



2016 InTechFibres activity and research projects portfolio

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InTechFibres Research Activity

- Objectives of the partnership
 - To increase the value chain of lignocellulosic materials through incremental or breakthrough innovations in processes, fibres, molecules, derivatives ... , taking into account production costs reductions, environmental impact limitation and sustainability of processes and products,
 - To understand the mechanisms involved in the studied or developed treatments and/or processes and/or products,
 - To facilitate the transfer of the research results to the industry
- Research projects are classified according to their potential applications
 - Green chemistry
 - Papers and boards
 - Wood industries (Building – Furniture)
 - Other applications

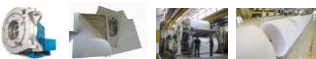


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Green chemistry

- Modelling of interactions between **cellulose microfibrils** in fibre walls **NamiMod**
- Genophytochemical variability for the management of potential forestry **sources of bio-molecules** **GenEcoChem**
- Conditions of integration for the valorization of **lignins** from black liquors in pulp mills **Iliqo**
- Valorization of fibres panelboards from **furniture elements wastes** **RecyFibres**
- Synthesis of new **bio-sourced copolymers** from hemicelluloses and fatty acids **Syncobio2**
- New biopolymer based on renewable synthons from catalytic de-oxygenation of **hemicelluloses** **Catbiose**
- **Microfibrillated cellulose** production by twin screw extrusion **Cerise**
- Development of qualitative tools for industrial **lignins** specific for their use and modification (PolyNat project) **Qualin**
- **Pickering** emulsions stabilised by nanoparticles from biomass **BioPick**



Papers and Boards

- **Reduction** of costs and environmental impact in the production of bleached chemical pulps **Ecokraft 2**
- Control of cooking through liquid analysis with NIRS **NIRS-Liq**
- Combination of lignocellulosic components **valorization** and chemical pulp fibres production **ExtraPulp**
- New virgin/recycled pulp manufacturing processes using **Deep Eutectic Solvents** **ProviDES**



Building and Furniture

• Functionalization of fibre/panelboards based on polysaccharides grafting	FuncPan
• Wood-based thermal insulation materials	Wotim
• Eco-conception of multifunctional composite materials based on wood fibres with optimised properties	EcomatFib
• Design of fireproofing bio-sourced formulations	Ignibois
• Durability conferred to wood by injection of extracted and modified lignins	DurLig
• Development of innovative techniques to confer colour to wood in surface	WoodColor
• Development of a tool to control the heat treatment of wood according to NIMP15 standard	NIMP15

Mettre images composites, énergie,
forest

Other Applications

• Extraction of hemicelluloses for the production of polyamide fibres	Polywood
• Mobile and Flexible Industrial Processing of Biomass	MobileFlip
• Research Infrastructure for circular forest bioeconomy	Erifore
• Microfibrillated cellulose as new bio-based material for designing bio-active soft tissue repair medical device	Celical

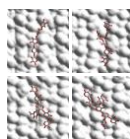
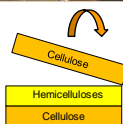
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Modelling of interactions between cellulose microfibrils in fibre walls (NamiMod)

2014-2016 – Valérie Meyer

• Objectives

- To decrease the energy consumption
- To develop an innovative test for measuring the adhesion between cellulose and hemicelluloses
- To simulate the fibre wall deconstruction at the atom level
- To determine the best pretreatment conditions for breaking the strongest linkages (specific enzymes)
- To validate at pilot scale these defined pretreatment conditions



• Value created for the industry

- Decrease in energy consumption by 20% (2000 kWh/t)
- Increase in MFC suspension dry matter content up to 5%
- Enhancement of the process efficiency

Genophytochemical variability for the management of potential forestry sources of bio-molecules (GenEcoChem)

2014-2017 Luc Harvengt & Denilson da Silva Perez

• Objectives

- To describe the variability of reference wood species (maritime pine and eucalyptus sp.)
- To measure the phytochemical diversity levels of the plant (breeding populations and varieties)
- To acquire performance data of tools and methods for the chemical analyses
- To define the potential sources of bio-molecules in the Aquitaine region and their probable evolution



• Value created for the industry

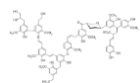
- Evaluation of the potential of molecules to be valorised from two wood species
- Cartography of wood molecules in a tree

Conditions of integration for the valorization of lignins from black liquors in pulp mills (Iliquo)

2015-2017 Frédérique Bertaud – Sandra Tapin-Lingua

• Objectives

- To establish the technical and economic conditions of a lignin production line integrated in a pulp mill (industrial simulated scenarios, process optimisations)
- To evaluate the variability of the lignins quality and quantity depending on the mills (raw materials, processes)
- To identify promising lignin's applications
- To define lignins specifications according to their use (ID Sheet)



• Value created for the industry

- Additional income for the pulp mills by the production of a new product
- Increase in pulp production capacity, due to the partial black liquor extraction
- Use of lignin into the lime kiln instead of fossil resources

Valorisation of fibreboards from furniture elements wastes (RecyFibres)

2015-2017 – Denilson Da Silva Perez - Michael Lecourt - Auphélia Burnet

• Objectives

- To improve fibreboard recyclability for uses in manufactured products
- To identify methods for fibreboards defibering
- To evaluate the potential of producing fibres for papers/boards and insulation products from these recovered materials



• Value created for the industry

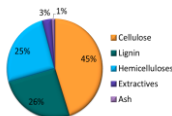
- Evaluation of fibres quantity available from recycled furniture elements wastes
- New source of lignocellulosic fibres for chemical pulp or insulation board production
- Reduction of raw material costs
- Sustainable development

Chemical valorisation of lignins: towards fine chemicals and polymers (Syncbio2)

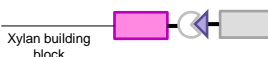
2015-2016 – Denilson da Silva Perez

• Objectives

- To develop original and innovatives pathways to improve the extraction, preparation and purification of hemicelluloses, oligosaccharides and fatty acids
- To design, optimise and scale-up the conditions of synthesis of new biosourced amphiphilic conjugate from hemicelluloses oligosaccharides (particularly from xylans) and fatty acids
- To study the physico-chemical properties of conjugated systems and the applications of these hybrid materials in different sectors



Coupling
« Click Chemistry »



• Value created for the industry

- Opening of new markets to pulp mills
- Upgrading of a co-product
- Creating new products for different markets, including wood, fibres and papers

New biopolymer based on renewable synthons from catalytic de-oxygenation of hemicelluloses (Catbiose)

2016-2018 Denilson da Silva Perez

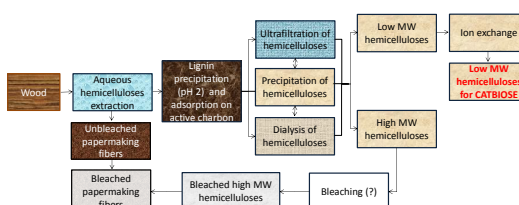
Objectives

- To extract hemicelluloses at high yield while preserving the quality of kraft pulp
- To fractionate efficiently in a hemicelluloses-rich high-purity and colorless fractions at reasonable costs
- To control and optimize the synthesis of polyesters and non-iso-cyanate polyurethanes from the obtained polyols and di-acids with physicochemical characteristics comparable to commercial products
- To scale-up all the process steps



Value created for the industry

- Opening of new markets to pulp mills
- Upgrading of a co-product
- Generating bio-based resources for plastics production



Microfibrillated cellulose production by twin screw extrusion (Cerise)

2016-2018 – Valérie Meyer

Objectives

- To develop a new « green » pretreatments in order to weaken the internal cohesion of lignocellulosic fibres, thus facilitating the liberation of cellulose microfibrils
- To use twin-screw extrusion for a microfibrillation process at high consistency in a continuous system requiring low energy consumption
- To increase the value of MFC through new materials made of 100% of cellulose



Value created for the industry

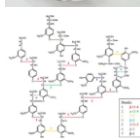
- Important energy savings during MFC production compared to high pressure homogenisation (from 5 to 1 MWh/t)
- Possibility to develop in-situ reactive extrusion strategies (more simple process)
- To make available, MFC at high solid content easily transportable and usable after mixing with various matrix

Development of qualitative tools for industrial lignins specific for their use and modification(QuaLin)

2016-2018 – Frédérique Bertaud

• Objectives

- To develop a panel of simple, accurate and robust analytical tools dedicated to the characterisation of lignins
- To measure the sulfonation degree of lignins
- To determine the molar mass distribution of lignins
- to measure the hydroxyl groups in lignin, indicators of their reactivity



• Value created for the industry

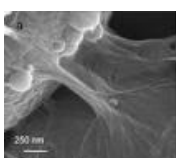
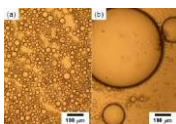
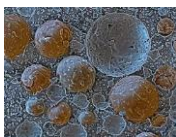
- Better knowledge of the lignin produced by pulp mills
- Valorisation of lignins in different industrial sectors and products

Pickering emulsions stabilised by nanoparticles from biomass (BioPick)

2015-2016 Denilson da Silva Perez

• Objectives

- To valorise unexploited biomass resources to produce very stable emulsions
- To produce a wide range of natural particles to be used in emulsions
- To control the size of the droplets inside the emulsions
- To develop inverse emulsions in which active principles are encapsulated and can be liberated, due to their low stability



• Value created for the industry

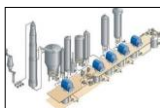
- New ways to valorise the biomass resources, especially fibres and microfibrillated cellulose for cosmetics and pharmaceuticals

Reduction of costs and environmental impact in the production of bleached chemical pulps (EcoKraft 2)

2012-2016 – Auphelia Burnet

• Objectives

- To optimise the conditions of the bleaching stages in order to reduce their number, to save energy, water, chemicals and production time.
- To develop a new efficient alkaline chlorine dioxide stage
- To substitute sodium hydroxide by new alkali sources to decrease the environmental impact, the cellulose degradation and scaling problems.



• Value created for the industry

- Reduction of environmental problems (COD, recalcitrant COD, ...): > 20%
- Decrease in production costs: > 10%
- Increase in production capacity: +5%



Control of cooking through liquid analysis with NIRS (NIRS-Liq)

2016-2018 – Denilson da Silva Perez

• Objectives

- To study the feasibility of predicting the chemical composition of cooking liquors by the way of near infra-red spectroscopy (NIRS).
- To develop fast and reliable method for analyzing the conversion of wood into pulp in the kraft process.
- To evaluate the possibility to use NIRS for analyzing on-line the cooking liquors.



• Value created for the industry

- Better use of wooden raw materials in a context of wood shortage
- Better control of pulping processes
- Increase the efficiency of cooking to save chemicals: 10%
- Decrease in production costs: 10%
- Decrease in scaling problems



Combination of lignocellulosic components valorization and chemical pulp fibres production(ExtraPulp)

2016-2018 Auphélia Burnet – Michael Lecourt

• Objectives

- To extract molecules (hemicelluloses, lignin, extractives) by multistage process of wood chips in combination with production of fibres or cellulose of an equivalent quality or with enhanced properties,
- To adapt the process of production of fibres or cellulose to the new raw material
- To valorise the effluents of the process,
- To determine the functionalities of the fibres for applications in paper/board, chemistry or MFC.



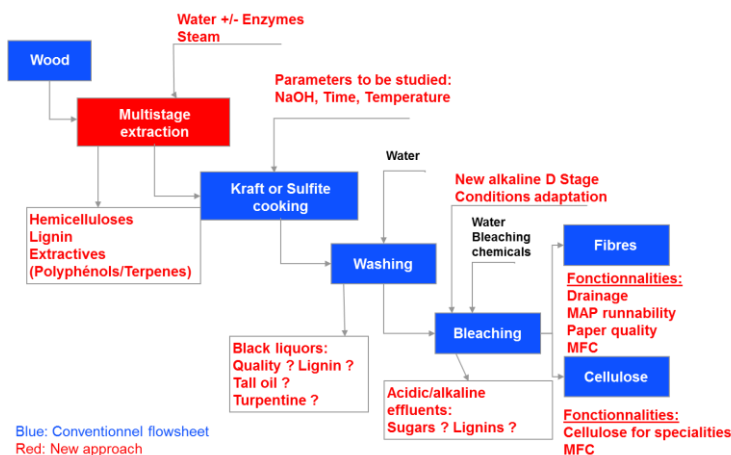
• Value created for the industry

- Increase in profit of chemical pulp mills with the production of molecules of interest.
- Diversification towards new markets.
- Increased valorisation of wood molecules, more particularly in the process effluents.
- Production of reactive fibres or cellulose presenting different functions.
- Increase in production capacity by the way of an optimised process combined with molecules extraction, for various usages.



Combination of lignocellulosic components valorization and chemical pulp fibres production(ExtraPulp)

2016-2018 Auphélia Burnet – Michael Lecourt



Combination of lignocellulosic components valorization and chemical pulp fibres production (ProviDES)

2016-2018 Mohammed Krouit

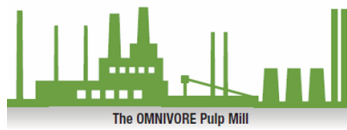
• Objectives

- Develop radically new, sustainable and techno-economically feasible technologies for pulping with
 - lignin dissolving DES
 - cellulose dissolving DES
 - removing contaminants with DES



• Value created for the industry

- Reaching 80% CO₂ reduction in a pulp mill
- Reducing by at least 40% in process energy intensity compared to conventional pulping processes
- Reducing by 50% of investment costs compared to current pulping installations



The OMNIVORE Pulp Mill

Functionalisation of fibres/panelboards based on polysaccharides grafting (FuncPan)

2014-2017 – Michael Lecourt

• Objectives

- To develop a system based on functionalised polysaccharides as a pre-coat to level off the panelboard dimensional variations
- To graft on this pre-coat different molecules or polymers in order to confer to the panelboard new properties for furniture applications



• Value created for the industry

- New market for polysaccharides
- Panels for furniture with new properties

• Objectives

- To create new high volume and high added value applications to wood-based materials by developing cellulosic thermal insulation materials
- To develop a high performance wood-based cellulosic thermal insulation material by foam forming to replace the oil-based insulation materials



• Value created for the industry

- New application for wood fibres
- To evaluate the applicability of the new materials on buildings and benchmark them to conventional building insulation products
- To enhance the recyclability possibilities of thermal insulation materials

• Objectives

- To eco-define an innovative and optimised composite based on natural fibres
- To optimise performances of composites based on fibres for insulation applications
- Determine relationship between process conditions and insulation material properties



• Value created for the industry

- Improved performance of insulation materials based on natural fibres
- To create added value to insulation materials through multi-objectives optimisation

• Objectives

- To select relevant formulations techniques based on technical specifications (formulated products, chemical grafting on fibres, addition of co-polymers)
- To develop bio-based products allowing flame retardancy (inorganic compounds, nano-clay, clays nano-particles, nitrogen compounds, phosphorus-based)
- To develop formulations allowing grafting the fibres surface to promote fireproofing properties
- To qualify flame retardant properties of materials treated with these formulations



• Value created for the industry

- New ways to use wood fibres for fire retardant products
- Fibres with new properties through functionalisation

• Objectives

- To develop original and innovative methods for preparing, functionalising and re-introducing lignin derivatives to increase wood durability
- To study the transmitted durability from laboratory to real scales
- To develop technical solutions for wood uses with a short duration (pallets) or a long duration (building), taking into account the end of life of the products
- To study the fixation and time stability of lignin derivatives after re-introduction in the wood as protecting agents



• Value created for the industry

- New way of valorisation of lignin extracted from black liquors
- Wood products with a longer durability with a bio-sourced solution

Development of innovative techniques to confer colour to wood in surface (WoodColor) 2015 – 2017 Céline Reynaud - Sandra Tapin-Lingua

• Objectives

- To develop chemical and enzymatic treatments able to modify the color of solid wood surface by oxidizing organic compounds responsible of graying wood
- To generate a stable color on wood surface against UV/water (decorative wood surfaces)
- To transfer of existing methods from the pulp industry to the wood industry
- To develop biotechnological treatments applied on solid wood



• Value created for the industry

- Wood products for already exterior aesthetic aspects (cladding)
- Innovation in technical ways to give new colors to the wood for a stable color exposed to different cardinal points
- More environmentally wood accelerated ageing techniques

Development of a tool to control the heat treatment of wood according to NIMP15 standard (NIMP15)

2015-2016 Denilson da Silva Perez

• Objectives

- To develop and design a tool based on near-IR spectroscopy (NIRS) to control the heat treatment of a wood product
- To determine also the wood species used in the wood product



• Value created for the industry

- New methods for the wood industries to detect if wood products were heat-treated
- Standardisation of the method

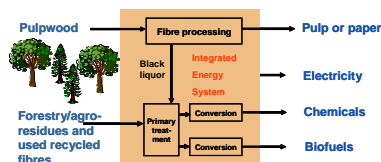
• Objectives

- To extract glucomannans (hemicelluloses) from the wood before chemical kraft pulping
- To use the C6 sugars as precursors of bio-sourced monomers of diacids and diamines
- To synthesise by polycondensation of these new monomers in one or several polyamide grades



• Value created for the industry

- Opening of new markets to pulp mills
- Upgrading of a co-product



• Objectives

- To down-scale and adjust different technologies (pre-treatment, hydrothermal treatment and saccharification, hydrothermal carbonization, torrefaction, slow pyrolysis, pelletizing and briquetting) to a mobile unit with different biomasses
- To develop a technical solution for the mobile unit and to build at least one demonstration unit
- To evaluate the feasibility of the potential mobile units
- To generate business plans for commercializing the mobile unit



• Value created for the industry

- New ways of valorisation of lignocellulosic biomasses
- Reduction of transportation costs

• Objectives

- To coordinate, complement and update major European research infrastructure to enable and unlock the full potential of available forest biomass in balance with diverse use of forests
- To develop enabling technologies for new value added products from forest biomass which can be utilised by European industry
- To enhance utilisation of renewable raw materials and renewal of established European process industry in particular at forest, chemical, biotechnical and energy sectors



• Value created for the industry

- Conceptual design and plan for cooperation arrangements between the main European RTD providers
- Upgraded bioeconomy competence base by providing contact interface for facilities for education and training



• Objectives

- To develop a novel class of biomaterial substrate device, based on microfibrillated cellulose, with controlled release of active molecules for improving soft tissue repair
- To offer clear and expected solutions for addressing remaining clinical needs, such as infection, pain and recurrence



• Value created for the industry

- New high added value and fast growing market for MFC in the soft tissue repair market (over € 2.5 billion in 2012)

