Demonstration of an integrated innovative biorefinery for the transformation of Municipal Solid Waste (MSW) into new BioBased products

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PERSEO Bioethanol®: Urban Biorefinery. The company

INDUSTRIAS MECÁNICAS ALCUDIA S.A.

- Metal mechanical company founded in 1979.
- Located in L’Alcúdia (Valencia – Spain)
- High technological capacity. Experience in petrochemical and refinery sectors.
- 25,000 m2 of facilities. 180 employees.
About 100 Mt of municipal biowaste is generated every year in Europe.

Only about a third (30 Mt) of this was separately collected and composted and/or digested (European Compost Network (ECN))

New Waste legislation (22 may 2018)

- Mandatory separate collection of bio-Waste: 31/12/2023
- Maximum 10% landfill of MSW 2035.

Biorefinery from organic urban waste

Biotechnological process: Transform the organic fraction of municipal waste into advanced bioethanol, bioproducts and bioenergy.

- The Process is Real, Feasible, Replicable and Profitable.
Demo Project Budget: 15 M€
Duration: 4 years project (6/2017 – 5/2021)
The objective is to introduce a new model of OFMSW (Organic Fraction of Municipal Solid Waste) treatment. This model encompasses multiple bioproducts, aiming for higher value outcomes.

The approach includes:

- Landfill
- Composting
- Anaerobic Digestion

OFMSW is transformed through a biorefinery process, yielding:

**URBIOFIN - BIOREFINERY**

**BIO-BLOCKS**
- Bioethanol
- Volatile fatty acids
- Biogas

**BIO-POLYMERS**
- Polyhydroxyalkanoates
- Combined PHA's

**ADDITIVES**
- Bioethylen
- Biochemical products

The objective is to achieve Biofinery, generating multiple bioproducts with higher value.
**Project Challenges**

- **To tackle the issues inherent to MSW treatment**, such as variability in composition (seasonality and geographic location) and presence of inhibitors to downstream biotechnological processes.

- **To validate the whole value chain at demonstration scale** (TRL 5-7).

- **To demonstrate at Demo-scale the economic and environmental benefits of the Urbiofin** treatment and conversion technologies of the OFMSW into final or intermediate products.

- **To validate safety, quality and purity of the products** in order to meet commercial and/or regulatory requirements.

- **To assess the environmental and socio-economic performance** of the whole value chain using a Life Cycle Assessment (LCA)
Module I.
Conversion of OFMSW to bioethanol and bioethylene

Non-organic (Recycling)

MSW

Sorting

OMSW

Pre-treatment + Hydrolysis + Fermentation

OMSW

Catalysis

Vinasse

BIOETHANOL

APPLICATIONS

FRUIT RIPENING

PRODUCTS

BIOETHYLENE

Bioproducts:
Market of bioproducts

- **Bioethanol:**
  - Biofuel: 90% of total biofuels. **Market Forecast in Europe:** 13 billion € in 2030
  - **Chemical Building block:** Bioethanol is considered as one of the “top 10” potential biobased raw materials for the chemical industry. (US Energy Department)

- **Bioethylene:**
  - Global bioethylene market size was over USD 160 billion in 2015 and is foreseen to exceed USD 235 billion valuation by 2024
Module II. Conversion of OFMSW to VFAs for production of PHA.

- **Module II**: BIOGAS
  - OMSW → AD1 → VFAs → Elongation → PHA production (pure culture)
  - AD2 → VFAs → Elongation → PHA production (mixed culture)
  - Extraction → Extraction
  - MCL-PHA → SCL-PHA

- **Bioproducts**
  - COSMETICS
  - BIOPLASTICS
  - AGRICULTURE
  - BIOPLASTICS

- **Applications**
  - BIOETHANOL
  - BIOGAS
  - BIOPHARMACEUTICALS
  - BIOPHARMACEUTICALS

- **Products**
  - CIAM Innovation Center
  - CLAMBER Pilot Plant
Bioplastics:

- Biodegradable bioplastics market is expected to double between 2014 and 2019.
- In the case of PHA market it is expected a growth from 32 to 104 Mton, mainly related to flexible or rigid packaging and agriculture purposes.
Module III. Biogas bioconversion to biomethane and added value products

Biogas

Upgrading

Microalgae

Hydrolysis + concentration

PHA production + Extraction

SPBD

DRY GRANULES

AA

SCL-PHA

MODULE 3

APPLICATIONS

PRODUCTS

SOLID FERTILIZER

LIQUID FERTILIZER

AGRICULTURE BIOPLASTICS

CIAM Innovation Center

Bioproducts:

BioPlastic

AD 2 = 40 m³
Market of bioproducts

✈ Biofertilizers

✔ Global bio-based fertilizers market is expected to reach USD 1.9 Billion by 2020 at a CAGR of 14.0% from 2015 to 2020

Advantages of bio based fertilisers vs conventional (mineral) fertilisers

✔ It is a recovered / renewable origin bioproduct
✔ It improves soil quality/health and not only crop productivity
✔ It contains higher components and nutrients concentration
✔ It offers easy manipulation and application in field
✔ Slow release of nutrients and improved crop yield
✔ It reduces the environmental footprint of crop production
The achievements

Process definition and improvements

Pilot plants start the DEMO activity.

- Final products requirements

2017-2018

2019-2020

2020-2021
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