STUDY REGARDING THE PRODUCTION OF BIOGAS USING BIOMASS RESULTING FROM AGRICULTURAL RESIDUES AT THE UNCONVENTIONAL ENERGIES LABORATORY AT POLITEHNICA UNIVERSITY OF TIMISOARA

Adrian – Eugen CIOABLĂ, Ioana IONEL, i Mihai JĂDĂNEANȚ*,
Politehnica University of Timisoara, Faculty of Mechanical Engineering, TMTAR, Bucureşti, Romania
Alexandru SAVU
SC Savprod SRL, C. Ressu, Bucureşti, Romania

Related with the evolution of the industry and also with the growth in the need for energy in the last decades, biomass can be used to sustain the process of combustion for the wastes with small calorific values. In this context, the use of biomass and the ways of transforming it in energy for the industrial use is one of the main objectives that Romania is trying to achieve after adhering to the E.U.
The main purpose of the study is to present some information about the types of biomass used in our days, their use in industry and also to present a model of installation that is presently under construction at the Politehnica University of Timisoara that will try to give some answers related to the potential possibilities using this kind of materials.

Key words:
Biomass; clean energy; biogas

STUDIJA O PROIZVODNJI BIOGASA OD BIOMASE DOBIJENE OD POLJOPRIVREDNIH OSTATAKA U LABORATORIJI ZA NEKONVENCIONALNE ENERGIJE NA POLITEHNIČKOM UNIVERZITETU U TEMIŠVARU

Imajući u vidu razvoj industrije i rast potreba za energijom tokom poslednjih godina, biomasa se može koristiti za proces sagorevanja otpada male kalorične vrednosti. U tom kontekstu, korišćenje biomase i njeno pretvaranje u energiju za upotrebu u industriji predstavlja jedan od glavnih ciljeva koje Rumunija pokušava da postigne od kako je postala deo Evropske unije. Glavni cilj ove studije je da pruži neke informacije o vrstama biomase koje se danas koriste i njihovoj upotrebi u industriji, ali i da prikaže model jednog postrojenja koji se trenutno izrađuje na Politehničkom univerzitetu u Temišvaru, a pomoću koga ćemo pokušati da pružimo odgovore o potencijalnim mogućnostima za primenu ove vrste materijala.

Ključne reči:
biomasa; čista energija; biogas

1. INTRODUCTION

Biomass is considered to be one of the main sources for clean energy, mainly biogas and it is one source with great potential that is used at a small scale in present but this scale will encrease at a larger scale in the future.
The range that can be covered through the utilisation of this type of energy had grown in time, and in present after the biomass is treated it can be converted in one of the three major forms of energy : electricity, heat or fuel.
In the next figure it will be presented the technical potential of biomass in Europe (figure 1)

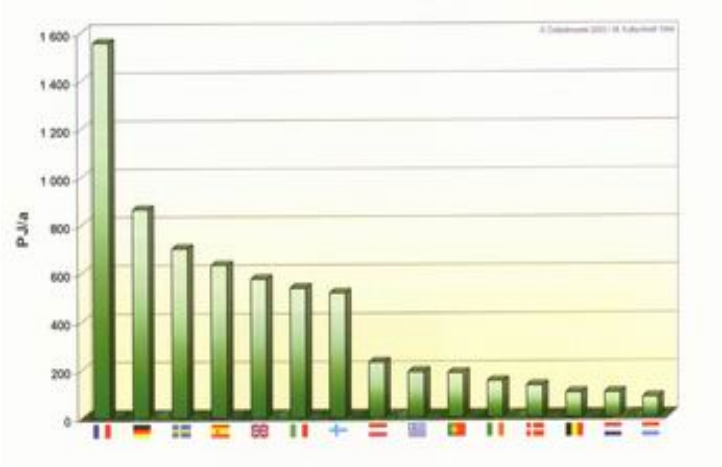

Figure 1 – Technical potential of biomass in Europe

Table 1 presents the estimative preponderance of energy sources in the year 2025.

Energy source	Energy cuantity (in terrawatts)
Energy from the sun	1,5
Biomass	3,5
Hydro and geothermal	2,5
Wind energy	1,0
Fission energy	0,5
Fossil fuels (oil, coal)	9,0
Total	**18,0**

Table 1 : The preponderance of the main energy sources in the year 2025

Related with the European Union's project to achieve an average share of electricity from renewable energy sources of 12% by the year 2010, biomass is expected to provide about 10% of the entire European energy supply, which is equivalent to about 5800 PJ (1 PJ = 1 petajoule = 10^{15} J).

2.BIOMASS AND CHARACTERISTIC FORMS OF BIOENERGY

The main categories that include bioenergy sources are divided in : solid, liquid and gaseous bioenergy sources. In the first category are included products made from wood, due to the industrial processing of wood products. Also, this category includes solid residues from agricultural crops.

Liquid bioenergy sources include ethanol from alcoholic fermentation and methanol from lignocelulose biomass such as wood. The most widespread energy crops are rape and sunflower.

Gaseous bioenergy sources – those category of sources are the result of converting natural biomass. They can be produced by microbiological processes such anaerobic methane

fermentation and also can arises trough the thermochemical conversion of solid biomass in gasification processes.

3.THE DEMONSTRATIVE INSTALLATION FOR THE PRODUCTION OF BIOGAS FROM AGRICULTURAL RESIDUES.

The installation for the production of biogas from biomass uses the anaerobic fermentation process of the solid but minced agricultural residues from the crops. This process consists in several parts, in which the organic matter is transformed by anaerobic bacteria to a gas consisting mainly of CH_4 and CO_2, and a residue called sludge or biosolids. The main result for this process is the storage of a significant fraction of the original biomass energy in methane, as the reactions that occur only give out a small quantity of heat.

In the first stage there are used different acids for the modification of the pH of the residues using acetic acid, or even sulphuric acid. After this stage, it will take place the methanogenesis process that can be produced in three different regimes:

- criophilic (10 ÷20^{o}C) during 90-120 days ;
- mezophilic (25÷35^{o}C) during 25-30 days ;
- termophilic (40÷55^{o}C) during aprox. 10 days.

The installation uses acetic acid because this acid is not very strong and it can be processed from the bacteria at CH_4 and CO_2.

Figure 2 presents the variation of the pH as a function of the acetic acid concentration.

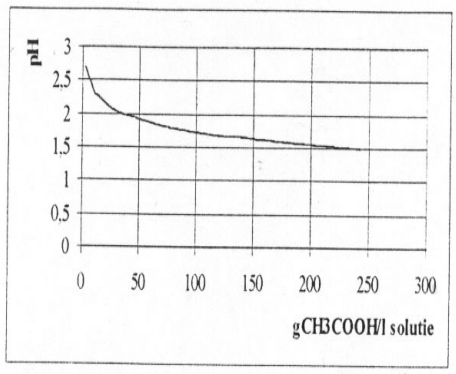

Figure 2 : Variation of the pH as a function of the acetic acid concentration

In Figure 3 is presented the schematics for the installation.

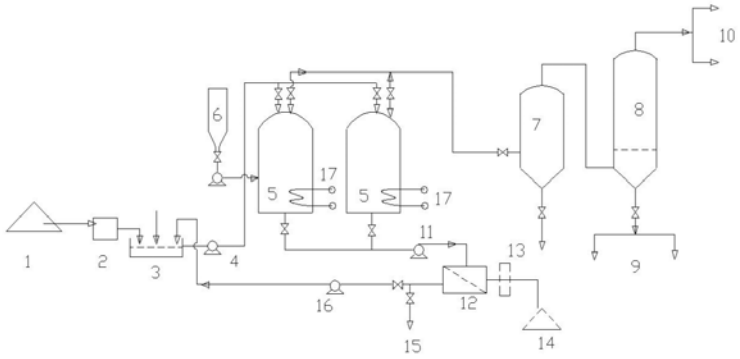

Figure 3 : Schematics for the demonstrative installation

1.biomass deposit; 2. mill; 3. tank for the preparation of the biomass suspension; 5. anaerobic fermentation reactor; 6. tank for the correction agent for the pH; 7. retaining filter; 8. CO2 absorber and pump;9.CO2 desorber and compressor; 10. utilisation of the biogas; 11. pump for the evacuation of the used material; 12. compost filter; 13. compost drier; 14. tank for compost; 15. liquid evacuation; 16. pump for the recirculating material; 17. heating system / reactors.

The hydrolysis reactor has a cylindrical shape. It's made of steel and has inside a submersible pump that has the role of inserting the biomass material with the water and the acetic acid inside the two fermentation reactors. A picture of this reactor is presented in Figure 4.

Figure 4 : Hydrolysis reactor

The fermentation reactors have on their upper parts a connection for feeding the biomass and evacuation of the biogas, for feeding the reactives, for measuring the pressure and the pH (Figure 5).

Figure 5 : Fermentation reactors

The heating system is composed mainly from a boiler made for an installation having a calorific value of 18KW/h., enough for heating the biomass at a temperature of 35 - 40°C, that is necessary in this case (Figure 6).

Figure 6 : The boiler used to circulate hot water trough the installation

The purification and the processing of the biogas will be realized trough a filter filled with steel material trough which the H_2S will be eliminated. After the filtering process, a part of the CO_2 is eliminated trough another filter with ceramic components. After the CO_2 is "washed" inside this filter with the help of a dosing pump, it will be deposited inside a bottle with the help of a compressor and a system of pipes and reservoirs connected with the main installation (Figure 7).

Figure 7 : The H_2S filter (in the back) and the CO_2 filter(in the front plan) of the installation, and also the dosing pump used for "washing"the CO_2 filter

Also, the biogas produced in the installation can be stored inside a cylinder, this method allowing the study of the exact values of the components present and a potential calculation for the burning capacity of the obtaining biogas, this being helpful in determining in witch way this biogas can replace the CH_4 used currently in the networks.(Figure 8)

Figure 8 : Storage cylinder for biogas

The electric installation will be relatively simple, it will be composed from an electric panel trough which the pumps of feeding / evacuation and recirculation of biomass will be commanded (Figure 9).

Figure 9 : Electric panel of the installation

4. CONCLUSIONS

From all the renewable resources, biomass is the only one which remains available at all times and also can be converted through different methods necessary to provide transmittable power.
Related to the information provided at a general level, it can be said that Romania has also a relatively big potential to develop installations to convert the biomass to biogas through different methods, like anaerobic fermentation or gasification.
A model of demonstrative installation using the anaerobic fermentation is presented in this study with its components and a short description of the process that takes place inside the installation.

5. BIBLIOGRAPHY

[1] Program OVAPED CEEX developed at the "Politehnica" Univerity in Timisoara : "Optimisation in the energetic potential development for residues for obtaining clean energy in the Romanian industrial installations".

[2] European Comission, Biomass Conversion Technologies – Achievements and prospects for heat and power generation (1998).

[3] John Andrews, Nick Jelley : Energy science – principles, technologies and impacts.

[4] Dr Semida Silveira, Bioenergy, Realizing the Potential (2005).