Journal of Young Scientist, Volume I, 2013
ISSN 2344 - 1283; ISSN CD-ROM 2344 - 1291; ISSN Online 2344 - 1305; ISSN-L 2344 – 1283

# BIOGAS FROM WASTERWATER TREATMENT PLANT

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***Abstract***

*One of the products obtained in a wastewater treatment plant is the biogas wich consist in a mixture of biogenic gases resulted from fermentation process of various organic substance. For a wastewater treatment plant the energy obtained in this way is important because is a renewable energy. The installations for biogas production in wastewater treatment plants are a very important component of it.*

***Key words****:biogas, methanogenesis, purge.*

## INTRODUCTION

Biogas is the term used for a mixture of gases (methane, hydrogen and carbon dioxide, etc.) of biogenic origin which are generated by processes of fermentation or gasification of various organic substances. These combustion gases serving as an energy source (biogenic energy). Energy from the chain, biomass →biogas → electricity and heat, is called renewable energy, the following recital: carbon dioxide released into the atmosphere from burning biogas, is a maximum amount equal to the amount absorbed by plants or forage consumed by animals during their crops. Methanogenesis is a complex microbiological process trough different materials (substrate) are converted into biogas and sludge fertilizer. The final role of this process are methanogenic bacteria, represented by numerous species, but they are not the only ones involved in the production of biogas.

## MATERIALS AND METHODS

Biogas is obtained in a biotechnology, fermentation of different materials containing organic substances essential as proteins, lipids, carbohydrates. The drawing below presents a complex schema of biomass transformation of various origins, into biogas, passing through four specific steps. It is noted that the whole process is split from one stage to another, the complex molecules that exist in the raw materials used in the production of biogas, the molecules becoming easier.

In step 1, the enzymes secreted by groups of aerobic and facultative anaerobic microorganisms, called exoyeasts, attack macromolecules such as cellulose, starch, pectin, hemicelluloses, fats, proteins and nucleic acids and compounds them into smaller molecules such as different types of sugars that celobioza, sucrose, maltose, xilobioza, then into acid as galacturonic acid, fatty acids, amino acid basis as fosfogliceric respectively, purines, pyrimidines.

In step 2 of the previous step are subjected to fermentation products after which it will get simpler molecules and compounds. In these compounds are carboxylic acids: formic, acetic, propionic, butyric, valeric, malic, etc. From this stage fermentation results gas like hydrogen, carbon dioxide, ammonia, hydrogen sulfide and various alcohols such as methyl, ethyl, propyl, butanediol etc.

In step 3, strictly anaerobic methanogenic compounds are formed from the larger

molecules in previous step. It follows, again, acetic acid, hydrogen, bicarbonate, formic acid and methanol.
In step 4 to form methane and carbon dioxide, main components of biogas, which will be found in small proportion in second gear resulting gases: hydrogen sulfide and ammonia. (Nikolic, 2006)

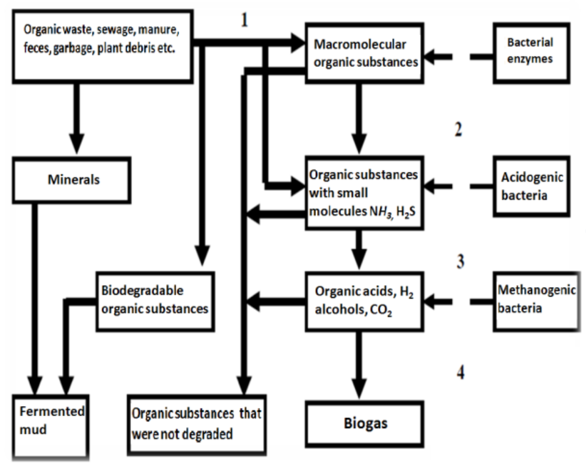

Figure 1. Stages of production of biogas

The raw material should provide favorable environment development and activity of microorganisms that contribute to digestion substrate and finally, the production of biogas. This environment must meet the following conditions: contain biodegradable organic matter; have a high humidity over 90%; to have a neutral or almost neutral reaction (pH 6.8 to 7.3); contain carbon and nitrogen in a certain proportion (C / N = 15 to 25); do not contain substances inhibitory to microorganisms: some heavy metals, detergents, antibiotics, high concentrations of sulfates, formaldehyde, disinfectants, phenols and polyphenols. Biogas can be used for organic material of very different origin: vegetable waste, household waste, human waste, animal manure, manure, wastewater from food and livestock, etc.
The main factor determining the production of biogas feedstock deserve attention. It is, of course, a surplus of biogas energy self-consumption significantly compared to energy from biogas that need their thermal needs of the production system. (Nikolic, 2006)
The idea before it was found that the raw material that produces biogas from self-consumption surplus must be organic load of at least 2,000 mg/dm3 BOD5. Above energy condition satisfied by almost all stations sludge from urban waste water treatment, sewage sludge from livestock, manure all, and some wastewater.
Resources of raw materials for biogas from food industry are very different results from different technologies for food or even certain technological phases. Further resources will be shown the main raw material for biogas production, structured food industries. Specific production, average of biogas, which can be obtained from various raw materials on a dry basis of them, is in the following table:

Table 1. Specific biogas production that can be achieved in various commodities, relative to their dry substance

| NAME | BIOGAS OBTAINABLE liters/ kg D.S. | METHANE CONTENT IN % |
|---|---|---|
| Wheat straw, whole | 367 | 78.5 |
| Chopped wheat straw to 3 cm | 363 | 80.2 |
| Chopped wheat straw to 0.2 cm | 423 | 81.3 |
| Alfalfa | 445 | 77.7 |
| Different herbs | 557 | 84 |
| Fodder beet leaves | 496 | 84 |
| Sugar beet leaves | 501 | 84.8 |
| Tomato stems, chopped | 606 | 74.7 |
| Corn stalks cut to 2 cm | 214 | 83.1 |
| Tree leaves | 260 | 58 |
| Barley straw | 380 | 77 |
| Barley straw | 360 | 75 |
| Stalks of flax or hemp | 369 | 58 |
| Cattle manure | 260-280 | 50-60 |
| Pig manure | 480 | 60 |
| Horse manure | 200-300 | 66 |
| Sheep manure | 320 | 65 |
| Poultry manure | 520 | 68 |
| Human feces | 240 | 50 |
| Sludge from municipal wastewater treatment | 370 | 50-60 |
| Yeast from alcohol distilleries | 300-600 | 58 |

[1]D.S.=dry substance

Human settlements are treated in terms of waste water, which are potential carriers of the settlement methane by this notion of population equivalent, denoted by the abbreviation PE.

Through numerous studies and statistics has been established that a PE daily remove a quantity of 54 g BOD5 pollutant. Since this is an indirect indicator of biodegradable organic load, there is a direct relationship between the amount of BOD5 discharged from a village and load limits of these waters. From energy balance of biogas plants that minimum load BOD5 substrate must undergo fermentation of 2000 mg/dm3. Because of this municipal wastewater have undergone a physical settling which separates sludge that will be introduced in fermenters of biogas. In this way loses some of the original potential wastewater so that in the 54 g / LE/day remain approx. 18 g / LE/day. The remaining potential is found in the supernatant decanter (decanted water) following treatment aerobic biological treatment.

Components of a biogas plant, although there are several types of biogas plants, the technical part of each installation should operate according to the same method. The "heart" of the system only serves to produce biogas. The main difference is in the choice of substrates and relevant treatment (the input). Energy use further, the gas is also subject to deviations and can be seen as an additional feature of the system, depending on the main results: gas, electricity or heat (the output).

Preparation and treatment Collector: most substrates require pre-treatment such as mixing, improper material removal, cutting or diluting.

Fermentation Unit 1: after processing, preparation and storage possible, the substrates are introduced into the fermentation one. The first container is needed for fresh substrates for fermentation process begins. It needs a cultural home for discontinuous processes in the continuous cultures of bacteria are already in place. During these substrates remain in the first digester varies between 20 and 80 days. The amount of gas produced is very high, all the gas generated is captured gas manifold. Digestre's temperature should be between 40-60 ° C. Thus, digester must have a heating system, often located in the basement of the fermentation unit.

Fermentation Unit 2: two containers of unity must necessarily be protected against water and total methane potential as wastewater effluent of the village.

It is also known that urban wastewater should not have a higher organic loading of 300 mg/dm3 BOD5, in terms of respecting the enactment NTPA 002/2002 regulating the gas, sealed and heated. They are usually made of steel or reinforced concrete.

Agitator / mixer: Each digester must have a mixer, crucial for maintaining homogeneity of the substrate and ensure that gas is delivered equally.

Tank of gas: gas tank varies, so it should be flexible. However, it prevented the air. The first result is progress and residues from biogas digester units.

Residues: residues from fermentation units are high quality fertilizer. During the fermentation process is decomposed carbon and carbon-nitrogen ratio of manure is coming. So nitrogen is easier to handle, and the effect of fertilization is easier to calculate. Also the volume is low and fertilizer more fluent. There are also additional benefits: mitigating odors and destroy weeds.

Unit heat and power plant: usually reaches biogas production unit of heat or power plant, but can be cleaned and used to power vehicles or placed in the natural gas grid. Gas cleaning: all biogas normally be cleaned by removing hydrogen sulfide and ammonia.

There is a huge variety of biogas plants. Types of facilities vary by fermentation processes, country or continent, the size, the nature of raw materials, etc climatic factors. Next will be presented two biogas systems which have been designed by biogas plants today (Figure 2, Figure 3) and a sketch of biogas plants from a brewery in Ploiesti, Romania.

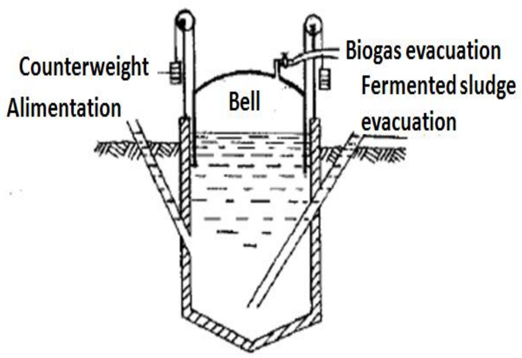


Figure 2. Biogas plant patent J.J. Patel

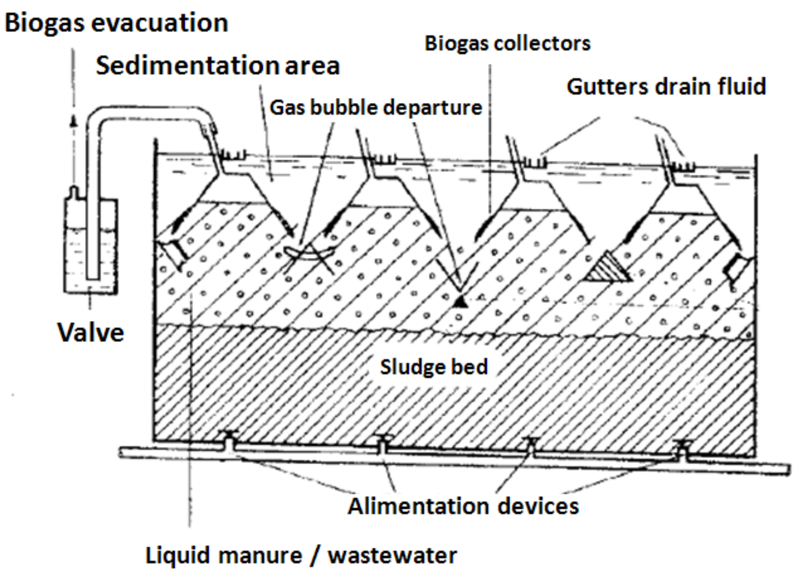


Figure 3. Biogas system UASB-Vageningen

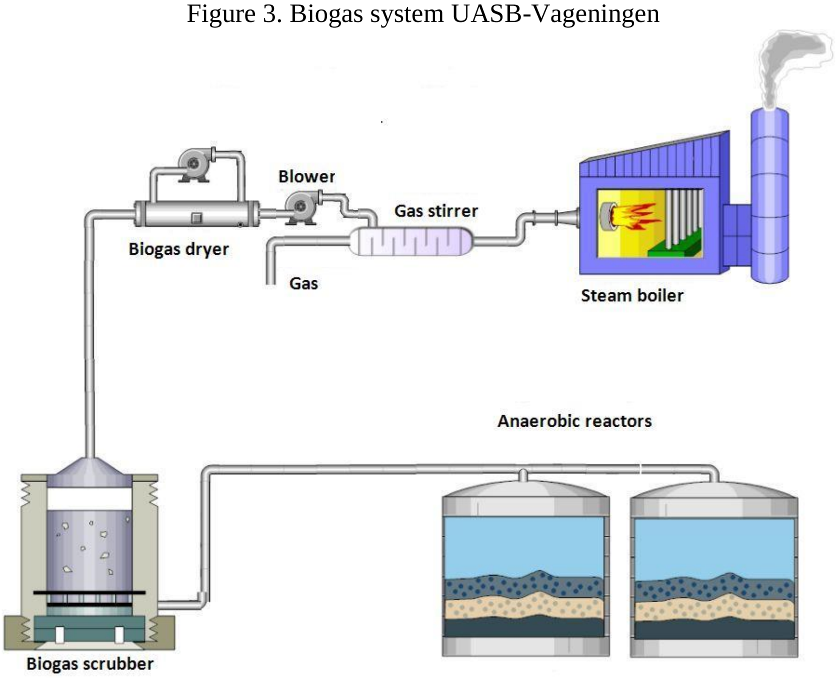


Figure 4. Biogas plant Ploiesti

This system above (Figure 4), required an investment of 200,000 euros, lowers the biogas emissions into the atmosphere. So far, biogas from the fermentation beer ingredients was evacuated through a flare system, but the new facility will capture and use it to produce heat.

The station will generate savings in natural gas consumption by 7% to about 10% in season and out of season. The station will allow annual production of a quantity of 500,000 cubic meters of biogas by treating about one million cubic meters of waste water.

## RESULTS AND DISCUSSIONS

Biogas is used: heat production - using simple heat generating gas (burning) of electricity and heat cogeneration - the simultaneous production of electricity and heat using complex systems: alternative endothermic engines and microturbines.

A small residential facility is enough electricity to power a house and ensure the entire amount of hot water, and if you live in a rural area, raw material resources are significant amounts.

In the next image is presented a heating system which can produce a thermal power up to 250 kwt and the biogas consume is between 65.8-100 mc/h and it has an efficiency of 85%.

Figure 5. Heating system with biogas

## CONCLUSIONS

Producing biogas installations can use a single substance or a mixture of wastes that can be decomposed by bacteria. Being a 100% renewable, can successfully replace conventional energy and protecting the environment. The biogas produced will contain between 45-85% methane, 15-45% between carbon dioxide and small amounts of hydrogen sulfide, ammonia and nitrogen.

Can be used in all applications that use natural gas as fuel. Energy value of biogas varies between 4.5 and 8.5 kWh / m³, depending on the amount of methane, carbon dioxide and other gases present. Using biogas plants have grown a lot and have become increasingly popular.

Figure 6. Biogas power plant

Biogas can be used in various applications, ambient heating, water, drying processes of various materials and used directly in turbines or fuel cells can produce electricity like in the picture above (Figure 6).The biogas power plant above can produce enough energy that can sustain a small village.

Thus, based biogas plants can be used both as a residential solution, as well as dairy farms, chicken and pig farms where the raw material is sufficient and constant.

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