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The National Centre for Research and Development

GDAŃSK UNIVERSITY OF TECHNOLOGY

Zakład Utylizacyjny

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Discovering good practice examples of industrial symbiosis and bio-based business model

DIGEST-PLAST Project

Methane fermentation of biomass containing biodegradable polymeric material

Bio-plastics - Industrial symbiosis or new environmental threat?

Beata Szatkowska, PhD

Renata Tomczak-Wandzel, PhD

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Aquateam COWI AS

- Independent consultancy and R&D
- 34 years experience
- Expert link in technology transfer
- Operational experience worldwide
- Recognized by authorities
- Multidisciplinary expertise
- State of the art lab and field equipment

Areas of Expertise:

- Municipal wastewater
- Organic waste
- Industrial wastewater
- Municipal drinking water
- Algae and biofuels
- Process microbiology
- Contaminated soils
- Ecotoxicological studies
- Environmental risk assessment & monitoring
- Chemical use in process
- Oil & gas (PW, SW)

Aquateam COWI is a specialized R&D group operating in the water&sewage sector and waste management. The company has the status of a *research institute* and focuses on applied science. It carries out its own research projects and large-scale cooperation with other research institutions and universities.

General information

PARTNERS:
Gdańsk University of Technology, Faculty of Chemistry
Municipal Waste Utilization Plant in Gdańsk
Aquateam COWI AS – Norwegian partner

DURATION: 1.10.2020 – 31.10.2023

BUDGET: 1 324 780.34 EUR

KEYWORDS: natural resources, biodegradable plastics, anaerobic digestion, biogas, biomass

https://chem.migracja.pg.edu.pl/digest-plast

The subject of the project is methane fermentation of the organic fraction of waste from selective collection and the organic fraction separated from mixed municipal waste. Additionally, the project focuses on biodegradable polymers. Commonly introduced biodegradable polymers will undoubtedly have an increasing impact on the properties of the feed directed to bioreactors, and thus on the efficiency of biogas production, digestate quality and its susceptibility to composting, especially in terms of the presence of so-called microplastics, which are now very popular substitute for conventional polymers. DIGEST-PLAST project investigates possibilities of the organic fraction of municipal and industrial waste utilization for renewable energy (biogas) production. The project's concept expands problems presented in the implemented POM-BIOGAS project. Also it draws attention to the growing problem with the appearance of a biodegradable polymers in the surrounding environment, which fate during such processes like methane fermentation has not been thoroughly studied yet. The studies planed in the project will include the assessment of the tendency of conversion of biodegradable polymers to microplastics. Finally, the scope of the project will verify, how the presence of biodegradable polymers influences the course of methane fermentation. Since, biodegradable polymers are not collected separately from the waste stream and hence are not subjected to appropriate treatment to reveal their biodegradable nature, they may be considered harmful, similarly to microplastics. The aim of the project will focus on an enhancement of biodegradable plastic decomposition during methane fermentation process. Different pre-treatment methods will be suggested to optimise process flow. Additionally, the process scale-up will be demonstrated and the simplified method for estimation of fertilising properties will be developed.

Project WPs

WP 1 MARKET OF BIODEGRADABLE PLASTICS

Task 1.1 Legal aspects of handling and disposal of biodegradable plastics in European Union, Poland and Norway

Task 1.2 Mapping and assessment of biodegradable plastics in Pomerania Region

WP 2 FEED PREPARATION

Task 2.1 Pretreatment methods of biodegradable plastics prior anaerobic digestion

Task 2.2 Preparation and characterization of model feed with varying amount of biodegradable plastics

Task 2.3 Establishment of design factors for the anaerobic digestion process when biodegradable polymeric materials are present in the biomass

WP 3 BIOGAS YIELD

Task 3.1 Biogas potential of anaerobic digestion with biodegradable plastics - AMPTS test

Task 3.2 Evaluation of biodegradable plastics fate during anaerobic digestion

Task 3.3 Quality assessment of obtained biogas and its application potential

WP 4 PROCESS SCALE UP, PILOT INVESTIGATION

Task 4.1 Process scale up – large laboratory + pilot investigation

Task 4.2 Odor emission control in the fermentation process, reliable evaluation and minimization

Task 4.3 Impact of basic process parameters on conversion of biodegradable plastics to microplastics

WP 5 DIGESTATE PROPERTIES AND USAGE

Task 5.1 Digestate quality properties and microplastics presence evaluation - development of simplified method

Task 5.2 Composting and characterization of digestate containing biodegradable plastics, within the Utilization Plant composting facility

Task 5.3 Socioeconomic analysis of the digestate use from origin of feed with biodegradable plastics

Bio-PLASTIC

Types of polymers in terms of biodegradation and the sources of their origin

Biodegradable polymers made of renewable resources (so-called "double green"): PLA, PHA, TPS, starch blends	Non-biodegradable polymers produced from renewable resources: Bio-PE, Bio-PP, Bio-PET
Biodegradable and petrochemical polymers: PBAT, PCL, PBS	Non-biodegradable and petrochemical polymers: (PE, PP, PET, PS, PVC)

bioplastics - either bio-based or biodegradable or both

bio-based - is (at least partly) derived from biomass (e.g. from corn, sugarcane, trees, algae etc.)
biodegradable - implies that microorganisms that are present in the environment can convert the material into natural substances (i.e. water, carbon dioxide or compost) without polluting the environment

European Bioplastics Association

Bio-PLASTIC

- 335 million tonnes of plastic produced annually, in Poland alone it is 650 thousand tones
- nearly 1% - bioplastics
  - ✓global production capacity will increase from around 2.11 million tonnes in 2018 to around 2.62 million tonnes in 2023
  - ✓biopolymers such as PLA (polylactic acid) and PHA (polyhydroxyalkanoates) are the main drivers of this growth in the field of biodegradable plastics

Bio-PLASTIC

Industrial symbiosis or new environmental threat?

- It is expected that bio-plastics will be a part of organic fraction of municipal waste
- How will it affect the digestion/composting process?

high biogas production → desired in fermentation
good biodegradability → desired in composting plants

↓

recommendations for proper segregation and legislation – eg. PLA going to organic fraction

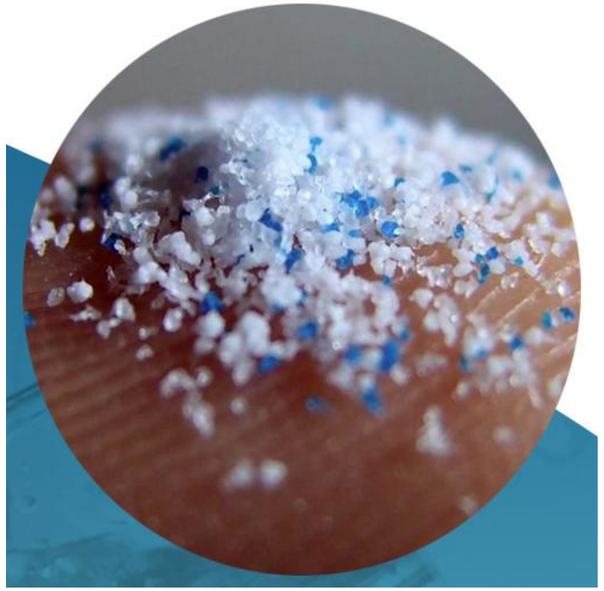
interference of digestion
microplastics generation

↓

verification of the role of bioplastic and avoidance of next environmental threat – contribution to microplastics generation

Stakeholders: Utilisation Plant (biogas plant & composting facilities), Bio-plastic producers, Environmental policy makers

Thank you for your attention



Aquateam COWI AS
Karvesvingen 2, 0579 Oslo, Norway
E-mail: aquateam@aquateam.no
www.aquateamcowi.no

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