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BIOETHANOL: ECOLOGICAL FUEL

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Abstract: Production and using bioethanol are imposed by the necessity of the **gas emission with glasshouse effect** allowence, mainly the carbon dioxide, and by replacing with **fossil combustibles** having **finite resources and more and more higher costs**. The **raw materials** for bioethanol are presented, and also the reduced **carbon dioxide emissions** (CO_2) resulted from bioethanol and the efficiency coefficients achieved production bioethanol out of corn, sugar cane and cellulose. The Spark Ignition Engines (SIE) having flexible engine are focused, these engines being modified to run both on **bioethanol and on gas** depending on the available carburant for the time being.

1. THE GENERAL FRAME OF THE THEME

This paper focuses the production and using bioethanol necessity towards **gas replacing** especially in the power-driven vehicles.
In fact, the bioethanol is an ethyl alcohol coming out from cereals and, in consequence of this matter, the general term further used is simply **ethanol**; the denomination “bio-gas” is any less used.
We can say that this biofuel constitutes in fact a “**rediscovery**” because it was used as a **combustible** for the Spark Ignition Engines (SIE) conceived by Nicolaus A. Otto in **1860** and used by himself since 1861 for suplying SIE.
In **1893** Henry Ford himself designed a SIE engine that would use ethanol as combustible and, after that, he built in Midwest, together with Standard Oil, **a factory in a view to produce this carburant**; so, in 1921 the ethanol represented 25% of the society sales; the factory was closed in **1940** because of the gas much lower prices offered by the oil industry. In spite of all that Henry Ford continued the ethanol promotion.
Begining with **1925**, the bioethanol was commercialized in Germany as an **additive** for the octane value increasing of gas.
Due to oil crisis and the necessity of emphatic allowence of carbon dioxide emissions, the **biofuels were discovered** arround **’70.**
The ethanol hardly **recovered the force** in **2000**, especially as an **additive** for the gas mix which is less pollutant.

1.1. The allowence of carbon dioxide emissions

The carbon dioxide has a **great balance** in the volume of glasshouse effect gas emission that are entering the Earth atmosphere. A conventional measurement unit, **ppm** – parts per one million parts of the Earth atmosphere, allowed to measure or estimate, at certain spaces of time, the **content of CO_2 in ppm** and, **corresponsive** the **average global temperature of Earth atmoshere** (Table 1).
The carbon dioxide balance was measured to grow with 2 ppm/year and the threshold of CO_2 admission in atmoshere was estimated to be arround 450 ppm; the average global temperature was theoretically calculated to be **14,6°C** correspondent to threshold of CO_2. These two values will be attended in **2045**.
Above these values, the Greenland and the West Antarctica ice calottes will be melting, with severe implications such as the significant augmentation of sea level.

Table 1. Carbon dioxide (CO_2) emissions in Earth atmosphere

Crt. No.	YEAR of measurement or estimation	CO_2 CONTENT in ppm	Average global TEMPERATURE in the atmosphere in °C
1	1.800	280 m)	14,0 m)
2	1.950	315 m)	14,4 *)
3	2.008	380 m)	14,5 *)
4	2.045	450 *)	14,6 m)

m) measurement; *) evaluation/calcullus

The value of exess heat retained by carbon dioxide was proven to be arround 2 W/m^2 year, corresponding to 2 ppm/year value. So the research, studies and tests are imposing in a view to emphatic allowence of glasshouse effect carbon dioxide emissions in the "atmosphere".
The carbon released through **fossil combustibles burning** is raising the Earth temperature each moment; the **biofuel carbon is coming from the atmosphere**, being captured in plants during their growing period and it is theoretically neutral regarding the carbon emissions.

1.2. The bioethanol

The ethanol is used as a carburant like a **gas alternative** under two forms:

- **In native state**, E100 (100 parts ethanol to 0 parts gas);
- **In composites** with gas, as an **additive** in different balances being symbolised for ex. as E25 (25 parts ethanol to 75 parts gas)**.**

The E85 ethanol is recomanded to use **during winter time** because the amount of 25% gas in the composite is necessary for **cold-start ability**.
For both forms the symolistic has the following meaning: the **E** character is coming from **ethanol** and the adjacent figures are representing the **ethanol/gas report**.
At global level (in 2006) over **45 milliarrds liters** were produced, whereby **19 mld.** liters in USA and **15 mld.** in Brasil.
One of the bioethanol advantages is refering to its **superior octane value towards gas** leading so to the autovehicule higher performances regarding the **engine power and its acceleration**.
The main countries production bioethanol are: Sweden, Spain, Germany, France, Poland, Hungry, Finland, Romania.

The bioethanol sustainers are claiming that its production and using from no nutritional materials are helping to:

- **Rural economy** augmentation;
- **The decrease of dependency** towards fossil combustible imports;
- **The decrease** of carbon dioxide (CO_2) emissions

1.3. The flexible automobiles

In the middle **'80-ies** almost all cars sold in Brasil were running with **native ethanol**, having so a **modiffied engine**. In the beginning of **1990** the **oil lower prices** decided Brasil to decrease the ethanol production **subventions** and so its price raised immediately.

Beginning with **2000** the oil prices bigan to grow; the car owners wanted again carburants based on alcohol but, having in mind the last experience, **they didn't want to depend exclusivelly on bioethanol**.
The motor vehicule producers began to search for a cheeper solution **to let a car run on both types of carbuarants**. An **engine fuel feedind system** was conceived so that the car was running using **any ethanol and gas composite**, even gas or ethanol exclusively.
In **2003**, in Brasil, the first flexible motor vehicule "**Total Flex"** showed up. Years after that, most of the flexible autovehicules didn't use gas because 1 litter of ethanol was cheeper than the gas one. Starting with **2008**, almost 85% of the automobiles sold in Brasil are **the flexible type**.

2. RAW MATERIALS FOR BIOETHANOL PRODUCTION

Generally, the bioethanol is produced out of:

- **Vegetable nutritional crops** containing mainly **sugar**;
- **No nutritional raw materials** containing mainly **cellulose**.

The largest amonut of biofuel are produced out of vegetable nutritional crops (Fig.1).
The innovative technologies are directed upon bioethanol production out of **no nutritional raw materials and of different nature** that would **not compete with nutritive plants**; most of these are presented in structural scheme in Figure 1.
The raw material used **in our country** to produce ethanol is the corn and the resulted molasses from the sugar factories.
The European Bioethanol Fuel Association EBIO supports:

- the extension of **regenerable raw material depot**;
- **the low impact** of bioethanol on the environmnet;
- **minimum changes to bring upon internal combustion engines**

3. ETHANOL FROM CORN IN USA

The corn is used in USA to produce ethanol which is considered as home energy. If the hole corn crop would change in ethanol only **12%** of the necessary gas is replaced.
Important subventions were offered for manufacture and using ethanol. The **research is financed** in a view to replace **15%** of the anticipated redundance of gas with ethanol and other regenerable combustibles in 2017. The hole ideea is to produce ethanol out of vegetable no nutritive material: shanks, prairie grass, fast gowing trees, junk of electronical components or even of algae and germs. This new vision is involving the performant autovehicule production plants and also the community in a view to increase the efficiency of cultivation and acquisition of no nutritive plants and junk.
The subventions for ethanol is leading to small states rebirth, such as: Nebraska, Wahoo. Arround 16 factories were developped in Nebraska so that they are consuming 1/3 from the corn crop of the state; the prevision is to open up another 50 factories. In Nebraska **2008** was the first year in which only corn was cultivated towards beans that was not cultivated at all.

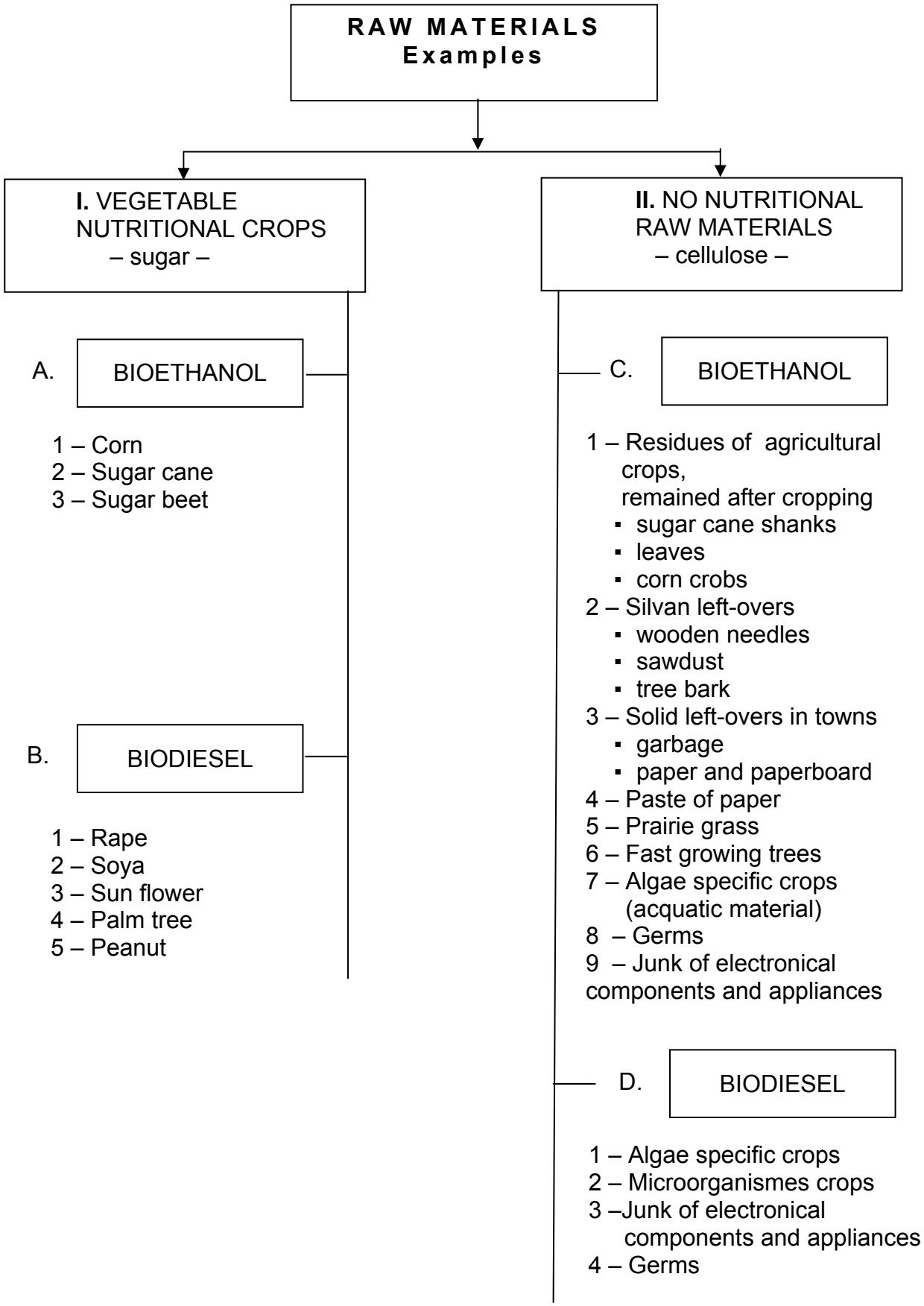


Fig. 1. – Vegetable nutritional and no nutritional crops and other raw materials for biofuel production

In USA there are only 1200 gas stations, most of them being located along the corn crop, which are selling ethanol in the composite form E85 that is used by autovehicules having special conceived engines.

Production bioethanol out of corn has some **law efficiency** aspects:

La producerea bioetanolului din porumb sunt câteva aspecte care determină o **eficienţă scăzută**:

- The farina of corn grist must be changed in sugar contents using an **expensive enzyme** ;
- The ethanol energy rezulted of corn is less bigger than the fossil combustible consumed (Fig. 2 and 3).

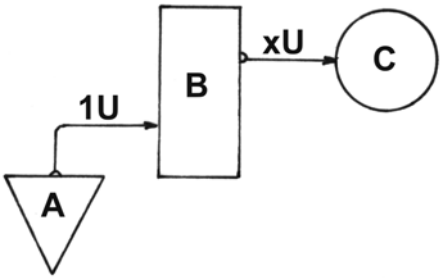
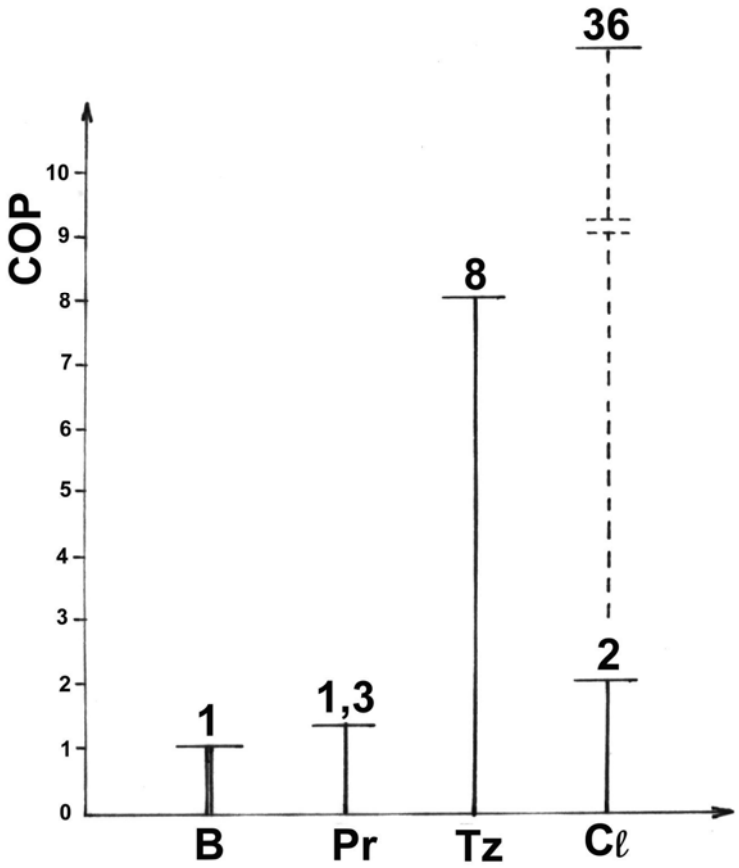


Fig. 2. –The technological scheme in energy transfer from the fossil consumed combustibilul to the rezulted bioethanol

A – Fossil consumed carburant (1U); B – Ethanol factory; C – Resulted energy from ethanol (xU); U –Conventional measurement unit; x –multiplication coefficient



ENERGETICAL BALANCE

Fig. 3. – The performance coefficient values (COP) in energy transfers

B – Gas; P_r – Corn; T_z – Sugar cane; C_l -- Cellulose

3.1. The performance coefficients (COP) in the technological process regarding the energy changing

$$COP = \frac{A(J)}{C(J)}$$

A is the **fossil combustible energy** used to produce regenerable carburant (input energy);
B is the **regenerabil fuel energy** resulted (outputenergy).

$x_{Pr} = 1{,}3$, corn
$x_{Tz} = 8$, sugar cane
$x_{Cl} = 2...36$ for cellulose depending on the nature of raw material and the production method (Fig. 3)

3.2. Law emissions of carbon dioxide released by bioethanol

Carbon dioxide emissions (CO_2) of autovehicules running with bioethanol are **much lower** than those of autovehicules consuming gas (Fig. 4). Furthermore, the ethanolul is releasing **carbon of the atmosphere** that is captured by plants used in the bioethanol production, in their growing period.
Theoretical, the ethanolul could even run **car races**, **planes** and **helicopters**, and also **ships**, as all these being neutral from the carbon emissions point of view. The **carbon** released through **fossil combustibles burning is raising the Earth temperature** in each moment.

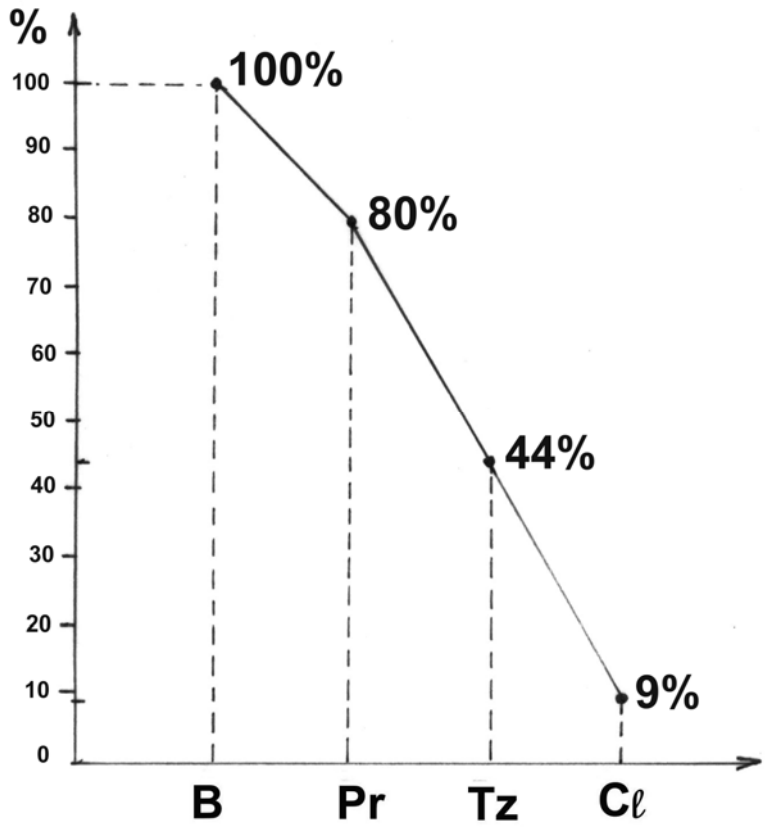


Fig. 4. – Gas emission with glasshouse effect proportions in conventional units (U)
B – Gas; P_r – Corn; T_z – Sugar cane; C_l -- Cellulos

CONCLUSIONS

(1) The bioethanol is used as **additive in gas**, mostly **in composite with higher proportion of gas** up to E85, and any less as **native etanol**;
(2) The bioethanol has **an octane value superior towards thatone of gas** improving so the engine performances**-** power and acceleration, making it more efficient and increasing its endurance;
(3) The bioethanol impact upon the environment is very low. The carbon of ethanol **is coming from the atmosphere being captured by plants in their growing period;**
(4) The vehicle using ethanol must have a **modified engine towards thatone using gas;**
(5) After 2000 many **flexible automobiles** showed up with engine having a special fuel feeding system that allows it to run using an ethanol-gas composite, only with ethanol or with gas;
(6) **The ethanol energetic balance** is favourable to any king of raw material system used for its production.

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