesterification of triglycerides with alcohol (methanol) [3]

Today's diesel engines are still compatible for use of biodiesel fuel that can be produced from many renewable resources, such as for example: soybean oil, sunflower, canola, animal fats, marine algae etc. [5]

Today is the world's largest number of vehicles designed combustion engines, particularly that using diesel fuel, provided that their number is still increasing. Such an increase is an important issue

as the dependence on fossil fuels, whose reserves are nearing their end, and the resulting pollution of the environment on which the world has reacted and began to research alternative fuels. [5]
Biodiesel fuel is the only other alternative fuels that can be used in conventional diesel engines with minor modifications to the engine or fuel system. To date, the world carried out many studies on biodiesel as alternative fuel and found a lot of advantages over fossil fuels, especially diesel. [5]

Today, biodiesel is the most widespread alternative fuel in Europe. Biodegradable and not harmful to the environment. Besides the production of biodiesel conditional employment of the local rural population, while reducing impact on oil prices. The use of biodiesel in public transport contributes to reducing emissions of pollutants, which affect the quality of life in urban areas. Biodiesel is technically adequate substitute for diesel of fossil origin, and requires no modifications to diesel engines. The characteristics of biodiesel are similar to mineral diesel, and the improvement stems from the oxygen content of biodiesel, which provides better combustion process and improves lubrication, which in part compensates for the effect of lower energy content. Used as pure or blended with diesel fuel of fossil origin (B100, B20, B5 or B2 - number indicates the percentage of biodiesel in themixture). This compatibility with existing engines prompted many countries to turn to biofuels, convinced that it will thus be able to reduce the cost of fossil fuels. [6]

WHY BIODIESEL

- *The need for increased security in the supply of liquid fuels for transport and agriculture sector using renewable sources,*
- *The need to be used as fuel in diesel engines less polluting, while not requiring modifications to engines and can be mixed with fossil diesel,*
- *The solution: reduce emissions of gases (especially CO_2) that participate in the greenhouse effect and its influence on global climate,*
- *Biodiesel burns 75% cleaner than diesel from fossil fuels.*
- *Biodiesel is biodegradable and less toxic than table salt,*
- *Biodiesel does not emit CO_2 gases into the atmosphere,*
- *The production of biodiesel has no unused waste,*
- *Provides better ignition and lubricity which means greater engine efficiency and durability,*
- *The high lubricity of biodiesel compared to mineral diesel, causing less wear of pistons, sealing rings, cylinder walls and precision parts for fuel injection pumps, and also allows better engine start. [7]*

EXPERIMENTAL WORK

In the chemical laboratory of Metallurgical Institute "Kemal Kapetanović" Zenica, were synthesized biodiesel from rapeseed oil and waste cooking oil, according to the selected method. After that performed the chemical analysis that pure biodiesel as well mixtures, to determine whether pure biodiesel and mixtures corresponding to the applicable standards.

PREVIEW OF MEASUREMENT RESULTS OF EXHAUST GASES

The measurement of exhaust gases exiting the exhaust pipe have been made in the company AGRAM Inc. Ljubuški Station for the Technical Overview Zepce, on the devices CARTEC CET 2000B and CARTEC CET 2000D, and on the Metallurgical Institute "Kemal Kapetanovic" Zenica. The engine used for this purpose is the manufacturer Skoda, Felicia 1.9 D type, built in 1997, mileage driven, the engine about 250.000 thousand.

After blending, the mixtures are independent of each other poured into the tank car, after which the exhaust gases are measured. The results are shown in table 4.

Table 1. European standard EN 590 and EN 14214

Parameter	Unit	EN 590	EN 14214	Test method
Density 15 ^{0}C	kg/m^3	820 - 845	860 - 900	ISO 3675
Kinematic viscosity at 40^{0}C	mm^2/s	2.00 - 4.50	3.5 - 5.00	EN ISO 3104
Cetane index	-	min 46	min 46	ISO 4264
Flash point	^{0}C	min 55	min 120	ISO 2719
Corrosion of copper tape	^{0}corrosion	Klass 1		ISO 2160
Water content	mg/kg	max 200	max 500	ISO 10370
Ash content	% m/m	max 0.01	max 0.02	ISO 3987
Sulphur content	mg/kg	max 10	max 10	JUS C.A1.059
Carbon residue	%	max 0.30	max 0.30	ISO 10370
Acid number	mg KOH/g	-	max 0.50	JUS B.H8.025
Content of phosphorus	mg/kg	-	max 10	PERKIN ELMER Analytical Methods for ICP
Na + K	mg/kg	-	max 5.0	PERKIN ELMER Analytical Methods for AAS
Ca + Mg	mg/kg	-	max 5.0	PERKIN ELMER Analytical Methods for AAS

*Table 2. Results of analysis of mineral diesel (1 *), biodiesel from rapeseed oil (2 *) and biodiesel from waste cooking oil (3 *)*

Parameter		Unit	Results			Standard
			1*	2*	3*	
Density 15 ^0C		kg/m^3	830	861	863	BAS ISO 3675
Kinematic viscosity at 40 ^0C		mm^2/s	2.513	4.220	4.890	BAS EN ISO 3104
Distillation	50 %	^0C	266.5	275	276	BAS ISO 3405
	250 ^0C	% v/v	47	39	40	
	350 ^0C	% v/v	95	91	93	
	95 %	^0C	348.5	360	358.5	
Cetane index		-	54	48	48	BAS ISO 4264
Flash point		^0C	60	150	162	BAS ISO 2719
Cloud point		^0C	-5	6	8	ISO 3015
Pour point		^0C	-21	-15	-14	ISO 3016
Water content		mg/kg	120	320	430	BAS ISO 10370
Ash content		%	<0.001	<0.001	<0.001	ISO 3987
Corrosion of copper tape		^{0}corrosion	1A	1A	1A	ISO 2160
Sulphur content		%	0.058	0.005	0.006	JUS C.A1.059
Carbon residue		%	0.32	0.16	0.18	BAS ISO 10370
Acid number		mg KOH/g	-	0.465	0.350	JUS B.H8.025
Content of phosphorus		mg/kg	-	<10	<10	PERKIN ELMER Analytical Methods for ICP
Na + K		mg/kg	-	3.7	4.2	PERKIN ELMER Analytical Methods for AAS
Ca + Mg		mg/kg	-	4.5	4.7	PERKIN ELMER Analytical Methods for AAS

Table 3. Results of analysis mixture of 20% biodiesel from rapeseed oil + 80% mineral diesel (1) and 20% mixture of biodiesel from waste cooking oil + 80% mineral diesel (2*)*

Parameter		Unit	Rezults		Standard
			1*	2*	
Density 15 ^0C		kg/m^3	845	846	BAS ISO 3675
Kinematic viscosity at 40 ^0C		mm^2/s	2.987	3.015	BAS EN ISO 3104
Distillation	50 %	^0C	272	272	BAS ISO 3405
	250 ^0C	% v/v	43	42	
	350 ^0C	% v/v	94	95	
	95 %	^0C	353.5	354	
Cetane index		-	49	49	BAS ISO 4264
Flash point		^0C	84	88	BAS ISO 2719
Cloud point		^0C	-1	-1	ISO 3015
Pour point		^0C	-19	-18	ISO 3016
Water content		mg/kg	195	205	BAS ISO 10370
Ash content		%	<0.001	<0.001	ISO 3987
Corrosion of copper tape		^{0}korozije	1A	1A	ISO 2160
Sulphur content		%	0.037	0.040	JUS C.A1.059
Carbon residue		%	0.22	0.24	BAS ISO 10370

Table 4. Tabular overview of results of measurements of exhaust gases of diesel the engine

	CO % vol	CO_2 % vol	HC ppm vol	O_2 % vol	Carbon black % vol	SO_2 % m/m
Mineral diesel (D5)	0.15	3.30	25.00	16.54	2.04	0.120
20% biodiesel from rapeseed oil + 80% mineral diesel	0.03	2.92	4.00	16.83	0.35	0.074
20% biodiesel from waste cooking oil + 80% mineral diesel	0.03	2.97	4.00	16.14	0.36	0.080

CONCLUSIONS

Biodiesel has properties the same as those of mineral diesel, used as a substitute mineral diesel or some mixture with it. Today's more demanding environmental standards provide a powerful stimulus for its production and use. Although pure vegetable oil and animal fats have the ability to burn, though are rough is rarely used as fuel because they have a very high viscosity, causing the flow from the tank to the engine. These problems can be mitigated by heating fuels, the use of larger diameter pipes and chemical modification.

Mineral fuels come from plants that were growing a few tens of millions of years, while biodiesel comes from plants that grow constantly and is refreshed. To get the raw material for mineral diesel, it is f orty million years, while the raw material for biodiesel takes several months.

Besides these plant oil, as raw material for biodiesel, is used animal fats and waste cooking oil which we have in large quantities.

Waste cooking oil is the most accessible raw materials for biodiesel production. Very low cost and environmental benefits (according to the Law on waste defines as not a hazardous technological waste), make these a popular sources of oil for biodiesel production. In addition it can serve as a raw material for biodiesel production, the benefits of collecting waste cooking oil and reduce the cost of wastewater treatment. It also reduces the number of rodents in the drainage systems that use waste oil as a food.

By producing of biodiesel can be used surpluses from agricultural production, protect the environment, reduce unemployment and the possibility of reducing oil imports and reduce dependence on oil itself.

Based on the results of analysis of mineral diesel, it is evident that all parameters are satisfied in terms of the standard EN 590, except that the sulfur content is increased. Results of analysis of both diesels satisfy limit values of EN 14214.

The amount of biodiesel added to diesel in mineral proportion improves the characteristics of mineral diesel. The consequence of this improvement in short can be reduced to the following:

- *Mixtures have a less volatility than is the case with mineral diesel, that can be seen from the results the beginning of distillation, higher ignition point ensures safer storage, transport and use.*
- *The sulfur content reduces the emission of SO_2 gases in the ecological point of view important characteristic in terms of preserving the environment.*
- *Water content was also reduced by the addition of both biodiesels with mineral diesel.*
- *Biodiesel begins pouring at a higher temperature than diesel fuel, but there are additives that prevent pour point. Blending biodiesel with diesel fuel will reduce pour point.*
- *In terms of the measurement results of exhaust gases of diesel engine (table 4.) can be said the following:*
  - *The content of CO is significantly reducing by the addition of any mixture (up to 88%). Carbon monoxide is a toxic gas which combines with hemoglobin in the blood, passivates it and not allows it contact with oxygen. Therefore, carbon monoxide haze a toxic effect on living organisms.*
  - *The content of CO_2 is reducing in proportion to the addition of any mixture (up to 38%).*
  - *The content of hydrocarbons (HC) is also proportionately reduced depending on any added mixture.*
  - *The content of free O_2 which was created during combustion is very good in both mineral diesel and for mixtures, and ranges from 16.14% to 17.20%.*
  - *The content of carbon black (C) is reducing by adding biodiesel to mineral diesel, which is a consequence of the fact that biodiesel contains about 11% oxygen, which improves combustion of fuel in the engine.*
  - *Given the fact that pure biodiesel contains almost no sulfur, it is quite logical the reduction of SO_2 in the exhaust gases, which is a direct cause of acid rain.*

During the experiment by the authors, while testing mixtures biodize / mineral diesel it was noted the following:

- *A slight increase of fuel consumption during operation with dose mixtures,*
- *Improving in the traction motor power,*
- *Unchanged sound of engine,*
- *Rubber hoses and gaskets remained undamaged, there was no increased consumption of any motor or other mineral oils.*

The mentioned facts point to a smooth possibility of using mixtures biodiesel / mineral diesel in diesel engines of older generations.

Given the limited oil reserves in the world, production and use of biodiesel fuel as an alternative fuel has become a component of modern agricultural production. Significant impact on the economic, commercial and strategic interests and a minimum negative impact on the environment are the reasons which indicate the necessity of introducing biodiesel fuel use.

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