BIOGAS PRODUCTION FROM OLIVE WASTE AND OLIVE POMACE IN MARMARA REGION

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Abstract

Increasing the world population everyday and developing technology for the facilitation of human life, increases the energy consumption per capita. This causes the increase in researches and applications on new energy sources and as a result biogas production have become widespread in many countries. In countries where the biogas technology is common, all kinds of organic waste is being processed. By this way, energy production is achieved, and the waste that can harm the environment is sterilized. Also, soil and water pollution is prevented and natural balance is supplied as well as waste from the plants can be evaluated as fertilizer.

In this study, olive pomace and olive mill waste-water which are the important issues of Bursa-Marmara Region and its surroundings were used. Olive pomace, olive mill waste-water and different types of manure were fermented in four fermenters having a volume of 3 liters under anaerobic conditions. The produced biogas is investigated according to defined parameters. The aim of this study is to produce biogas from agricultural and animal sourced wastes and using the gas in energy converting technologies.

Keywords: Biogas, anaerobic fermentation, olive pomace, olive mill waste-water
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1. Introduction

Since conventional energy reserves are gradually beginning to run out of energy today, energy has been one of the most expensive production inputs. In order to keep the limited energy resources for a long time in proper use, it is required to renew the sources and also new energy sources of must be used [1].

Implementation of biomass-based energy programs will not, of course, be a definitive solution to the countryôs energy problem, but it will bring new insight for efficient energy use in the household sector, especially in rural areas where 40% of the population live (26 million) [2]. In our country, from field plants that form the basis of the agricultural sector (wheat, barley, tobacco, cotton, rice etc.), approximately 65 Mton agricultural waste and 160 Mton livestock manure was formed yearly [3].

Agricultural waste that cannot be used as animal feed is incinerated in the open air or is left to decay. This situation raises environmental and health problems. But the waste disposal by incineration or use during the winter for heating purposes does not produce desired amount of heat. Also, after heat production it became impossible to use the waste as a fertilizer. Biogas technology is used to produce energy from organic wastes as well as being the soil usable [4].

Although Turkey has a wide range of energy resources, these resources are limited. Since, Turkey is an energy importing country. More than about 60% of energy consumption in the country is met by imports and the share of imports continues to grow each year. However, our country has high rate of renewable energy (biomass, hydro, wind, solar, geothermal, etc.). Therefore, it is critical to supply its energy demand by using domestic nonrenewable resources (such as lignite, hard coal, oil and natural gas) and renewable resources [5].

Biogas is a clean source of energy and has a high heat value. After biogas production, wastes are not removed; they are converted into valuable fertilizer [6]. Especially in rural areas, biogas has a positive impact on environmental health. Because, along with the appropriate climate conditions, nature fermentation occurs, and unwanted odor, images and human health-threatening diseases are invited. Instead of this, as a result of biogas production from agricultural and animal waste, the smell of the extent of this waste disappears as well as the factors arising threatening human health [7].

Biogas is the name given to gas mixture produced by fermenting organic wastes, particularly sewage in anaerobic conditions. The composition of the gas obtained from a well operated biogas reactor is as follows: 55-70% CH_4, 30-45 % CO_2, and trace amounts of H_2S, H_2O [9]. In general, 40-60% of the organic matter is converted in to biogas. The heat content of the methane varies according to the methane percentage in the gas mixture; it is approximately 36000 kJ/m^3 [8].

According to data approximately, the amount of olive produced in Marmara Region is 1,200,000 tons annually. 365,000 tons of these amount is used as itself, and the remaining amount is used in olive oil production. As a result, approximately 130,000 tons of olive oil is produced [9]. Accordingly, although the amount of the liquid waste depends on the olive oil extraction technology, in general the amount of released waste water is 0,5-1,5 m^3/ton olive [10]. When these values are considered in detail, about 450,000-1,200,000 olive pomace is polluting the environment if not processed [11].

In this study, olive pomace and olive mill waste-water of small and medium sized olive oil plants are discussed in Bursa and Marmara Region. In order to dispose these wastes, biogas technology is applied and, a study on electricity production is intended.

2. Experimental Study

In this study, olive pomace and olive mill waste-water which are important problem of Bursa and the surrounding area were used. Olive pomace, olive mill waste-water and different types of manure were fermented under anaerobic conditions at 35-37°C constant temperature. The contents of the fermenter were mixed in certain proportions, and all tests have been repeated. The contents of the experimental runs are given on Table 1. Four glass fermenters having a volume of 3 liters have been put into a volume of 140 liter heating room.

Table 1. Contents of the fermenters

Fermenter	Volume (liter)	Content
1	3	150 gram olive pomace 200 mL olive mill waste-water 150 gram cattle manure 2000 mL water
2	3	150 gram olive pomace 200 mL olive mill waste-water 300 gram cattle manure 2000 mL water
3	3	150 gram olive pomace 200 mL olive mill waste-water 150 gram sheep manure 2000 mL water
4	3	150 gram olive pomace 200 mL olive mill waste-water 150 gram quail manure 2000 mL water

Heating room was kept at constant mesophilic temperature by using 200 W heater and fan. During the experiments the mixing of the fermenters were provided at regular intervals. The amount of produced gas was recorded.

Table 2. Parameters and results of the experiments

Parameter	Cattle manure	Quail manure	Sheep manure	Olive pomace	Olive mill waste-water
Dry content (%)	17.4	15.33	36	52.4	9.3
Organic dry content (%)	50.1	42.41	14.25	80.2	73.7
C (%)	30	87.5	83.6	2.7	--
N (%)	1.66	3.80	6.55	0.7	0.67
C/N Ratio	18	14	22	0.38	---

If biogas is produced from wastes by using animal manure, the ratio of C/N changes between 15/1 and 30/1. Most fresh animal manure provides this ratio. There is no necessary to regulate this ratio.

3. Results and Discussion

The results of the experiments are given in Figure 1.

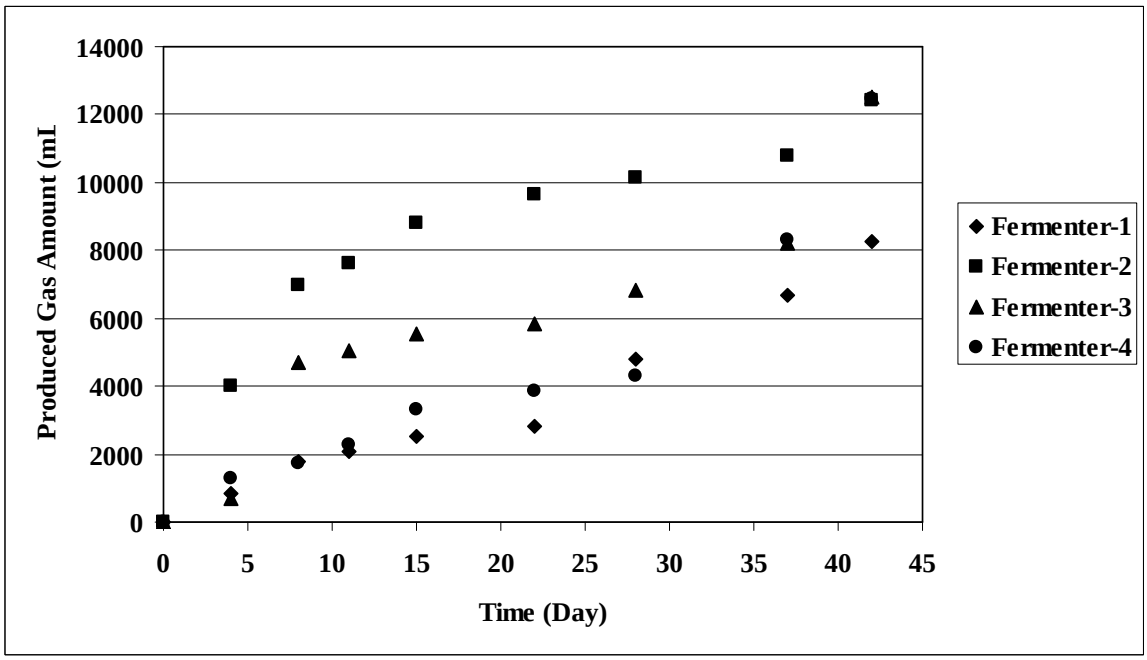

Figure 1. The amount of produced gas in four fermenters

When the results of the experiments were evaluated, maximum biogas production was obtained in 1st reactor. This result supports the positive effect of the increase in the amount of yeast as fertilizer. Also, the obtained values as a result of the experiments are in parallel with the literature values.

Although, sheep and quail manure give better results than cattle manure in literature, this could not be observed in our results. This may be because of the manure taken from the farm of the universities were lack of sufficient and appropriate in terms of bacteria. Also the chosen reaction temperature was 35-37^{o}C. This temperature may be enough for the mesophilic conditions but not enough for the bacterias. Bacterias may be inhibited under these conditions.

The fact that the fossil energy sources will run out, highlights the growing importance of renewable energy sources. Approximately 30% of the Turkeyôs electric production depends on the fossil resources, and 48% depends on the naturel gas exported [12]. In Turkey, agricultural and especially industrial organic wastes are not evaluated enough, and unfortunately still causes environmental pollution. Also problems occur in the purification by the treatment plants. Biogas production from animal and industrial wastes contributes the economy and also reduces environmental pollution as well as provides environmentally friendly energy production.

As it is seen in Table 2, as well as the solution for the environmental problems, also economic heat source can be obtained. 4,270,000 KWh used for electric production and 4,099,200 KWh used for domestic heating may be supplied only with a plant. 64,575,000 KWh for electricity generation and 61,992,000 KWh heat source potential exist if it is treated totally.

Table 3. Biogas, electricity and heat amounts using olive pomace and cattle manure

Material	Waste amount (ton)	Produced biogas (m^3/ton)	Produced biogas (m^3)	Electric generation (x1.75) (kWh)	Heat generation (x1.68) (kWh)
Olive pomace	20.000	82	1.640.000	2.870.000	2.755.200
Cattle manure (1000)	32.000	25	800.000	1.400.000	1.344.000
Total	52000	107	2.440.000	4.270.000	4.099.200
Total olive pomace	450.000	82	36.900.000	64.575.000	61.992.000

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