

Biofuels and green chemicals from sugar beet through direct processing

Acronym: CHEMBEET

Coordinator:
Dutch Sustainable Development BV (NL)

Partners:

- Stichting DLO (NL)
- University of Warmia and Mazury (PL)
- Van Antwerpen Milieutechniek BV (NL)

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Introduction

Improving the sustainable society is important for government and companies. The overall aim is to support the development of cleaner and renewable sources; especially the right way for the utilization, conversion of resources in a circular way. The use of biomass is an interesting option, because of the worldwide availability of the biomass. It also can be produced and consumed on a CO₂-neutral basis. Sugar beet is seen as the most attractive bio-based crop: for the impact as soil improver, higher yield of the other rotation crops and for a stable farmer's income.

The transition is deployed from fossil industries into more bio-based chemical industries. Research found several critical points in the regular work process of conversion of the sugar beet into (food grade) bio-ethanol. Feedstock flexibility, CAPEX, OPEX, High Water Usage, Waste/residues and Robustness could improve in the work process. CHEMBEET invested to solve these problems and optimize the process, including an attractive cost price.

Results

The aim of CHEMBEET is to integrate a new biomass pre-treatment (Betaprocess) liberating sugars for processing in the Direct Processing with Betaprocess concept. In the pilot installation in Lelystad sugar beet was successfully treated and the released sugars were fermented (2 x 1,5 m³ capacity) into ethanol. As a result of the pilot this is now scaled up to larger fermentation capacity and a full scale commercial plant is now ready to market.

Main objective of this concept is biomass processing, using the complete sugar beets within the cradle to cradle principle, finally no products are left. All products have a destination, starting with ethanol, CO₂ and other streams such as cellulose, hemicellulose and pectin which are available for use as aerogels, fibres and for the paper and cardboard industry. The produced EtOH can be used as building blocks others than biofuels, f.e.; for cosmetics, paint, pharmacy, solvents, disinfectants and for chemicals, etc.

Direct Processing with Betaprocess consists of three steps: pre-treatment, fermentation and distillation, besides these steps also sugar beet storage silos and EtOH silo's. Using Betaprocess and its effect is unique; no enzymes are needed for fermentation. Betaprocess works with low pressure, low temperature and the effect is realized in a split second resulting in use of less energy and thus in a lower cost price per Kg product and no waste streams left. Other pre-treatment methodologies use high pressure or high temperatures or both.

By using only the pre-treatment part of the Direct Processing with Betaprocess you can produce fermentable sugars. This product is the basis for growing bacteria to develop for example PHA's, single cell proteins, itaconic acid, etc.

During the CHEMBEET project research took place in all aspects of the entire value chain. Therefore we are gratified that we can conclude that the starting points for valuable and sound business cases are available. The technology from beet to ethanol is proven, although some minor aspects have to be checked in the scale up fermenters. But the overall conclusions in all separate process steps are very positive. With the CHEMBEET results farmers can have a more and important role in the establishment of the GREEN ECONOMY.

As conclusion of the CHEMBEET project the Direct Processing with Betaprocess is ready for the market and ready for a green future.

Project partners

During the project there was close cooperation between all partners. ACRRES has updated its experience with fermentation and distillation technology. VAM Watertech was active with the pre-treatment, washing and crushing. As conclusion of WP2 we conclude that the use of water can be lower in combination with less tare. This will be a new development for VAM.

UWM developed based on the available streams more know how about algae growing, biogas production from residual streams and the development, using sugar beet, to other products, such as ABE and IBE fermentation, succinic acid, lactic acid. All these results give a real good view about the potential of sugar beets in the green economy.

The overall conclusion for DSD is that the Direct Processing with Betaprocess is available for scaling up. The overall business case is attractive for farmers and investors, it will provide them a stable income on a longer term

Acknowledgment

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The ERA-NET Bioenergy is a network of national ministries and agencies. It contributes to further development of the European research area in bioenergy and strengthening of national research programmes through enhancing international cooperation and coordination.

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