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POTENTIAL FOR BIOGAS PRODUCTION AND UTILISATION BASED ON REGIONALLY AVAILABLE SUBSTRATES

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Abstract

The presentation will give an overview about regionally available materials and biodegradable residues (substrates), which are potentially suitable for biogas production. There will be discussed possibilities for mono-digestion and co-digestion of specific substrates (e.g. nitrogen-rich materials, algae etc.), considering theirs potential and eventual troubleshooting. Data from several national and international projects will give an information about potentials of the biogas technology. The best practice examples will show gained experiences made by already implemented projects.

Introduction

In many regions in the world, biogas plays or will play an important role in the regional and local energy supply. As suitable substrates, in the ideal case, are used locally available materials to avoid long transport distances. Nevertheless, there are still many challenges on the field of gaining of the substrates, theirs logistics, stocking, pre-treatment, digestion, digestate treatment and distribution.

Almost in each European region are beside the typical agricultural substrates (e.g. pig or cattle manure, maize or grass silage etc.) also available residues of food and beverage industry (e.g. residues of fruits, vegetables, brewer`s spent grains, slaughter-house wastes etc.) and biodegradable fraction of municipal waste. In some regions, there are potentially some more specific substrates available. An interesting example could be the Dnieper cascade reservoirs polluted by cyanobacteria (also known as blue-green algae). The algae cause the every year «blooming» of the water area close to city Kremenchuk.

Material and methods

There were taken several blue-green algae samples from the Dnieper cascade reservoirs during the booming period (year 2017). The samples were analysed for basic chemical parameters and biochemical methane potential (BMP).

Results

The results of the basic chemical parameters and BMP are presented in the tables 1 and 2.

Table 1: Results of chemical analysis (substrate characteristics - blue-green algae)

Parameter		Unit	June 2017	August 2017
Dry matter [1]	DM	[%]	0.52	6.60
Organic Dry Matter[1]	oDM	[%]	-	5.43
Chemical Oxygen Demand[1]	COD	[g O_2/kg]	10.4	65.1
Total Kjeldahl Nitrogen [1]	TKN	[g/kg]	-	5.27

[1] related to fresh matter

Comparing the samples from June and August 2017, the later sample has significantly higher DM and COD.

Table 2: Biochemical methane potential (test in triplicate)

Methane yield Sample August 2017	Organic Dry Matter [Nm^3/Mg oDM]	Chemical Oxygen Demand [Nm^3/Mg COD]	Fresh matter [Nm^3/Mg FM]
Test 1	246.9	206.1	13.40
Test 2	262.6	219.1	14.25
Test 3	264.3	220.5	14.35
Average	**258.0**	**215.2**	**14.00**

The average methane yield of the analysed sample (August 2017) was 258.0 Nm^3/Mg oDM eventually 215.2 Nm^3/Mg COD and 14.00 Nm^3/Mg FM. The test took almost 50 days and 90% of the total methane yield were produced during the first 34 days.

Discussion

The significant differences in dry matter content by the two analysed samples indicate wide variations during the blooming season, possible influence of locality and harvesting method. The average methane yield is comparable e.g. to values for pig manure at similar dry matter content (6-7%) published by *FNR (2004)*. The measured methane yield related to the organic dry matter was lower than 350–391 $Nm^3\ t^{-1}$ oDM published by *Gruber-Brunhumer et al. (2015)* but in this case, the author investigated a different algae strain and used pre-treatment methods.

Conclusions

It is possible to use the blue-green algae as a substrate for biogas production. Taking into account the data of the first preliminary analyses, there is to expect an influence of harvesting method, pre-treatment and material logistics on the efficiency of the whole system for anaerobic digestion of algae. Based on these first results, it is can be recommended to carry out further sampling and analysis during the blooming period and develop a suitable harvesting method.

References

FNR (2004): Handreichung Biogasgewinnung und –nutzung, Fachagentur Nachwachsende Rohstoffe e.V. (FNR), Leipzig 2004

Gruber-Brunhumer et al. (2015): Gruber-Brunhumer, M.R., Jerney, J., Zohar, E., Nussbaumer, M., Hieger, C., Bochmann, G., Schagerl, M., Obbard, J.P., Fuchs, W., Drosg, B., 2015. Acutodesmus obliquus as a benchmark strain for evaluating methane production from microalgae: Influence of different storage and pretreatment methods on biogas yield. Algal Res. 12, 230–238. https://doi.org/10.1016/j.algal.2015.08.022

DIN 38 409 - H1 – 1: Dry Matter Content (DM)

DIN 38 409 - H1 – 3: Organic Dry Matter Content (oDM)

DIN 38 409 - H41, ÖNORM M 6265: Chemical Oxygen Demand (COD)

DIN 38 414-S8 and VDI 4630 (modified form): Biochemical Methane Potential (BMP)