7th INTERNATIONAL MULTIDISCIPLINARY CONFERENCE
Baia Mare, Romania, May 17-18, 2007
ISSN-1224-3264

EXPERIMENTS ON THE MAXIMUM BIOGAS PRODUCTION

Kalmár, Imre – Nagy, Valéria
college professor, Ph.D student
Szolnok College Technical and Agricultural Faculty, 1, Petőfi tér, Mezőtúr
kalmi@mfk.hu, valinagy@mfk.hu

Abstract: *The re-integration of structural formation of agriculture has come into limelight, as well as the notions of multifunctional agriculture one of which exercises is the cultivation of renewable raw materials, have appeared recently. Biogas, the main component of which is methane, takes form during the anaerobic degradation of biomass originating in the course of agricultural production. On the one hand, methane is combustible gas with great power energy; on the other hand it is also climatic gas. The energy produce from biomass is a future oriented technology which helps us – to a certain degree – to be independence of the utilisation of the fossil energy carriers while we burden our environment minimally.*
Key words: *sustainable agriculture, biogas, technological experiments, increasing of biogas production*

INTRODUCTION

The renewable energy sources upgrade in parallel with the exhaustion of energy sources of fossil origin, at the same time the world needs for environment protection demand the substitution of these energy sources. The potential energy carrier of biogas taking shape during the anaerobic fermentation of organic materials namely one of the main constituents of biogas is methane, the combustible gas of great energy content. Biogas production realises such a cycle process in which energy production plays a significant role and our environment is not burdened with greenhouse effect gases. We can prevent methane getting into the atmosphere during the energetic utilisation.

The content of the organic matter of thin manure from animal breeding farms which is deliverable, easily manipulate-able is relatively small, thus the obtainable biogas quantity is specifically little as well. For this reason we often apply various organic material agents, various by-products and wastes, or plant biomass cultivated with the objective of direct energetic utilisation to increase the specific biogas output in biogas workshops based on thin manure, as a result of which the biogas output increases and the fermented manure can be recycled into the cycle of plant cultivation with the aim of replacing nutritive material. Thin manure belongs to the biomass varieties of agricultural origin. The agricultural biomass

potential has a large selection which can originate from plant production and from husbandry, too.

Biomass of plant production

- by-products of agriculture and forestry
- by-products and wastes of products of agriculture and forestry
- wastes and by-products of town management
- energy plant production
  - ~ field growing plants
  - ~ ligneous plants

Biomass of husbandry origin

- Wastes and by-products of the husbandry
- Wastes and by products of the butcheries

Recently, there-integration of structural formation of agriculture has come into the limelight as well as and the notions of multifunctional agriculture, the exercises of one of which is the cultivation of renewable raw materials, preserving and care-taking of land, furthermore, the preservation of cultural values and lifestyles, the country values and not the least the preservation of the healthy state of environmental elements (soil, water, air) as well.

Based on the data of the territory and inhabitants of the EU and Hungary, it can be asserted that Hungary has good possibilities to biomass production. We have 1.5 times higher agricultural territory per inhabitants than the average of EU 15. EU has directives on the use of the renewable powers. The rate of the renewable power is very low in the energy balance of Hungary. The largest rate of power in Hungary is the natural gas.

The rate of renewable powers needed by Hungary will increase by 5 percent in 2010. Hungarian agriculture has a good chance: firstly, we need to increase the rate of the renewable powers and secondly, Hungary has enough agricultural territory for biomass production and the reduction of the gas dependence is expected too.

1. MOTIVATIONS AND OBJECTIVES OF THE EXPERIMENTS ON THE MAXIMUM BIOGAS PRODUCTION

Why needs be for experiments on maximum biogas production? There are so many biogas workshops worldwide. Objective of the set up biogas workshops was primarily: the destruction of wastes and only secondarily was the economical operating. Nowadays because

of the price of the fossil powers, economical operating of biogas workshops has become important.

There is the rich sort of the biomass with agricultural origin. The degradation of different input materials needs different bacteria branches. Previous experiments worldwide on the biogas production are experiments on the degradation of organic material. These have realised representative periodical working method but the biogas workshops work continuously. For this reason we need to perform technological experiments on increasing biogas production.

The main objectives of the experiments: trying representative industrial conditions, technological experiments on the increase of biogas production so as to help set up new biogas workshops and economical operating of these.

Main tasks towards the realization of the objectives:

- Development of the experimental method and the special instruments for experiments
- Planning and trying of the tests
- Evaluation of the experiment results
- Conclusions, proposals

2. THE METHOD OF THE EXPERIMENTS

The types of experiments are comparative experiments. Comparison of biogas production of the fermentors can come only after the homogenization and stabilization. *Table 1* shows the method of our experiments in detail.

Table 1. Work phase of the experiments

Work-phase	***Period [day]***	***Manipulations per fermentors***						
		1.	***2.***	***3.***	***4.***	***5.***	***6.***	***7.***
Homogenization	3-7	Same conditions, homogenization of the input materials						
Stabilization	14-21	Refilling of the basic material provided for the same essential conditions						
Comparison	14-42	Manipulation conditions, continuous work method						
Total degradation	14-	Without manipulations, discontinuous work method						

Some factors influence the biogas production, so we need to measure and control the influence factors and the technological parameters of the biogas production. *Influence factors of the methane production* are technology temperature, degradation period, microbiological

manipulation, refill frequency, mixing cycle (frequency, period), physical-chemical property of the degradable materials. *Technological parameters* are biogas quantity, components, temperature, period, property of the degradable materials. The controlling and measuring of the technological parameters need special laboratory instruments. We need to develop special laboratory instruments for our experiments. The developed fermentor line has automatic time controlled mixing and gas measuring system, and we can control the degradation through the windows in the new stainless fermentors.

Fig. 1 The developed automatic fermentor line

3. RESULTS OF THE EXPERIMENTS

The experiments on the biogas productions have been made in the frame of a lot of projects with a few partners. Our partners were, for example, a few departments of some universities and noted companies.

3.1. Biogas utilisation technology with closed cycle in husbandry farms

In our first experiments we tested the effect of bacteria manipulation, and continuously the periodical working method. *Fig. 2* shows the average gas production per fermentors in comparison with the work-phase of the experiment.

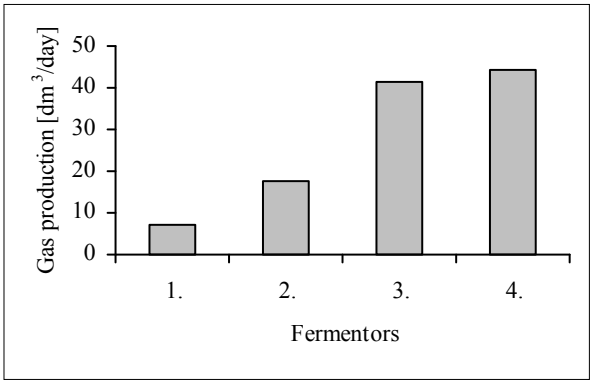

Fig. 2 Average gas production in the experimental fermentors

The gas production was highest in bacterium manipulated, refilled fermentor. The input material was thin manure in all of the fermentors.

3.2. Experiments in support of the recycling possibilities of degradated manure in biogas workshops

There is straw in large quantity – as admixture to biogas production – from plant production because admixture in the next experiment was straw

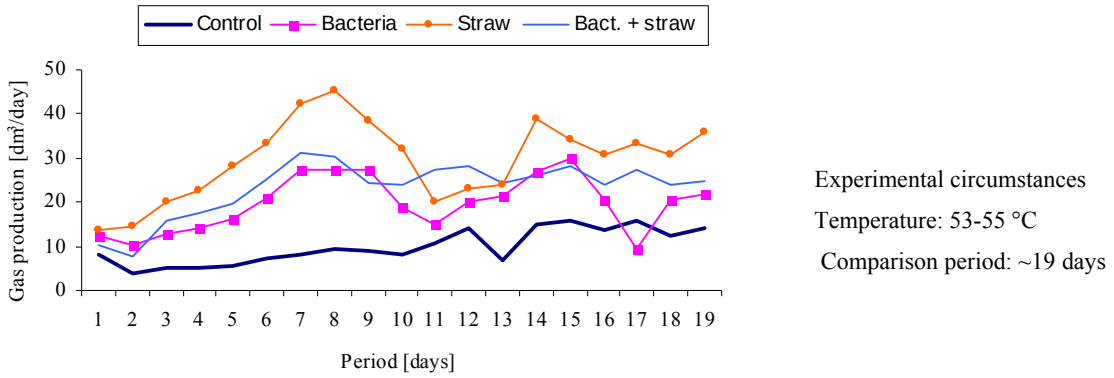

Fig. 3 Gas production in the experimental fermentors

The admixtures increased the gas production in relation to control. It was interesting to learn that the effect of the straw treatment was stronger than the combined treatment. In this experiment we used probably unsuitable bacteria branches towards degradation.

3.3. Experiment on increasing biogas production with mushroom compost

In Hungary mushroom growing in large scale significantly takes a great ratio in horticulture. The by-products of mushroom growing, the grown mushroom compost can also be the additive of biogas production. The energy obtainable from biogas may be utilised in the process of mushroom growing.

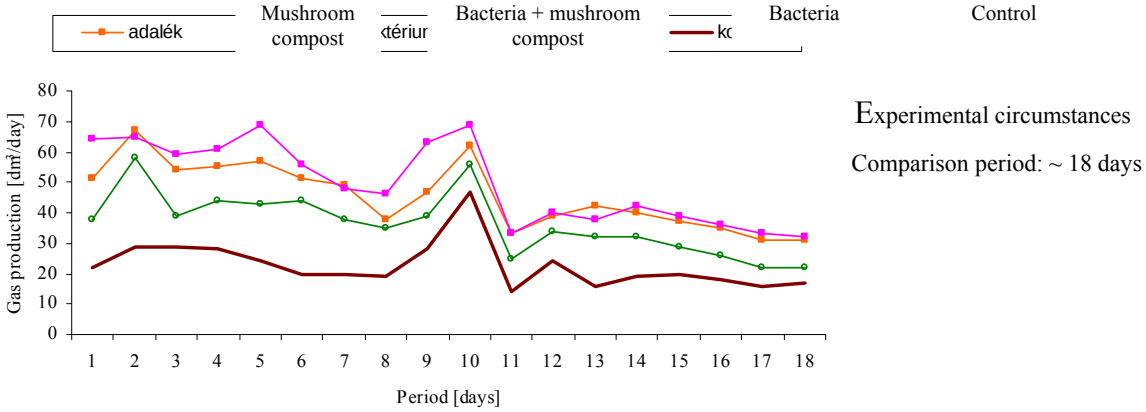

Fig. 4 Gas production in the experimental fermentors

We can see in *Fig. 4* the effect of the additive mushroom compost. The gas production was highest on the effect of the combined mushroom compost and bacterium treatment.

3.4. Experiments on increasing biogas production with milling industry bran

Because of the recession of husbandry in Hungary, the bran can be potential additive material of biogas workshops, too. In the next experiment the additive was bran and in the fourth treatment we used water as basic material instead of thin manure. The gas production was highest on the effect of the bran and bacterium treatment. On the effect of the bran additive in water gas production was higher than the controlled thin manure. We can see in *Fig. 5* the methane production with the recycling of materials.

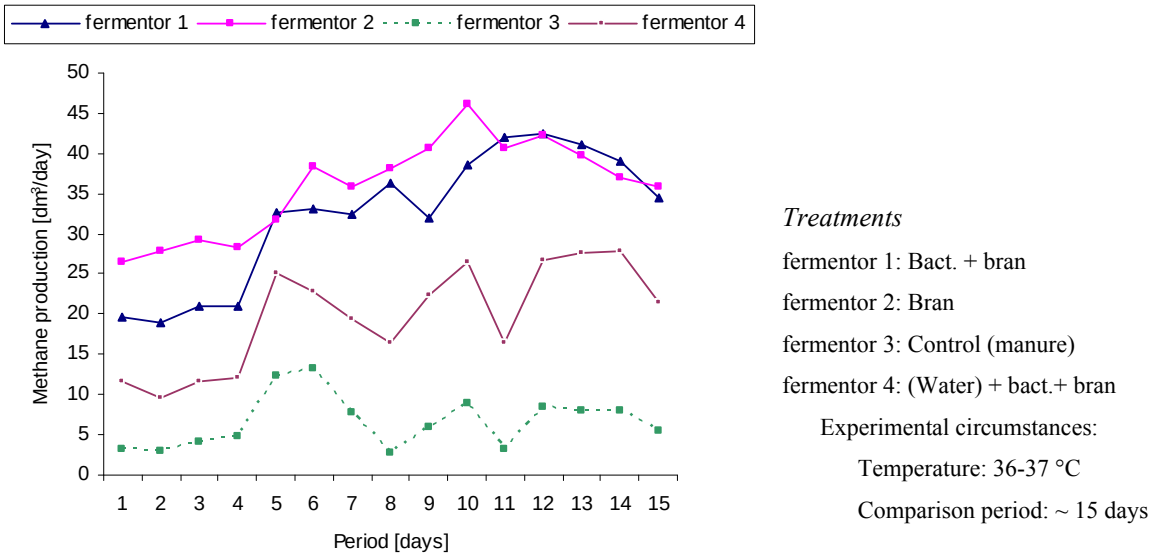

Fig. 5 Methane production with the recycling of materials

3.5. Complex, connected heat- and electrical energy production technology based on biomass

Finally we used two sorts of sweet sorghum as additive in the frame of our project: complex connected heat- and electrical energy production technology based on biomass. *Fig. 6* shows that the biogas production was higher on the effect of both treatments than of the control, but the Hungarian sort „Berény" produced high quantity of biogas than „Sucrosorgho".

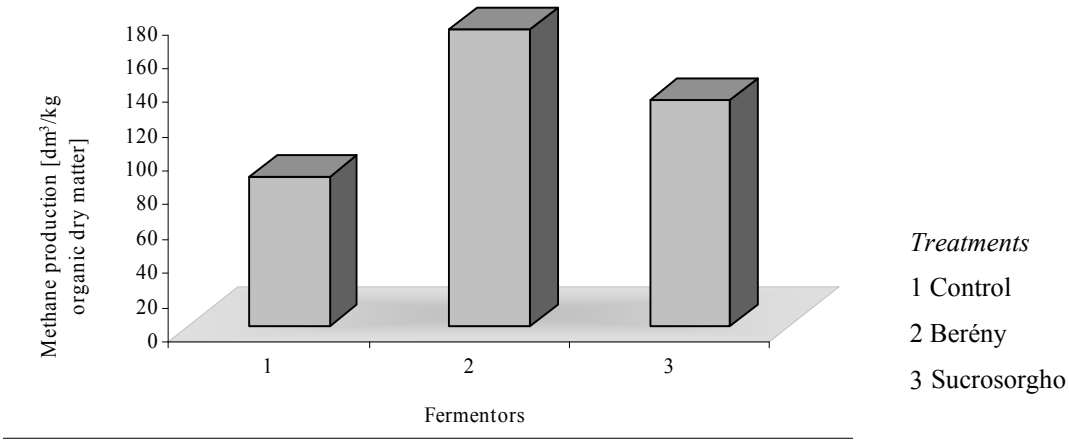

Fig. 6. Methane production in experimental fermentors

5. SUMMARY, CONCLUSION

Results

- Elaboration of experiment methods
- Development of special laboratory instruments for experiments
- Experiments by using thin manure as basic material and bacterium branches, straw, bran, mushroom compost and sweet sorghum as additive materials
- Biogas production increased on the effect of additive
- Biogas production was higher on the effect of bacterium combined treatment than simple additive

Main conclusions

- Biogas production can be increased by biomass additive
- Before the set up of biogas workshops there is need to try experiments on maximum biogas production with input materials

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