Preliminary Data on Biogas Production from Waste Sludge of Wastewater Treatment Plant of Durrës

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Abstract

Utilization of waste sludge as a renewable resource for energy recovery is the appropriate solution of how to manage the continuously increasing waste sludge generation effectively in order to meet stringent environmental quality standards, and at the same time, how to sustain the supply of reliable and affordable energy for our future generations and ourselves.

In this paper are presented experiments for the gas generation from the waste sludge of Wastewater Treatment Plant of Durrës (WWTPD). According to the European Directive 2009/28/CE plants fed by renewable energy sources are plants from: biomass, solar, wind, hydro, etc. In this regard, biogas has an important role because Wastewater Treatment Plant can produce energy from various types of biomass. The final aim is the implementation of biogas production technology by the waste sludge of Wastewater Treatment Plant of Durrës to turn it into a source of renewable energy.

In our study, for biogas production by anaerobic fermentation was used sludge of primary sedimentation tank mixed with activated sludge of clarifier of WWTPD. The experiment was performed in laboratory conditions for about one month by measuring the percentage of dry matter and organic matter of the sludge. The conditions of biogas production are the temperature of fermentation (35°C ± 2), pH (should be ≤2) of water to avoid CO_2 gas production. The amount of biogas produced and the above parameters were monitored every day.

From the data obtained during the laboratory experiments, was observed that the amount of biogas produced depends on the amount of organic substances that substratecontain, in our case the waste sludge. The results are presented in graphical and tabular manner for the whole period of monitoring.

Biogas produced by anaerobic fermentation by waste sludge of WWTPDis an important source of renewable energy for this plant. Line of biogas production will bring economic benefits to the plant itself and environmental benefits for the region of Durres.

KEYWORD: sludge, anaerobic fermentation, biogas, wastewater treatment plant,renewable energy

1. INTRODUCTION

The development of society is closely related to energy consumption through transport, industry, and various other services. The decreasing of fuel reserves fossil, the environmental pollution, the damage of the ecosystem and the effects on public health, also have an impact in energy consumption. In this context, the renewable

sources of energy it is a necessary solution. According to European Directive 2009/28/CE, should be considered the renewable source of energy,as: wind, solar, geothermal, tidal, hydropower, biomass, biogas from landfills, as well as biogas from wastewater treatment. Among renewables, biomass represents not a highly untapped resource, which can produce biogas and bioenergy. Biogas, produced by anaerobic fermentation of waste sludge at Wastewater Treatment Plant (WWTP) is categorized as renewable energy.

In this study is presented the possibility of biogas production from waste sludge of Wastewater Treatment Plant in Durrës, in accordance with European Directive 2009/28/CE. WWTP, up to now, is the only plant in Albania who can produce biogas through anaerobic fermentation. Given that the wastewater treatment plant is a large consumer of electricity and is supplied with power from the transmission network, the line of biogas can reduce the quantity of electricity supplied from the network. The utilisation of waste sludge for bioenergy would be a solution for waste management and environmental protection for the city of Durrës.

2. MATERIALS AND METHODS

The waste sludge of WWTPD contains the sludge sedimented from water flow by the primary settlement tank and the activated sludge of clarifier. What is important to know is the quality of sludge that means; the percentage of dry substrate and organic matterTo have real and exact results, for biogas production were used three samples of WWTPD waste sludge, calculating the average of the values. To have the conditions according to standards, during fermentation proccess in laboratory scale, for the physical, chemical, and microbiological quality, every day during one month are monitored the following parameters:

- the temperature of fermentation(35˚C ±2);
- pH of water (pH≤2) where biogas is released;
- laboratory temperature;
- the ammount of biogas produced in every graduated cylinder.

The quantitative evaluation of biogas is calculated usin combine gas law as follow[1]:

$$V_0^{tr} = V \cdot \frac{(p - p_w) \cdot T_0}{p_0 \cdot T}$$

V_0^{tr}– Volume of dry gas in normal condition (in mlN);
V – Measured volume of gas;
p – Gas pressure at measured time (in hPa);
p_w– Vapor pressure of water (in hPa);
T_0– Normal temperature, T_0 = 273K;
p_0– Normal pressure, p_0 = 1013 hPa;
T – Laboratory temperature (in K).

Also are determined:

- % of dry matter of the sludge samples [2];
- % of organic matter (total volatile at 550^{o}C) of the same samples[2];
- ammount of biogas in m^3 CH_4/kg sludge dry matter.

3. RESULTS:

The first results, which serve to understand better the process are the quantitative and qualitative parameters of the WWTPD sludge, analyzed initially. The quantity of biogas production depends by the organic matter that the sludge contains**.**

The calculated values of the data obtained during experiments are shown in the tables below:

	Vessel (gr)	**Vessel + Sludge** (gr)	**Sludge** (gr)	**Dry matter + Vessel** (gr)	**Dry matter** (gr)	**Dry matter** (%)	**Average Dry matter** (%)	**Inorganic matter + Vessel** (gr)	**Inorganic matter** (gr)	**Organic matter** (gr)	**Organic matter** (%)	**Average Organic matter** (%)
	3.22	78.26	75.04	12.11	8.89	11.86	12.03	5.47	2.25	72.79	97.00	97.17
	3.14	92.13	88.99	13.83	10.69	12.02		5.55	2.41	86.58	97.29	
	3.21	87.58	84.37	13.38	10.17	12.06		5.55	2.34	82.03	97.22	

Tab. 1- WWTPD waste sludge

Samples	**Glass Schott weight (gr)**	**Glass Schott + Sludge (gr)**	**Sludge (gr)**
S 1	304.52	797.30	492.78
S 2	298.24	801.40	503.16
S 3	302.35	811.58	509.23

Tab. 2 - Ammount of sludgefor each glass Schott

Based on the analysis, the percentageof dry matter of the WWTPD waste sludge is aproximately 12%; and of the organic matter is approx97.17%(as shown in tab. 1). This high percentage of organic matter is a result of the activated sludge of the clarifier and from the organic matter of the municipality wastewaters. Taking into consideration the above mentioned data, its supposed to proceed with experiments for the produciton of biogas from WWTPD waste sludge in laboratory scale.

In the Table 2,are shown the quantities of waste sludge for the 3 samples, used in the fermentation process which will be performed in the glass Schott. Every day, for each sample, the volume of biogas released in the graduated cylinders is measured, according to the running time. The data obtained from the fermentation process are shown in the Figure 1.

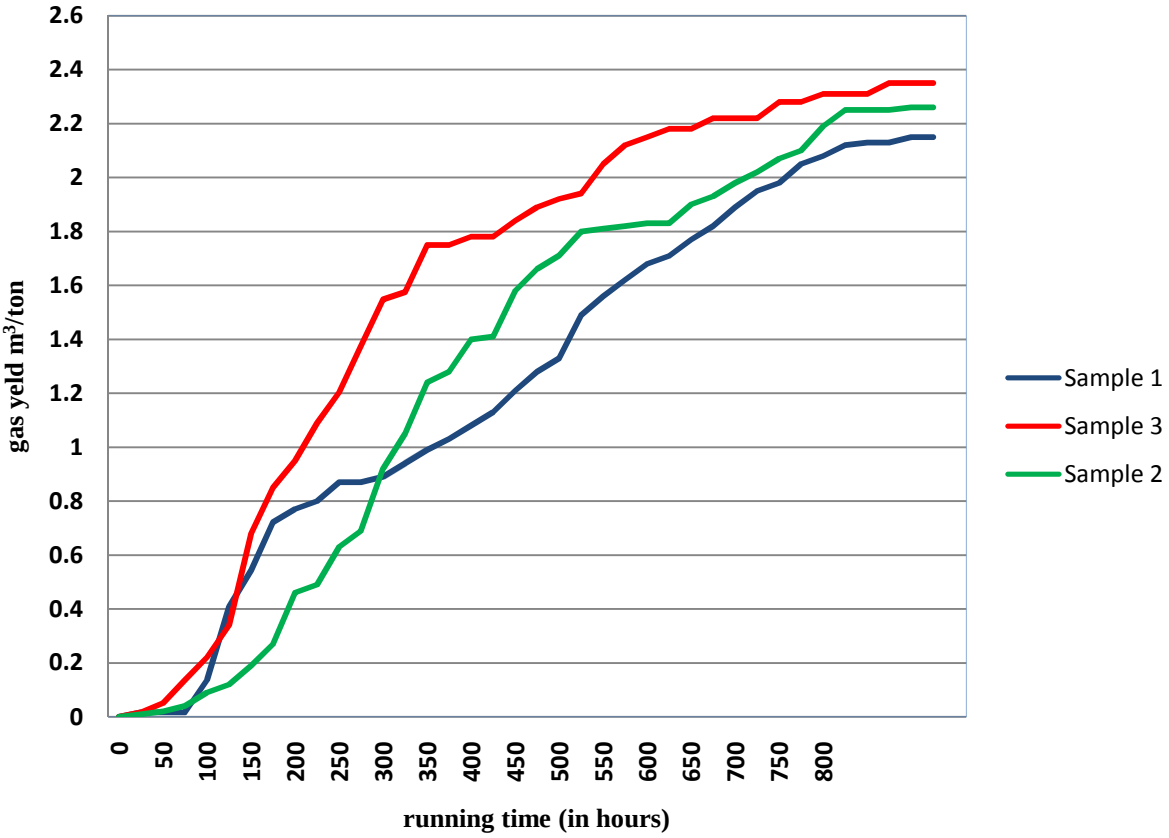

Fig. 1 – Gas production in the run time

In all the samples, the fermentation starts after some hours (up to 50h). At the beggining, the process goes slowly, from the possible presence of mineral compounds that block the activity of enzymes produced by microorganisms, during the degradation of the organic matter. After this period, the fermantation process progresses faster (look at the graph), because of a larger presence of easily biodegradable organic compound (monomer). After 800 hours the volume of produced biogas is at the maximum level.As seen in the graphs,in all the samples, there are fluctuations on the amount of biogas production during run time, because ofthe composition of waste sludge, no constant temperature within the glass Schott, no regular mixing, etc.

4. CONCLUSIONS:

- Approx. 7 ton per month of sludge is produced by the Wastewater Treatment Plant of Durres,which is a considerable quantity of biomass and waste too.
- The reasons of the fluctuations during run time of biogas production are: no constant temperature within the glass Schott, no regular mixing, the composition of waste sludge, etc.The maximum amount of biogas produced by the WWTPD waste sludge is after 800 h.
- Based on this preliminary data, the average amount of biogas produced from WWTPD waste sludge is 2.25 Nm^3/h, which can be used as a renewable souce of energy for the plant.

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