OUR SOLUTIONS

BIO-BASED CHEMISTRY
OUR SOLUTIONS

IFPEN is working on the development of new processes, catalysts and biocatalysts for the transformation of lignocellulosic biomass into major bio-based chemical intermediates, which are more environmentally-friendly than the same fossil-based products and address the growing need to reduce industrial greenhouse gas emissions while offering a diversification of supply sources.

Summary:

OLEFIN PRODUCTION FROM BIO-ALCOHOLS

In partnership with TotalEnergies and Axens, IFPEN has developed a process and a catalyst for the production of bio-based olefins: **Atol®** is an original and competitive technology that makes it possible to produce bioethylene via the dehydration of renewable ethanol from the fermentation of non-food lignocellulosic biomass. The bioethylene produced can be directly integrated in existing polymerization units, for the production of polyethylene, polystyrene, PET and polyvinyl chloride. Optimized in terms of energy efficiency and with an excellent performance in terms of activity and ethylene selectivity, Atol®, marketed by Axens, is considered to be the most advanced and most profitable dehydration technology available on the market, with reduced investment and operating costs. Moreover, at the beginning of 2021 it was chosen by Sumitomo Chemical for a circular

economy deployment project in Japan. It will convert ethanol, produced from household waste, into polymer-grade ethylene that will then be converted in Sumitomo Chemical's facilities into polyethylene, a key product for the manufacture of numerous bio-based plastic items.

In addition, IFPEN is conducting research aimed at developing processes to **convert sugars into bio-based intermediate molecules** for the manufacture of polymers and other bio-based products.

BIO-BUTADIENE PRODUCTION

The **BioButterfly project** is aimed at developing a **butadiene production process using fermented ethanol** of plant origin. **Supported by Ademe, the project brings together Axens, IFPEN and Michelin** and is being conducted as part of a strategy to create a French bio-based synthetic rubber sector for the manufacture of tires.

Thanks to biomass from plant residues (wood, rice husks, leaves and cornstalks), Michelin estimates that 4.2 million metric tons of wood chips could be incorporated in their tires each year. Watch a video explaining Michelin's recipe to design fully sustainable tires by 2050.

> *"The BioButterfly project covers all the research and development steps for a butadiene production process, from fundamental scientific concepts through to validation on an industrial simulator of the various catalysis and separation operations. We conducted the first experiments on pilot units installed at the IFPEN Lyon site in 2017. The experimental data acquired confirmed the* ***economic and environmental performance of the process*** *compared to the fossil option. Research has continued with the definition of an extrapolation pilot unit, the construction of which started at the beginning of 2020 with tests set to begin in 2022. This pre-industrial demonstrator will be used to validate the operation of the process and the quality of the butadiene produced.."*
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> ***Ludovic RAYNAL, Project manager, IFPEN***

700 catalysts tested during high-throughput experimentation and 300 catalytic tests conducted on pilot unit.

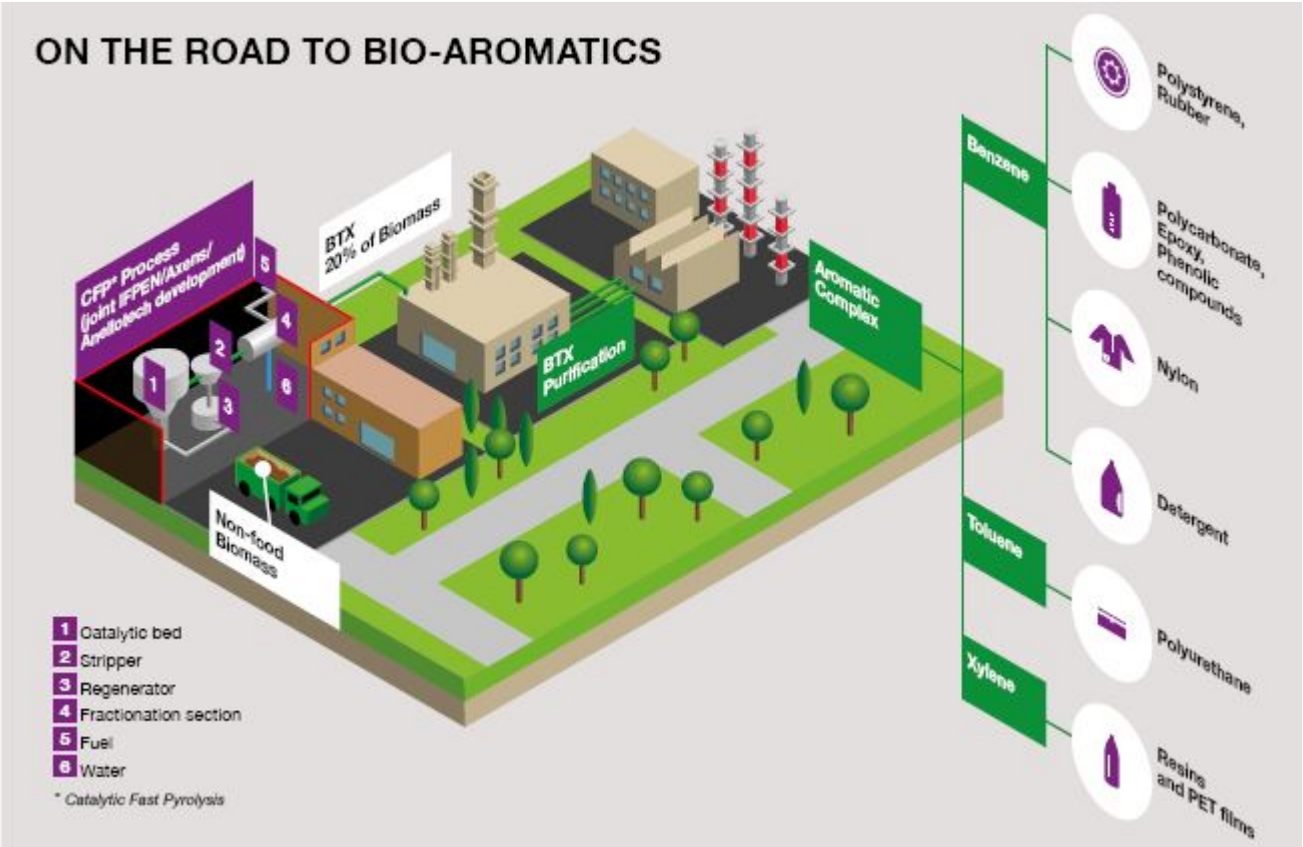
BIO-AROMATICS PRODUCTION

In 2015, **IFPEN and Axens joined forces with American company Anellotech** to develop **Bio-TCat, a bio-aromatic production technology** (BTX for benzene, toluene and xylene) based on renewable raw materials. By combining Anellotech's process for the thermocatalytic conversion of non-food lignocellulosic biomass with Axens' hydrotreatment process, the objective is to achieve 100% bio-based BTX in few steps, while minimizing costs, energy consumption and CO2 emissions. These bio-aromatics will find numerous applications, particularly in polyesters for bottles and textile fibers. Bio-TCat will also enable the production of a very high-quality gasoline base.

The TCat-8® pilot unit installed at Anellotech's site in Silsbee (Texas) has been operating since 2017 with a view to demonstrating the technological and economic viability of thermocatalytic conversion. Operated with the support of IFPEN personnel present on the pilot site, the TCat-8® unit has recorded a cumulative total of more than 5,000 hours of bio-BTX production.

In February 2019 Anellotech, IFPEN and Axens announced they had successfully produced bio-based aromatics.

Next step: the purification of larger quantities of paraxylene for the manufacture of renewable PET bottle prototypes. Once the development phase has been completed, the industrialization and marketing of Bio-TCat™ technology will be handled by Axens.



BIO-BASED ALCOHOL PRODUCTION

In addition to ethanol production from non-food lignocellulosic biomass using the Futurol™ process recently marketed by Axens, IFPEN is conducting research to develop **biotechnological processes for the production of bio-based propanol and butanol**. A stable microorganism has been developed and an innovative implementation approach tested on a 100-liter scale. R&I work is continuing to optimize the various building blocks of the process with a view to creating a process that can be taken to market.

BIO-ACRYLIC ACID PRODUCTION

IFPEN, Cargill and Axens joined forces to launch a project for the development and industrial scale-up of a catalyst and process for the conversion of a lactic acid into a bio-based acrylic acid of plant and renewable origin. This conversion process resulted from a technology developed in the laboratory by Procter & Gamble eand for which Cargill obtained an exclusive license at the beginning of 2020. The use of bio-based acrylic acid, a raw material that is contained in numerous everyday products such as acrylic glass, adhesives and super-absorbent polymers, will contribute to the development of the bioeconomy and lead to a reduction in greenhouse gas emissions of more than 50%.

> *« The catalyst and process we are going to develop with our partners are based on a conversion technology that has already been tested in the laboratory. However, a number of significant challenges still need to be overcome prior to industrial scale-up. Each partner will have a decisive role to play: Cargill will contribute its experience in the field of bio-based materials, IFPEN will focus on the development of the catalyst and the conversion process required for the large-scale conversion of lactic acid into bio-based acrylic acid and Axens will facilitate industrial scale-up in line with existing environmental standards. »*
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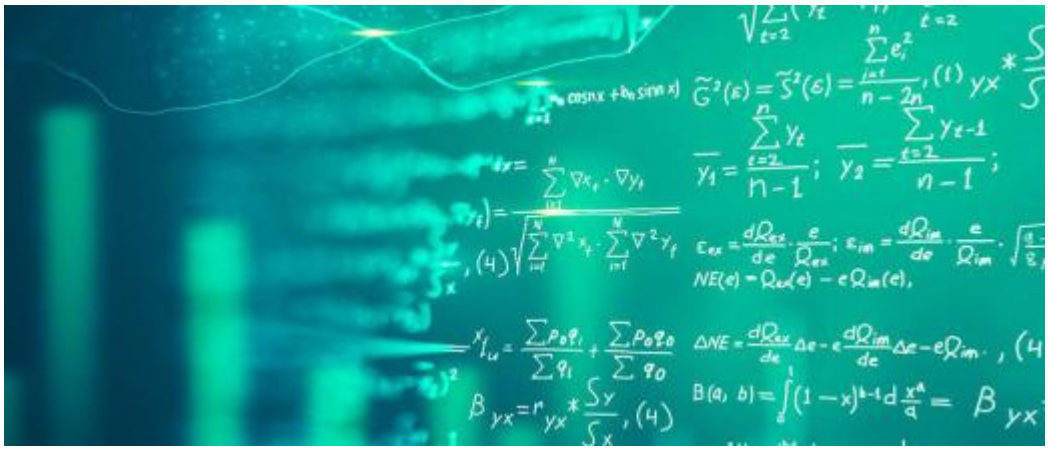
> ***Vincent Coupard, Project manager, IFPEN***

CONTACT

Abdelhakim Koudil

Program manager: "Conversion of residues and heavy crudes", "Biomass to chemicals" and "Gas treatment and conversion"

abdelhakim.koudil@ifpen.fr



Fundamental Research

News November 2021

Rémi Hocq, a former IFPEN PhD student, receives a 3rd award for his research work

Renewable energies **Bio-based chemistry**

Innovation and Industry

News December 2020

Cargill, IFPEN and Axens collaborate to advance lactic-to-acrylic-acid technology

Press release

Innovation and Industry

News May 2019

Bio-TCat™ technology viability confirmed during extensive Anellotech pilot plant campaign

Press release

Renewable energies Bio-based chemistry

Innovation and Industry

News February 2019

Bio-paraxylene production: on the path to 100% bio-based bottles

Press release

Climate, environment and circular economy | Plastics recycling | Renewable energies | Biofuels

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