biocore

A biorefinery concept for the transformation of biomass into 2nd generation fuels and polymers

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NEWSLETTER

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BIOCORE is a FP7 European project which begun in March 2010. This 4 year program aims to demonstrate **the industrial feasibility** of a **biorefinery concept**. The consortium is composed of **24 partners** coming from European companies, NGO, universities or R&D institutes. The project includes a world–class Indian R&D institute (TERI, New Delhi), which supplies vital data that will help to understand how biorefining can be developed in India.

BIOCORE has now been running **for more than 25 months** and the results obtained so far are very promising. This newsletter presents a**n overview of the highlights and progress made during the first 2 years**. We hope you find the information contained within this newsletter useful and we encourage you to visit the BIOCORE website in order to obtain more information.

Upfront biomass fractionation technologies

The BIOCORE project has successfully devised **a strategy for biomass fractionation** that is sufficiently robust to use a wide variety of biomass resources, including **agricultural coproducts**, such as **straws**, and **woody biomass.**

Key results:

- The organosolv technology showed that it is perfectly feasible to process SRC poplar without a prior debarking step. This finding is significant, because it provides energy savings linked to the fact that debarking is avoided.
- Hardwood/softwood mixtures have been tested and allowed us to establish that a 90:10 (hardwood/softwood) mixture can be processed, without any modifications to the standard "wood" protocol.
- BIOCORE researchers have tentatively identified an innovative solution that will hopefully allow softwood to be used in the process in the near future. Initially, softwood was excluded, because the resin content is a serious handicap, hampering the penetration of the solvent system.

Technologies for C5 and C6 sugar processing and sugar-based products

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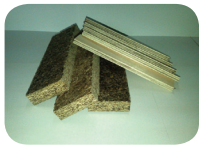
A characteristic of BIOCORE is the **wide product portfolio** that is being targeted, using a variety of technologies that employ novel tools, such as **new enzymes** and **microbial strains** or **heterogeneous catalyst.** Over the initial 24 months of the project several tools and processes have been investigated and, in certain cases, validated for pilot scale demonstrations.

- DSM demonstrated that the performance of its proprietary thermostable cellulase cocktail on the C6 cellulose pulp is such that pilot scale trials are feasible.
- DSM also identified hemicellulase mixtures and single enzymes that will be suitable for the depolymerization of xylo–oligomers contained within the C5–rich stream.
- VTT has engineered new strains for the production of xylitol and xylonic acid, using xylose–rich syrups as the starting material. Currently the process performance of the best xylitol producing strain is at least equivalent, or perhaps superior, to that of any similar strain described so far in the literature. Therefore, these results are highly promising for future pilot scale trials.

- Using a multi–functional catalyst, KULeuven have successfully demonstrated the impressive lab scale performance of a one–pot process that allows cellulose to be converted into isosorbide in high yield and high selectivity.
- DLO developed a biobased plasticiser compound, which has been designed to replace di(2–ethylhexyl) phthalate (or DEHP) as a plasticizer for PVC. When incorporated into PVC, the resultant biobased plasticizer, synthesized starting with glucose, outperforms the commercial plasticizer. Scale up of the synthesis is now underway in order to allow application testing.

Lignin-based products

During the initial phase of BIOCORE a significant number of R&D activities have been focused on the **characterization, modification and use** of lignins arising from CIMV (BioligninsTM) and ethanol/water (benchmark) processes.



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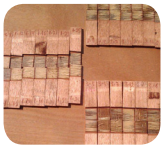

Plywood panels using PF adhesive formulation containing lignin

Key results using CIMV Biolignins™:

- IWC has investigated synthesis of polyurethanes (PU) and proved that the lignin function is not limited to a crosslinker role, but also procures higher thermostability of PU. IWC produced a novel foam, with a high content of renewable materials in the end–product, whose characteristics correspond to current requirements of construction and refrigeration industries.
- SYNPO has developed a solvent–free process for the production of a novel polyurethane (PU) cast resin, which is 100% bio–based and displays interesting properties, such as increased surface hardness (*c.f.* a benchmark PU cast resin formulation) and high electrical resistivity.

These processes have been successfully validated at lab scale and are now ready for pilot

- CHIMAR has investigated the production of biobased adhesives for wood–based panel production. It was shown that up to 70% of phenol could be substituted in phenol–formaldehyde (PF) adhesive formulations when using certain types of modified CIMV BioligninsTM. Interestingly, bio–resins could be used to make plywood panels and panels for interior and exterior application.

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Process modeling and assessment of the BIOCORE concept

Modeling of the different processes that constitute the BIOCORE concept, and the assessment of performances in terms of **economic gains, environmental advantages and social benefits** is a strategic goal for the BIOCORE project. The outcome of this process was the selection of <20 value chains that hold sufficient economic and environmental potential to warrant further study within the framework of BIOCORE.

To model the functioning of biorefineries and to investigate the effects of different geographical, social, economic and political contexts, BIOCORE is using a **case study approach**. During the second year it was possible to further define the study content, including a description of the predicted business environment in 2025.

- Regarding India, the main feedstock will be rice straw, although the development of appropriate field to factory logistics constitutes the biggest hurdle for its use.
- For Germany, it appears that woody biomass availability is compatible with the implantation of a BIOCORE biorefinery, which would require 6% of current hardwood felling or approx. 2% of total wood felling in the target area.
- In Hungary, smaller refinery units adjusted to local needs and with a diverse sustainable feedstock potential seem to be an acceptable solution by local stakeholders. A biorefinery plant seen as a cutting edge technology is very welcome.
- For France investigations are ongoing and local stakeholders are being consulted.

Methods have also been devised to **assess environmental impacts from the "field"** (crop and forest production), to the "factory gate" and a modeling tool for supply mobilization pathways has been finalized. Regarding the final integrated assessment of the BIOCORE concept, **an internal report,** which prepared the ground for further methodological development in all of the targeted areas (*i.e.* economic, environmental and social sustainability assessments, including SWOT analyses) was finalized. In addition, BIOCORE partners have participated in **a cross-project harmonization activity,** which will ensure that identical methods are used to assess the performance of the concepts and processes that are being developed in BIOCORE, SUPRABIO and EUROBIOREF.

Pilot scale demonstration of value chains

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An important aspect of BIOCORE is **the pilot scale demonstration of certain value chains.** The first successful pilot scale demonstration of a value chain was that of the **production of 2nd generation bioethanol from wheat straw.** Working together, CIMV and DSM successfully produced a 150 l batch of ethanol from 1T of raw material. The pilot trial was highly successful, because the hydrolysis of the cellulose pulp using DSM's thermostable cellulose cocktail worked well and the yield of ethanol after fermentation and distillation was very promising.

The result constitutes a key step in the BIOCORE project, which aims to demonstrate the feasibility of producing 2nd generation bioethanol as precursor for materials such as **bio-PVC,** from non-food lignocellulosic biomass. Currently, Arkema S.A. is using the 2nd generation ethanol to perform trials aimed at the production of 2nd generation ethylene.

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SEVENTH FRAMEWORK PROGRAMME

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