IMPROVEMENT THE COLD START PROCESS OF IC ENGINES FUELED WITH BIODIESEL

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Abstract: *Even though currently the future use of biofuels in road transport (in terms of fossil fuel crisis) is much debated by specialists, biofuels can be successfully used on the farm by the ease with which they may be obtained and especially due to the effect polluter much lower than the fossil fuels. Reducing pollution from agriculture technological operations is a necessary condition to develop in the future agricultural development on a sustainable basis. To truly become a competitive fuel market, compared with fossil fuels, biofuels must optimize parameters related to characteristics of density, viscosity, freezing point and especially the specific calorific value. Global research about the efficient use of biofuels have emphasized only the immediate results of their use in supplying engines that equip tractors and agricultural machinery, related to consumption, pollution and wear of engines component parts. Theme and direction of research addressed in the paper represents an innovation in the field of national and global research on biofuels. Also, the degree of novelty of the work is defined by the methods and materials used in the research, managing to highlight first, the importance of parameters like speed of sound in biofuels (with subsequent implications in the possible development of "flex-fuel" systems) and isotropic adiabatic coefficient (with direct implications in determining the exact time of injection process). This paper presents findings related to the influence of external energy intake in the form of ultrasound, electromagnetic field and ionization on the physical parameters of biofuels (biodiesel and bioethanol), the main parameters considered are (speed of sound, density, isotropic adiabatic coefficient, pH index). Practical implications of the work are found in the immediate applicability in the possibility of increasing the performance of agricultural tractors powered by biofuels and also open new directions in applied research on ways of streamlining the use of biofuels. Results and conclusions issued in the work are possible due to the unfolding of the first phase of research project PNII2008ID175, financed by CNCSIS.*

Key words**:** *biofuels, cold start process, ultrasounds, IC engine.*

INTRODUCTION

It is known that diesel engines easy start depends directly by self-ignition quality and indirectly by cetane index, viscosity, fuel freezing and cloud temperature [1, 4].

In terms of behavior at low temperatures due to high amounts of vegetable oils cloud point temperature ($+12^{o}$…$+30^{o}$C) compared to diesel (-22^{o} ... 0^{o}C) some problems will appear related to flow through the injection pump (loss of engine power), clogging filters and supply lines [2].

Based on these considerations we can say that physical and chemical properties of biofuels have an important role on technical considerations related to their use in compression ignition engines [4,5].

Given that currently there is mainly machinery and vehicles that are equipped with engines built with older technology than that used in 2000, made technical changes to increase reliability as well as fuel engines to use vegetable oil (pure form or mixed form) must [2,3] :

- to ensure the possibility of using alternative fuels in compression ignition engines in any season calendar;

- to ensure the superior performance in terms of lower pollution than petroleum based fuels;
- do not involve important changes in engine design (overall piston chamber, cylinder, cylinder head etc.), in order to not increase significantly the cost price;
- do not affect the strength and thermal characteristics of engine mechanism parts;
- to increase the reliability of compression ignition engines that work with such fuels.

On the basis of previously presented, is considered that the minimum necessary technical changes to be made on components and / or installation of the engine especially when used as biodiesel or pure vegetable oil based on the percentage of biofuel from vegetable oil mixture biofuel (diesel + vegetable oil) is more than 70%, to facilitate their use in low temperature ambient conditions [6]. Currently, these technical changes are recommended:

- heating the biofuel inside the tank (with heat exchanger - Figure 1 or electrical resistance - Figure 2) [2];
- biofuel heating with heat exchanger mounted on the supply route (after the tank), constructive solutions are proposed as those presented in Figure 3 [2,3].
- mixed supply systems, starting systems that allow diesel initial start, operating with biodiesel and diesel stop [2]. The fuels switch to equip such a mixed power system shown in Figure 4.

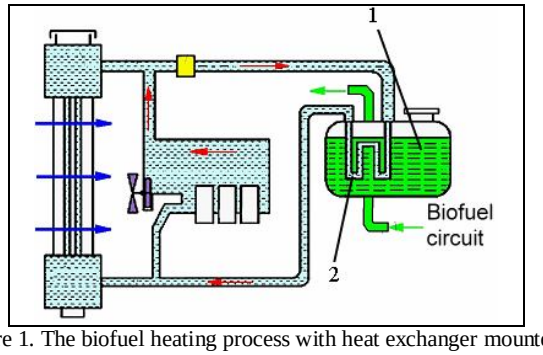


Figure 1. The biofuel heating process with heat exchanger mounted inside of fuel tank (1-biofuel; 2- heat exchanger)

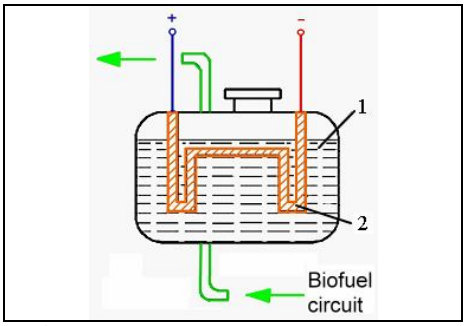


Figure 2. The biofuel heating process with electric resistence device mounted inside of fuel tank (1-biodiesel; 2-electric resistance)

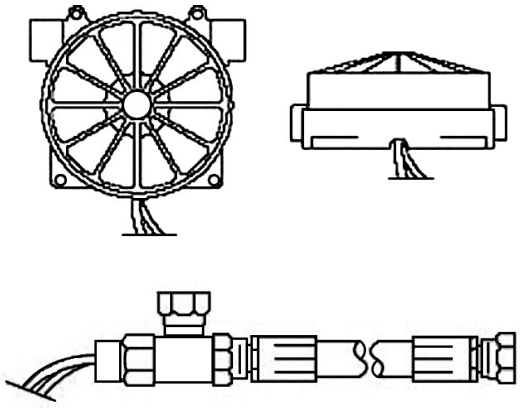


Figure 3. The biofuel heating process with heat exchanger mounted on fuels supply circuit

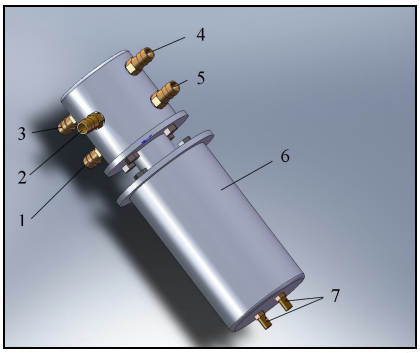


Figure 4. Fuel switcher (1-biodiesel in; 2- to injection pump; 3-diesel fuel in; 4-diesel fuel out; 5-injection pump retour; 6-electromagnetic command system; 7-electric conexions).

MATERIALS AND METHOD

The proposed method to improving the cold star procees of biofuel feeded IC engines is based on an ultrasounds system (Figure 6) that consist to a ultrasound PZT transducer, a electronic system that generate the ultrasounds (Optel) and a fuel filter (Mopar type 7-41354).

Achieving thermal effect induced in biodiesel due to the interaction of ultrasound with its molecular structure. With this increased energy level and degree of activation of molecules which increase the intensity of clashes between them. The result of these clashes is the energy dissipation of friction (in the process of collision) as the heat in the volume of biodiesel [7].

Energy consumed for the actual heat through ultrasound is 3 ... 5 times smaller than existing solutions in the cases presented above. Also, the decoupling of device is automatic when reaching the desired temperature. The ultrasonic emitter device is positioned in the manner most advantageous to the bottom battery fuel filter.

The measuring devices consist of an IR Testo 850 thermometer and an IR thermal camera Wuhan Guide IR type, used to achieve the ultrasounds thermal transfer process on biofuel. The biofuel was Rapeseed pure vegetable oil and the experiments start at -15^{o}C (alleged as base temperature for experiment).

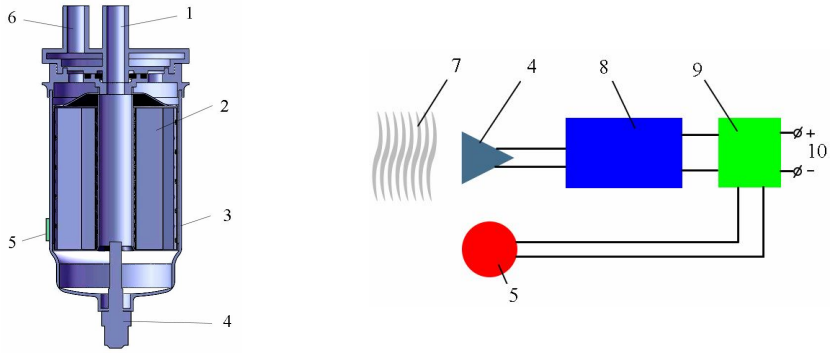
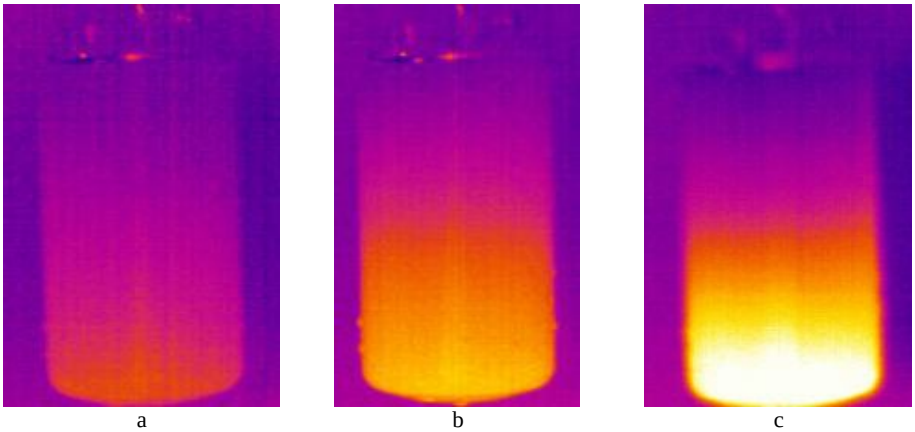


Figure 6. The cold start ultrasound system (1-biofuel out; 2-filter element; 3-filter case; 4-PZT ultrasounds emitter; 5-thermal sensor; 6-biofuel in; 7-ultrasounds; 8- ultrasounds generator; 9-electronic control unit; 10-engines battery)

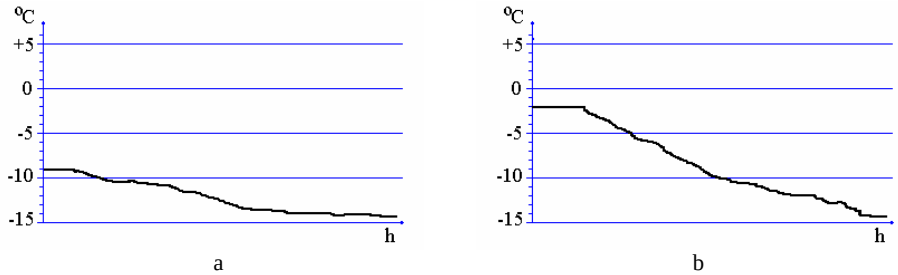
RESULTS AND DISCUSSION

The results of experiment (the fuel filter thermal finger-print and the temperature distribution along the filter case height) are presented in Figures 7-9.



a b c

Figure 7. The effect of ultrasound on biodiesel (a-10sec; b-20sec; c-30sec)



a b

Figure 8. The temperature distribution on fuel filter longitudinal plane (a-10sec., b-20sec.)

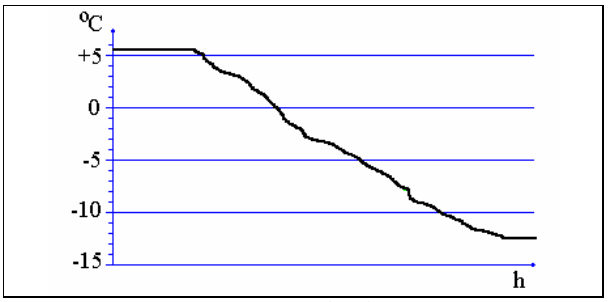


Figure 9. The temperature distribution on fuel filter longitudinal plane (30 sec.)

CONCLUSIONS

- The cold start of internal combustion engines fueled with biodiesel eliminates the above disadvantages (of other systems) in that it is fitted with an ultrasound-producing system, reduced the weight and easy to assemble all forms of fuel filter battery construction that currently existing in the construction of internal combustion engines fuel supply systems.
- By applying the cold start system into the construction of a CI engines feeding system obtains the following advantages: simple and reliable construction due to lack of moving mechanical elements; effect of heat transfer instantly to biodiesel; automating the process of cold start; weight and reduced dimensions; ease of installation and operation.
- Energy consumed for the actual heat through ultrasound is 3 ... 5 times smaller than existing solutions in the cases presented. Also, the decoupling device is automatic when reaching the desired temperature.
- The device is positioned in the manner most advantageous to the bottom ultrasonic emitter battery fuel filter. Location at the bottom offers the innovative advantages:
  - Quick release hole in the filter output of biodiesel by engine;
  - Already heated biodiesel will further upward movement leading to the thermal effect of ultrasound near the amount of fuel and contribute to melting paraffin deposits and agglomerations of the filter elements (Figure 10).

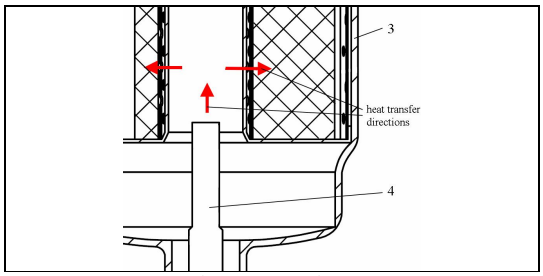


Figure 10. The heat transfer direction from heated biodiesel to fuel filter element (3-filter case; 4-PZT ultrasound emitter).

AKNOLEDGEMENTS

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