CIRCforBIO

LIFE18 CCM/GR/001180

2nd Newsletter

MAY 2021

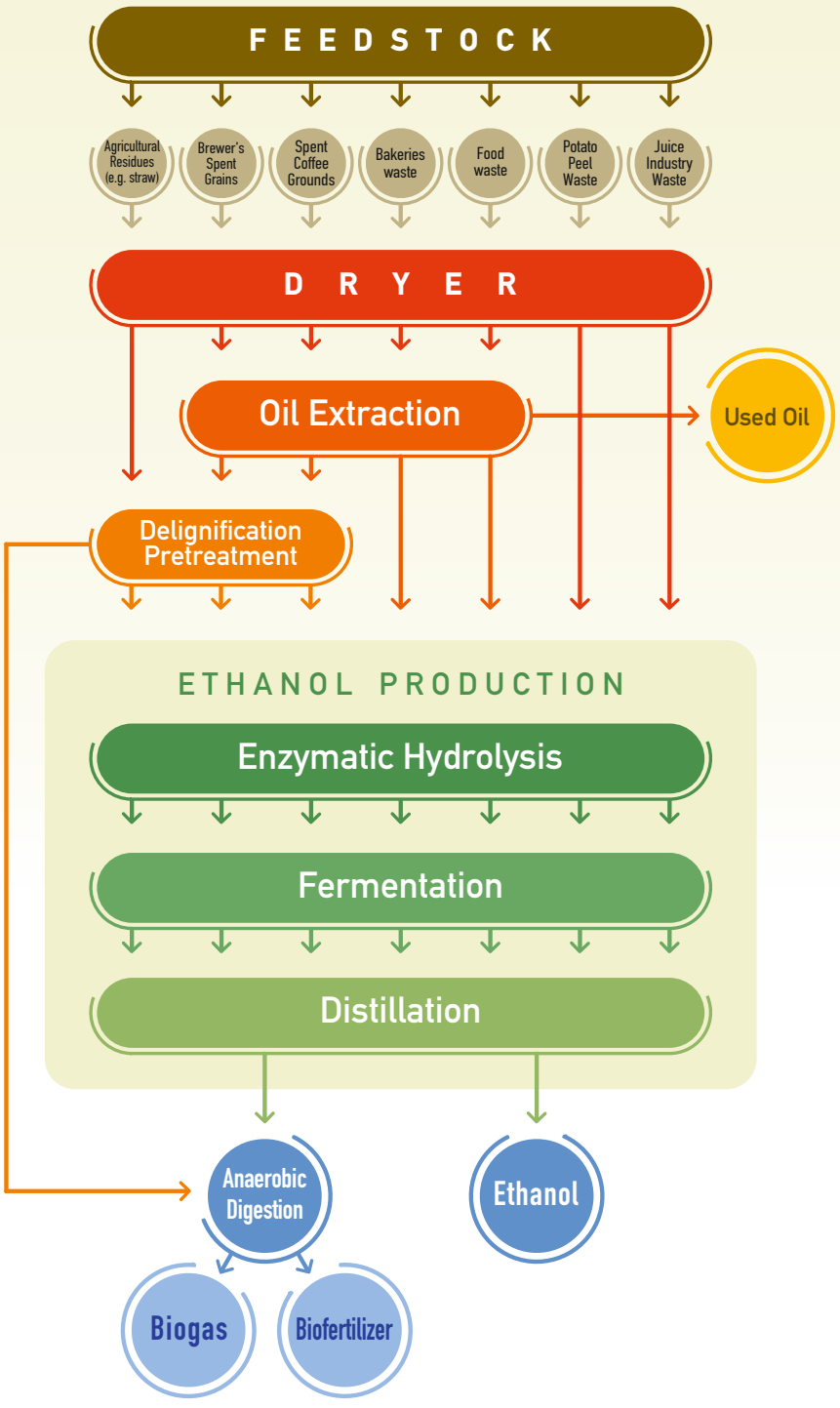
Biorefinery System

The Concept

The biorefinery system will treat 1 tonne feedstock per day to produce used oil, ethanol, biogas and biofertilizer. The feedstock will firstly be dried and then directed to the ethanol production unit, where it will be hydrolyzed and then fermented and distilled. Depending on the substrate, the feedstock might prior be directed to the oil extraction unit and/or the delignification unit whereas the treatment of the residues will be performed in the Anaerobic Digestion unit. The different substrates have been analyzed in terms of their composition and properties in order to determine their treatment requirements.

The Design

The designs for the construction of the different biorefinery system units have been finalized. In the upcoming six months the biorefinery system will be installed and start its operation at Lavrio Technological and Cultural Park. The design characteristics of the different units of the biorefinery systems are presented below.



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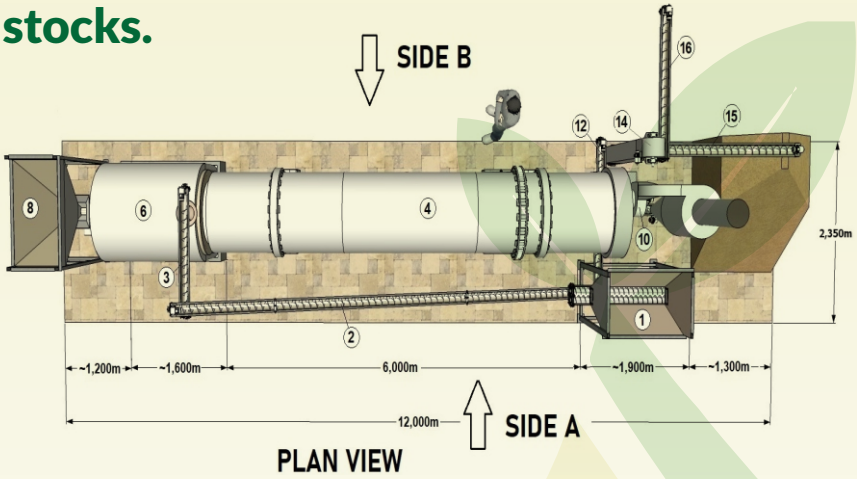
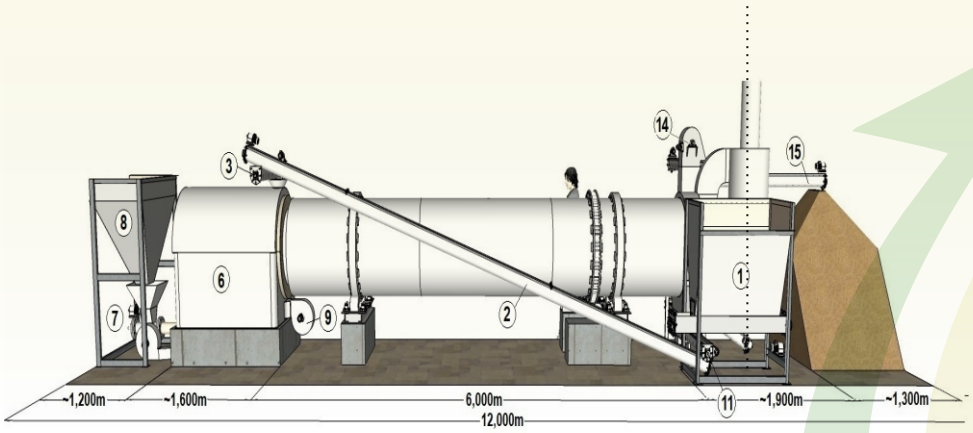
Rotary drum dryer

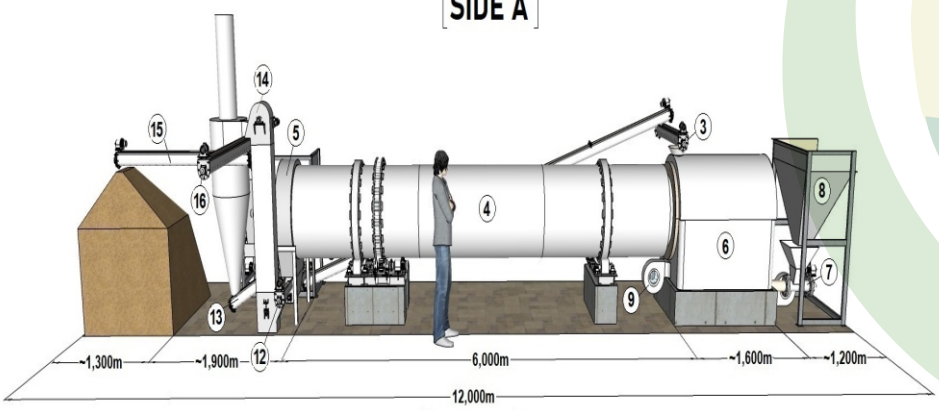
Objective: Simultaneous drying, grinding and homogenization of feedstocks.

- Capacity of biomass drying: 250kg/h feedstock (moisture level: initial 70% and final 6-8%) moisture
- Evaporation capacity: 170kg/h water
- Capacity of biomass burner: 60kg/h
- Material flow via screw conveyors
- Control of air emissions via a cyclone





SIDE A



SIDE B

1	Feeding silo (with a double screw conveyor) Feeder screw
2	Feeder screw & mixer
3	Aerial feeder screw
4	Rotary drum dryer
5	Dryer outlet
6	Combustionchamber
7	Burner
7.a.	Fuel feeder screw
7.b.	Air fan
8	Silo of solid fuel
9	Secondary air fan
10	Flue gas fan
11	Dry material conveyor screw (8%) – to mixing
12	Dry material conveyor screw (8%) – to oil extraction unit
13	Cyclone dust conveyor screw
14	Lift platform for the dried material (8%)
15	Dry material conveyor screw (8%) – to storage
16	Dry material conveyor screw (8%) – to oil extraction unit

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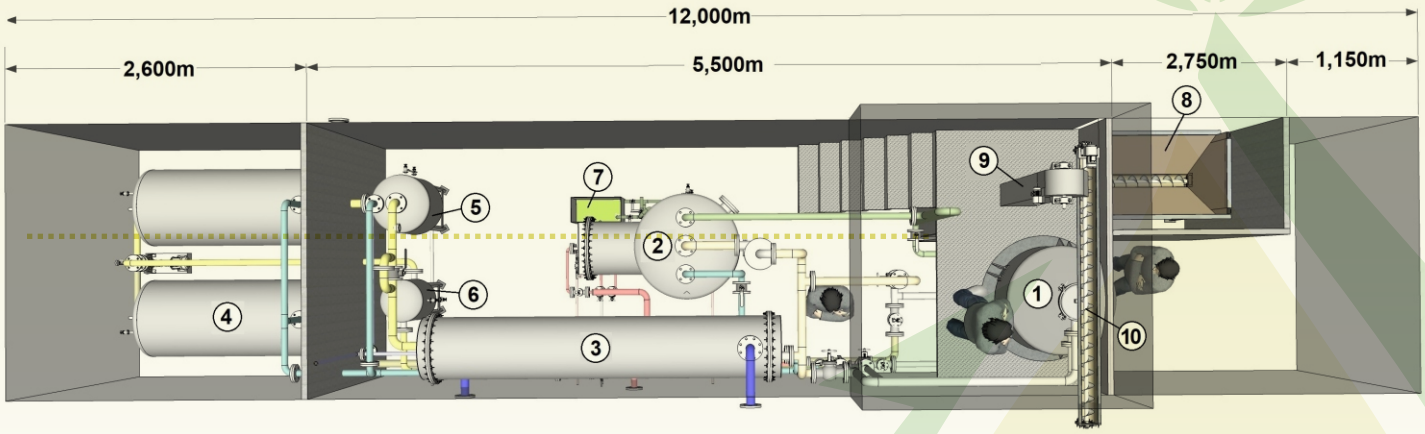
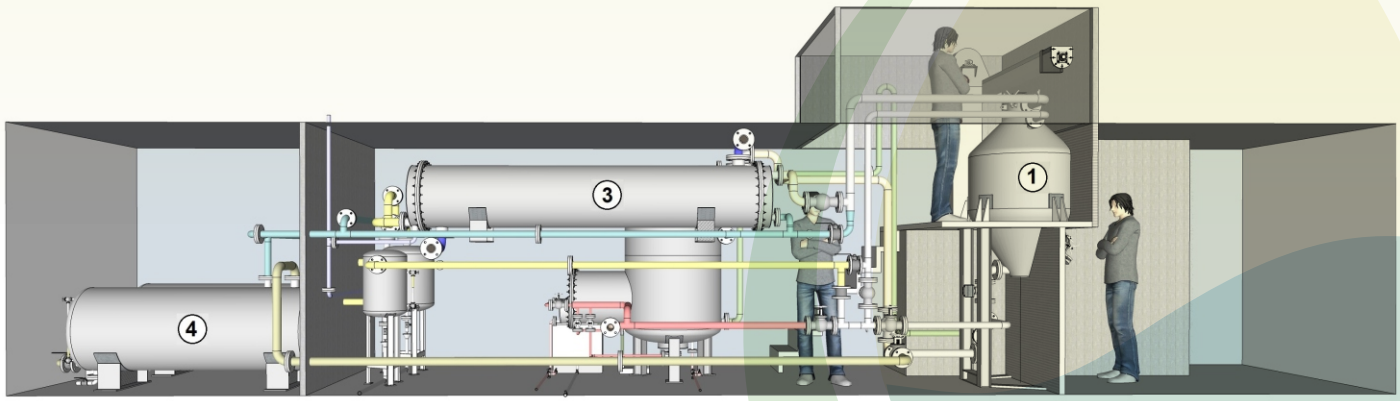
Oil extraction unit

Objective: Recovery of oil content of dried feedstocks by solid-liquid extraction

- Capacity: 500 kg/cycle
- Oil extraction vessel: working volume 1 m^3 (950mm x 1650mm)
- Extraction solvent: hexane working in closed loop (evaporation-condensation-recycling)





1	Oil extraction vesse	6	Dewatering of hexane
2	lMiscella tank – Distillation unit	7	Tank for the final product
3	Heat exchanger for cooling	8	Feeding silo
4	Hexane tank	9	Lift platform for the dried material (8%)
5	Water-hexane separator	10	Conveyor screw (feeder)

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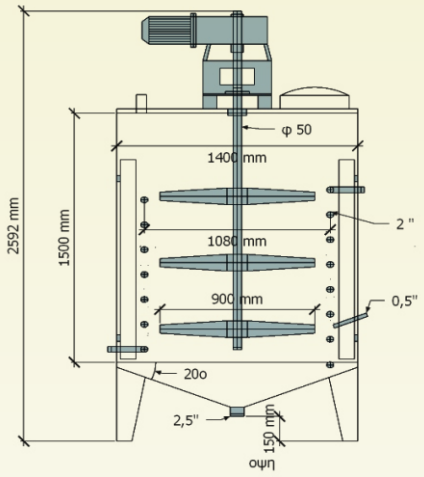
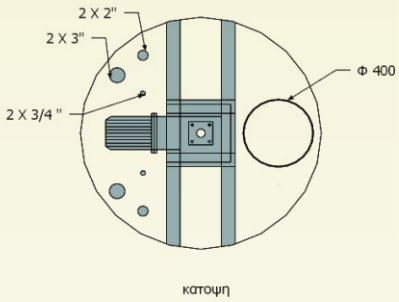
Ethanol production unit

Objective: Enzymatic hydrolysis, fermentation and recovery of produced ethanol

- Stainless steel AISI 304 bioreactor with working volume 2m^3
- Heating needs 210kW covered via steam external coil
- Cooling needs 163kW covered via chiller
- Ethanol recovery via a single step distillation system

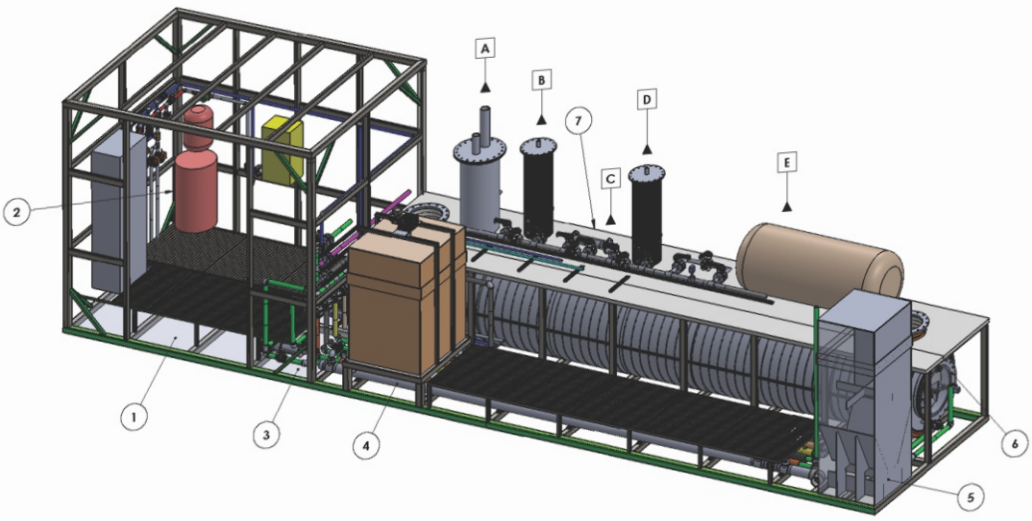




Anaerobic digestion unit

Objective: Management and valorization of all processes' residues

- Plug-flow anaerobic bioreactor (polypropylene) with working volume 5 m^3
- Sedimentation tank (polypropylene) with working volume 1 m^3
- Biogas dehumidification with 1.5KW$_e$ Chiller unit system & activated carbon bed (150 kg) for the hydrogen sulfide (H_2S) removal
- Organic loading rate: 10kg COD/m^3/d



A	Overpressure tank
B	Solids filter
C	Chiller
D	Overpressure filter
E	Gas storage

1	Pumping station
2	Hot water station
3	Reception station
4	Homogenization tank
5	Sedimentation tank
6	PFR reactor
7	Gas section

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Lab and pilot-scale optimization of the process

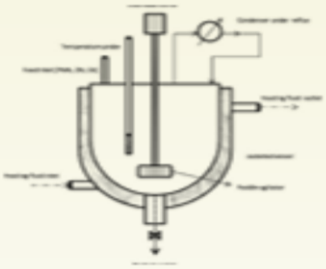
Lab scale optimization of the operational conditions related to the processes involved, namely pretreatment, enzymatic hydrolysis, fermentation, anaerobic digestion, has been performed for the different variety of biomass feedstocks either municipal or industrial.

Mixtures of different biomass feedstocks have also been tested at lab scale.

The optimized conditions obtained from lab scale application are currently used in Pilot-scale trials aiming to upscale the operational condition at the demo plant to enable the effective treatment of 1 tonne of biomass per day.

Information on the optimization of the biorefinery processes will be given in the next newsletter.

$V_{reactor}$=250mL-
Process Verified
(lab scale)



$V_{reactor}$=4L-
Process Verified
(bench scale)

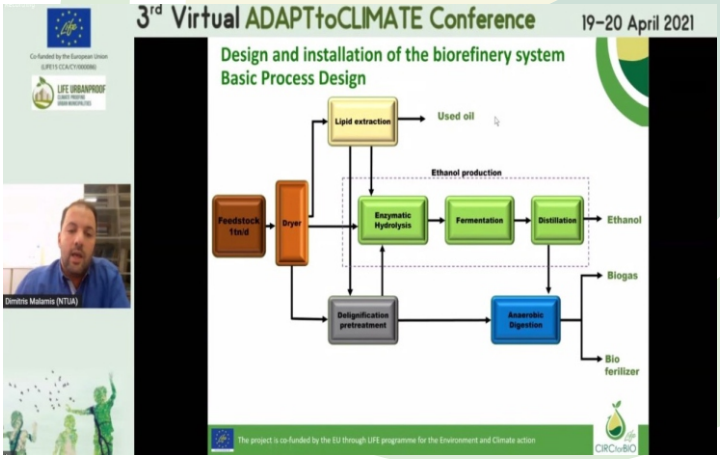
$V_{reactor}$=0.2m3-
Process verified
(pilot scale)

Communication and dissemination actions

The project has been presented in conferences, other websites and through technical publications, despite the challenges that Covid-19 pandemic has posed towards a wide spectrum of human activities.

Presentation of LIFE CIRCforBIO project

Presentation of LIFE CIRCforBIO project from Dr. Dimitris Malamis (NTUA) at the 3rd Virtual ADAPTtoCLIMATE conference, held in the framework of LIFE UrbanProof Project, on 20th of April 2021.



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LIFE CIRCforBIO project in other websites

LIFE CIRCforBIO was presented at the section "LIFE Project of the month", as the LIFE Project of March 2021, of Greek LIFE Task Force website. The section "LIFE Project of the month" contains information regarding the identity, the good practices and the results of ongoing and completed LIFE projects. The afore-mentioned information for LIFE CIRCforBIO can be found at the following link:

https://www.lifetaskforce.gr/en/life/life-project-of-the-month/march-2021

Dissemination of LIFE CIRCforBIO project through technical publication

The 1st technical publication in the frame of LIFE CIRCforBIO project was released in 16th December of 2020.

Kavalopoulos M., Stoumpou V., Christofi A., Mai S., Barampouti E.M., Moustakas, K., Malamis, D., Loizidou M. Sustainable valorisation pathways mitigating environmental pollution from brewers' spent grains. Environmental Pollution (2021) 270 doi:10.1016/j.envpol.2020.116069

https://www.sciencedirect.com/science/article/pii/S0269749120367580

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