

4th Newsletter

FEBRUARY 2023

Biorefinery Concept Installation Progress

Thermal pretreatment unit - Dryer

Installation of organic waste dryer using biomass as fuel that serve for stabilizing the feedstock inhibiting biodegradation and enabling storage. Also, it helps opening up biomass fibers and making them more accessible for subsequent processes.



Preparation

Selection and preparation of the field for the unit to be installed.



Oil extraction unit

Installation of prototype unit for extraction of oils from biowaste. A liquid extraction method will be adopted

Ethanol bioconversion system

Installation of the bioreactor of the ethanol bioconversion system where bioethanol will be produced from biowaste after enzymatic hydrolysis and fermentation.



Anaerobic digestion plant

Installation of an anaerobic digestion system to treat the residues from the previous steps.

Thermal pretreatment unit - Dryer

Installation of a rotary drum waste dryer using biomass as fuel. The dimensions of the dryer are 0,95 m diameter and 6,00 m length. 1 tonne per day of feedstock can be processed under optimum conditions after 4-5 hours. The output materials have 6% - 8% moisture. This process is important for two reasons:



- Stabilizing the feedstock inhibiting biodegradation and enabling long period storage.
- Destroying the compact structure of biomass fibers and making them more accessible for subsequent processes.

Biorefinery Concept Installation Progress

Oil extraction unit

The prototype unit for extraction of oils from biowaste is ready to run through a liquid extraction method using hexane as organic solvent. The main components of the unit are the extractor where extraction of oils will take place and the distillation tank where hexane will be separated from oils. The collected oils will be converted to biodiesel by our partners.



Ethanol bioconversion system

The installed bioreactor will be utilized for the production of bioethanol from biowaste via enzymatic hydrolysis and fermentation. The volume of the bioreactor is 2 m³ and the feedstock planned to be processed per batch is about 200 to 300 kg. The process of simultaneous saccharification and fermentation (SSF) will be the main pathway that will take place in the bioconversion system. In the same tank the distillation of the produced ethanol will also take place. The collected bioethanol will be tested and evaluated for biofuel applications according to relevant specifications.



Anaerobic digestion plant

The anaerobic digestion (AD) system is almost in full operation. It includes a plug flow reactor (PFR) of 5 m³ active volume with an horizontal agitation – mixing system. In this system, all the residues from the previous steps will be treated in order to produce biogas. The system is energy autonomous as it uses part of the produced biogas for the heating requirements of the PFR keeping temperature at a mesophilic range. The rest of the biogas will be collected and will be utilized in different pathways. For all the sub-systems, start-up trials have initiated.



Communication and dissemination actions

Presentations

- Dr Dimitris Malamis presented LIFE CIRCforBIO project at the 9th INTERNATIONAL CONFERENCE ON SUSTAINABLE SOLID WASTE MANAGEMENT, CORFU2022, held in Corfu between 15th and 17th of June 2022.
- Dr. David Bolzonella (UNIVR) presented LIFE CIRCforBIO project at the 7th INTERNATIONAL CONFERENCE ON INDUSTRIAL BIOTECHNOLOGY (IBIC), which was held in Naples between 5-8 June 2022.
- F. Battista, D. Bolzonella, presentation on Chain elongation for medium chain fatty acids production, at GRICU 2022, National Conference, between 3-9 July 2022. Ischia, Italy referred to experimental data of LIFE CIRCforBIO.
- Felekis V., Stavraki C., Malamis D., Mai S., Barampouti E.M., presentation on Improving sustainability of potato processing industries, at the 9th International Conference on Sustainable Solid Waste Management, held in Corfu, between 15-18 June 2022.
- Nikolaou M., Stavraki C., Bousoulas I., Malamis D., Mai S., Barampouti E.M., presentation on Ethanol production from bakery waste, at the 9th International Conference on Sustainable Solid Waste Management, held in Corfu, between 15-18 June 2022.



Articles

- LIFE CIRCforBIO: A modern circular economy system for multi-source biomass conversion to value added products, [www.ecotec.gr/ta-periodika mas/#No-186-36](http://www.ecotec.gr/ta-periodika/mas/#No-186-36)
- SEVT Annual Report: Article for CIRCforBIO uploaded in website.
- The project was included in the Report of the Alliance for Food Waste and published at SEVT newsletter (May 2022 issue)

Communication and dissemination actions

Technical Publications

- Sofokleous, M., Christofi, A., Malamis, D., Mai, S., & Barampouti, E. M. Bioethanol and biogas production: An alternative valorisation pathway for green waste. *Chemosphere*, 296 (2022), doi:10.1016/j.chemosphere.2022.133970
- Christofi A., Tspiras D., Malamis D., Moustakas K., Mai S., Barampouti E.M. Biofuels production from orange juice industrial waste within a circular economy vision. *Journal of Water Process Engineering*, 49 (2022), 103028, doi.org/10.1016/j.jwpe.2022.103028
- Felekis V., Stavraki C., Malamis D., Mai S. & Barampouti E.M. Optimisation of Bioethanol Production in a Potato Processing Industry. *Fermentation*, 9(2), 103 (2023), doi.org/10.3390/fermentation9020103
- F. Battista, L. Zuliani, F. Rizzioli, S. Fusco, D. Bolzonella. 2021. Biodiesel, Biogas And Fermentable Sugars Production From Spent Coffee Grounds: A Cascade Biorefinery Approach. *Bioresource Technology* 342(4):125952. <https://doi.org/10.1016/j.biortech.2021.125952>
- F. Rizzioli, F. Battista, D. Bolzonella, N. Frison. 2021. Volatile Fatty Acid Recovery from Anaerobic Fermentate: Focusing on Adsorption and Desorption Performances. *Industrial & Engineering Chemistry Research* 60(37). <http://dx.doi.org/10.1021/acs.iecr.1c03280>
- F. Rizzioli, N. Frison, D. Bolzonella, F. Battista. 2022. Optimization of volatile fatty acids production for PHA synthesis from food wastes. *Chemical Engineering Transactions* 93: 133-139. DOI: 10.3303/CET2293023.



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