DEMETER – DEMONSTRATING MORE EFFICIENT ENZYME PRODUCTION TO INCREASE BIOGAS YIELDS

Enjoy reading the DEMETER newsletter!

The transition from an economy based on fossil resources to a bio-based economy is a must and should be realized sooner than anticipated at the moment. A drastic reduction in greenhouse gas emission is urgently needed as the goals set to limit global climate change are not being met. The conversion of biomass into energy sources (biofuels, biogas) and chemicals plays an essential role in this transition.

To efficiently convert biomass and agricultural, industrial and municipal waste into fermentable sugars, chemical building blocks or bio-based materials, enzymes play an indispensable role.

The project will demonstrate a yield increase and a cost reduction of a C1-based enzyme as well as its positive effect on biogas production and making the enzyme available for wide-spread application in biogas production throughout Europe.

DEMETER's objectives are to increase the yield of this industrial fermentation process by at least 20%, improve the product recovery process by 40%, and reduce overall product cost by at least 15% while increasing the productivity of the process.

DEMETER will bring innovation to both the fermentation process used for production of the enzyme, and to the use of enzyme-enhanced fermentation in production of biogas.

- Innovation in enzyme production technology
- Innovation in the use of enzymes to enhance biogas production
- Higher process yields of at least 20% compared to the state of the art
- Cost reduction of at least 15% compared to conventional down-stream processing of the fermentation broth

Which are the involved companies and what they will do?

Genencor International B.V. (part of the DuPont Industrial Biosciences Group) is a Dutch biotechnology company that develops and commercialises enzymes derived from (fungal) micro-organisms. The enzymes are applied by a wide range of industries in the house hold & personal care, bioethanol, bio-refineries, animal feed and food sector. GIBV is an active partner in R&D programs with different national and international companies, research institutes and universities. GIBV scientists and partners have developed and patented strains of the fungal micro-organism *Myceliophthora thermophila* C1 to rapidly discover and express both homologous and heterologous genes; and to manufacture novel enzymes encoded by those genes, using C1 as the host organism from beginning to end.

Industrial strains of C1 have been developed and the full genome of C1 has been sequenced, which revealed many genes encoding biomass active enzymes including enzymes active on cellulose such as cellulases and carbohydrate oxidoreductases.

GIBV has the leading role as coordinator of DEMETER . GIBV's task will be the development of the enzyme production process to create an economic viable process with a clear application in biogas production. GIBV will coordinate one field test at a large biogas plant. As coordinator GIBV will provide both legal and managerial input for the project.

Bio Base Europe Pilot Plant (BBEPP) is a flexible, diversified and independent pilot and demonstration facility for process development, scale-up and custom manufacturing of biobased products and processes from lab to multi ton scale. Bio Base Europe Pilot Plant performs the entire production chain in one single plant, from biomass feedstock up to final refined products. BBEPP combines technologies (biomass pretreatment, biocatalysis, green chemistry, fermentation, biorefining and downstream purification) for advanced manufacturing of biobased products utilising a wide spectrum of modular unit operations. It operates according to the open innovation service model: companies and research institutes throughout the world that are active in the bio-based economy can make use of this test facility for their technological developments. Bio Base Europe Pilot Plant has successfully performed over 200 projects for more than 100 companies.

In this project, BBEPP is active in the Enzyme Yield Improvement (WP2) and in the demonstration phase (WP4). In WP2 it will assist in optimizing the downstream process to improve the recovery of the enzyme, in WP4 it will scale up and demonstrate the process on 15 m3 scale.

The company MIAVIT GmbH was founded in 1964 by the veterinarian Dr. Hans W. Niemeyer and comes from the field of animal nutrition, today's headquarters of MIAVIT is situated in 49632 Essen (Oldb.) Germany with a second production facility in Tarragona, Spain. MIAVIT has now around 290 employees and is in the capable hands of Stefan Niemeyer since 1988. MIAVIT is a manufacturer and distributor of pre-mixes for the compound feed industry, for specialty feed (eg supplementary feed, feed additives), for highly concentrated vitamin mixtures for the food industry and for biogas additives. MIAVIT has over 50 years of experience in animal nutrition, and over 10 years of experience in supervising biological processes in biogas plants. Miavit is active in over 60 countries of the world and has an export market of around 55%. The MIAVIT Biogas team supports both the direct customer as well as the distribution of biogas additives by various national and international partners.

MIAVIT supervise biological processes, advise biogas plants of different process engineering, process control, plant size and feedstock spectrum. With this expertise MIAVIT will test the new enzyme in two of its closest biogas systems. These systems will be fed on a daily basis with a calculated amount of enzyme based on the daily feeding rations. Each system will be fitted with added sensory and control equipment to be able to record all necessary data relating to the enzyme trials. MIAVIT will constantly monitor the biogas systems, testing the parameters of all relative data. A test phase of six months for each system is required to be ab le to get an accurate result with also one month before the teas and one month after to determine the effects before and after. This data will then be used in the present project first of all by selecting suitable commercial biogas systems for the newly developed enzyme. Secondly, MIAVIT is able supervise the selected plants during the test series intensively and take all relevant data during the testing period. In addition, MIAVIT offer appropriate distribution channels to market the newly developed enzyme product in Germany and around Europe.

The MIAVIT GmbH will be the task manager for the test series of newly developed enzyme product in agricultural biogas plants (WP 4.2) in this project. The MIAVIT GmbH will use the results that

have been achieved with the newly developed enzyme product in laboratory fermenters to choose agricultural biogas plants that will be then supplied with the newly developed enzyme product.

DBFZ is a non-profit limited liability company, owned by the Federal Republic of Germany, represented by the German Ministry of Food and Agriculture (BMEL). The research institute was commissioned by the federal government to carry out applied research with a focus on the efficient use of biomass as a renewable energy source. The scientific efforts for the establishment and integration of biomass within the series of the already existing energy sources are made by taking into account technical, ecological, economical, social as well as energy-economical aspects. All aspects of the chain of use are taken into account, i.e. from the production to the availability to the distribution of the energy to the end consumer. The institute is certified in accordance with DIN EN ISO 9001. At the moment, the DBFZ employs about 140 scientific employees in the Research departments of "Bioenergy Systems", "Biochemical Conversion", "Thermo-chemical Conversion" and "Biorefineries".

The Biochemical Conversion Department of the DBFZ researches the production of energy from biomass using microorganisms, in particular technologies for biogas recovery and use. One of the key objectives of the research activities in this context is to improve the efficiency of the overall biogas process whilst cutting costs. The identification and quantification of the effect of enzymes on the biogas process, in particular on biogas yield and rheological characteristics in lab- and technical-scale will be one part of the work at DBFZ. Further a model to quantify the overall effect of the enzyme addition to a given full scale process should be developed.

The results will be validated in a demonstration test at the research biogas plant. DBFZ will also support during the validation at other full scale sites. Based on the model a plant assessment should be developed to get a quick answer about the potential benefit from enzyme addition. All results will be brought together to a guideline for plant design and operation. DBFZ is leader of WP 3 (Impact of the Enzyme production on biogas processes) and contribute to WP 4 (Demonstration).

Organic Waste Systems (OWS) is a world leading company in the construction and operation of anaerobic digestion plants, in the biodegradability and compostability testing of different types of materials and in waste management consultancy. OWS is a private company constituted in 1988 with headquarters in Ghent (Belgium) and subsidiaries in the USA and Germany. OWS developed the DRANCO process (dry anaerobic composting) to treat several types of organic municipal waste streams. In the last 10 years, OWS also offers processes for energy crops and agro/industrial waste streams (DRANCO-Farm and BES reactors). The latest addition to OWS's waste treatment portfolio is the SORDISEP technology in which biogas, qualitative compost and recyclables are recovered from unsorted municipal waste streams. Besides design, construction and automation of anaerobic digestion and composting plants, OWS also offers extensive biological consultancy in AD-related projects, ranging from feasibility studies (including pre- and post-treatment) over start-up of AD-plants (both own technology and constructed by third parties) to routine analyses and biological monitoring of the process. OWS also offers diverse consulting services in the field of biodegradation and composting, waste composition, waste separation, recycling, integrated waste management and related legislation in both Europe as the USA.

OWS also provides contract research laboratory testing for the determination of the biodegradability and compostability of plastics, packaging materials, consumer products, detergents… under strict quality conditions. As a strictly independent laboratory working conform ISO 17025, OWS is recognized by all certification bureaus worldwide working in the field of biodegradability and compostability.

The Biogas Consulting & Support division of OWS is involved in different research topics with the aim to improve the efficiency of the anaerobic digestion process. As such, OWS will test the effect of the enzyme on the total biogas and methane production potential and rate of different substrates, together with the effect on the rheology of the digestate (WP 3). OWS will also test and evaluate the effect of the enzyme in 2 full-scale DRANCO anaerobic digestion plants (WP 4) and together with DBFZ and MIAVIT develop a model to assess the potential benefit of enzyme addition for any biogas plant. All results will be brought together to a guideline for plant design and operation.

Ciaotech, part of the PNO Group (http://www.pnoconsultants.com/), is specialised in Innovation Management and funding, providing support services to private and public organizations in Innovation processes, Technology Transfer, IT solutions and funding for research, development and innovation.

PNO is a European group, made up of a pool of around 250 professionals including scientists, engineers, consultants, a Brussels policy advisory service, as well as financial and legal experts, with consolidated experience in innovation processes and funding in international working environments (Europe, Latin America, and USA). Created in 1985, PNO is a high-growth knowledge intensive company, operating in 12 European countries. The growth is explained by a unique combination of services, based on profound insight in research, innovation and funding strategies, up-to-date knowledge and over 25 years of hands-on expertise with real-life European innovation projects and more than 500 funding programmes in most EU countries. The company has the proven capability to link innovation suppliers and adopters from a unique Europe-wide client network in multiple sectors, using advanced methodologies, ICT solutions and proprietary on-line networking.

PNO has its own community building, management and dissemination tools, the core one being Innovation Place © www.innovationplace.eu. With Innovation Place, PNO offers its clients an innovative service concept, up-to-date web-based tool, knowledge base and European wide communities to manage their own innovation, projects, funding knowledge and networks, combined with the best consultancy support.

As key advisor to the European Technology Platform (ETP) SusChem, the European Council for the Chemical Industry (CEFIC) and Association SPIRE PNO supports the development of medium to long term research and innovation agendas for resource efficiency, amongst others supporting the drive towards the security in Critical Raw Materials. Furthermore, PNO recently co-managed the process of developing a Public Private Partnership and the SPIRE 2030 Innovation Roadmap (www.spire2030.eu) for the sustainable process industry, as well as the new Vision and Strategic Innovation and Research Agenda of WssTP for the innovation in the field of Water, as input toHORIZON 2020.

PNO Ciaotech will act as Work Package Leader of WP5 on LCA, Techno-economical evaluation, and exploitation.

Based on its extensive experience in consulting and innovation management, it will support the project partners in the economic and environmental evaluation of the developed enzyme products, as well as in the development of the exploitation plan.

Biomoer is combined heat & power biogas plant formed by cooperation of 4 different companies closely located to each other allowing use of the generated electricity and heat

Dairyfarm Hulsen Kwappenberg VOF a dairy farm of 105 cow's and 90 calves and heifers situated on 65 hectares for grazing and growing grass and feed corn. The Biomoer facility is situated at this farm.

Kwekerij Loos a modern greenhouse company (3 hectares) producing strawberry's, of which 2 hectares using artificial lighting. By using this additional lighting Kwekerij Loos can deliver Dutch Strawberry's from October till June. On the Brabantse Wal, Kwekerij Loos also have 6 hectares soilheated grown asparagus. These asparagus are harvested in March, April and May. The company therefore produces sustainable Strawberry's and Asparagus.

Dairy farm Maas A dairy farm with 85 dairy cows and 70 calves. It also has 55 hectares of land in use for grass and feed corn.

Asperge-akkerbouwbedrijf Van Tiggelen Van Tiggelen produces asparagus and other agricultural produce.

The biogass facility consists of two primary and one large secondary digester . The produced gas fuels two CPH turbines totaling an average output of 2000 kWh. Both cow and pig manure are being digested with the addition of various other energy containing materials from agricultural waste and fatty by-products.

The main role of Biomoer in DEMETER is to perform field test using C1-LC4 enzyme in WP4 (Demonstration). Biomoer has tested enzyme addition from several suppliers and has a good control and analytical protocols

DEMETER Consortium

GENENCOR INTERNATIONAL BV

www.biosciences.dupont.com

BIO BASE EUROPE PILOT PLANT VZW

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www.dbfz.de

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

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