



DEMETER – DEMONSTRATING MORE EFFICIENT ENZYME PRODUCTION TO INCREASE BIOGAS YIELDS

Enjoy reading the DEMETER newsletter!

Nowadays, the transition from an economy dependent upon fossil resources to a sustainable bio-based economy is becoming a priority for the society. One of the most promising developments in this regard is the conversion of biomass into energy sources (biofuels, biogas), making the optimization of these conversion strategies an essential step to reach such transition. For the efficient conversion of biomass or agricultural, industrial and municipal waste into fermentable sugars, chemical building blocks or bio-based materials, enzymes play an indispensable role. However, enzymes have not been specifically developed for the biogas production so far, but enzymes efficiency is largely evaluated by trial and error. Thus far, the use of enzymes has not lived up to the expectations as little or no effects could be observed. Hence, efficient enzyme-enabled biomass conversion requires the availability of enzymes that have proven to be effective in practice and can be produced at an industrial scale. GIBV has developed a new enzyme product derived from the fungus *Myceliophthora thermophila* C1, that has proven to have the potential to increase biogas production by at least 10%. Although the efficacy of the enzyme has clearly been shown, the current fermentation process does not provide sufficient yield in industrial production to be cost-effective for large-scale application.

The DEMETER project aims to optimize the fermentation process of the C1 product and demonstrate this on industrial scale. The objective of DEMETER is to increase the yield of this industrial fermentation process by at least 20%, improve the product recovery process by 40%, and reduce overall product costs by at least 15% while increasing the productivity of the process. In addition, DEMETER will demonstrate the efficiency of the enzyme in eight field trials in biogas plants throughout Europe.

During the first 18 months of the DEMETER activities, many progress and results have been achieved. An improved fermentation process for enzyme production at lab-scale was developed by GIBV and transferred to partner BBEPP for scale-up to pilot level and first runs at industrial scale. A Design of Experiment (DoE) approach has been applied to the fermentation process and the results have also been used to develop a mathematical model based on all the different variables and parameters present in the fermentation process. The results showed an optimized medium composition and conditions for the fermentations. The improved fermentation process to produce the enzymes for biogas applications has been successfully transferred to BBEPP. Similar titers and yields, as obtained in the labs of GIBV, have been reproduced at 150 L and 1500 L scale. The improved fermentation process showed an improved protein production yield of 35%. BBEPP has also compared different strategies to optimize the downstream process for enzymes

purification. Scale-up to 1500L has been performed and the recovery has been improved to >90%. DBFZ has performed laboratory tests in batch and semi-continuous scale for wet biogas fermentation processes. All together eight semi-continuous biogas tests with a substrate mixture of straw plus cow manure and rye-silage plus cow manure are now still in operation. So far the effect of the enzyme addition is very limited. We think that this might be due to the optimized process conditions in the lab scale fermenters. A second set of semi-continuous biogas tests have been started in which the process conditions are less optimized (variation of hydraulic retention time, different substrate, etc). A dry biogas process has been tested at laboratory scale by OWS in batch and continuous digesters to assess the long-term effect of the enzyme on different types of organic waste materials: organic household waste and roadside grass, residual household waste, and manure and agricultural waste (mainly corn stover). For each substrate, 4 reactors are running: 2 without and 2 with enzyme addition. So far, a small effect of the enzyme has been observed in the mesophilic agricultural digesters (2% more biogas produced and a higher process stability) and in the thermophilic OF-MSW digesters (8% more biogas produced and a higher process stability). No effect of the enzyme on the total solids and/or volatile solids content was observed. In the next period, the viscosity of the digestate in all test reactors (wet and dry fermentations) will be determined. For the next



The DEMETER partners in Gent for the consortium meeting – April 23rd – 24th 2018

period 8 large scale field trials are scheduled to demonstrate the effect of the enzyme on industrial scale. These results will be compared with the lab scale results and correlations between the two will be determined.

Many public dissemination materials and tools have been produced in the project's framework. A poster and a brochure are available on the website (public documents page). Thanks to the fruitful and challenging work done so far by the whole consortium, DEMETER was presented in many national and international events to show its progresses to the scientific and industrial community.

Dissemination activities: top events

On 6 and 7 December 2017, DEMETER project joined the BBI Stakeholder Forum in Brussels. The event brought together all of BBI JU ongoing projects and DEMETER, as the other projects, presented its consortium and the project objectives in a dedicated exhibition and in thematic workshops. More than 600 participants took part in the event and the two-day programme provided ample opportunities for networking, especially in the project exhibition area.



Bio Base Europe Pilot Plant has been actively promoting the DEMETER project within its network. On February 19th, 2018, BBEPP inaugurated a new process hall for large scale downstream processing (associated with an investment of 9.36 million euro). More than 500 people attended this event and followed a tour through the facilities. A forum was given to DuPont to present the ongoing collaborations they have with BBEPP. Wim Van Canneyt from DuPont presented the DEMETER project.



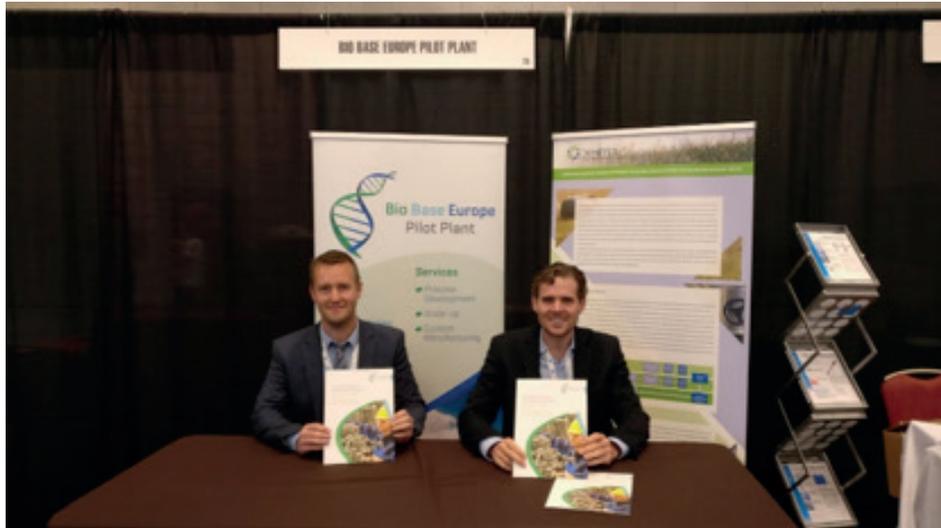
Wim Van Canneyt (DuPont) presenting the Demeter project on the Impact event



More than 500 industrials attended the Impact event

In addition to this great exposure, BBEPP also organizes plant visits on a regular basis for groups and individuals interested in our activities. Approximately 2000 people visit BBEPP every year. All of them get an introduction and an overview of the projects we are involved in, including the DEMETER project.

BBEPP also attended the RAFT conference ((RAFT™ 12) October 29-November 1, 2017) in Bonita Springs, FL. BBEPP had a booth and promoted the DEMETER project among the 300 participants.



BBEPP attending RAFT

Last 18th October 2017, MIAVIT presented the aims of the DEMETER project during the 6. Biogas Symposium Saxony-Anhalt. The regional meeting gathered mainly plant operators and possible advantages and applications of an enzyme use in AD plants were explained and discussed.

The project took part also in the BIOGAS Convention & Trade Fair, held in Nuremberg on December 12th 2017. A short presentation about the aims and challenges of DEMETER was held at the exhibitor forum at the world wide biggest biogas trade fair. The fair gathered an audience composed by scientists and investors, politicians and plant operators.

DBFZ presented a poster of the DEMETER project in the Conference of the European Biogas Association, held in January from 24th to 26th 2018 in Antwerp. More than 300 participants among companies, research organizations, industrial associations took part in the event.

In the framework of the “Biogas - expo & congress” organized at the end of January 2018 in Offenburg, DBFZ gave a presentation of DEMETER, providing the attendees with general information about disintegration process and the project first results. The event gathered 300 participants from Germany, France and Switzerland.



In the framework of an effective dissemination able to reach a key audience of professionals in the field of the circular economy as well as industrial stakeholders and researches from the scientific community, CiaoTech organized and attended many national and international events where DEMETER was presented

with oral and poster presentations.

The project was presented in the 7th edition of IFIB2017 - the Italian Forum on Industrial Biotechnology and Bioeconomy, organized in Rome the last October. At the event, more than 300 participants from 29 different countries were present to discuss about circular economy, energy and biorefineries, agro-food, life-sciences, policies on industrial biotech and bioeconomy, bio-based industries. The IFIB 2017 Forum was structured in conferences, partnering events, poster sessions and startup on stage. During the poster session, the CiaoTech team presented the project DEMETER - Demonstrating more efficient enzyme production to increase biogas.



DEMETER participated in the “European Funding and Circular Economy: methods and tools for a sustainable development” conference, organized in Rome by Euronews in collaboration with CiaoTech/PNO and Innovation Engineering. CiaoTech Team introduced the case of study of DEMETER to a wide audience, including important Italian policy makers and relevant big companies.



In November 2017 took place ECOMONDO, the leading euro-Mediterranean area green and circular economy expo. It represents an international event with an innovative format that brings together all sectors of the circular economy in a single platform: from material and energy recovery to sustainable development. During the seminar “XIX National Conference on Composting and Anaerobic Digestion”, Patrizia Circelli presented DEMETER to a wide audience of industrial stakeholders expert in the field of biogas, with a specific focus on the first results that Ciaotech obtained, using advanced strategies and tools, for the Stakeholder and Market Analysis.



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For more info about project visit the DEMETER website at: www.demeter-eu-project.eu



Co-funded by the Horizon 2020 Framework Programme of the European Union

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