Knowledge Based Bio-Economy towards 2020
Turning challenges into opportunities

Success Stories

Conference
13 & 14 September 2010
Brussels

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EUROPEAN COMMISSION
European Research Area

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Content

Introduction

The Knowledge Based Bio-Economy towards 2020 conference (KBBE) takes place under the auspices of the Belgian Presidency. During its presidency, Belgium aims to contribute to the EU 2020 strategy so as to bring Europe a step closer to a green, sustainable and competitive economy.

Research and Innovation policy is an important part of the EU2020 strategy and also the Belgian Presidency focuses on priorities such as the realisation of the European Research Area, the contribution of R&D to a sustainable society, the simplification and the strengthening of the efficiency of research programmes, co-ordination of member state policy and initiatives and the shift to a greener, more sustainable industry.

On a European level, important policy measures and financing efforts for Research and Innovation already exist and also the member states have done (and are doing) tremendous efforts. In Belgium we find a lot of good illustrations and results of European and international collaboration, certainly in the biotechnology sector. On the following pages you can find a selection of success stories with a strong link to Belgium and the KBBE conference.

The KBBE towards 2020 conference kicks off with a site visit to the Life Sciences Cluster at the Technology Park (Ghent) and to the Bio Base Europe pilot plant and the BioRefinery site in the harbour of Ghent. Most of the success stories included in this leaflet, relate to the site visit: Ablynx and nanobodies, Bayer BioScience, the global biotechnology innovation center of Bayer CropScience, Cropdesign with its rice genomics platform, the Flanders Institute for Biotechnology (VIB) with its poplar research (all at the Technology Park) and Bio Base Europe, a Flemish-Dutch-Interreg funded pilot plant.

Other success stories with a Belgian root include the production of biopolymers Sorona®, a result of a successful collaboration between DuPont and Genencor Bruges, Sophied, a Framework programme project co-ordinated by Belgian researchers on environmentally friendly dyes and Sommer Needlepunch (DS Textiles Platform) who also provide the event carpet for the KBBE exhibition.

Background

Founded in 2001 in Ghent, Belgium, as a spin-off of the Flanders Institute for Biotechnology (VIB), Ablynx is a biopharmaceutical company focused on the discovery and development of Nanobodies, a novel class of therapeutic proteins based on single-domain antibody fragments, for a range of serious and life-threatening human diseases. The Company currently has over 230 employees. Ablynx completed a successful IPO on Euronext Brussels [ABLX] on 7 November 2007 and raised €50 million through an SPO in March 2010.

Ablynx is developing a portfolio of Nanobody-based therapeutics in a number of major disease areas, including inflammation, thrombosis, oncology and Alzheimer's disease. Ablynx now has over 25 programmes in its therapeutic pipeline including four Nanobodies in clinical development. So far, Nanobodies have been successfully generated against more than 220 different protein targets including several complex targets such as chemokines, GPCRs, ion channels and viruses, which are typically very difficult to address with conventional monoclonal antibodies. Efficacy data have been obtained in 35 in vivo models for Nanobodies against a range of different targets.

Ablynx has an extensive patent position in the field of Nanobodies for healthcare applications. It has exclusive and worldwide rights to more than 130 families of granted patents and pending patent applications, including the Hamers patents covering the basic structure, composition, preparation and uses of Nanobodies.

Ablynx has ongoing research collaborations and significant partnerships with several major pharmaceutical companies, including Boehringer Ingelheim, Merck Serono, Novartis and Pfizer (previously Wyeth Pharmaceuticals). Ablynx is building a diverse and broad portfolio of therapeutic Nanobodies through these collaborations as well as through its own internal discovery programmes.

The Company's lead programme ALX-0081, an intravenously administered novel anti-thrombotic, entered a Phase II study in patients undergoing percutaneous coronary intervention (PCI) in September 2009. Ablynx demonstrated proof-of-concept by biomarker for ALX-0081 in December 2009. ALX-0681, a subcutaneous administration of the anti-von Willebrand factor (vWF) Nanobody recently concluded a Phase I study.

In September 2009, Ablynx's partner Pfizer entered a Phase II study in RA patients, with an anti-TNF-alpha Nanobody.

In December 2009, Ablynx initiated a double-blind, randomised, placebo-controlled Phase I study with ALX-0141, a Nanobody targeting Receptor Activator of Nuclear Factor kappa B Ligand (RANKL), in healthy postmenopausal women. ALX-0061, an anti-IL6R Nanobody is in preclinical development for the treatment of autoimmune and inflammatory diseases. In February 2010, Ablynx announced that it had reached its criteria for initiating the preclinical development of ALX-0651, a Nanobody against CXCR4, and will progress this programme towards the clinic. CXCR4 plays an important role in cell mobility, tumor growth and metastasis. In March 2010, Ablynx

advanced an anti-RSV Nanobody, ALX-0171, into preclinical development. ALX-0171 will be developed for the treatment of respiratory synctial virus (RSV) infections, delivered through inhalation and has the potential to be effective both in the prevention of infection as well as in treatment once infection has occurred.

Nanobody® is a registered trademark of Ablynx NV.

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BAYER BIOSCIENCE

Company Profile

Bayer BioScience NV has been founded in 1982 and is located in Ghent, Belgium. The company is the global biotechnology innovation centre of Bayer CropScience, one of the major divisions of the Bayer group. This center integrates plant biotechnology research and global business support functions – such as legal, intellectual property, bio analytics and regulatory expertise - to optimize the innovation process. Bayer BioScience N.V. now has 300 employees.

BioScience, one of the three business groups of Bayer CropScience AG, is a leading international player in the research, development and marketing of seeds with added value traits. Innovation and product development are focused on vegetable seeds and the agricultural crops such as oilseed rape, cotton and rice. BioScience has more than 2700 employees worldwide. The headquarters are in Lyon, France.

Science and Technologies or Services

Bayer BioScience has developed a broad portfolio of patents and know-how during the last two decades enabling the engineering of plants with valuable new traits and the application of modern plant breeding techniques. Bayer BioScience combines expertise in the following areas to create a unique insight and position in the market:

- expertise of bringing first generation biotech products (herbicide resistance, insect control) to the market;
- the availability of state-of-the-art research and development competencies;
- collaborations with leading academic groups and;
- synergies between different Bayer subgroups.

Elaborating on achievements for crop management solutions (weed and insect control), crop productivity & quality enhancement, researchers deploy genetics and genome engineering for trait discovery. Fast screening methods and performance testing, supported by information management and analytical services, allow an early and reliable identification of promising new products. Fully equipped laboratories, plant growth rooms, state-of-the-art greenhouse facilities and a research field trial team enable completion of the most complex plant biotechnology projects. Intensive interaction between the legal department, intellectual property department, quality assurance team, quality control team and the regulatory department is required to prepare new traits for commercialization.

These global and regional BioScience business support functions are based at the innovation centre to optimize integration with the research activities and to ensure accomplishment of the world-wide business objectives in an efficient, socially responsible and sustainable way.

Alliances

BioScience has established research collaborations and license agreements with startup companies, seed companies and public institutes around the world.

Product Description

BioScience is currently commercializing seeds in oilseed rape, rice and cotton and vegetables through the global presence of the organization. Commercialization of proprietary traits in other

crops is achieved through partnerships or license agreements with major players in the respective crop markets.

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Bio Base Europe
Innovation & training for a sustainable biobased economy

Bio Base Europe is the first open innovation and education center for the biobased economy in Europe. Flanders and The Netherlands have joined forces to build state-of-the-art research and training facilities to help the transition from an economy based on fossil resources to a biobased economy based on renewable resources. This leading initiative stimulates the economic growth, the innovation capacity and the sustainable development of our society.

The founding fathers of Bio Base Europe are Ghent Bio-Energy Valley and Bio Park Terneuzen. Bio Base Europe consists of a Pilot Plant in Ghent (Belgium) and a Training Center in Terneuzen (The Netherlands).

The **Bio Base Europe Pilot Plant** is a flexible and diversified pilot plant that operates at ton scale. It has been build to close the critical gap between scientific feasibility and industrial application of new biotechnological processes. It enables you to assess actual operating costs, specific strengths and weaknesses of new biotechnological processes and this before costly, large-scale investments are made.
The Bio Base Europe Pilot Plant is a one-stop-shop that performs the entire value chain in a single plant, from the biomass green resource up to the final bioproduct. It focuses on second generation technologies converting agricultural waste products and non-food crops into biofuels, bioplastics and other bioproducts.
The Pilot Plant is situated in the Port of Ghent in Belgium and is accessible for companies and research institutions throughout the world.

The **Bio Base Europe Training Center** is an education, network and exhibition center promoting the development of a sustainable biobased economy. It offers general and company-specific training and connects closely with the market demand. The Bio Base Europe Training Center will address an industry-wide shortage of skilled process operators and technical maintenance specialists for biobased and sustainable energy processes. It also encourages network activities, technological innovation and entrepreneurship and develops a public information and communication program for the biobased economy.
The Bio Base Europe Training Center is situated in Terneuzen in The Netherlands and is accessible for companies and research institutions throughout the world.

GHENT BIO-ENERGY VALLEY

About Ghent Bio-Energy Valley Ghent Bio-Energy Valley is supporting the development of sustainable biobased activities in the region of Ghent, Belgium. Ghent Bio-Energy Valley is a joint initiative of Ghent University, the City of Ghent, the Port of Ghent, the Development Agency East-Flanders and a number of industrial companies that are active in the fields of the generation, distribution, storage and use of bio-energy and biobased products. Ghent Bio-Energy Valley is a leading European initiative for the development of the biobased economy of the future. Ghent Bio-Energy Valley promotes the development of the biobased economy through collaborative programs, joint initiatives and synergy creation between the partners in the fields of Research &

Development, structural measures and policy, logistics and communication towards the general public.

About Biopark Terneuzen Established in February 2007, Biopark Terneuzen is an initiative that represents new thinking in the creation of biobased industrial sustainability. Biopark Terneuzen was initiated by the Zeeland Province, Zeeland Seaports and the participating industrial parties. Building on the economic and knowledge transfer advantages obtained through the co-location of associated businesses, Biopark Terneuzen raises the platform to a higher level. Its core mission is the development of the biobased industry in the Kanaalzone. One of the ways to pursue this goal is smart linking that promotes and facilitates the exploitation of key synergies between its partner companies. Specifically the potential to exchange and utilise each other's by-products and waste streams as feedstock or utility supplements for their own processes. This contributes to their productivity, to the conservation of non-renewable resources and the reduction of environmental burden.

About Interreg IV Interreg IV is a 2007-2013 programme funded by the European Union from the European Regional Development Fund (ERDF), to advance cross-border cooperation and stimulate sustainable social-economic development in European border regions. The steering committee of the Dutch-Flemish Interreg IV program that assigned the Bio Base Europe initiative among others consists of deputies for international cooperation of the eight Dutch - Flemish border regions as well as a representative from both the Dutch and Flemish governments.

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History

CropDesign is an agricultural biotech company delivering agronomic traits for the global commercial seed markets. CropDesign was founded in 1998 as a spin-off from the VIB (Flanders Institute for Biotechnology) and was financially backed until 2006 by a consortium of venture capital funds led by GIMV. Today, the company employs ca. 100 people at its research facilities in Ghent. Since June 2006 CropDesign is part of BASF Plant Science.

TraitMill™

The company's trait discovery and development program focuses on enhancing grain yield in corn and rice. Corn is the world's leading crop in terms of seed market value and yield enhancement is the most important value driver for both growers and seed companies. The rice seed market is today less developed but is expected to represent a substantial growth opportunity for the years to come.

The company's trait discovery program is powered by the TraitMill™ platform, a unique platform for applied genomics. Through TraitMill™, the company has discovered a range of proprietary leads for yield-enhancement, drought tolerance and improved nutrient use efficiency, and is further testing and developing those leads in rice and corn with the aim to launch commercial products in these crops. The company also applies its technology in other business areas, including molecular farming.

The TraitMill™ comprises proprietary bioinformatics tools, high throughput gene engineering systems, efficient methods for plant transformation, and a unique set up for automated high resolution phenotypic evaluation of crop performance.

CropDesign has the ability and capacity to modulate the expression of hundreds of genes and evaluate their effect in planta through automated screening methods. TraitMill™ has been developed to work in real crops and is currently running in a high throughput mode for rice. With the TraitMill™, CropDesign has the largest corporate program for high-throughput agronomic trait identification in cereals.

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History

Sommer Needlepunch, market leader in event carpets, with head offices located in Baisieux, in the north of France, belongs to the DS TEXTIL PLATFORM group, which was founded in 1898 and is located in Dendermonde, Belgium.

Besides Sommer Needlepunch, the group consists of:

- DS Fibres: market leader in dope dyed polyester fibre
- DAM De Saedeleir or DS Technical textiles: specialised in technical nonwovens.

The group employs a work force of 250 people and generates a turnover of 75 million euros. Sommer is specialized in floor covering solutions for events, domestic, and contract use and more recently artificial grass. The company has been in business for more than 50 years and supplies customers around the world. The care for the environment has always been an important consideration for the company, especially for the issues related to the consumption of raw materials and energy and the development of new products. During the last five years they proved to be a trendsetter in the development of sustainable eco-friendly solutions, believing strongly that economy and ecology can go together.

Eco2-punch-carpet

Where did the idea come from?

- August 2004: Alken-Maes introduced a biodegradable cup for the folk festival in Dranouter (Belgium). The article caught the attention of the DS Group.
- September 2004: Cargill DOW (at the time) responded to our request and saw it as an excellent 'strategic fit'.
- October 2004: Acquisition by DS of Sommer Needlepunch. Sommer having the Biocolor technology (100% recyclable carpet).

Important milestones:

- September 2004: Meeting with NatureworksPLA in Brussels, Belgium.
- February 2005: First resin-trials for the production of PLA-staple fibres in Dendermonde.
- April 2005: Project approval by IWT, Flanders, Belgium.
  DS Textile Platform
- October 2005: Collaboration on coloration started with Ciba
  Specialty Chemicals, Basel, Switzerland.
- February 2006: Presentation of the BIOCOLOR PLUS carpet at Centexbel Symposium Ghent.
- February 2006: presentation to NatureworksPLA of the first fully biodegradable carpet in Paris, France.
- September 2006: Lecture at the Internationale Chemiefasertagung in Dornbirn, Austria.

What is it about?

- ECO2Punch® is a real ecological alternative to the conventional oil-based carpets. (Event and residential use).
- ECO2Punch®, made from 100% natural fibres exclusively produced from natural renewable agro-resources (plants), without oil. The technological process that enables to transform plant sugar into natural polymers (polylactic acid PLA) is sourced by our partner, Natureworks LLC and is distributed under the registered name IngeoTM.

- ECO2Punch®, a significant reduction of greenhouse gas emission in the atmosphere, compared to standard process (using fossil-based polypropylene):
  - CO2 emission reduced by 60%, that is to say, for a carpet production of 20 000 m2, the quantity used yearly by 2 cars or another 18 barrels of oil.
- ECO2Punch®, a significant reduction of energy consumption required for manufacturing - energy consumption reduced by 50 %, that is to say, for a carpet production of 20 000 m2, the equivalent quantity used yearly by 5 cars or another 67 barrels of oil.
- ECO2Punch®, a recycling rate close to 100 % while greenhouse gas emissions are close to zero. At the end of the Copenhagen summit, the carpet was collected and was sent to our partner, GALACTIC, one of the largest acid lactic producers in the world, in order to be recycled. Unlike the other known processes (incineration, skip), LOOPLA®, a unique recycling process, enables to convert the carpet back to virgin lactic acid (basis-monomer of the PLA), and raw material to manufacture a new ecological carpet! The ecological loop was then fully achieved.
- ECO2Punch® is the only carpet that can be recycled with respects of the "cradle to cradle'' concept.

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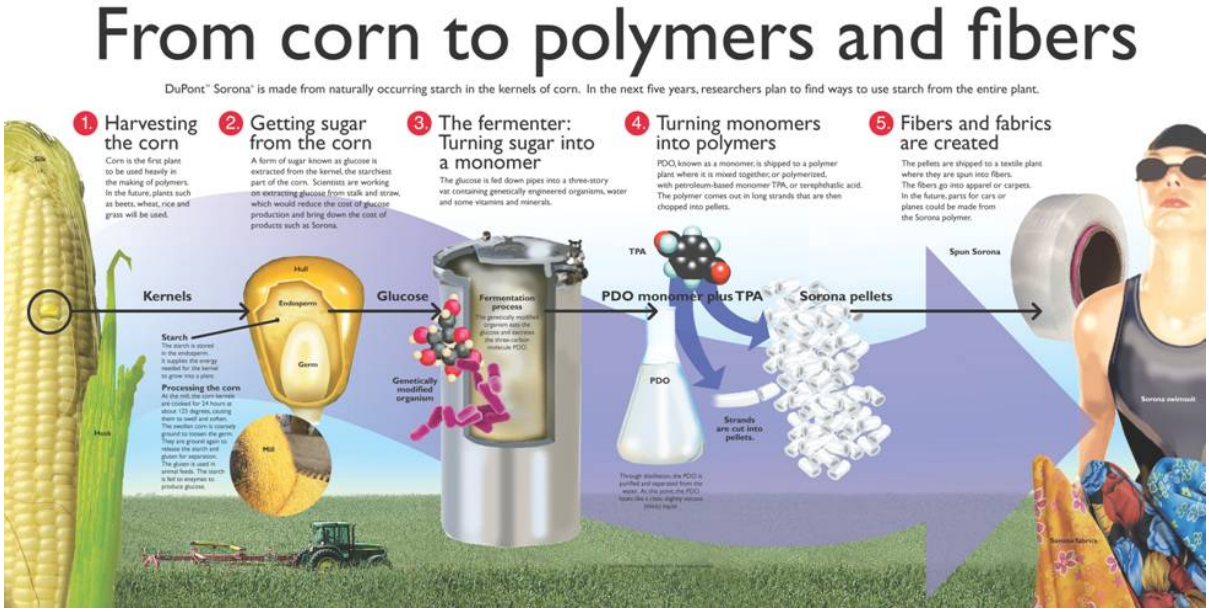
DuPont™ Sorona® Renewably Sourced Polymer

DuPont continues its legacy of polymer and fiber innovation with DuPont™ Sorona® renewably sourced polymer. Sorona®, the most advanced polymer platform in over six decades, offers both performance and environmental benefits to a wide range of end uses. Sorona®, an innovative polymer made in part with agricultural feedstocks (glucose from corn), provides uncompromised performance while reducing dependency on oil and petrochemical feedstocks as well as energy use and greenhouse gas emissions that can lead to global warming. In addition to fibers for textiles, apparel and carpet, Sorona® also can be used in films, filaments and engineering resins. Sorona® contains 37 percent renewably sourced ingredients by weight.

Sustainability Aspects

DuPont introduced its newest polymer platform, Sorona®, in 2000. Although, DuPont knew about poly(trimethylene terephthalate) (PTT), the chemical name for Sorona®, since the 1940s, it was never commercialized due to the high cost of the key ingredient, 1,3-propanediol (PDO). A seven-year research program that began in 1993 in collaboration with Genencor**(*)** concluded with the development of a process to make Bio-PDO™ from corn sugar. In 2004, a joint venture between DuPont and United Kingdom-based Tate & Lyle was formed to commercialize the process. Commercial production of Bio-PDO™ at the Loudon, Tenn. facility began in November 2006. A 35% expansion to the Loudon facility was announced in May 2010 with this new capacity expected online in the summer of 2011.



At the Loudon plant, corn sugar – a bi-product from the Tate & Lyle corn wet mill is used as the feedstock in a proprietary fermentation process to make Bio-PDO™. From a cradle-to-gate life cycle perspective, the production of Bio-PDO™ consumes 40 percent less energy and produces 56 percent less greenhouse gas emissions versus petroleum-based propanediol. Production of 4.5 million tons of Bio-PDO™ in the Loudon plant saves the energy equivalent of nearly four million

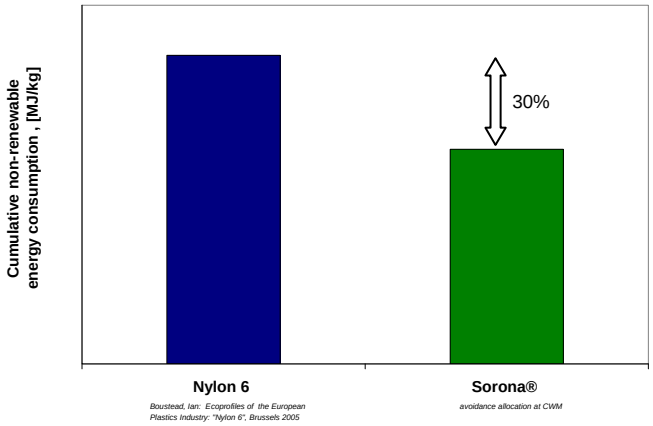
liters of gasoline per year. Bio-PDO™ is also certified as readily biodegradable based on an Organization for Economic Co-Operation and Development (OECD) Guideline Test for Biodegradation.

When polymerized with DMT (dimethyl terephthalate) or TPA (trimethyl terephthalate), Bio-PDO™ becomes the 'green' ingredient in Sorona® polymer, resulting in Sorona® being 37 percent renewably sourced by weight. Polymer chips are sold to licensed fiber producers and carpet mills for production of Sorona® fibers for apparel and carpet. Sorona® polymer also is sold to producers of automotive parts, packaging and engineering thermoplastic materials.

A cradle-to-gate life cycle assessment shows that the production of Sorona® renewably sourced poymer provides significant environmental benefits over the production of an equal amount of nylon6. Based on design data, the Sorona® production process uses 30 percent less energy and reduces greenhouse gas emissions 63 percent over an equal production of nylon6.

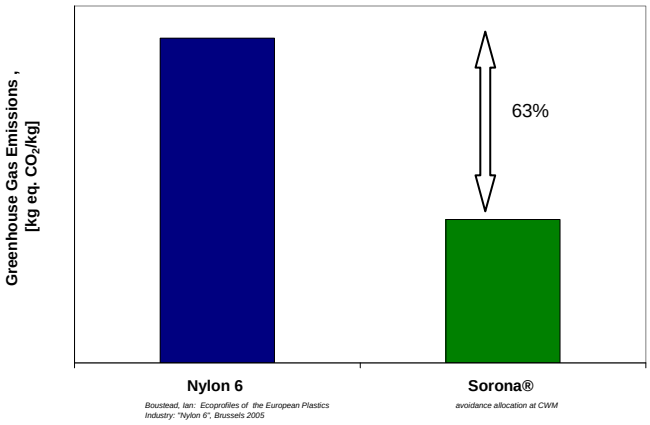
The life cycle assessment (LCA) study was conducted via ISO standards and was peer reviewed by Prof. Konrad Saur, an internationally recognized LCA expert, with Five Winds Consulting.

Sorona®/Nylon6 Benchmark: Energy



30% Energy Savings from DuPont™ Sorona® process vs. Nylon 6 process

Sorona®/Nylon6 Benchmark: GHG



63% Less Greenhouse Gas Emissions vs. Nylon 6 Process

Uses and Applications

Sorona® provides a unique combination of benefits to a wide variety of end uses. In addition to fibers and fabrics, Sorona® can be used in films, filaments, engineering thermoplastic components and materials.

SORONA® FOR APPAREL

Today's active consumers demand carefree clothing that can go from workplace to play space. In today's busy world that means clothing that is comfortable, attractive and, above all, easy to care for. Fabrics made with Sorona® renewably sourced polymer offer apparel designers and manufacturers unmatched design flexibility and versatility for garments that meet these demands.

SORONA® FOR CARPETS

Carpets made with Sorona® provide exceptional performance plus environmental benefits. SmartStrand™ with DuPont™ Sorona® renewably sourced polymer, a line of residential carpet from Mohawk Industries, combines permanent, natural stain resistance with superior durability and crush resistance. Made in part with renewable resources, Sorona® is one of the most revolutionary materials to hit the carpet industry in 20 years.

SORONA® IN AUTOMOTIVE APPLICATIONS

DuPont™ Sorona®, represents a breakthrough technology enabling renewably sourced materials to be used in automotive carpet, upholstery fabric and engineering parts. Fibers made with Sorona® provide a unique set of features, such as softness and stain resistance that open the door to bold new designs.

Sorona® in automotive carpet

The unique molecular structure of Sorona® allows carpet to provide both durability and permanent stain protection that won't wash or wear off so coffee and juice spills clean right up.

Sorona® also has lower moisture retention, allowing carpets to dry faster resulting in reduced chance for mold and mildew odors. This makes vehicles easier to clean and maintain for greater driver satisfaction.

Sorona® in automotive fabrics

The same stain resistance advantage Sorona® provides to carpets is also valued for seat upholstery, door pillars and headliners. In addition, automotive fabrics made with Sorona® have a luxurious feel, superior stretch and recovery, and increased durability along with fade resistance to keep automotive interiors looking new.

Sorona® in engineered plastic parts

In addition to good strength and stiffness, tests indicate that Sorona® provides improved surface appearance, lower warping and good dimensional stability, making it very attractive in a range of uses for automotive parts and components, electrical and electronics systems as well as industrial and consumer products.

(*) In the nineties DuPont collaborated with Genencor® for the development of 1,3-propanediol, a key monomer used for the production of Sorona®. In April 2005, Genencor International Inc was acquired by Danisco (DK). In Belgium Genencor has build strong relationships, for instance with the University of Ghent.

Du Pont de Nemours (Belgium) was founded in 1958 and employs more than 1300 people. Sites are located in Antwerp, Mechelen, Heusden Zolder, Brussels and Ieper. DuPont Mechelen is the largest manufacturing plant of DuPont in Belgium. It has four production units -- Performance Coatings, Performance Polymers, Vespel® parts and shapes, and Teflon® Finishes – as well as a European center for training, marketing & sales, research & development and sourcing & logistics. Mechelen is also the oldest DuPont site on the European continent and the second largest DuPont production site in the Europe, Middle East & Africa region.

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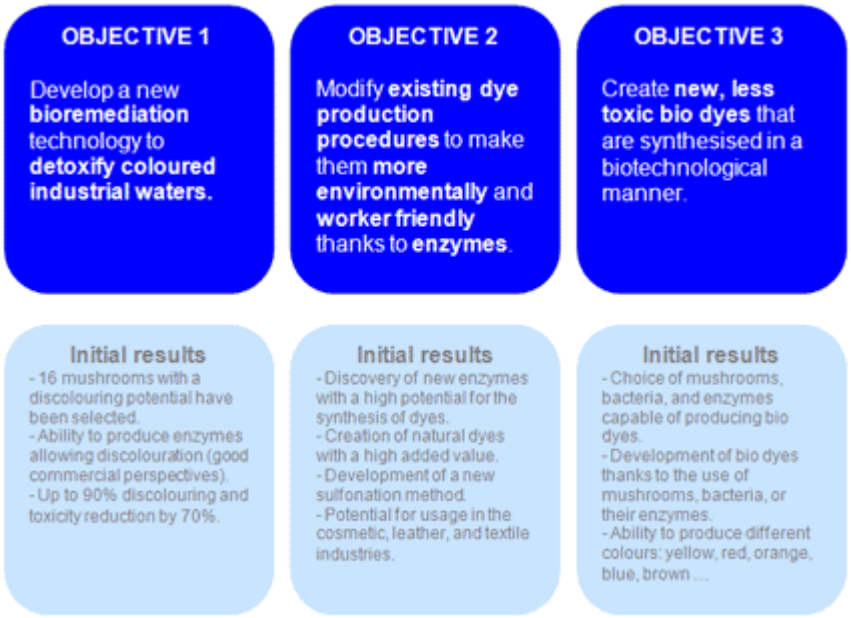
History

SOPHIED is a joint research and innovation initiative, led by the Catholic University of Louvain and has as an objective the development of new, durable bio procedures for the European colour industry.

To address the problems encountered by the colour industry (weak market competitiveness, lack of innovation, toxicity, environmental risks, and health risks for those working in the industry), SOPHIED groups and coordinates research, analysis and pilot testing at 7 universities, 3 research centers and 16 SMEs across Europe.



Background

Colour dyes are not something that often crop up in many people's list of environmental and health concerns. However, almost all of the clothes and fabric that surround us have been treated with colour dyes and many of us also use dyes to colour our hair.

Epidemiological evidence exists to indicate that regular and long term use of hair dyes for women can be associated with the development of bladder cancer, while during dyeing processes, up to 40 per cent of the dyes are not consumed by the substrate to which they are applied and they then find their ways into wastewaters and are flushed into the environment.

The traditional colour industry, until recently, was an important activity in Europe. It is now suffering from many relocations to developing countries, notably because of the costs encountered by the supplementary treatment required for better environmental protection and high labour costs. The new European legislation and directives are useful to protect the health of European citizens and the environment, but nevertheless lead to new industrial difficulties. The use of dyes creates a problem as much at the level of their production as at the level of the discharge of wastewaters. The Directive 2002/61/EC limits the use of dyes for colouring textiles, leather articles and all supplies containing textile.

Considering that the dye industry is weak in research and development, it appears to be clear that new regulations such as the REACH Programme (Registration, Evaluation, and Authorizations of Chemicals) considerably limit possibilities for the development of new dyes.

During the dry filling process, between 10 to 40% of dyes are not fixed onto the textile to which they are applied and end up in effluents discharged by industry. Therefore, they are found in the environment and constitute a risk for living organisms.

Several European directives currently attempt to minimise these risks but do not provide concrete, realistic treatment solutions for industries that create pollution. This is the same as far as the production of environmentally and worker friendly dyes are concerned. The SOPHIED project aims at finding innovative solutions to these problems.

Dye industry

Thanks to the production of dyes through more environmentally friendly processes, as well as through wastewater treatment, enzymes can help to reduce the potential environmental impact of dyes. Bioprocesses to produce biobased colorants have been developed and recently patented as an alternative to traditional chemical synthesis. While the creation of chemical-based dyes requires temperature up to 70-90°C in harsh conditions, the enzymatic synthesis of these colorants can be obtained at ambient temperature, under mild conditions. A life cycle analysis24 has shown that on an industrial scale, enzymatic processes could help to reduce CO2 emissions and toxicity towards the environment.

Enzymatic treatment of coloured wastewater was shown to cut toxicity towards human cells in half. A LCA25 showed that, as compared to classical chemical sludge, enzymes can reduce by 10 times the impact on global warming, reduce by a factor of 2 the impact on the ozone layer, reduce by a factor of 3 the impact on abiotic (non living components in the environment) depletion and decrease by a factor of 3 the impact on marine toxicity.

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History

The Flanders Institute for Biotechnology is a non-profit institute devoted to research in the life sciences. Around 1200 scientists engage in basic research on the molecular mechanisms that regulate the functions of the human body, plants and microorganisms. VIB is allied with four Flemish universities – UGent, K.U.Leuven, Universiteit Antwerpen and Vrije Universiteit Brussel – thus combining the strengths of 70 different research groups into a single institute. Its research aims at fundamentally moving the boundaries of our knowledge. VIB supports the conversion of research results into products for consumers and patients through its technology transfer activities. It furthermore develops and distributes a large range of science-based educational material about all aspects of biotechnology.

Since 1996, Prof. Wout Boerjan (Ghent University) has been head of the Bioenergy Research Group at the VIB Department of Plant System Biology, with Dirk Inzé being the department director. Boerjan has been a pioneer in the poplar research. There is enormous potential to improve plant cell walls by exploiting the available genetic resources and by genetic modification. This potential has remained largely unexplored. Boerjan was the first to demonstrate that it is possible to modify trees genetically so that they produce less lignin. This is of economic importance as the presence of lignin complicates the processing of wood for the production of, among other things, paper, bioethanol and other biomass-based materials. Limiting the amount of lignin facilitates the conversion of wood into bioethanol. It is now well recognized that burning fossil fuels and deforestation are major contributors to climate change, and that plant biomass can serve as an alternative renewable and carbon-neutral raw material for the production of bio-energy.
For this research, poplars are used as model systems.

In January 2010, Prof. Boerjan received recognition of his life's work being awarded the title of Forest Biotechnologist of the Year by the international Institute of Forest Biotechnology.

Poplar Field Research

Poplars are an interesting source for bio-ethanol. They grow fast, they need hardly any fertilizing and can grow on wet soils that are not qualified for agriculture. And because they get as much CO2 out of the air as they provide afterwards by burning, they are a sustainable source for biofuels. After one decennium of research, VIB researchers discovered that modified, lab-grown poplars that contain about 20% less lignin provide 50% more ethanol.

Progress of the research

The research started from a basic interest in the molecular mechanisms underlying the formation of wood. Wood consists of different polymers of which lignin is the most complicated one. Different groups contributed to mapping the biosynthesis route of lignin. The group of Boerjan then introduced a number of modifications with the aim of downregulating some of the key enzymes involved in this biosynthesis and subsequently studied the effects. It turned out that too much downregulation lead to serious negative side effects such as dwarfism. This supported the understanding that lignin performs a number of essential roles in the plant, that cannot be taken away. Trees with a limited downregulation of lignin biosynthesis, that showed limited or no growth retardation were subjected to further laboratory and greenhouse research. These trees turned out

to have interesting properties for applications in which lignin is a complicating factor, such as paper production and production of bio-ethanol. In later greenhouse research the wood of trees that contained 20% less lignin, proved to produce 50% more bio-ethanol than conventional poplar trees. The laboratory and greenhouse research were performed under strict contained conditions as required by the Flemish environmental legislation.

In a next phase, the research was taken outdoors. A small field trial was set up with the goal to verify whether trees grown under real life conditions (seasons, rain, wind, deep soil) would also produce wood that would be more easily converted into bio-ethanol. The start of the field trial was originally planned for 2008, but the Belgian Federal authorities in first instance refused a permit, even though the Belgian Biosafety Advisory Council had given a positive advice. This led to political outrage and parliamentary questions were asked on why this world class research was being hindered. VIB then filed a case at the Council of State which in December 2008 ruled in favour of VIB on all accounts and suspended the refusal of the permit. After some further negotiations VIB succeeded in securing a permit for the field trial in February 2009. The trial finally started in May 2009 with a delay of one year.

More information on the calvary that led to the approval of the field trial can be found on www.vib.be/poplar

Current laboratory research explores ways of altering the composition of lignin, and study its effects, without lowering the amount of lignin present.

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