biocore
A biorefinery concept for the transformation of biomass into 2nd generation fuels and polymers
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NEWSLETTER
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Year 3 has been a busy and fruitful year for BIOCORE partners. Several important milestones have been reached and a wide array of results obtained, thus ensuring that the final targets of the BIOCORE project will be reached at the end of the project.

This newsletter presents an overview of the main achievements of year 3. 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.

Assessing biomass availability using a regional-based case study approach

In year 3, the assessment of the availability of biomass was completed. This assessment used a regional case study approach that takes into account, economic, supply chain and environmental aspects.

Key results:

• In France's (and the EU-27's) biggest wheat producing region, wheat straw will be available in 2015 in sufficient quantities to supply a biorefinery requiring 150,000 dry tonnes per annum.

• In India, the extraction of rice straw for biorefining will lead to a reduction in the environmental impacts linked to open field burning. The uptake of surplus biomass presents many advantages including an opportunity to contribute to the energy demand in the region.

• More feedstock-flexible biorefinery concepts will be beneficial in feedstock-constrained regions. In Germany, the feedstock (hardwood) was found to be expensive, but transportation costs are low (well developed rail and fluvial networks).

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Rice straw collected in India

To obtain more information on assessment of the availability of biomass, please consult the BIOCORE website. A complete report will be available in the coming months.

Upfront biomass refining technology

In year 3, the adaptation and optimization of the upfront biomass fractionation technologies (organosolv technologies operated by CIMV and ECN) was completed and solutions to improve refining of the CIMV hemicellulose-rich fraction were found. A full mass balance analysis of the CIMV process performed by KULeuven and CIMV was completed.

Key results :

• Lignin recovery in the CIMV process is maximal.

• The C5-rich hemicellulose fraction contains over 60% dry weight sugars, of which approximately half are monomeric xylose.

• Similarly, regarding the C5-rich hemicellulose fraction, extensive analyses and round-robin testing provided considerable insight into the chemical composition of the fraction, revealing that some of the sugars are esterified.

• ECN developed a new, improved EtOH/water organosolv process route for herbaceous biomass. In an extra step before biomass, pulping proteins, waxes and other extractives from the feedstock are removed to eliminate their influence on the fractionation process. Consequently, the final cellulose pulp is purer and the isolated lignin more closely resembles native lignin.

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CIMV Pilot

Investigating the valorisation of process residues

In year 3, the analysis of BIOCORE process residues as feedstock for heat and power generation was studied by ECN. Of the two major types of residues associated with the BIOCORE process (*i.e.* fines from biomass comminution and fermentation residues), focus was given to fines.

Key results :

- Wheat and rice straw fines are difficult fuels on a stand-alone basis, mainly due to high alkali content.
- Combustion shows good burnout / efficiency of 99.5%. Low temperature gasification showed a lower burnout / efficiency of 96%.

Based on the results, it is possible to recommend that fines should be either co-fired with coal, or with other biomass, and that potassium binders, such as aluminium silicates, should be added. Nevertheless, when fines and coal are co-fired, the resulting fly ashes are not compliant with EU criteria for use in concrete (EN-450-1), but these might be suitable as fertilizer in certain EU member states.

Technologies for the conversion of five and six-carbon sugars into valuable products

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In year 3, partners ascertained that a certain number of biotechnological processes will be eligible for pilot scale studies in year 4. Moreover, year 3 was dedicated to the identification of enzymes that can be used to improve the availability of fermentable sugars in CIMV's hemicellulose-rich fraction.

- Regarding the biotech production of xylitol, VTT achieved excellent results, attaining a production of 108 g xylitol L^{-1}, with a productivity rate of 0.82 (± 0.1) g L^{-1} h^{-1} and a yield of 0.89 g [g xylose consumed]$^{-1}$ using 70% of CIMV C5 syrup as substrate.
- Working on the production of isopropanol by Clostridium acetobutylicum, INRA successfully created a prototype strain that produces isopropanol in a mixture with butanol and ethanol.
- Using a bifunctional catalytic concept, KULeuven finalized work on the direct conversion of cellulose into isosorbide in a one-pot process. Isosorbide yields of up to 63% could be achieved.

Development of lignin-based products

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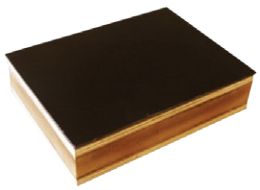
CIMV Biolignin powder

Working with CIMV's Biolignin™, in year 3 partners made some decisive steps towards demonstrating the commercial opportunities for organosolv lignins.



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BIOCORE DEMO SAMPLE : a sandwich board consisting of polyurethane foam containing Biolignin between plywood panels bonded with lignin resin

- CHIMAR used Biolignin™ as a substitute for phenol in the preparation of phenol-formaldehyde resins that were subsequently employed to prepare wood panels. Up to 70% (w/w) substitution of phenol was achieved using raw Biolignin™. The resultant plywood panels were shown to meet current standards for indoor and outdoor use, and were found to emit approximately 3 times less formaldehyde than the level permitted by current regulations. Overall, this means that Biolignin-based plywood boards will be competitive with current commercial benchmark products.
- SYNPO used Biolignin™ to prepare a flexible polyurethane elastomer which, compared to a benchmark PU elastomer, displays a 2-fold increased tensile strength, 3-fold increased toughness and increased electrical resistance (2 orders of magnitude). SYNPO's original formulation has been patented and the search for partners who are interested in the commercial development of the product are being sought for.
- Using Biolignin, IWC has developed and patented a rigid PU formulation that can be used for the production of thermoisolating foams.

Process modeling and sustainability assessment of the BIOCORE concept

During year 3, partners finalized the selection of target product value chains that will be subjected to the final integrated sustainability analysis. Regarding this analysis, other work focused on the methodologies that will be used to achieve this, with all methodologies now being ready for use. Specifically:

- Partners from TERI and Imperial College London finalized a joint paper on the harmonization of methodologies for social assessment. This work was conducted jointly with colleagues from two other FP7-funded projects, EUROBIOREF and SUPRABIO.

- For the environmental (IFEU) and economic (NOVA) assessments the software tools and their associated databases were developed, tested and internally reviewed. These are now ready for implementation in year 4.

- Several BIOCORE partners worked hard to organize an international workshop on social, legal, and policy assessment and SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis. This event took place on 5th March 2013 in Brussels. About 50 people representing NGOs, associations, companies and authorities from Europe and India attended the workshop, thus helping to make this a very successful day.

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Other work was directed towards the preparation of flowsheet models. In this respect:

- NTUA completed a lot of work on CIMV's core processes, integrating process updates into its overall process description. Process integration revealed that attractive energy savings (up to 70% in some cases) are possible.

- Product pathway scoping was extended by incorporating energy integration. In this way, quite favorable process energies were obtained (up to 85% energy savings).

- Interestingly, modeling work clearly indicated that in the case of the BIOCORE concept, thus *a fortiori* the CIMV process, co-localization or co-production will be a smart way to achieve maximum process efficiency.

- Overall flowsheet models were produced for 23 product pathways. The new models combine knowledge from experts and literature data, and offer a convenient background to analyze, cost and scale-up the different variants of the CIMV-based biorefinery concept.

Dissemination

In year 3, BIOCORE partners organized the second edition of its biorefining training school in Wageningen. Moreover, the management team pursued its efforts to ensure communication of the project's achievements, especially through the edition of a technical note on lignin, which can be downloaded from the BIOCORE website.

Working with its partners from FP7 projects EUROBIOREF and SUPRABIO, the BIOCORE consortium also began work on the organization of joint showcase event conference that is scheduled for 11-12th February 2014 in Brussels. This co-organized public conference will offer a unique opportunity to interested stakeholders to discover firsthand the major achievements of the three FP7-funded biorefinery flagship projects. Save this date in your agenda!

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BIOCORE is a FP7 project that 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, NGOs, universities and R&D institutes. The project includes a world-class Indian R&D institute (TERI, New Dehli), which supplies vital data that will help to understand how biorefinering can be developed in India.

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