EVALUATION OF THE ORGANIC WASTE BIOGAS POTENTIAL IN THE POMERANIAN REGION

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Abstract: Beneficial use of municipal and industrial wastes as potential sources of organic material suitable for anaerobic digestion and production of renewable energy (biogas) has been recognized in the world for many years. Ongoing Pomeranian Biogas Model project has already documented that municipal and industrial wastes in the Pomeranian region in Poland have a high potential for biogas production. Performed AMPTS (Automatic Methane Potential Test System) tests confirmed that high Specific Biomethane Potential (SBP) values can be obtained from both municipal and industrial organic waste fractions.

Introduction

The potential of anaerobic digestion to generate methane on an industrial scale has been recognized by engineers for decades, and nowadays it is widely applied around the word as an environmental friendly and sustainable technology to manage organic waste (e.g. food, agricultural, industrial wastes). In Poland, due to a number of economic, social and technical barriers, there are only about 190 biogas plants treating sewage sludge, animal manure and organic wastes, while in neighbouring countries (e.g. Germany) these figures are given in thousands. The total installed electrical power from biogas in 2012 in Poland was about 120 MW whereas according to the adopted strategic documents (Polish Energy Policy) this number should reach 802 MW in 2020 (Polish Economic Chamber of Renewable Energy). Therefore, more efforts should be made in Poland to map and evaluate available organic substrates, and to further develop anaerobic digestion technology.

This research was part of the Pomeranian Biogas Model (POM-BIOGAS) project which objective is to provide innovative technological solutions for production and utilization of biogas generated from organic waste. Presented studies include mapping of the availability of organic wastes from different sources in the Pomeranian Voivodeship and monitor their characteristics, in particular evaluation of their specific biomethane potential (SBP).

Material and Methods

Assessment of available organic substrates in the Pomeranian region was mainly based on statistical data acquired from Marshal's Office in Gdańsk, Central Statistical Office of Poland, Waste Management Plan for the Pomeranian Voivodeship 2018 ("Plan Gospodarki Odpadami dla Województwa Pomorskiego 2018"- PGO 2018) and Agency for Restructuring and Modernization of Agriculture (ARMA). Collected data were subjected to graphics analysis using GIS.

In order to characterize the potential of selected organic substrates the Automatic Methane Potential Test System (AMPTS II) was used (Figure 1). AMPTS is a device used to determine the biogas potential of particular substrates or mixtures of substrates. The system is nearly fully automatic and requires only careful set-up of the machine. The simple operation makes it easy to compare several substrates (or mixtures) under exactly the same conditions (batch test system).

Fig. 1. AMPTS system

Results

The Pomeranian Voivodeship is situated in the north-central of Poland and shares borders with Russia and 4 others Voivodeships. The administrative centre is Gdańsk which with another 2 major cities (Sopot and Gdynia) creates the Tree-city metropolitan area with a population of about 1 million people. In the entire Voivodeship the following sources of organic waste have been identified as important the Pomeranian region:

- organic waste from industrial sources;
- sludge from industrial and municipal wastewater treatment plants;
- biodegradable municipal waste (mainly food waste);
- biodegradable agricultural waste (manure).

Information about the most abundant types of organic wastes around Gdańsk has been analysed within two circles with the radius of 50 and 25 km. Within a distance of 50 km from Gdańsk, the total amount of organic waste is 3 280 973 t/a, distributed as: 446 676 t/a industrial waste, 28 192 t/a sludge,

2 270 772 t/a agricultural waste (livestock manure), and 535 333 t/a municipal organic waste.

Due to the facts that (1) biogas plants based on agricultural wastes are well known, (2) sludge (mainly sewage sludge) is already utilised in the digesters at wastewater treatment plants (WWTPs) industrial and municipal wastes were selected: for further studies (AMPTS test).

Different fractions of municipal organic wastes indicated Specific Biomethane Potential (SBP) values in the range of 295-415 Nml/gVS, while SBP values for industrial wastes were in the range of 357-524 Nml/gVS. The highest SBP among all tested organic substrates was recorded for overdue food products from the supermarket and that amounted to 524 Nml/gVS. Moreover, high SBP value equal to 464 Nml/gVS was recorded for the mixture of municipal organic waste fraction and industrial (supermarket) waste.

Conclusions

Biogas production plants based on the use of agricultural residues (mainly manure) have recently become more and more popular, while experiences and scientific studies on biogas production from the organic fraction of municipal and industrial wastes are still limited in Poland.

Studies in the POM-BIOGAS project showed that municipal and industrial wastes in the Pomeranian Voivodeship, with amounts close to 1 Mt/a (within the distance of 50 km from Gdańsk) occurred to be an important source of organic material which can be subjected to anaerobic digestion.

Moreover, performed AMPTS tests indicated high biogas potentials for both municipal and industrial organic wastes. One kg of VS (volatile solids) coming from those wastes can give up to 500 Nl of biomethane.