# BIOGAS EXPERIMENTS WITH PIG SLURRY AND WHEAT PROCESSING RESIDUES

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**ABSTRACT**
An energetic aim of the utilisation of the manure meaning serious environmental load with other wastes between the economic structural relations of a certain micro-region increases the profit-making ability of reverse investments to this aim significantly together with byproducts. The economical operation of the pork breeding claims the increase of the firm size especially, which may entail the considerable increase of the environment-damaging effects. The many times beneficial application of the biogas production (energy production + environmental protection investment + bio-manure production + the treatment of hazardous waste and its utilisation) expounds his effect then only, if the possible coferment's power generating ability is modelled similar to operating circumstances between conditions on an experimental road beforehand. I outlined the possible techniques of application being attached to the different methane content of the biogas in my work. I pretended with the loads changing, the changing of substrate combinations and the changing of manure production in the course of the experiments. The intensity of the methane production of the direct measure of the activity of the methanogen bacteria, and than like that, the most sensitive, typical indicator of the digester's yield. The combination of the produced gas and its yield features that may be useful to estimate the stability of the anaerobic system. Consequently the results of the examinations bring practical profit on the sizing, investment and firm operational area indispensable.

**Keywords**: renewable energy sources, laboratory with half firm methods, fermentation process, agricultural main and by-products

## INTRODUCTION

The biogas production based on the pork liquid dung, and the other waste of agricultural main product of processing known, and accepted technological procedure in the EU's member states, as the result of which biogas and fermented manure is produced. The quantity and the quality of the raw materials and additives, and the biogas forming in the function of the parameters of the applied technology are strongly variable (KALMAR ET AL.2003, ARTHURSON 2009). The target of my experiments aimed the increase of the proportion of the renewable energy sources of application is to increase the methane quantity originating from the various organic matters, to increase of the intensity of the formation, to produce stable gascontent. Making the organic matters polluting the environment harmless is the indirect result of the application of the technology. The biogas increasing a greenhouse effect with big methane content means concentrated environmental load and source of danger and on the other hand unutilized energy source on a farming area where the use of the exterior power sources is considerable anyway (GOTTSCHALK 1979, GERARDI 2003). While the economy size is his principle from below, the relatively little energy content of the biomass in the view of the transportation expense from above limits the firm concentration. Because of this it is expedient to examine the energetic utilisation of all possible organic waste at least with laboratory or half firm methods.

## MATERIAL AND METHOD

At the Engineering and Agricultural Faculty of Szolnok College there is an appropriate, available, semi-automatic experimental system, representing the operating circumstances, providing similar conditions suitable the formation process of the biogas, regulating change of influencing factors and all of necessary measurements of typical data. The liquid pig manure was used during my biogas production experiments as basic substance. I used the bran as additive. The application of appropriate bacteria strain may decrease the time of fermentation and the measure of the demolition may improve and the methane content of the forming biogas may be growing.

The supreme features of industrial byproducts and wastes suitable for biogas production:

dry matter
organic matter
nitrogen content
C:N proportion
specific gas yield

The technology of fermentation experiments, the process of the experiment series:

a) Loading of laboratory digesters, setting of the treatment combinations
b) Sampling.
c) Measurements, examine of parameters

We may split the process of the fermentation into sections according to the table 1..

We can dose ~ 50 $dm^3$ of liquid dung mixture pro treatment to take the factors in connection with the capacity of the fermentors into account. It is possible the simultaneous examination the effect of 9 treatment combinations with in a heatable room placed, mobile by manual power, hermetically closed fermentors. We applied the continuous (filling up) system, wich is most widespread in the practice, it can be reproduced the process sections, as the launching, load change, receipt change, according to certain expert opinions each single daily measurement combination for a separate experiment can be qualified.

**Table 1.**

**The parameters measured during the experiment series, measuring devices, methods, frequency**

| Serial number | Measured parameter | Device | Method | Comment |
|---|---|---|---|---|
| 1. | Fermentor temperature (oC) | digital thermometer | | once a day, at the same time |
| 2. | Gasyield ($dm^3$) | gasmeter | | |
| 3. | Gascontent % | GA45 gas analyser | | |
| 4. | Conductivity (mS/cm) | Hydrolab | electrometria | once a day, at the same time |
| 5. | Soluted oxigen (mg/l) | | | |
| 6. | pH | | | |
| 7. | Salination (PSS) | | | |
| 8. | Redoxpotential (mV) | | | |
| 9. | BOD5 (mg/l) | Oxi Top 110 | pressure dropping | from samples selected based on professional viewpoints |
| 10. | COD (mg/l) | NANOCOLOR | photometria | |
| 11. | Dry matter content | drying cupboard | | once a day, at the same time |

I measured the most important parameters to follow the degradation process *(Table 1)*. The *Table* **2** contains the different treatments in the different process periods.

**Table 2.**

**Experiment series and treatments**

| No. | Process period | Dura-tion time | Treatments and fermentors 1. | 2. | 3. | 4. | Comment |
|---|---|---|---|---|---|---|---|
| 1. | Stabili-zation | | Composition: 50% fresh liquid manure; 25% manure from the store; 25% sludge from the store | | | 1<br>100 % water | Same circumstances |
| 2. | Refilling period with fresh substance | 7 days | 6,6 vol.% refilling with fresh substance daily | | | 6,6 tf % water refilling | |
| 3. | refilling with fresh substance daily (running up period) | 15 days | 6,6 tf % refilling with fresh substance daily | | | | 32 – 37 °C different process |
| | | | Bact. treatment 4 V/V % (once) Bran additive 60g/day (45g DM ) | Bran additive 60g/day (45g DM ) | control | Bact. treatment 4 V/V % (once) Bran additive 60g/day (45g DM ) | |
| 4. | comparative experiments, refilling period – Fresh material | 15 days | Compaund: 6,6 tf % refilling with fresh substance daily (1,2,3 – liquid pig manure; 4 – water) | | | | |
| | | | Bran additive 60g/day (45g DM.) | Bran additive 60g/day (45g DM.) | control | Bran additive 60g/day (45g DM ) | |
| 5. | comparative experiments, refilling period – Recirculated material | 15 days | 6,6 vol % recirculated material daily | | | | |
| | | | Bran additive 60g/day (45g DM) | | control | Bran additive 60g/day (45g DM ) | |

## RESULTS

The water-based, pure bran starting treatment for biogas production is only a fraction of bacteria was able to power. The relative effectiveness of recirculation technology here refers to the slowdown degradation. The liquid pig manure based on 6.6 V / V% loading, dry matter content 45 g / day of wheat bran dosing the gas production more than doubled, the methane content to 5%, the influence of the bacterial treatment increased by 7.5%. Generally the by-products examined by me the methane content reduced by the bacterial treatment, the gasproduction was increasing, but in the case of wheat bran I didn't notice that. The bacterial treatment didn't increase the performance of the bran additive, but the methan content was growing, which has been unique among the experiments *( Table* **3**). The substrat load was not too high, because the daily gasproduction generally increased in case the different treatment *(Figure 2)*, but in the recirculation technology the organic matter content was decreasing from the substrate, that's why the yield was decreasing *(Table 3)*. The changing of the methane content is generally paralell with the production. It shows the condition of the decomposition process *(Table 4)*. The situation isn't similare in the case of recirculation, water based treatment, mainly the slow speed of the decomposition. The recirculated didn't reconstructed substrat increased the production *(Figure 3.)*.

**Table 3. The average gas production of the fermentors in the course of the comparative experiments with wheat bran additive**

| | | Average gasyield ($dm^3$/day) in the fermentors | | | | Specific fermentor volume referred gasyield($dm^3/dm^3$day) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1. | 2. | 3. | 4. | 1. | 2. | 3. | 4. |
| biogas production | Fresh substrat load | 55,1 | 62,7 | 24,2 | 17 | 1,102 | 1,254 | 0,484 | 0,34 |
| | Recirculation technology | 40,9 | 42 | 10,1 | 22,9 | 0,818 | 0,84 | 0,202 | 0,458 |
| methane production | Fresh substrat load | 32,3 | 35,9 | 13,2 | 6,6 | 0,646 | 0,718 | 0,264 | 0,132 |
| | Recirculation technology | 23,6 | 24,2 | 6,3 | 10,6 | 0,472 | 0,484 | 0,126 | 0,212 |

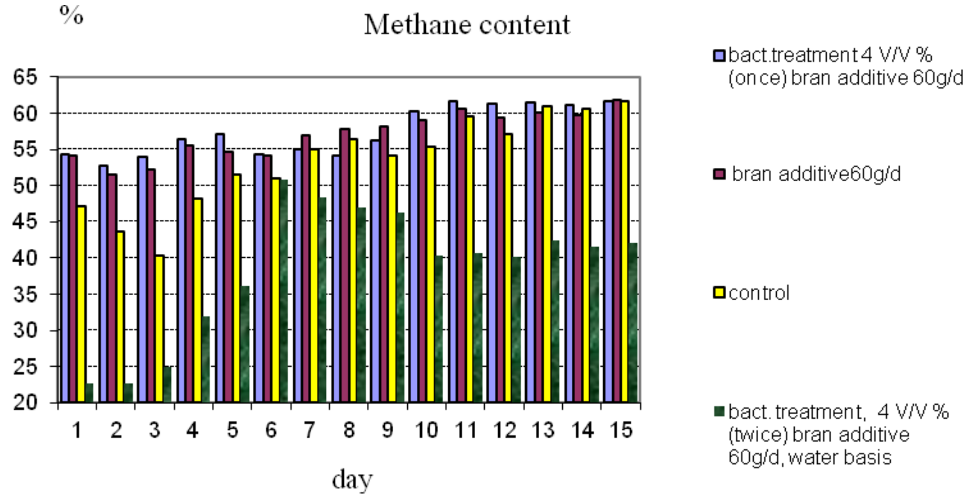


**Figure 1. Methane content, refilling technology, fresh material (15 days: from 37th day to 51st day)**

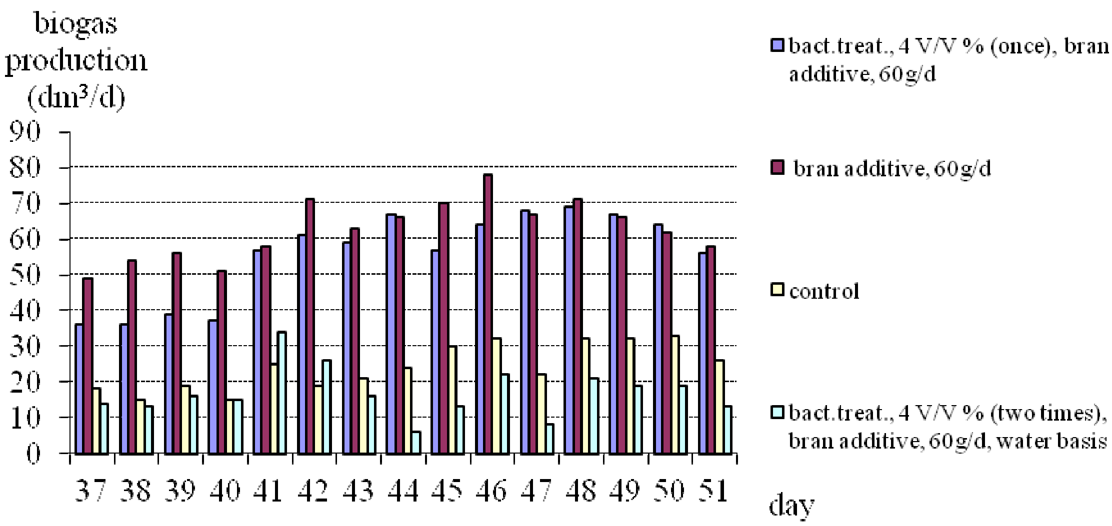


**Figure 2. Biogas production, refilling technology, fresh material (15 days: from 37th day to 51st day)**

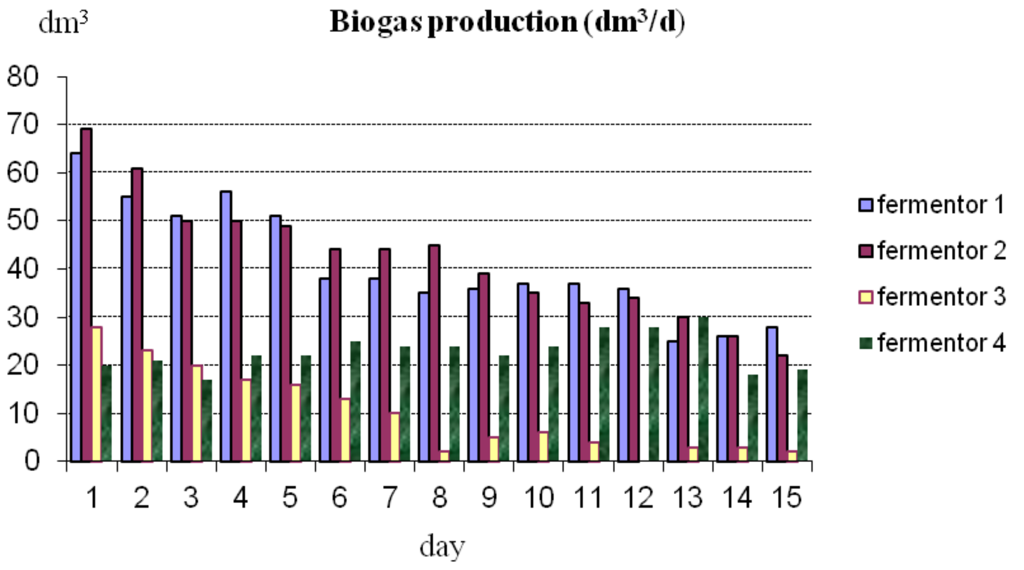


**Figure 3. Gasproduction in recirculation, refilling technology**
1. FERMENTOR: BACTERIA TREATMENT: 4 V/V % (ONCE), BRAN ADDITIVE 60G/D; 2. FERMENTOR: BRAN ADDITIVE 60G/D; 3. FERMENTOR: CONTROL; 4. FERMENTOR: BACTERIATREATMENT, WATER BASIS 4 V/V % (TWICE), BRAN ADDITIVE, 60G/D

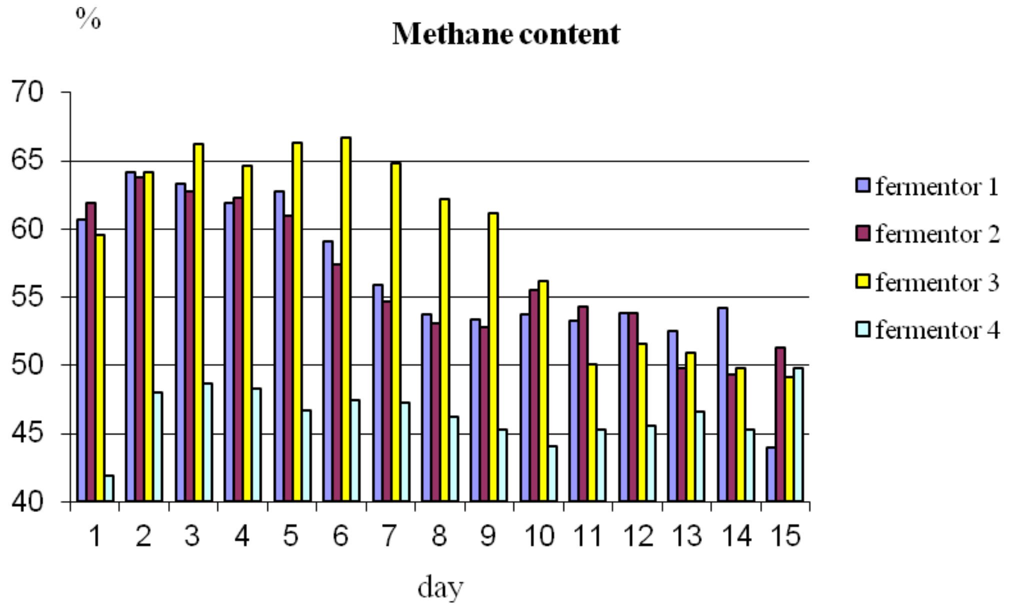


**Figure 4. Methane content in recirculation, refilling technology**
1. FERMENTOR: BACTERIA TREATMENT: 4 V/V % (ONCE), BRAN ADDITIVE 60G/D; 2. FERMENTOR: BRAN ADDITIVE 60G/D; 3. FERMENTOR: CONTROL; 4. FERMENTOR: BACTERIATREATMENT, WATER BASIS 4 V/V % (TWICE), BRAN ADDITIVE, 60G/D

## CONCLUSIONS

By the liquid dung basis control the examined 3,4-4,6 % average dry-matter content province was growing the average quantity of the developing gas (16,98 $dm^3$/days -23,04 $dm^3$/days). That is the 35 %-os average dry-matter content increase nearly 35 %-os average a quantity of gas caused an increase. The gas forming increase is bigger quantity compared to the control, with similar dry-matter content, than the methane content decrease. The result fall into the applicable category yet though.

I resourced the yield increasing effect of the weat bran among the by-products of the milling industry. Above it as a control method I compared the specific yield of bran additive to the production of the control. The bran was running with 60g drymatter/day/fermentor load 0,72 $dm^3$ methane/ $dm^3$ /day production, what was made worse a little bit the bacterial treatment (0,65 $dm^3$ methane/ $dm^3$ /day). In case of twice bacterial treatment on water basis the recirculation technology let more time to the bacterias for the decomposition (0,21-0,13 $dm^3$ methane/ $dm^3$ /day).

## REFERENCES


ARTHURSON, V. (2009) Closing the Global Energy and Nutrient Cycles through Application of Biogas Residue to Agricultural Land – Potential Benefits and Drawbacks. Energies 2, 226-242.

GERARDI, M. H. (2003) The Microbiology of Anaerobic Digesters. USA: Wiley-Interscience, 286.

GOTTSCHALK, G.(1979). Bacterial Metabolism. New York: Springer-Verlag, 154.

KALMÁR, I., KOVÁCS, K. L., BAGI, Z.(2003) Sertés hígtrágyára alapozott biogáz referencia üzem. MTA AMB Kutatási és Fejlesztési Tanácskozása. Gödöllő, 2. 82-86