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Researches on the Advantages for the Environment of Using Bio-Fuels to Vehicles

Mariana DUMITRU

Faculty of Agricultural Sciences, Food Industry and Environmental Protection, Lucian Blaga University of Sibiu, Romania; mariana_dumitru2001@yahoo.com

Abstract: The paper presents researches on the possibilities and advantages for the environment of using bio-fuels , especially bio-ethanol and bio-gas. The international context is favorable to using bio-fuels, considering that a direction of European Union establishes that in 2020, 20% of the energy consumption of Romania must be provided by rechargeable energy. One source for producing bio-fuels, not so much used until now is sugar beet. Sugar beet wastes are estimated as 1.22 times sugar production, since the total dry matter of processing wastes and field wastes exceed the weight of sugar in the ratio of 55:45. The novelty of the present paper approach is the fact that sugar beet is less used for producing bio-fuel, although its energetic efficiency is bigger than that of some of much studied bio-fuels, such as bio-diesel. Other advantages presented by sugar beet as bio-fuel is the fact that the technology can be completely mechanized, the possibility of preserving it for long periods of time as syrup and a very good efficiency. On the other hand, are presented the compared quantities of bio-gas obtained from different materials, from which resulted that sugar beet leafs have the best quantity of methane from bio-gas. The paper presents a big degree of practical applying and contains original researches. Another aspect which is worthy to be considered is that the emissions released by a motor using bio-ethanol are considerable less than that of a motor using conventional fuels.

Key words: bio-fuels, bio-ethanol, bio-gas, sugar beet, emissions.

INTRODUCTION

The International Energy Agency estimates that in Europe, the oil resourses will finish in 40 years, those of natural gases in 60 years and those of coal in 200 years, fact that in aproximately 20 years, Europe shall be compelled to import 70 % from its necessary energy. As a result of these provisions, the states from EU were obliged to find some renewable sourses of energy. The European Union wants that , untill 2020, 20% from the energy consumption of the comunity states to be provided from reneable sourse. It is probably that the best solution that the conventional fuels should be replaced with some fuels obtained from renewable sources, which are known as bio-fuels.

A permanent sourse of energetic material is represented by plants, which contain carbohydrates which store energy. The area of bio-fuels is large and from this list we can number: bio-ethanol, bio-diesel, bio-gas, hydrogen. All of these fuels, except hydrogen, are obtained from plants. In this paper we will especially reffer to using bio-ethanol as a fuel, considering the advantages that this renewable fuel presents.

1. The advantages and disadvantages of using bio-fuels instead of classic fuels

- Some of the advantages of using bio-fuels are the following:
- They are obtained from renewable staples
- Burnig of bio-fuels releases less CO_2 than oil, which means less pollution for the environment

- An important advantage is that using bio-fuels reduces the environmental pollution
- They are bio-degradable
- The plantation of bio-fuels leads to developing of agriculture and has a positive social impact, through the creation of new work places
- The bio-fuels can be used mixted in certain proportions with classic fuels, without the need of changing the autovehicles motors

The disadvantages of using bio-fuels are:

For the moment, the prices of bio-fuels are bigger than the classic fuels

- The increasing demand of bio-fuels could lead to significant amendments on the food products market
- Some of the plants that are cultivated for bio-fuels are: the corn, sugar beet, palm trees and soya. Some of researches insist that cultivation of these plants, although represents an alternative to oil, will worsen the global warming phenomenon

MATERIALS AND METHODS

Researches concerning using bio-ethanol as bio-fuel

The amidine from plants can be transformed with the help of enzymes in glucose, which can be fermented by micro-organisms in ethanol. That is another possibility of exploiting the energy stored in corn, which is its transformation in ethanol, which can be mixted with gasoline and burned in motors. Beside corn, another vegetal products are used for bio-fuels: sugar beet, soya, rape or even oils resulted after frying foods. Animal fats are another renewable source for bio-fuels.

The advantage of using bio-ethanol as bio-fuel is the possibilty of obtaining it using the sub-products or agricultural and industrial junks such as: straws, paper, cobs, etc. The cellulose junks can be hydrolised to simple carbohydrates, which can be fermentated to ethanol or another compunds which can be fuels or staple for chemical industry. The converssion of the woden-cellulose biomass to ethanol is made through hydrolise and fermentation.

The procedure imposes the pre-hydrolise of the woden-cellulose biomass, followed by a mutual stage of enzyme saccharification of cellulose and the fermentation of the resulted carbohydrates to ethanol. The wooden-cellulose biomass is first treated and detoxificated, releasing the carbohydrate components. The saccharification together with fermentation is achieved in the lack of oxygen. After a few days of saccharification and fermentation, the most of cellulose will be converted in ethanol.

In Table 1 is presented a comparative analysis of the most used bio-fuels.

Tab. 1[4]

A comparative analyis concerning the main bio-fuels

Biofuel	Main characteristics	Advantages	Disadvantages
Ethanol from agricultural bio-mass	Alcohol obtained through fermentation of cereals, technical plants and other vegetal sources	Fuel with big octane and reduced emissions of gases with green house effect	Consumes big quantities of agricultural, food or feed bio-mass
Ethanol from wooden-	Alcohol obtained through conversion of wooden-	Fuel with big octane and reduced emissions of gases	Difficulties in transportation through

cellulose	cellulose biomass to carbohydrate followed by fermentation into ethanol	with green house effect. It does not use food or feed staples	pipelines. It is more expensive than ethanol from cereals
Biogas	Mixture of gasses in which prevails methane, obtained through fermentation without air of manure or other agricultural or industrial junks	The staple is worthless, it can be a source of energy in rural comunities or poor zones of the world	It is difficult to liquidify and can not be used in transports. Its composition is not homeogenous, depending on staple and technology
Bio-diesel	A fuel resembling to diesel oil, obtained from vegetal oils	It reduces emissions and is lubrificant for motors	Difficulties in transportation through pipelines. It is not agreed by all constructors of motors
Renewable diesel oil	A fuel resembling to diesel oil, obtained from vegetal oils and hydrocarbons	It corresponds to standards for diesel oil with a very low contain of sulfur, the addition of animal fats improves the ignition properties. It can be transported through pipelines	Emissions are higher than bio-diesel
Bio-butane	Alcoholic fuel, resembling to ethanol	Easier to transport, less corrosive for pipelines than ethanol	It is not yet produced in big quantities

Approx. 80 % from the world production of bio-ethanol was used as fuel for motors with internal burn. The world production of ethanol for cars is dominated by Brazil and USA, in 2006 having the level of 51 million liters, having an increase of 150 % reported to 1996. In Brazil, bio-ethanol is produced from sugar cane, without effecting the food production and assures approximately 40 % from the consumption of fuels for motors with sparkle ignition and approx. 70 % from the motors of new cars are of flex-fuel type.

In the USA, bio-ethanol is produced mainly from corn, but in this case the energetic balance is less favorable than in the case of sugar beet or sugar cane.

In what concerns the characteristics of bio-ethanol, this has a bigger octane number than gasoline, thus resulting a more efficient burning (including the CO2 emissions reduced compared to motors which function only with gasoline, emissions without sullphides and hydrocarbons). The energetic power on liter is less with 34 %, being necessary more fuel for the same number of Km. For reaching a higher efficiency, an autovehicle must be provided with a motor exclusively projected for functioning with bio-ethanol, that is a motor with a bigger compression rate of fuel mixture (values near 20:1). The only actual vehicles with motor special designed for functioning with bio-ethanol are buses and trucks.

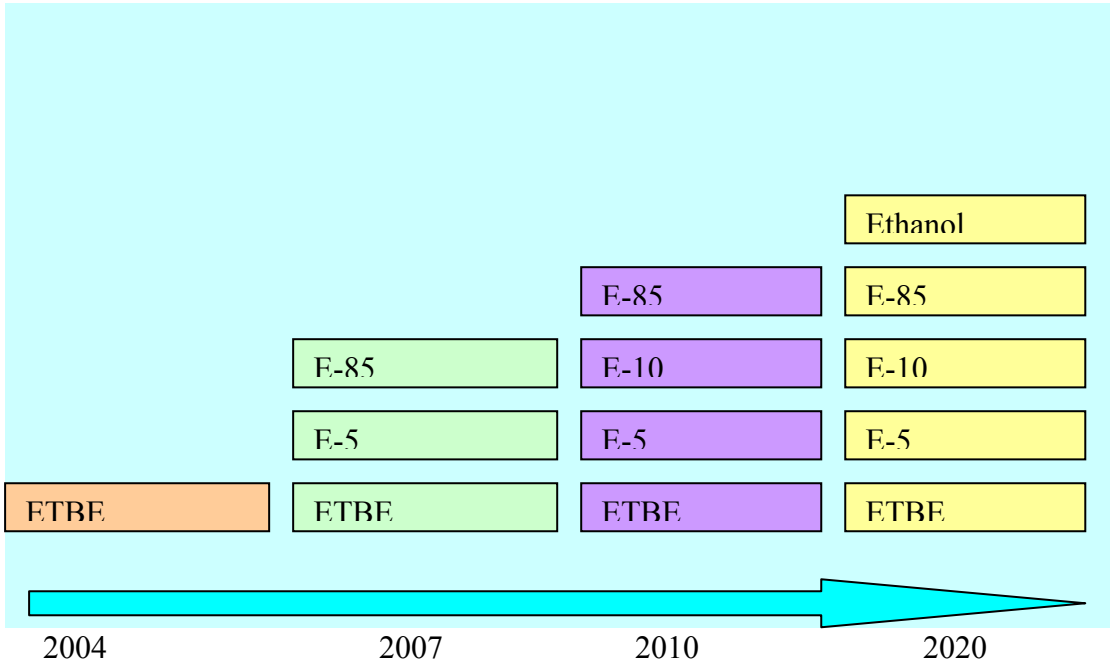

Fig.1. The evolution of implementation of bio-ethanol based fuels

In the European Union countries, using bio-ethanol as a fuel is made as it is or through obtaining ETBE (ethil-tert-buthil-ether) from bio-ethanol (45%) and isobutene (55%). The last one, although is not entirely based on renewable sources, has the advantage of using an oil product with a relative low value and very well known chemical processes.

The experiments made in UE countries aim to confirm the advantages of using bio-ethanol and the encouraging of converting auto vehicles to bio-ethanol. Suede is a pioneer in this domain, having approx. 13 000 auto vehicles which function with mixture of bio-ethanol and 200 distribution stations 9reffering to year 2005), and almost 60 % of fuel distribution centers are ready to offer to consumers E 85 after 2009. In the same time, we mention that in Stockholm the public transport is exclusively based on bio-fuels.

It is appreciated that in France, beginning with 2008, are approx. 200 0000 auto vehicles which can use both gasoline and bio-ethanol.

In England, the plans for using bio-ethanol are effective begging with 2005. As a result, at the beginning it was observed a bigger increasing market, especially based on imported bio-ethanol.

Bio-ethanol can be synthetically made from oil or through germ conversion of bio mass in the fermentation process. In 1995, approx. 93 % from the entire world bio-ethanol was produced through fermentation and only 7 % through synthetic method.

A bigger increase of energetic efficiency can be considered of obtaining bio-ethanol from bio mass, thus promoting its use as efficient renewable fuel and environment friendly.

A new technology which allows using bio-ethanol from bio mass as a fuel will also create a large market for the agricultural products. Such a technology could provide a new source of energy, efficient and not polluted, for the small communities in small remote villages.

Bio-ethanol is easy to transport and has a low toxicity, which makes it more advantageous from the environment point of view.

From all bio mass used for making bio-ethanol, there are 2 types of basic materials: direct fermentable and cellulose and starch based materials. From the first type, the biggest use has sugar beet and different intermediate products of making sugar. In our country, bio-ethanol is mostly obtained from sugar beet. Considering the agricultural conditions of our country and the Romanian farmers experience, the sugar beet crop can assure the basic material for bio-ethanol, without jeopardizing population food supply.

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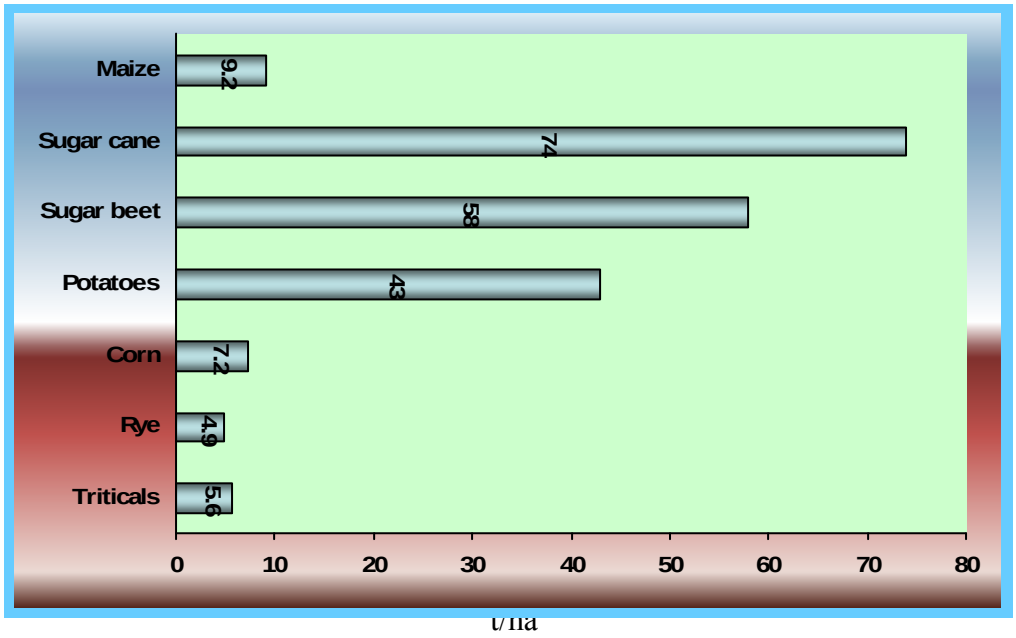

Fig.2. Specific production of bio-fuels (t/ha) in different energetic crops [3]

Thus, 1 ha cultivated with sugar beet can supply the basic material for producing 6240 l of bio-ethanol, which replace 4160 l of common gasoline. The raw material used in our country for obtaining bio-ethanol is molasses.

In the technologic producing process of bio-ethanol from sugar beet results a series of other products, such as sugar beet noodles, which can be used for producing bio gas, for completing food in zootechny etc.

Bio-ethanol can be used either as additive, or as substitute for gasoline. Ethanol with < 1 % content of water can be combined with gasoline in any proportion, until to pure ethanol 100 %.

There are the following alternatives of using bio-ethanol to motors with internal burning:

- Additive for gasoline (ETBE), the procedure is simple and not expensive, but now there are not enough production capacities for ETBE
- Through adding ethanol in moderate quantities, direct in gasoline or in diesel oil up to 15-25 %, fuels known as E15 or E25. In this case, there are fears concerning the quality of the obtained fuel
- Through using mixtures rich in ethanol (E85, E95, 85-95% ethanol of fermentation). It is the most desirable method, these mixtures can replace gasoline or diesel oil through using ethanol direct in the car (this is the case of Brazil)

Reffering to consumption, approx. 1,5 l of ethanol replace 1 l of gasoline.

The efficient use of alcohols as fuels supposes some constructive and adjusting modifications of motors, both for diminishing some negative influences and for capitalization of favorable properties.

Between the main problems which occur at using alcohols as fuels in motors with sparkle ignition can be considered:

- the tendency of reducing of the effective power at a constant debit of alcohols, as a result of their smaller thermal power, compared to gasoline (through ethanol burning results only 66 % from the energy released through gasoline burning)
- the decreasing of necessary Oxygen for burning, thus, in whole, the thermal power of the mixture Oxygen –air, compared to mixture volume, is a little modified (ethanol needs only 61 % from the air necessary to burn gasoline). As a result, the maintain of unchanged motor power can be assured to a given cylinder capacity, through the correspondent increase of the fuel debit (in the same time, the fuel tank capacity must be increased)
- the difficulty of starting the engine to low temperatures, determined by the reduced steam pressure to low temperatures. This disadvantage can be solved through improving spraying (ethanol needs for vaporization 2,6 times heat than gasoline)
- the tendency of worsening spraying in the admission system to carburetor motors, determined by the high values of vaporization heat of alcohols, which needs re-projection of the admission system
- bad qualities of oiling, determined by the reduced oiliness of alcohols, which concerns directly the rubbing couples, in the first place to the pump level and in the high pressure section of the supplying system
- the incompatibility of alcohols with the lubrication oil; corrosion determined by alcohols and also the direct chemical attack of some specific compounds resulted during burning

The using of bio-ethanol has a very good effect on the level of reducing of the main polluted emissions of motors (fig. 3).

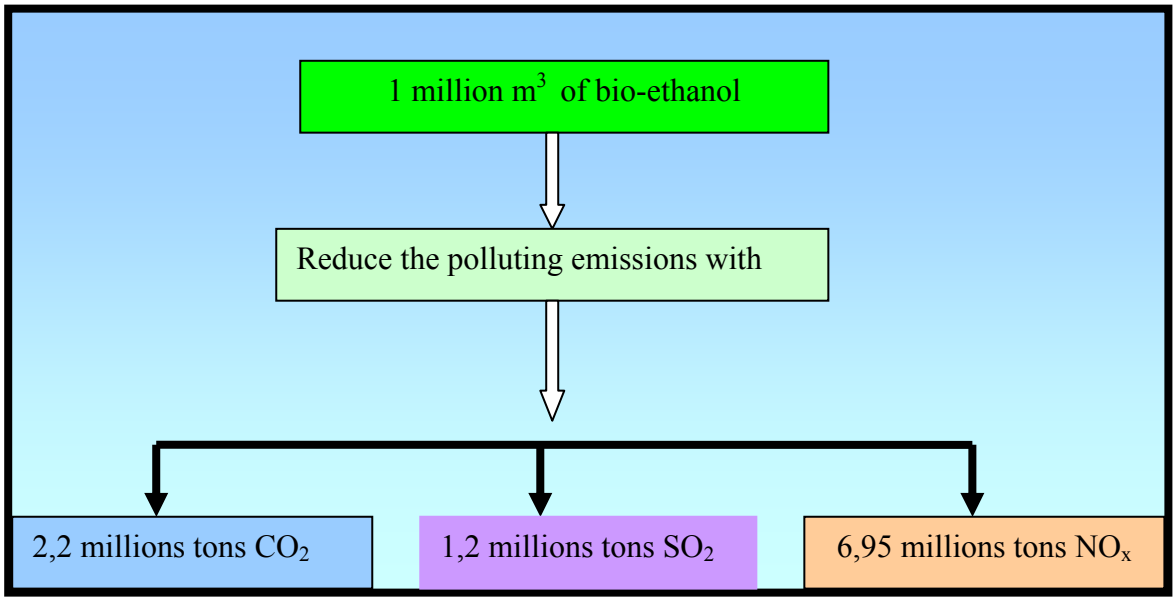

Fig. 3. The effect of using bio-ethanol over the level of polluting emissions

RESULTS AND DISCUSSIONS

The necessity of using bio-fuels is now world wide recognized, (as it is shown in fig. 1), that is why we concentrated our researches especially on bio-ethanol and bio gas, which are some of the most competitive fuels which can to used to vehicles. From the consumption point of view, the numbers are acceptable, thus 1,5 l of ethanol replace 1 l of gasoline. As an advantage, bio-ethanol has a bigger octane number than gasoline, thus resulting a more efficient burning and the emissions of CO2 are reduced, also emissions are free of sullphides and hydrocarbons.

There are more technological possibilities of obtaining bio-ethanol and bio gas, one of them being a bio reactor using different vegetal materials [1], [2].

Reffering to consumption, approx. 1,5 l of ethanol replace 1 l of gasoline.

Between the advantages of using bio-ethanol we can consider: bio-ethanol has a bigger octane number than gasoline, thus resulting a more efficient burning, including the CO2 emissions reduced compared to motors which function only with gasoline, emissions without sullphides and hydrocarbons.

Bio-ethanol is easy to transport and has a low toxicity, which makes it more advantageous from the environment point of view.

We also presented the main disadvantages of using bio fuels, such as: it supposes some constructive and adjusting modifications of motors, the difficulty of starting the engine at low temperatures, bad qualities of oiling, determined by the reduced oiliness of alcohols.

CONCLUSIONS

A technology which allows using bio-ethanol from bio mass as a fuel will create a large market for the agricultural products. Such a technology could provide a new source of energy, efficient and not polluted, for the small communities in small remote villages.

All the disadvantages presented in the paper can be annulled by small changes made to motor components.

From all the aspects presented above, using bio fuels is a tendency in countinous growing all over the world.

REFERENCES

1. Moise, G. (2011). Opportunities to use of self pressurized membrane bioreactors in food industry, The XVIIth Edition of the Symposium: Food Science, Processes, and Technologies: "New trends in food safety and processing" The 2nd International Conference on Food Chemistry, Engineering & Technology May 19 – 20, 2011, Timişoara, Romania

2. Moise, G. (2011). Membrane bioreactor concept with potential use in food biotechnology, The XVIIth Edition of the Symposium: Food Science, Processes, and Technologies: "New trends in food safety and processing" The 2nd International Conference on Food Chemistry, Engineering & Technology May 19 – 20, 2011, Timişoara, Romania

3. Dumitru, M. **(**2010). Researches on the alternative fuels which can be used to motors, The 9 th International Symposion "Prospects for the 3-rd Millenium" 30 sept.-2 oct. 2010, Bulletin of University of Agricultural Sciences and veterinary Medicine Cluj-Napoca, ISSN 1843-5246, vol.67, pag.115-122, Cluj-Napoca

4. Dumitru, M., Gherman, I. **(**2010). Researches on using sugar beet for producing bio-fuels (bio-ethanol and bio- gas**),** International Symposium Trends in the European Agriculture Development, Timişoara, 20-21 may 2010*,* Research Journal of Agricultural Sciences, ISSN 2066-1843, Timişoara

5. Dumitru, M. **(**2010). Researches on the possibilities of using alternative fuels at automobiles and tractors motors, International Symposium Trends in the European Agriculture Development, Timişoara, 20-21 may 2010, Research Journal of Agricultural Sciences, ISSN 2066-1843, pag.277

6. Dumitru, M. **(**2008). Studies over agricultural machines performances, Seria a XII-a, Agricultură, Editura Agroprint, Timişoara, ISSN 1221-5279, vol.40, pag. 437- 441

7. Dumitru, M**. (**2008). Studies on determination of quality work and energetic index of tractors*,* Ist Scientific Agronomic Days, November 13. – 14., Slovak Agronomic University of Nitra, Slovak Republic, ISBN, 978-80-552-0125