Trakia Journal of Sciences, Vol. 8, Suppl. 3, pp 53-56, 2010

Available online at:
http://www.uni-sz.bg

ISSN 1313-7069 (print)
ISSN 1313-3551 (online)

RESEARCHING OF THE INJECTIONS' PROCESS OF NOZZLES FOR DIESEL ENGINE WITH WORK BY BIOFUELS

St. Stanchev*, I. Ginkov, N. Kolev

Technical College – Jambol, Trakia University, Stara Zagora, Bulgaria

ABSTRACT
Experimental studies for the process of injection into the diesel engine most commonly used biofuels are conducted. The obtained results concerning the performance of nozzles with different types of bio-fuels and fuel mixtures give rise to this type of use of fuels in engines with direct injection.

Key words: diesel engine, biodiesel, injection, work process

INTRODUCTION

In recent years due to depletion of oil stocks, research into the area of alternative fuels has been more topical. Since Bulgaria practically hasn't its own oil resources, the research in this area are particularly relevant. In agricultural surplus production of vegetable oils for use as fuel provides a good opportunity to regulate the agricultural sector and avoid crisis in it. Many countries already produce fuels of this type and many companies – engines, capable of using vegetable oils.

To ensure full and quality burning in high-frequency diesel engines, the fuel must meet the following key performance requirements (1):

- To have the necessary self-combustible temperature, so as easily carry out cold-start, soft work of engine and complete combustion;
- To be sprayed, evaporated and mixed to the necessary level so that it provides good and long work of engine;
- To be able to move through engine pipeline under all operating conditions;
- To not cause corrosion on parts of the combustion apparatus and other equipment;
- To have a minimum tendency to formation of deposits.

***Correspondence to:** *Stancho Stanchev Associate Professor Doctor, Technical College – Jambol, Trakia University – Stara Zagora, "Graf Ignatiev" street №38, Jambol 8600; e-mail: stan4ev_49@abv.bg*

EXPOSE

Biodiesel is fuel produced from biological resources different from oil.
Organic fat /vegetable or animal / they are hydrocarbons similar petroleum diesel. It is used in two ways:
1. As pure biodiesel (symbol B 100)
2. As mixture with petroleum diesel (30% biodiesel + 70% petroleum diesel)
Plant fuels have a number of advantages before oil (2):

- extracted from annually renewable sources;
- environmentally friendly in practice;
- they are cheaper than conventional diesel – it has no duty;
- they do not contain sulfur;
- they have a higher index lubricant;
- it is better solvent for previous delays.

Disadvantages of pure biodiesel:

- it freezes at 263^0 K , if a product is from vegetable oils and 289^0 K – from animal fats;
- it breaks seals made from rubber;
- it mixes good with water, which leads to corrosion, more smoke and reduced power.

For these reasons, the biodiesel is mixed with petrodizel.

When using the fuel of plant origin in diesel engines there are prerequisites for degradation of the mixture-formation. This is particularly true in the case of using the filtered and refined vegetable oils because they evaporate much more difficult than diesel. This requires taking

special measures to improve combustion and mixture-formation (3).

If the engine is with direct fuel injection are recommended following ways to improve mixture-formation:

- using one-hole nozzle providing the necessary length of fuel torch;
- air turbulence in the combustion chamber at a rate approximately 4.5 times higher than the speed of the crankshaft of the engine;
- to be kept high temperatures in the combustion chamber to that applying different methods, including increasing the degree of compression;
- temperature sprinklers do not exceed 493° K;
- increasing pressure fuel injection. This improves the subtlety of spraying and prevents covering of the nozzle with deposits;
- shutdown cooling system, regimes of small loads with the purpose of to raise the temperature in the combustion chamber;
- adding small amounts low-octane gasoline or methanol, from 5 to 10%;

The purpose of this study is:
To investigate the influence of vegetable oils /biofuels/ with work of nozzles for fuel injection in diesel engines.

Tasks of the experimental research are:
1) To analyze the physico-chemical and operational parameters of vegetable oils as a "biofuel".
2) To develop a methodology and establish a framework for testing experimental research work of the diesel engine nozzles.
3) To conduct comparative research on the work of the nozzle of a diesel engine in working with plant fuels and different ratios of mixtures of plant and mineral fuel.
4) To determine the effects of plant fuels and their mixtures on the process of nozzles' spray.

Experimental Study.
The survey was conducted through a device for checking and regulating nozzles КП-1609 and metallographic microscope METAM P-1.

Assessment and regulation continues until the establishment of leaking of nozzles according to established norms for the engine.

The density of the needle to her bed in the body of sprinklers is checked with a mixture of diesel and well-filtered engine oil under pressure 23 MPa (4).

The viscosity of the mixture under normal ambient temperature should be between 1.85 and 1.9 in Engler.

Normal pressure for testing the density of needle's spray, such as the nozzles ФШ $5X15^0$ is 20-18 MPa. The duration of the pressure drops from 9 to 20 seconds. Faster pressure drop may be due to insufficient density of the needle into the bed of sprinklers or adherent deposits on the surface of the needle or the opening of sprinklers.

The quality of the fuel spray should be done at a pressure of 12,5±0,5 MP and to measure up to following requirements:

- the fuel to be sprayed as a mist, which does not visible with the naked eye drops and streams, and the form mist to be conical flare;
- cone angle of the spray torch fuel should not be less than 10^0;
- in the start and final point of broadcasting should not be allowed to drip fuel nozzle;
- in the start and final point of broadcasting should be clear and crisp.

Uniformity of dispersion is checked on the screen of thick paper or network rubbed with a chalk. In quality broadcast fuel the stain on the screen must have a round shape (disk) with slight lightening to the periphery and the center. If the resulting spot on the screen does not meet the above requirements, the nozzle apart, wash with petroleum, then with gas oil (diesel), carefully assembled and tested at 10-12 MPa. The magnitude of the scattering angle is determined by the diameter D of the printed spot of the dispersing fuel.

The scattering angle must vary between 10 and 25°, corresponding to the footprint on the screen with a diameter of 38 mm to 95 mm.

Conducting experimental research
Surveys of the work of the pin nozzle were made with the following types of fuels for diesel engine:

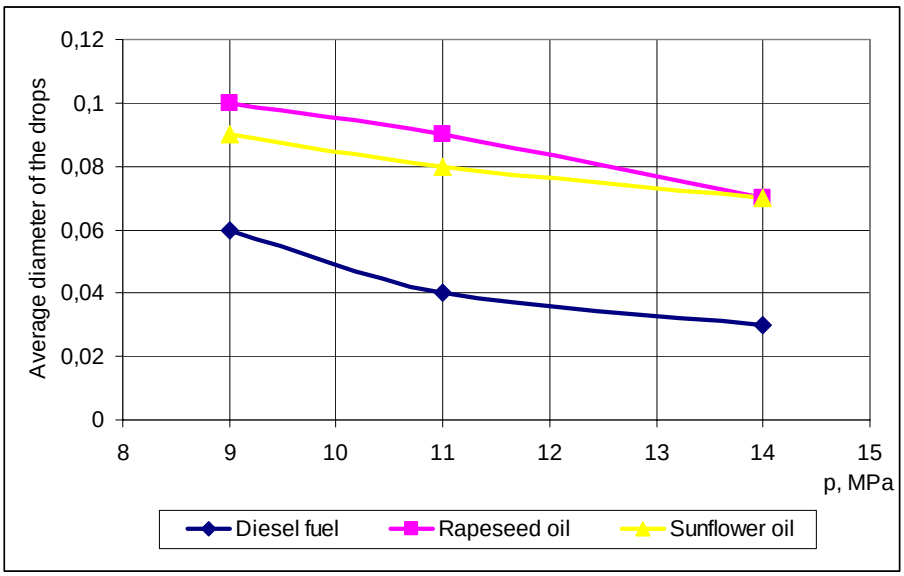
- Diesel fuel (DF) – 100 % ;
- rapeseed oil (CO)– 100 %;
- Sunflower oil (SO) – 100%;
- Diesel fuel – 50 % and rapeseed oil – 50 %;
- Diesel fuel – 70 % and rapeseed oil – 30 %;
- Diesel fuel – 30 % and rapeseed oil – 70 %;
- Diesel fuel –50 % and Sunflower oil – 50 %;
- Diesel fuel –70 % and Sunflower oil – 30 %;

Results of the survey

Experimental studies have been made in the laboratory of the Technical College Yambol using the above described devices. The obtained results are caused in **table 1.**

Table 1. *Average diameter of the drops*

№	Pressure injection, *MPa*	Average diameter of the drops, *mm*		
		Diesel fuel	Rapeseed oil	Sunflower oil
1.	9	0,06	0,10	0,09
2.	11	0,04	0,09	0,08
3.	14	0,03	0,07	0,07



Graphs of experimental studies

RESULTS

From comparative studies of the work of diesel nozzle and various vegetable oils and fuel blends are found:

1) Diesel fuel is dispersed in tinier droplets in a good and fractional composition. This makes it more adapted for use in comparison with oils from rapeseed and sunflower.

2) Vegetable oils from rapeseed and sunflower are spread on larger drops which imply worse mixture-formation and hence incomplete combustion of fuel mixture.

3) The mixture-formation of the fuel pass no dripping with diesel, with blends of 50 percent diesel and 50% mixture of rape and 70 percent diesel and 30% rapeseed or sunflower oil, too. In other cases this process is unsatisfactory.

4) The angle of the spray cone is the highest (280) when work of diesel nozzle and mixture of 70 % diesel fuel and 30% rapeseed oil.

5) While working with the nozzle in the cone of the burning torch it does not receive streams of fuel only with diesel fuel and with 70% diesel and 30% vegetable oil.

6) The axis of symmetry and shape of the cone of the fuel torch do not change with different types of fuels and mixtures.

7) Top quality is spread out when diesel fuel and mixtures are in the ratio of 70% diesel fuel and 30% vegetable oil. The process of

dispersal in vegetable oils is unsatisfactory because of their greater density.

CONCLUSIONS

The conducted experimental research about the work of nozzles with diesel fuel and other types of biofuels and fuel mixtures make possible to identify the positive aspects of using this type of fuels in engines with direct injection and the existing problems in this regard.

This allows to extend knowledge about alternative fuels and to open new opportunities for the use of vegetable oils as fuel. Most appropriate about to improve the quality of broadcasting in the engine cylinders is to use mixtures in the ratio of 70 percent diesel and 30 percent vegetable oil.

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