

EFFECT OF INHIBITORS USED IN LIVESTOCK PRODUCTION ON FERMENTATE QUALITY AND BIOGAS PRODUCTION

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Abstract. Methane fermentation is one of the ways to obtain gaseous fuel from biomass. Agricultural and industrial products are used in this process. Various additives (biological and chemical substances) which can be used in the fermentation process may affect the quality of produced biogas. An analysis of the effect of inhibitors used in livestock production to improve the hygienic conditions of the environment where animals dwell was presented in the paper. These preparations have a significant influence on methane fermentation process and amount of obtained final product.

Key words: methane fermentation, biogas

Introduction

Development of renewable energy sector is of crucial importance for the realization of basic objectives of power engineering policy. Energy generation from renewable sources ensures positive ecological effects and is instrumental in the development of less developed areas. The main measures in this respect comprise support for generating electricity, heat and chill from Renewable Energy Sources and manufacturing biofuels. The bases for the development of renewable energy engineering in Poland were provided by “The Development Strategy of Renewable Energy Sector” adopted by the Parliament of the Republic of Poland in 2001. It assumed the increase of the share of energy from renewable sources in Poland's primary energy balance to 7.5% in 2010 and to 14% in 2020 [Strategia rozwoju (on-line) 2001]. Contemporary systems of renewable energy production from biomass make possible implementation of new technologies and their development [Rusak et al. 2006]. It is necessary to analyse the raw materials which may find applications in the processes of green energy production. One of the most popular methods is incinerating solid biomass. However, it is not the only way of effectively obtaining energy from biodegradable raw materials. Biogas production is increasingly gaining in popularity [Kowalczyk-Juśko et al. 2009]. Biogas combustion in the engines of packaged generator sets (PGS) makes possible utilization of energy from biogas to generate electricity and heat [Grzesik 2006]. Biogas may be produced from various kinds of biomass (sludge, municipal waste, livestock and plant production waste) or purposefully acquired from energy plants [Buraczewski et al. 1990]. Biogas may be also produced from kitchen wastes which are wastes from canteens and must be utilized [Kowalczyk-Juśko 2008].

Methane fermentation is an anaerobic decomposition of organic substances by the activity of bacteria, during which we obtain mainly carbon dioxide and methane. The process is widespread in nature and takes place e.g. on peatlands, in slurry and in the ruminant rumen.

The inhibitors used in animal dwelling places are meant to inhibit the process of aerobic fermentation and reduce gas formation in these facilities. The main gas undergoing reduction is ammonia.

Methods

The aim of the investigations was determining the effect of inhibitors used in livestock production on the quality of the main component for biogas production (slurry) and on the course of fermentation process.

An experiment was conducted to identify the effect of inhibitors used in livestock production on the quality of produced biogas. In the experiment, kitchen wastes and inhibitors used in agricultural production, i.e. Sekol Jalka and Sannisty+Liquid were added to swine slurry. These substances hygienize the animal dwelling environment, but there is no information in the available literature how they influence the future fermentate quality. In order to determine the effect of inhibitors on the biogas production process, laboratory analyses were conducted using the preparations available on the market. The paper presents the effect of two inhibitors:

- Sekol Jalka, which a product containing bacterial spores, which after activation improve the quality of natural fertilizer, increase liquid slurry parameters and reduce ammonia level in the pig house. In the place of its application the preparation reduces the occurrence of pathogenic bacteria, contributes to hygienization of the environment in the farm building and leads to better utilisation of energy values of fodder.
- Sannisty+Liquid is a bio-enzymatic preparation causing a decrease in ammonia quantity in the air, it is used for odour control, improving liquid slurry parameters, faster decomposition of natural fertilizer and for general improvement of animal health.

The investigations were conducted on swine slurry to which kitchen waste (i.e. mashed potatoes, vegetables (cucumber and pepper) and chicken meat) were added.

The experiment was conducted in the laboratory of Institute of Agricultural Engineering, Prague, (Výzkumný Ústav Zemědělské Techniky (VUZT), in compliance with the methodology applied for all experiments carried out at the Institute. The experiment used one bioreactor composed of 5 reactors (3.5 litres each). The reactors were placed in a water coat with the temperature of 41°C. The first reactor containing 79% of the excrements and 21% of kitchen waste was the control sample, whereas 79% of excrements and 21% of kitchen waste were weighted into the remaining four reactors, to which were also added inhibitors in the amounts normally used in farm buildings. The percent admixture of kitchen waste was selected in the way which allowed to determine how it affected the amount of obtained biogas and the whole process of methane fermentation.

The experiment was conducted for 35 days and during that time the following parameters were measured: content of oxygen, nitrogen and methane in produced biogas.

Results

Figure 1 shows the effect of Sekol Jalka inhibitor on the quantity of generated biogas. It can be noticed that in case of the reactor containing the control sample, percent content of CH_4 reached the level of 70% on the 10th day and was gradually diminishing during the experiment. In the reactors containing Sekol Jalka inhibitor, percent content of CH_4 reached the level of 70% on the 10th day of the experiment and remained on a similar level during the whole period of the experiment. Application of this inhibitor favourably affected the course of fermentation process and the amount of obtained final product.

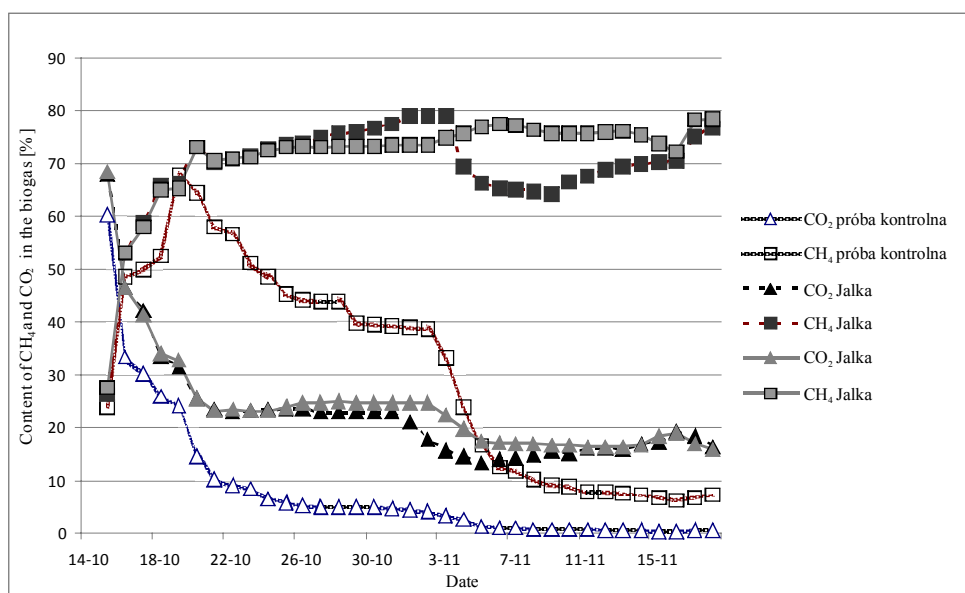


Fig. 1. Content of CH_4 and CO_2 in biogas produced from slurry with added Sekol Jalka

Figure 2 shows the effect of Sannisty+Liquid inhibitor. Including this inhibitor in the fermentation process caused a slight increase in CH_4 content in the obtained biogas in relation to the control sample. On the 10th day of the experiment the percent content in the control sample and in the reactors containing the inhibitor reached the maximum level of c.a. 70% and then gradually decreased over the following days. Despite the fact that Sannisty+Liquid inhibitor causes a faster decomposition of natural fertilizer (aerobic fermentation), its influence on the efficiency of biogas production is lesser than Sekol Jalka inhibitor.

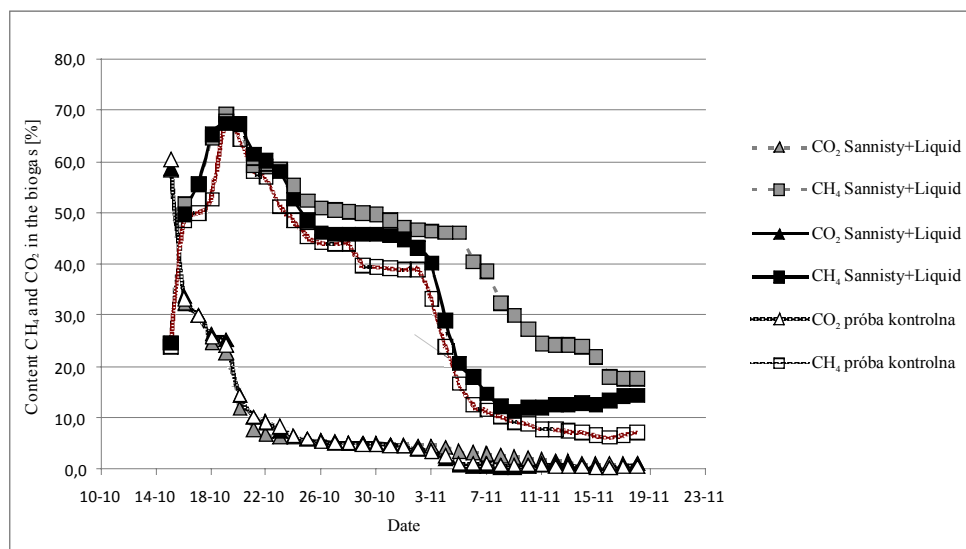


Fig. 2. Contents of CH₄ and CO₂ in biogas produced from slurry with added Sannisty+Liquid

Conclusions

1. Analysed inhibitors used in farm buildings affect the process of anaerobic fermentation.
2. Analysis of results revealed that application of Sekol Jalka inhibitor caused a considerable increase in methane production and maintaining it on a high level (c.a. 70%).
3. Application of Sannisty+Liquid inhibitor causes purification of animal dwelling environment, but it does not affect significantly the course of anaerobic fermentation process, since the results are approximate to the control sample.

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WPŁYW INHIBITORÓW STOSOWANYCH W PRODUKCJI ZWIERZĘCEJ NA JAKOŚĆ FERMENTATU ORAZ PRODUKCJĘ BIOGAZU

Streszczenie. Fermentacja metanowa to jeden ze sposobów pozyskiwania paliwa gazowego z biomasy. W procesie tym wykorzystywane są produkty pochodzenia rolniczego i przemysłowego. Do procesu fermentacji można stosować różne dodatki (substancje biologiczne i chemiczne), które mogą wpływać na jakość wytworzonego biogazu. W pracy przedstawiono analizę wpływu inhibitorów stosowanych w produkcji zwierzęcej w celu poprawy stanu higienicznego środowiska, w którym bytują zwierzęta. Środki te mają istotny wpływ na proces fermentacji metanowej oraz ilość pozyskiwanego produktu finalnego.

Słowa kluczowe: fermentacja metanowa, biogaz

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