DIESEL ENGINE PERFORMANCE AND USING OF ALTERNATIVE FUELS

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Rezumat. *Această lucrare prezintă un nou concept privind combustibilii. Rezervele mondiale de resurse fosile sunt în scădere, așa că se caută alternative pe termen lung și cu impact redus. În lucrare am specificat alternative pentru înlocuirea motorinei și impactul acestora asupra motorului prin compresie.*

Abstract. *This paper presents a new concept regarding fuels. The world's reserves of fossil resources are declining, so long-term and low-impact alternatives are being sought. In the paper we specified alternatives for diesel replacement and their impact on the engine by compression.*

Keywords: Diesel, Engine performance, Alternative fuels

1. Introduction

Global energy demand has increased over the last two decades due to the growing number of transport and industrial vehicles in need of conventional fuels. As oil reserves dwindle and prices rise, researchers and engine manufacturers are carefully looking for alternative and environmentally friendly fuels, such as vegetable oil, ethanol, etc. Biomotor is a type of biodegradable and renewable fuel that is produced from vegetable oil or animal fats and can be used for diesel engines either directly or after conversion to methyl ester by transesterification.

Biofuels are unconventional, alternative fuels produced from bioregenerable sources from nature (biomass), which, after burning in the engine, produce less polluting emissions that would affect the environment. The term "biofuel" covers "a wide range of fuels derived from biomass, including solid biomass, liquid fuels and various types of biogases". Biofuels have come to the attention of the public and the scientific world with rising oil prices, the need to ensure energy security and the concerns of climate change [1], [2].

Biofuels are neutral in terms of the greenhouse effect because when they are burned in the atmosphere, the equivalent amount of carbon dioxide is released which was photosynthetically fixed by plants when the plant raw material from which the biofuels were obtained was produced. Research in recent years has shown that solar energy stored in biomass can be a renewable and non-polluting source of energy, representing a viable alternative to fossil fuels. Biofuels are "any solid, liquid or gas obtained from biomass that can be used as fuel (Directive 2003/30 / EC of the

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European Parliament and of the Council on the Promotion of the Use of Biofuels or other Renewable Fuels for Transport 2003"; VIEWLS, 2005;
The only renewable carbon source that can be used as a substitute for fossil fuels is biomass. Biomass consists of vegetation, organisms, municipal solid waste, waste from sewage treatment, animal waste, residues from agriculture, forestry and certain industrial wastes [3], [4].

2. Combustion process within the internal combustion engine

In the case of the use of fuels in internal combustion engines, in order for the chemical reaction to transform the fuel into thermal energy to take place, it is necessary for other substances to participate. For this reason, in order for the chemical reaction to take place additionally, a quantity of oxygen from the atmospheric air will be introduced to the fuel from the combustion process.
The air-fuel mixture will be made through the fuel system (by fuel injection or carburetor) according to the so-called stoichiometric ratio which has the value of 14.7: 1 for spark ignition engines and 14.5: 1 for compression ignition engines; that is, for every 14.7 parts of air, a part of fuel will be introduced in the case of spark ignition engines, respectively for every 14.5 parts of air, a part of fuel will be introduced. Adherence to these values will ensure proper engine operation as well as increased performance.
Any deviation below the above values means a fuel-rich mixture which will result in increased fuel consumption, soot and calamine deposits inside the engine and on the exhaust system in the case of compression ignition engines, contamination. and the loss of oil properties implicitly increased engine wear but also low performance.
On the other hand, any deviation above the above values leads to problems such as overheating and possible deformation of the valves, low performance, as well as decreased properties and premature aging of the lubricant film between moving parts which will result in increased wear. inside the engine.
In order to ensure that the air-fuel ratio is always in the optimal range, it is recommended to periodically change the air and fuel filter (maximum 15,000 kilometers) and in case of replacing the different parts of the fuel system (carburetor, etc.) to set the mixture. to be made according to the specifications corresponding to each vehicle.
The lambda sensor or oxygen sensor makes it possible to inject modern electronic fuel and control emissions. It helps to calculate the real-time air-fuel mixture in an internal combustion engine and transmits data to the engine control unit (ECU) whether the air-fuel mixture is rich or poor. "The sensor does not actually measure the oxygen concentration, but rather the difference between the amount of oxygen in the exhaust gas and the amount of oxygen" in the atmosphere.
This sensor is located on the exhaust system, before the catalyst, but in more modern cars there are at least 2 oxygen sensors, one before the catalyst and one after the

catalyst, ensuring the efficiency of the catalyst and the reduction of pollutant emissions into the atmosphere.

3. Biofuels used to power compression ignition engines

3.1. Biofuels

The current concept of mobility as well as the transport and distribution infrastructure is based on liquid fuels. Due to their high energy density, they are one of the best energy storage media. The most important liquid biofuels are bioethanol and biodiesel (methyl ester fatty acids), which are produced and used worldwide in significant quantities. Bioethanol produced from sugars or starch and biodiesel produced from vegetable oils or animal fats are considered generation I biofuels (Figure 1) [5].

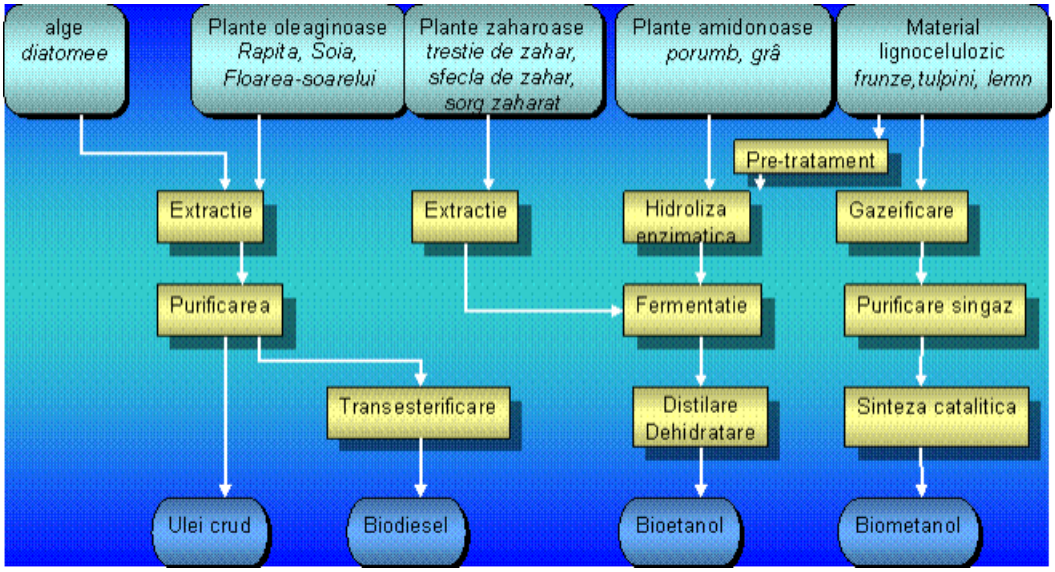

Fig. 1. The main sources of biomass and the processes for obtaining biofuels

Hydrogenated vegetable oils (HVO), synthetic fuels (BtL - liquid-biomass) and bioethanol and biodiesel However, plant products, cellulose, jatropha or algae are considered superior to second-generation biofuels. However, large investments, technological problems and the high cost of second-generation biofuels raise many questions about the availability in the near future. Biofuels have been around for many generations, depending on the complexity of the technology and the chemical production processes. Some of them, those of the last generations, currently exist only on paper, and many of them are synthesized exclusively in the laboratory.

- ”First generation” biofuels
- ”Second generation” biofuels

- ”Third generation” biofuels
- ”Fourth generation” biofuels

3.1.1 Biodiesel

Biodiesel is a fuel obtained by the transesterification process of fats and oils. This fuel has diesel-like properties, which makes it possible to use it either directly in diesel engines or as an additive to conventional diesel.
Although there are many controversies related to the production of biodiesel (its production costs are much higher than that of conventional diesel), as well as its use in diesel engines, there are also advantages related to its use as fuel: improving the lubricating qualities of diesel content low sulfur, increase the flash point, decrease the density of smoke, CO, CO2 and particle content, its biodegradability. All these advantages lead to the idea that biodiesel is a good candidate for its use in diesel engines.
Preparation: ”Fats and oils are made up of triglycerides. Each triglyceride is composed of three long-chain fatty acids with a number of carbon atoms between 8 and 22, which are linked to a molecule of glycerol”. Biodiesel is made up of fatty acids that are chemically bound to a molecule of methanol. Following the transesterification process, the glycerol molecule is almost completely removed from the composition of the finished biodiesel.
The ”technologies for obtaining commercial biodiesel” could be classified as follows:

A. Transesterification in homogeneous alkaline catalysis of refined oils
B. Basic catalyzed transesterification of low-fat vegetable fats and animal fats
C. Transesterification in acid catalysis
D. Transesterification in basic and acid heterogeneous catalysis
E. Enzymatic transesterification
F. Transesterification using microwaves
G. Transesterification using ultrasound

3.1.2 Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG)

Compressed natural gas (CNG) is an alternative fuel based on the compression of methane at about 1% of its volume, present under standard atmospheric pressure. The density of the energy contained in one unit of CNG is equivalent to about 42% of liquefied petroleum gas and about 25% of conventional fossil fuels (diesel and petrol). The transport, storage and use of compressed natural gas takes place at pressures between 200 and 280 bar, which requires the development and implementation of appropriate standards to ensure the safe use of such an alternative fuel.

Liquefied natural gas (LNG) is mainly methane subjected to a liquefaction process, by which its volume is reduced by about 600 times, thus becoming suitable for storage and transport in tanks. Unlike CNG, the pressure of liquefied natural gas is about 4 bar, and the density of the energy contained in a unit of LNG is about 2.4 times higher than that of CNG. To keep it in a liquid state, it must be brought and stored at temperatures below -150ºC

3.1.3 HVO diesel from renewable sources

Or synthetic diesel as it is also known is obtained by hydrotreating raw renewable materials, such as vegetable and animal fats or rapeseed oil, this being an alternative process of esterification, through which bio diesel is obtained.
HVO diesel is the second generation of biodiesel fuel, this "green" diesel being produced on an industrial scale since 2007.
The raw material for HVO comes from controlled and certified cultivation facilities and, as such, does not compete with food production.
HVO is sulfur-free and does not contain aromatic hydrocarbons, and no ash is produced during the combustion process. The fuel can be used either in its pure form, as an alternative to conventional diesel or as a mixture, in order to improve the overall performance of the environment.
The unmixed use of HVO above all leads to significant improvements in carbon dioxide performance.
HVO has characteristics comparable to conventionally produced petroleum-based diesel, so no modifications to the engines or their peripherals are required.
The same goes for oil change intervals and for cleaning the particulate filter. Engine performance and maximum torque value remain unchanged.
The pure ”HVO, HVO100, can be used in diesel engines without modifications and is approved for all heavy vehicles on the market of the top engine manufacturers, such as Scania, Volvo, Mercedes, MAN” and others.

3.2 Physico-chemical properties of biofuel

The physico-chemical properties of the fuels directly influence some processes (such as: spraying, vaporization, self-ignition) which affect the combustion process itself, on which the ecological and energy behavior of the engine depends to a large extent. Among the most important physicochemical properties of fuels must be mentioned: fractional composition, density, viscosity, flash point, cetane number, cetane index. There are also properties that condition engine wear, such as: mineral acidity and alkalinity, organic acidity, sulfur content, corrosion on the copper blade, water content, etc. Other properties of fuels influence the transport, storage and handling of fuels.

Density

An important property of petroleum products and that is part of the product specifications is the density. Fuel density influences engine performance because the air-fuel ratio and energy content in the combustion chamber are influenced by the fuel density. In general, the density of biofuels is higher than that of petrol and diesel. Density increases as biodiesel levels increase; the specific values depend on the composition of the FA (Fatty Acids) and the purity. Contamination with other more or less suitable compounds can significantly affect the density of FAME (Fatty Acid Methyl Esters).
Density is the amount of substance contained in one cubic meter.

Viscosity

High viscosity can lead to large droplets, low spray and vaporization, small spray angle (dispersion) of the injection and a large penetration into the cylinder of the sprayed fuel. It can also reduce the flow rate of fuel, which could lead to inadequate fuel supply. Another consequence would be damage to the pump. High viscosity of the fuel results in a worsening of the combustion process, higher pollutant emissions and an increased dilution of the oil. In general, biodiesel fuel has a higher viscosity than conventional fuels and it is therefore important to control it within an acceptable range to avoid the negative impact on their performance of the fuel injection system.

Flash point

Flammability temperature, or flash point, is the lowest temperature, correlated with a barometric pressure of 101.3 kPa (760 mm Hg), to which the flame test is applied, causing the vapor mass above the sample to ignite under the test conditions. specified

4. Conclusions

Biofuels can provide an important alternative to fossil fuels in the short and medium term. They are liquid or gaseous fuels used in transport, produced from biomass.

- Biofuels obtained from different plant species (beets, potatoes, reeds, sugar sorghum, cereals, fodder plants, wood, etc.) by various technologies based on fermentation processes, used as such or mixed with conventional fuels can replace use of conventional fuels.

- Biodiesel has diesel-like properties, which makes it possible to use it either directly in diesel engines or as an additive to conventional diesel.

- Biodiesel is obtained by the transesterification reaction of vegetable oils or animal fats, the transesterification being a chemical process involving a number of consecutive reversible reactions between a triglyceride (fat / oil) and an alcohol

forming esters and glycerin. In the reaction of obtaining biodiesel, esters of glycerol (vegetable or animal fats) react with methanol, obtaining esters of methanol (biodiesel) and glycerol.

- Personal depletion of fossil oil resources and the need to supplement energy reserves, especially for the propulsion of means of transport, have led to the search for and use of alternative fuels. Research in recent years has shown that solar energy stored in biomass can be a renewable and non-polluting source of energy, representing a viable alternative to fossil fuels.

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