

# URBIOFIN

NEWSLETTER NO. 6

## THE PROJECT

***Demonstration of an integrated innovative biorefinery for the transformation of municipal solid waste (MSW) into new biobased products.***

Each person in Europe generates an average of 500 kg of MSW per year. Around 50% of this waste is composed of organic matter, made up of carbohydrates, proteins and lipids, all of which represent useful raw materials to synthesize value added products. However, to date this potential has not been fully exploited. Therefore, the URBIOFIN project aims to demonstrate the techno-economic and environmental viability of converting the organic fraction of MSW into bio-based chemicals such as building blocks, biopolymers and additives.

## OUR ACHIEVEMENTS SO FAR

During the last months, as in almost all sectors, the COVID-19 health crisis impacted the activities of the URBIOFIN project. Fortunately, the works especially in the 3 involved pilot plants could restart in May-June.

On 16<sup>th</sup> June 2020 the first URBIOFIN International workshop was organised as a virtual workshop. 65 participants attended the workshop showing a great interest in the project asking interesting questions. The 6<sup>th</sup> General Meeting was also held virtually on 27<sup>th</sup> July 2020 where the accomplishments of the last project months were presented and the ongoing and upcoming activities for the next 6 months period discussed.



First slide of the 1<sup>st</sup> URBIOFIN virtual workshop

The achievements per Work Package (WP2-WP8) are briefly described below:

## WP2 - CONVERSION OF OFMSW TO BIOETHANOL AS BUILDING BLOCK FOR THE PRODUCTION OF BIO-ETHYLENE

CSIC's bio-ethylene module tendering process has been finally awarded. Currently the supplier and CSIC finalised the engineering design. The new module installation and

start-up is foreseen by start mid-October 2020 at IMECAL's facilities.

IRIS has made studies to determine relevant online variables measurement of IMECAL's process with scale up samples. The finalization of the modelling for the fermentation and distillation stages is in progress, so the installation of the sensors will be realized soon.

In the coming months, it is expected to continue the demo trials at IMECAL with the biowaste from URBASER's waste treatment plant.

In the meanwhile, NOVOZYMES, CIEMAT and IMECAL will continue working in the optimisation trials with new enzymes combos.

## WP3 - CONVERSION OF OFMSW TO VFAS (VOLATILE FATTY ACIDS) FOR THE PRODUCTION OF PHAS

At URBASER the local warm start-up of the dehydration system was performed in the beginning of July with digestate from the hydrolytic digester. 91.1% of total solid removal was achieved.

Regarding the scl- and mcl-PHA production, CLAMBER is keeping on testing the mixed-culture in the 3L fermenter. For the pure-culture, WUR sent an updated version of mcl-PHA fermentation protocol at the beginning of July and CLAMBER has requested optimized amounts of antifoam.

Concerning the scl- and mcl-PHA extraction, various, more benign, solvents were compared for the efficiency of PHA extraction from bacterial biomass, both for scl-PHA produced by AINIA and mcl-PHA produced by WUR.

AINIA continues working on the cost-effectiveness of mixed-culture PHA production using synthetic VFA feeding. To this aim, the effect of OLR has been investigated under two operational conditions. Also, CLAMBER is still studying the processes using green solvents and valuing the necessary equipment.

## WP4 - BIOGAS BIOCONVERSION TO BIOMETHANE AND ADDED VALUE PRODUCTS

UVA researchers were teleworking full time and in contact with the engineering company EMATEC for polishing the final details on the engineering process and the equipment selection for the construction of the pilot plants. With the equipment shipped by EMATEC, the final layout installation of the plants for biogas upgrading into biomethane and the PHA production from biogas were done. End June 2020 the construction started with the download of the bioreactors, storage tanks pump and compressors.



*Finished construction of the pilot plants for biogas upgrading in Zaragoza*

So far, all the equipment has been located according to the previous layout defined. The pipe-line installation for liquid and gas streams are completed. The end of the pilot plants assembly, including all the electrical connections and control loops is done. Hydraulic and pressure tests for all the equipment with water and air will be conducted in September.

The High Rate Algal Pond was filled with water. A microalgae-bacteria consortium has been identified in the photobioreactor without previous inoculation.

The preparation of the methanotrophic bacterial inoculum capable of producing PHA has restarted after the COVID-19 crisis. Inoculum will be sent to URBASER plant when the hydraulic tests are finished.

Regarding the planning of the monitoring of the pilot plants performance, a schedule of experiments and sampling has been defined to establish future requirements of URBASER laboratory equipment. The construction is now finished, and the system will be hydraulically tested to start-up the plants in mid-August.

In recent months AINIA has continued optimizing the enzymatic hydrolysis of microalgae biomass. To this end, the percentage of hydrolysis and the concentration of free amino acids have been determined at different working conditions.

On the other hand, the enzymatic hydrolysis of the algae biomass has been scaled up to 40L and both the percentage of hydrolysis and the final concentration of amino acids will be determined in the upcoming weeks. This hydrolysate is frozen and ready to be sent to BPE to carry out the agricultural validation of its fertilizing capacity.

After re-opened laboratories at UVA, the lab-scale continuous tests conducted for process optimization were restarted. The influence of the trickling liquid velocity and

the internal gas recycling on siloxanes removal is being studied under both aerobic and anoxic conditions in a two-phase partitioning biotrickling filters (BTF). To date, the total siloxanes removal efficiency (RE) has increased from 48%, operating at a trickling liquid velocity of 2 m/h, to 56% at 10 m/h under anoxic conditions and from 40% to 50% under aerobic conditions.

A pilot biotrickling filter from UVA will be retrofitted into a two-phase biotrickling filter at URBASER facilities.

#### WP5 - FINAL APPLICATIONS AND INDUSTRIAL VALIDATION OF THE BIOBASED PRODUCTS DEVELOPED

At AINIA preliminary validation trials of cosmetic packaging started.

BPE started preliminary formulation and extrusion activities. Moreover, NATUREPLAST sent two different formulations to LEYGATECH using commercial PHA for extrusion tests.

For the production of granulated biofertilizers from the solid fraction of digestate, to optimise the granulation, preliminary granulation tests have been performed in the spouted bed dryer using a similar substrate. These tests will continue. URBASER has installed recently a solid-liquid separation system in their facilities and observed that the presence of undesirable plastics scraps has been reduced significantly. The solid fraction of digestate will be available when steady state conditions of the methanogenic reactor will be reached, at the end of 2020.

AINIA has already hydrolysed the microalgae and obtained the amount of liquid extract required to carry out the validation essays, which is stored and ready to be assessed as biostimulant in the next agronomic season.

WUR has performed PHA accumulation and extraction experiments at lab scale. URBASER will start to send VFAs to CLAMBER soon.

CLAMBER has estimated that mcl-PHA will be available in April-May 2021.

CSIC plans to start the bio-ethylene production in October 2020. The assessment of this bio-based product will take place afterwards on citric during the orange season and in banana during the beginning of 2022.

#### WP6 – INTEGRATION OF THE URBAN BIOREFINERY. ECONOMIC, ENVIRONMENTAL AND REGULATORY ASSESSMENTS

After taking over EXERGY's part in WP6, AINIA thoroughly reviewed the provided information, undertaking an analysis of the status and level of completion of each task, including a detailed check review of the process flow diagrams and initial mass balances. AINIA is now

updating the information to obtain a final and fixed PFD of the integrated biorefinery with all process flows and equipment correctly integrated.

BPE has reviewed and identified directives and national regulations that apply to the project and described the recent introduction of relevant legislation such as EU Directive on sludge, EU Directive on renewables, national regulation on residues and landfill etc.

The techno-economic analysis (TEA) will consider the potential markets for each bioproduct and how these might affect their value and viability, the regulatory framework will be taken into account to understand and define these markets.

#### WP 7 – COMMUNICATION, DISSEMINATION AND EXPLOITATION ACTIVITIES

Early this year CIEMAT presented the project in “Sustainable Bioeconomy: An overview of the future societies” in Madrid, and to Master students of the University of Jaén and Madrid. Also, IMECAL presented the project at the event “Jornada sobre biocarburantes en España” hosted by CIEMAT in Madrid.

The first URBIOFIN workshop specially addressed to Waste Management entities and related stakeholders was held virtually on 16<sup>th</sup> June 2020. External experts from the European Commission and LIPOR (Portugal) provided the latest news on the waste related EU initiatives as well as current waste management models around Europe. The [PPT](#) and the video of the whole virtual workshop are now available on the [URBIOFIN website](#) and [YouTube](#).

Furthermore, the [1<sup>st</sup> Factsheet](#) for stakeholders, particularly for municipalities and waste management companies, has been published and is available in our website.

During this period several scientific papers have been published.

#### WP8 – PROJECT MANAGEMENT

SES, EXERGY and VISUM left the URBIOFIN project as project members. We welcome [LEYGATECH S.A.S](#) and [IRIS TECHNOLOGY SOLUTIONS SL](#) as new project partners.

Due to the COVID-19 health crisis an extension based on Force Majeur was requested to the BBI-JU and approved.

#### PUBLICATIONS

*Polyhydroxyalkanoates (PHA) production from biogas in waste treatment facilities: Assessing the potential impacts on economy, environment and society*

V. Pérez, C. R. Mota, R. Muñoz, R. Lebrero  
Chemosphere, Volume 255, September 2020  
DOI: <https://doi.org/10.1016/j.chemosphere.2020.126929>

*Comparative evaluation of biogas valorization into electricity/heat and polyhydroxyalkanoates in waste treatment plants: Assessing the influence of local commodity prices and current biotechnological limitations*

V. Pérez, R. Lebrero, R. Muñoz  
ACS Sustainable Chemistry & Engineering, ACS Sustainable Chem. Eng., Volume 8, May 2020  
DOI: <https://doi.org/10.1021/acssuschemeng.0c01543>

*Comparative assessment of two biotrickling filters for siloxanes removal: Effect of the addition of an organic phase*

C. Pascual, S. Cantera, R. Muñoz, R. Lebrero  
Chemosphere, Volume 251, July 2020  
DOI: <https://doi.org/10.1016/j.chemosphere.2020.126359>

*Waste Biorefinery. Integrating Biorefineries for Waste Valorisation*

V. Pérez, A. Pascual, C. Coll Lozano, et al  
Elsevier, 2020  
Paperback ISBN: 9780128182284, eBook ISBN: 9780128182291

#### MEET URBIOFIN

Are you interested to meet our partners? The next international event where to learn more about the project is:

15th European Bioplastics Conference  
on 1 – 2 December 2020, Vienna | Austria,  
<https://www.european-bioplastics.org/events/eubp-conference/>

Please feel free to contact the coordinator for more information: [caterina@imecal.com](mailto:caterina@imecal.com)

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PROJECT PARTNERS

