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Generation of Biogas from Household in Maradi

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Abstract

Households is being an aerobically fermented to generate biogas using locally constructed digesters. By taking into account the experience on bio methane in the center of renewable energy of Sokoto in Nigeria, in China, in India and in several other countries of Asia, South America, We took the initiative to experiment the production at the first time of biogas and second the compost as alternative which can contribute to the solution of the problems respectively: energy for the cooking in the households and fertilization of grounds over-exploited. To this end we test bio methane of disputes substrata which we can find in the households of Niger; estimate quantitatively and qualitatively for the production of the bio gas; verify and argue the conditions of success and popularization of this technology in Africa generally. All these reasons bring us to be chosen by this simple and ecological technology then the use of uranium or coal which the republic of Niger has in big quantity.

Keywords: Household maradi; Bio gas niger; Bio methane maradi; Bio-gaz

Introduction

In the encyclopedia the biomass is defined as any organ of biological origin coming from underground. Our study would be concentrated in the biomass for the obtaining of bio methane or biogas with the aim of the transformation in energy.

The Sahelian countries are confronted with specific problems of an acuteness for whom the research for new alternatives is imperative:

- On the energy plan the successive droughts and the increasing anthropological pressure make difficult the satisfaction of needs in domestic energy of a population in constant increase [1].
- In certain regions the singeing of the straw and the animal waste to satisfy needs in calorific energy, in the detriment most of the time fertility of the lands that this waste contributed to reconstitute by one the contribution of organic matters.
- From the point of view of the health service, we observe that excrements, mud's of draining and waste water; vectors of pathogenic germs are cross-posted in the environment, in touch with the populations, without any preliminary treatment [2].

The competitive potential of biogas is also limited by its price. Huge fermentors or long retention times are necessary in the process; such methods are hardly applicable, probably because of her low efficiency now [3].

Materials and Methods

Domestic waste taken to Maradi is solid organic residues stemming from rests of meals and from waste water (fragment animal excrement…) rich in methanogenes microorganisms. The volume of the gas is calculated by means of a gas meter experimental, as the barrel one cylindrical shape $V = \Pi R^2 h$ a hour. A gradual slide provided with a transparent pipe show the volume of the gas [4].

Bio methane is a treatment process of the solid and liquid organic residues (excretion of animals, mud of slaughterhouse, waste water, plant fragments), which consists in degrading them by a bacterial community working there anaerobes in an environment saturated in water. It forms then of the biogas and the compost. The total reaction of the fermentation of the glucose to the following shape:

$$(CH_2O)_6 \rightarrow 2CO_2 + 2C_2H_5OH \quad (1)$$

In the processing procedure of the biomass, as the largest part of the energy of substratum is transformed into methane, only a small part is consumed by the cells of microorganism.

Let us see again the fermentation of the glucose: [5]

$$(CH_2O)_6 \rightarrow 3CH_4\,(g) + 3CO_2(g) \quad (2)$$

The energy k-mol burnt person 1 glucose: 2.81 GJ, 3K-mol methane (CH_4): 3× 0.89 = 2.67 GJ.

The exothermic reaction (2) and by taking into account low (weak) heat loss, 95 % of energy passes in methane. The change of enthalpy is of: 0.14 GJ / K-mol glucose. Of another one quoted (esteemed) the exchange of the free energy is a little more: 0.418 GJ / Kmol glucose. As $\Delta S = (\Delta H - \Delta G)/T$ = 927 KJ/K/K-mol glucose, it is easy to end that the reaction leads to the increase of entropy. In our case the anaerobic fermentation is made in 3 stages:

- Stage 1: fermentation of bacteria

All the various reactions which take place with the cooperation of about types of the fragments of bacteria and form fragments of various substances with a low molecular mass (Half sweet food is transformed into sugar, Protein - amino acid, Fat - in glycerin and fatty acid, nucleic Acid - in Connection of nitrogen hétérocyclique, Fish - in not organic phosphate)

$$C_6H_{10}O_{5+}\,H_2O \rightarrow (CH_2O)_6 \text{ (Energie libéré:-17.7 MJ/Kmol)} \quad (3)$$

$$(CH_2O)_6 + 6H_2O \rightarrow 6CO_2 + 12H_2 \text{ (Energie libéré:-25.9 MJ/Kmol)} \quad (4)$$

- Stage 2: bacteria Acetate

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Figure 1: Experimental small digester.

Applications	Observations
Cooking heating of the water, the lighting	Burner (0,33 - 0,64 m^3 / hour) The raw gas can be used as it stands
Refrigeration	Approximately 0,12 m^3 / hour / hectoliter of the capacity of the refrigerator Immediate adaptation of refrigerators to oil in the use of this gas
Supplies of still engines (motor-pump, generators…	0,45 - 0,50 m^3 / hour Require the purge of the bio gas. Engines working in the biogas are usually marketed

Table 1: Examples of use of the gas of fermentation.

	Material dries	Content of water	Organic matters(OM)
Household	2,72	97,28	67,13

Table 2: Proportions in (%) of dry subjects and organic matter of different substrates.

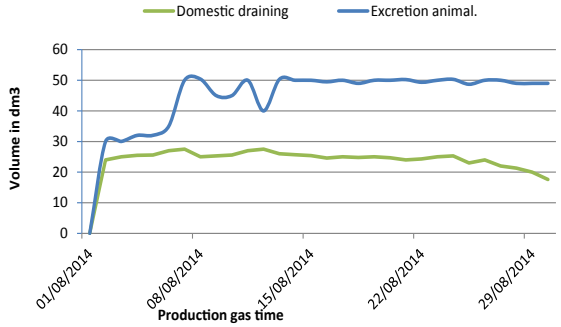

Figure 2: Production accumulated at the end of 30 days.

The decomposition continues, bacteria acetate are transformed into the alcohol and the upper acid in acetic acid, the hydrogen in carbon dioxide.

$(CH_2O)_6 + 2H_2O \rightarrow 2CH_3CO_2^- + 2\,H^+ + 2CO_2 + 4H_2$ (Power out:-216MJ/K-mol) (5)

$2CO_2 + 4H_2 \rightarrow CH_3CO_2^- + H^+ + 2H_2O$ (Power out:-94.9 MJ/K-mol) (6)

- Stage 3: Methanogene

Acetic acid, the hydrogen and carbon dioxide formed in stage 1 and 2 use methanogene with formation of the methane and the carbon dioxide of the acid, the methane and the water of the hydrogen and the carbon dioxide.

$CH_3CO_2^- + H^+ \rightarrow CH_4 + CO_2$ (Power out:-35.8 MJ/K-mol) (7)

$HCO_3^- + 4H_2 + H^+ \rightarrow CH_4 + 3HO_2$ (Power out:-136 MJ/K-mol) (8)

Condition t = 25 °, pH = 7. [6]

The materials used for research were domestic draining and animal excretion leaves collected from various locations within Maradi metropolis.

The gas produced was collected in an inverted graduated cylinder placed in a water bath. Minerals were determined thus; phosphorus by spectrophotometric method based on vanadomolybdo reagent while macro Kjeldahl method was used for estimation of nitrogen content. The pH was checked using a pH meter [7].

The experiments were led in digesters of intermittent type made with 200 liter (Figure 1) barrel provided with a skirt in galvanized iron of 2 mm of thickness which forms around the barrel a hydraulic joint 10 cms in width in which slides a metallic lid [8].

Samples of 20g of every substratum are taken and brought to the Laboratory National of Analysis of waters. The mixture to ferment, compound of waste of slaughterhouse and of manure of methanogenes bacteria is introduced into the digester which is hermetically closed by means of the metallic lid and the hydraulic joint filled with water assuring(insuring) the waterproof-ness [9].

From Table 1 above, it is seen the examples of use of the gas of fermentation in different way.

From Table 2 above, it is seen Household taken in the liquid state are rich in organic matters.

The percentage of organic matters is got by following expression:

$$OM = \frac{O2 - O3}{O1}.100$$

where OM – Organic matters in %; O1 - The cool samples of substrate; O2 – The samples substrate at 105°C; O3 - The samples substrate at 480°C after 6 hours.

Results and Discussions

The result of the generation and analysis are shown in Figure 2, the graphic of production the volume bio gas according to the 30 days for domestic draining and animal excretion in the University Dan Dicko Dankoulodo of Maradi.

Excretion animal: 1333.836 dm^3

Domestic draining: 712.7 dm^3

The experiment was led to the Faculty of Science and Techniques of the University Dan Dicko Dankoulodo of Maradi

The experimental device is conceived to guarantee the total absence of oxygen,

the experiments were led on a small digester of intermittent type (made by the University Dan Dicko Dankoulodo of Maradi in the workshop of the technical secondary school Dan-Kassawa of Maradi) established by a barrel of 200 liters (Figure 1) provided with a skirt in galvanized iron which forms with the barrel a hydraulic joint in which slides a metallic lid.

The metallic lid in sheet steel plays at the same time the role of gas meter which allows the collection the storage and the distribution of the biogas [10].

The result of the generation and analysis are shown in Figure 1, the graphic of production the volume bio gas according to the 30 days for domestic draining and animal excretion in the University Dan Dicko Dankoulodo of Maradi.

Conclusion

The question of the energy valuation of the biomass by anaerobic fermentation must be situated in a general framework of the economies of the countries of sub-Saharan Africa.

The progress in biotechnology of bioconversion of cellulosic materials into useful products is remarkable and attracting worldwide attention.

The advantages connected to the popularization of this technology are multiple:

- The biogas is a good quality ecological fuel which lends itself range of use: cooking of food, refrigeration, supply of electric generator.
- The digested (residue of the fermentation) rich in minerals and in organic matters could contribute to the improvement of the fertility of grounds.
- Improvement of the health service and to fight against the poverty.

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