US4Greenchem

Combined Ultrasonic and Enzyme Treatment of Lignocellulosic Feedstock as Substrate for Sugar Based Biotechnological Applications

ttz Bremerhaven

What is US4Greenchem about?

US4GREENCHEM aims to design a biorefinery concept for the **complete valorization of lignocellulosic biomass** that is energy- and cost- efficient. The concept combines mechanical pretreatment with the aid of ultrasound and mild CO_2 hemicellulose degradation to overcome its recalcitrance and disrupt inhibitors.

The overall **environmental goal** of the project is to develop a process that **minimizes the generation of by-products and waste. GHG emissions should be reduced by 30% compared to starchy ethanol** through the use of renewable feedstocks, green technologies and the production of additional high value products from the lignin fraction in an integrated biorefinery approach.

AIMS

- Develop **ultrasound (US) pretreatment** that effectively disrupts the lignocellulosic matrix with reduced energy input and minimal production of inhibitory byproducts.
- degrade lignocellulose with **SC-CO2 technologies** to maximize release of sugars
- Develop **purification and conversion strategies** for lignin-based products, for material valorization of the biomass.
- Optimize yield and reduce the cost of enzymatic hydrolysis of cellulose fibers via **new enzymatic cocktails** with improved thermal stability and reduced sensitivity to product inhibition, using **enzymes at high solid loadings** and enzyme recycle.
- Test for **fermentability** of the sugar fraction
- **upscaling** for pilot scale
- **Life Cycle Assessment** for comparison to existing technologies.

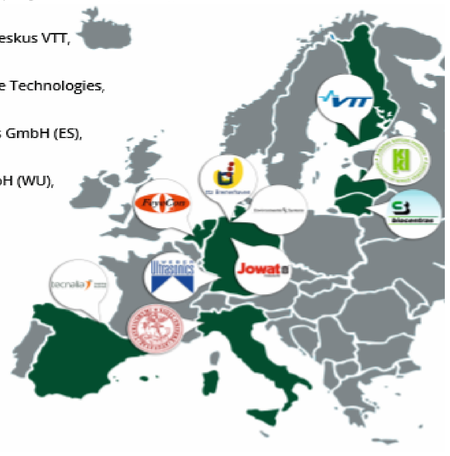
Milling process was applied, increasing the surface area and accessibility of the enzymes to substrate, increasing the saccharification rates and yields.

INNOVATION

ULTRASOUND can increase the surface area of the treated biomass and provide sufficient delignification to facilitate the hydrolysis of the carbohydrate components. Hemicellulose hydrolysis and further matrix degradation can be provided by the action of **subcritical and/or supercritical CO2 (SC-CO2).**

PARTNERS

- Verein zur Förderung des Technologietransfers der Hochschule Bremerhaven e.V. (TTZ), *Germany*
- Fundación Tecnalia Research & Innovation, *Spain*
- Università degli Studi di Torino (UNITO), *Italy*
- Latvijas Valsts koksnes ķīmijas institūts (LS IWC), *Latvia*
- Teknologian tutkimuskeskus VTT, *Finland*
- Feyecon Carbon Dioxide Technologies, *Netherlands*
- Environmental Systems GmbH (ES), *Germany*
- Weber Ultrasonics GmbH (WU), *Germany*
- JSC „Biocentras", *Lithuania*
- Jowat AG, *Germany*



Grant Arement: 669055
Starting Date: 01/07/2015
Duration: 48 Months

www.us4greenchem.eu

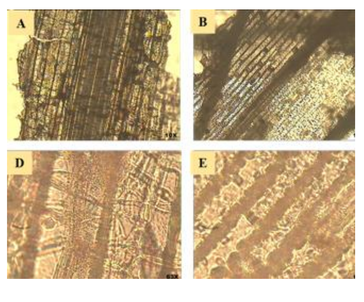
IMPACTS

The project will address the whole technological conversion chain from the **physical pre-treatment** that makes the carbohydrate chain accessible, to the **improved hydrolysis** of the carbohydrate fraction by enhanced enzymatic cocktails and the separation and valorization of the sugar components. The development of separation and valorization strategies for co-products from the lignin fraction and the full use of the remaining fraction for energy generation is also foreseen.

- The use of US4GREENCHEM technologies will improve the economic performance of the overall process through reduced waste and wastewater treatment costs and reduced costs for removal of impurities from the isolated sugar streams

- The integration of ultrasound and supercritical CO_2 with enzymatic hydrolysis into one process has the advantage of improving mass transfer during hydrolysis, allowing for enhanced enzyme performance under high-solid loading, more compact equipment and reduced overall infrastructure cost

- processes allow to separate the biomass in high quality streams increasing the versatility of the valorisation strategy. This generates a more competitive process that can be adapted to diverse geographical and economical landscapes.



the transverse fibers which are observed at a magnification of 10x on samples of raw straw (A, Figure 4), are no longer visible after treatment of the same sample in the US with water (B)

Contact

ttz Bremerhaven
Fabio Pereira / Anna Schneider
E-Mail: fpereira@ttz-bremerhaven.de or
Email: aschneider@ttz-bremerhaven.de

Horizon 2020 European Union Funding for Research & Innovation

Bio·based Industries Consortium

BIO-BASED INDUSTRIES Public-Private Partnership

This project has received funding from the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 669055