

CONCEPT OF BIOREFINERY COMES INTO OPERATION: THE EUROBIOREF CONCEPT



Franck Dumeignil^{1,2,3}

¹Univ. Lille Nord de France
F-59000, Lille, France

²CNRS UMR8181, Unité de Catalyse et Chimie du Solide, UCCS
F-59655 Villeneuve d'Ascq, France

³Institut Universitaire de France
Maison des Universités, 10 Boulevard Saint-Michel, 75005 Paris,
France

franck.dumeignil@univ-lille1.fr

Franck DUMEIGNIL is Professor at the University of Lille North of France, and the Deputy Director of UCCS. After his PhD at the University of Lille (1998), he spent 6.5 years in Japan. After a 2 years post-doctoral stay at NIMC in Tsukuba, he was subsequently employed at the Tokyo University of Agriculture and Technology (TUAT), first with a 2 years post-doctoral position, and then as an associate professor, within the frame of a Centre of Excellence (Scientific Cluster). He then decided to come back to Europe, where he subsequently coordinated many research projects. In January 2010, he was nominated vice-director of UCCS, UMR CNRS 8181, France, which comprises more than 200 people. He is currently the coordinator of the PCRD7 European Programme EuroBioRef '*EUROpean Multilevel Integrated BIOREFinery Design for Sustainable Biomass Processing*' (www.eurobioref.org), gathering 28 partners from 14 different countries for a global budget of 38 M€ (23 M€ of subvention) during 4 years (01/03/2010 - 29/02/2014). Within this large-scale project, his research team is more specifically involved in the development of a large variety of catalytic reactions. The EuroBioRef project has a real potential of strongly contributing to re-energize the biomass production, grow the industry and achieve the original dream of biomass sustainability across the whole of Europe. Franck Dumeignil has further been nominated as a Junior Member of the prestigious IUF academy from the 1st of October 2010. The mission of the Institut Universitaire de France is to promote the development of a high quality university research, and to strengthen interdisciplinary projects. He is co-author of more than 50 scientific articles, 6 patents, and more than 150 communications (oral and poster) in national and international congresses.

Abstract

The EuroBioRef project (European Multilevel Integrated Biorefinery Design for Sustainable Biomass Processing), a 4 years program coordinated by CNRS, France, has been launched on March 1st, 2010. It is supported by a 23 M€ grant from the European Union 7th Framework Program (FP7). EuroBioRef deals with the entire process of transformation of biomass, from non-edible crops production to final commercial products. It involves 28 partners (industry, SMEs, academics) from 14 different countries in a highly collaborative network, including crop production, biomass pre-treatment, fermentation and enzymatic processes, catalytic processes, thermochemical processes, assessed by a life cycle analysis and an economic evaluation of the value chain.

Introduction

The EuroBioRef concept is based on several principles that must be included in the new integrated

and flexible biorefinery that bridges the gap between the agriculture and the chemical industries by providing a stream for a variety of biomass feedstocks and producing a menu of finished green chemical products adapted to the future sustainable bio-economy-based European society. During this lecture, the EuroBioRef concept will be presented after a general introduction on biomass.

Experimental

The development & the implementation of biorefinery processes is of the utmost importance and constitutes the keystone for the establishment of an economy based on bio-resources. Nevertheless, contrary to petro-resources of which the nature and composition variations are 'relatively' limited, under the term 'bio-resource' or 'biomass' are gathered compounds of very different natures, namely cellulose, hemicellulose, oils, lignin and so on... Thus, a complete set of specific technologies must be developed in order to convert as smartly as possible each fraction. This implies, among others, the elaboration of a lot of processes based on catalysis. These latter constitute core technologies that will be implemented in the so-called 'biorefineries' of the future. Within this frame, we are elaborating and developing the EuroBioRef concept 'EUROpean multilevel integrated BIOREFinery design for sustainable biomass processing' (eurobioref.org), as a European project of the 'large-scale' type. EuroBioRef is a new highly integrated, diversified and sustainable concept, which involves all of the biomass sector stakeholders. The potential of all of the fractions issued from the various types of biomass is used to yield a value-added as high as possible in a sustainable and economical way. Further, the project has the specific aim to overcome fragmentation in the biomass industry. This means that decisive actions are taken to facilitate better networking, coordination and cooperation among a wide variety of stakeholders involved at all levels comprising of large and small chemical and biochemical industries, as well as academics and researchers from the whole biomass value chain, and also relevant European organizations. Specifically, the new concept adopts a flexible and modular process design adapted to large-scale but also small-scale production units, which will be easier to install in the various European areas. The overall efficiency of this approach will be a vast improvement to the existing situation, considering sustainable options, such as the production and the use of a high diversity of sustainable biomass adapted for European regions, the production of multiple products in a flexible and optimized way that takes advantage of the differences in biomass components and intermediates, or zero waste production associated with the smart and parsimonious consumption of feedstock.

Results and discussion

Some important results have been obtained during the first year, of which an outline is given below.

Various non-edible crops are now grown in field tests, despite some issues in accessing seeds for cultivating some of them. The project is thus seeking seed providers, with also the aim of diversifying the potential crop candidates. The project is especially developing a strategy for culture rotations and combinations in order to find synergies between edible and non-edible crops. In the case of non-edible crops, additional revenues for farming communities generated from new side-businesses, such as honey as well as silk production, is investigated to increase local development and sustainability of the production.

In addition, low-input (water, fertilizers, pesticides...) perennial crops and woody species are also grown in field trials for supplying the conversion units with lignocellulosic material.

An efficient and versatile pretreatment technology for lignocellulosic material has been developed and it will be thoroughly evaluated in a pilot plant that will be constructed in Norway. Concerning the vegetable oils, extraction has been performed for castor, jatropha and lunaria, and optimization is under way. After harvesting, crambe, safflower, cuphea and lesquerella oils will be extracted as well.

One of the original aspects of this project is to value a strong integration of the thermochemical, chemical/catalytic and biochemical processes, which work in synergy for transforming the whole crop. Several products were synthesized based on research on catalytic processes, and the first samples are now being tested for formulating aviation fuels and high value applications such as chemicals and polymers. These actions pave the way for demonstrations that are planned from next year.

As another strong point, life cycle assessment is not restricted to the carbon footprint but also includes the socio-environmental and economic impact assessment in order to determine the sustainability of the proposed solution. Some specific tools are now being developed for doing so, taking into account harmonisation efforts with major sister projects in the EU.

EuroBioRef has also a strong power of dissemination and education. Thus, the first EuroBioRef Summer School "*The concept of biorefinery comes into operation*", aiming at the effective training of young researchers from academia and staff from industry on the most up-to-date scientific and technological aspects of biorefineries, is now taking place on the 18-24th September 2011, in Castro-Apulia in Italy. A textbook will be edited based on this event.

As a conclusion, the launching of EuroBioRef was a success, and the first results are emerging, with demonstrations foreseen in the mid-term for some technologies that have provided early excellent results.

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