

Researches on the Alternative Fuels Which Can Be Used to Motors

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Abstract: The alternative fuels are substances or materials used as fuel, other than the old conventional fuels (oil, natural gases and coals).

The paper analyses the most important alternative fuels, such as: bio-diesel, alcohols and hydrogen, presenting at each category the main important characteristics, the advantages and disadvantages presented by them.

The methyl-ester which is known as bio-diesel can be used in all motors with ignition by compression, alone or mixed in any proportion with oil, with minor modifications at the injection system. Bio-diesel fuel assures the same motor power as oil does, having even a bigger cetanic number than the usual oil. After tests, it was observed that the consumption is also similar, at the same motor performances. The bio-diesel fuel has very good lubricant properties, such as its adding to oil leads to a better protection of the pieces in motion of the motor.

The second alternative fuel analyzed are the alcohols. The most used primary alcohol is the methanol, the most simple secondary alcohol is izo- propane and the most simple third alcohol is third-butanone. The most used alcohol as fuel is the methanol and the ethanol.

The methanol presents some disadvantages such as: the tendency of reducing the effective power, a big delay at self-ignition, the unfavorable properties of oiling, the reduced capacity of mixing with petrol fractions.

Finally, the paper presents some researches made on using hydrogen as fuel for auto vehicles motors.

Keywords: bio-fuels, bio-diesel, alcohols, methanol, ethanol, hydrogen.

INTRODUCTION

The decreasing of the classic resources and the increasing price of oil beryl as a result of petrol crisis created favorable premises for searching for another sources of fuels.

The estimations made on the current consumption level and the estimations on the real reserves of classic fuels show that these could be used approximately 44 years for oil, 69 years for natural gases and 125 years for coals.

The alternative sources of energy are: the nuclear fuels, the sun energy, the wind energy and the bio- mass. These energy sources have 2 major advantages over the classic fuels: they have a much longer life span or are completely regenerating and assure the increasing of noxious emissions (especially the carbon dioxide).

This slow passing from the old fuels to the alternative sources of energy is considered a major contribution to the lasting development of the world economy.

MATERIALS AND METHODS

Bio-diesel

The bio-diesel fuels are obtained from animal and vegetal grease, as a result of a process named trans-esterification. The methyl-ester which is usually named bio-diesel can be used to all motors with compression ignition, alone or mixed in any proportion with diesel oil, with minor changes to the injection system. The bio-diesel fuel assure the same motor power as diesel oil, having even a bigger cetanic number as usual diesel oil. After testing, it was realized that the consumption is similar too, at the same motor performances. The bio-diesel fuel has very good lubricant properties, such as its adding to oil leads to a better protection of motor.

A disadvantage of bio-diesel is the fact that it can damage some rubber types, damaging the hoses and garretings. This fuel can obstruct the filters, which must be changed more often than usual. The bio-diesel has a bigger jellification point than classic diesel oil, which is a disadvantage at temperatures below -20°C . Another disadvantage of bio-diesel is that of having double connections in its molecule, which determines its oxidation in time, decreasing the fuel qualities. The solution is simple: using the bio-diesel within the most 6 months from its purchase.

Alcohols

From alcohols, the most used in techniques are the ethanol and the methanol. Due to its reduced price, the methanol is indicated in many cases as the substitute, in some proportions or in integrity, of the petrol fuels.

If the methanol is introduced in cylinder in a liquid state, then the mechanic work of compression will be smaller, the temperature at the end of compression will be reduced and the motor with sparkle ignition will function with a better efficiency. On the other hand, when the methanol is injected direct in cylinder, the heat transfer from the hot walls of burning chamber is enough to assure its rapid vaporization. Under these conditions, a motor with direct injection with methanol presents an effective medium pressure with approx. 10 % higher and thus, a bigger power.

Solutions for changing the motor with compression ignition for functioning with methanol

Diesel motor converted at sparkle ignition

The solution applied implies the transformation of the original motor through introducing an electric installation of sparkle ignition. Another solution is that of dual fuel, which implies the partially replacing only of diesel oil through methanol. The diesel oil fraction introduced in cylinder assures the self ignition with a convenient delay for unfolding burning in good conditions. This solution presents the disadvantage of the presence of 2 separate injection circuits, from which one must function with pure methanol.

The third solution is the possibility of motor supplying with emulsion diesel oil – methanol, prepared mechanic by the supplying system. But, due to the reduced mixture of methanol with petrol fractions, this solution supposes the use of an additive, which participate in a comparable proportion of that of methanol. In this case, the supplying installation of the motor does not imply modifications, but the price of the fuel is sensitive bigger because of the additive use.

Hydrogen

The hydrogen permits the use of energy obtained from regenerating sources. In present, hydrogen is almost exclusively produced from old fuels, like: natural gases, oil and coals, base on some well established conversion processes. On the other hand, using hydrogen from bio-mass, reduces the quantity of CO₂ spread in atmosphere. The main processes of producing hydrogen are presented in Table 1.

For now, the electrolytic hydrogen is produced as a basic material for the chemical industry only in the economies where the electric energy is very cheap and it is, for now, very expensive to consider it as a fuel. Yet, if we look in perspective, when the old fuel will be exhausted, the hydrogen will become competitive with electricity as a source of combustion and heating.

Motor with internal burning supplied with hydrogen

When hydrogen was tested as a possible fuel, classic motors type Otto were used, which function at a low speed (2500-6000 rot/min). A normal speed for motor with hydrogen is that of 25.000-60.000 rot/min. The hydrogen burning process is 10 times faster than those of classic fuels. That is why, the crank-shaft rotation must be 10 times bigger. This is the first technical difficulty in the process of using hydrogen as fuel at motors with internal burning. With a motor with internal burning with hydrogen having a high speed is a motor which can generate the same power parameters at a low fuel consumption and without noxious.

The new system combines the diesel concept with the combustion properties of hydrogen, obtaining an equal efficiency with that of motors on diesel oil.

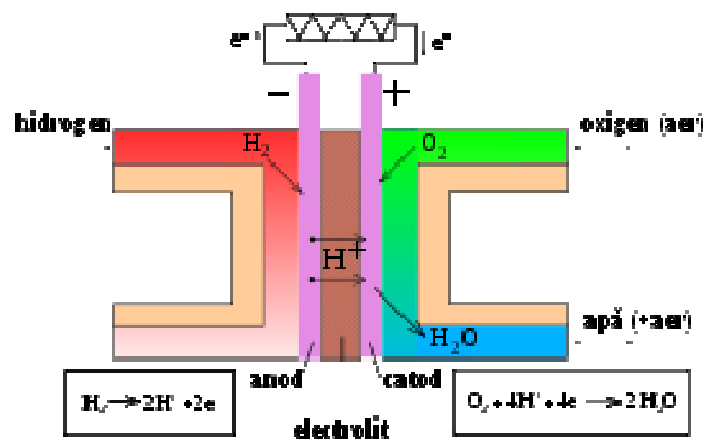


Fig. 1. Simplified scheme of a combustion pile based on hydrogen

Tab. 1

The main processes of producing hydrogen

Basis method	Process	Basis material	Necessary energy	Emissions
Thermal	Reforming with steam	Natural gases	Steam of high temperature	Some emissions Carbon catching may decrease their effect
	Thermo-chemical decomposition of water	Water	High temperature obtained from the nuclear reactors cooling	Without emissions
Thermal	Gasification	Coals, biomass	Steam and oxygen at high temperature and pressure	Some emissions Carbon catching may decrease their effect
Electro - chemical	Pirollyse	Biomass	Steam of middle temperature	Some emissions Carbon catching may decrease their effect
	Electrolyze	Water	Electricity of wind, sun, hydro and nuclear nature	Without emissions
	Electrolyze	Water	Electricity produced by natural gases	Some emissions at electricity production
Biologic	Photo - electrochemical	Water	Direct sun light	Without emissions
	Photo – biological	Water and algae species	Direct sun light	Without emissions
	Fermentation without air	Biomass	High temperature	Some emissions
	Fermentative micro-organisms	biomass	High temperature	Some emissions

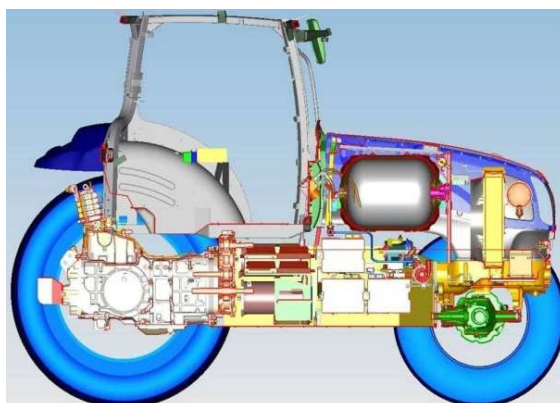


Fig. 2. Tractor prototype using hydrogen as fuel

The auto-vehicles propulsion with electric motor supplied with combustion pile

The combustion pile (Fig. 1) is a system witch converts the chemical energy in electrical energy. The fuel (the energy source) is situated to anode and at cathode is situated the oxidant.

In the last period, Holland launched a prototype of tractor using hydrogen as fuel (Fig. 2). This tractor has 0 emissions, using an electric motor which can develop 106 HP and with the help of a distributor , it sends the power to all the 4 wheels. This prototype has the disadvantage of a reduced autonomy (fuel for only 1,5 – 2 hours) and the its extremely high price. In spite of all these, the hydrogen tractor is an alternative for the future.

RESULTS AND DISCUSSION

Another advantage of bio-diesel is that it decreases the pollution emissions at the motor in which it is used. This is a very important property, considering the tendency of using products which damage the least the environment. This quality of bio-diesel is presented in Table 2.

Tab. 2.

Decreasing of pollution emissions when using bio-diesel

Polution product	Decreasing of emissions using bio-diesel compared to oil [%]	Observations
Sulphure oxides	–99	Sulphure content under 550 ppm
Monoxides of carbon	–20	–
Oxides of nitrogen	+1	–
Oxides of nitrogen with injection optimization	–23	Decreasing with 5% of injection advance
Solid particles	–39	–
Hydrocarbonates	–32	–
Soot	–50	–

After experiments over the effects that bio-diesel has on some of diesel motor components, it was established that it has a bad influence on some of these. Injectors (Fig. 3), valves (Fig. 4), the head of cylinder (Fig. 5), piston and crankshaft have sediments which influence negative the motor functioning. These disadvantages can be easily removed through using special additives.



Fig. 3. The bio-diesel influence over injectors



Fig.4. The bio-diesel influence over valve



Fig. 5. The bio-diesel influence over the head of piston

After experiments, it was proved that tractor motor can function in good conditions, if these component parts were reconditioned and better, if we can initially use some special additives which can limitate this bad influence over the pieces presented above. The composition of these additives is a subject for further investigations.

CONCLUSIONS

The purpose of the paper is to identify some alternative fuels which can be used for motor with internal burning, considering the situation that classic fuel will not last for ever. That is why the researches were oriented to the following alternative fuel: bio-diesel fuel, alcohols (especially methanol) and hydrogen.

All of these fuels can be used even in present, but each of them has advantages and disadvantages, which are presented.

For example, bio-diesel can be used to all motors with compression ignition, alone or mixed with diesel oil, but it requires with minor changes to the injection system. As advantages, the bio-diesel assures the same motor power as diesel oil, having even a bigger cetanic number. The consumption of a motor with bio-diesel is similar to that of a classic motor at the same motor performances. It also has very good lubricant properties, such as its adding to oil, leads to a better protection of motor. A big advantage of this fuel is the possibility of obtaining it from plants through a rather simple process.

A disadvantage of bio-diesel is the fact that it can damage some rubber types, damaging in time the hoses and garretings. It is also shown how this fuel can damage some parts of motor, such as: pistons, valves, injectors, crankshafts.

In what concerns the methanol, due to its reduced price, it is indicated in many cases as the substitute, in some proportions or in integrity, of the petrol fuels. As advantages, a

motor with direct injection with methanol presents an effective medium pressure with approx. 10 % higher and thus, a bigger power. The disadvantage consists in the changes which must be made to motor for functioning with methanol, such as diesel motor converted at sparkle ignition or the solution of dual fuel, which implies the partially replacing only of diesel oil through methanol.

The possibility of using hydrogen as fuel is a solution for the future, having the big advantage of using energy obtained from regenerating sources and no noxious. The disadvantage of such a motor is the very high price.

The quest for new fuels is a matter of big actuality, so that the researches continue.

REFERENCES

1. Hunt, D. (1995). Farm power and machinery management. Iowa State University. USA.
2. Dumitru, M. (2005). Mecanizarea agriculturii. Ed. Alma Mater. Sibiu.