Sveučilište u Zagrebu
Fakultet kemijskog inženjerstva i tehnologije

FKITMCMXIX

15th International Scientific and Professional Conference
WITH FOOD TO HEALTH
17th and 18th September 2025

15 hranom do zdravlja / with food to health
OSIJEK, CROATIA 2025

15th International Scientific-Professional Conference
WITH FOOD TO HEALTH

Microbial Synergy for a Greener Future through PHB Production from Sugars

Assoc. Prof. Dajana Kučić Grgić, PhD
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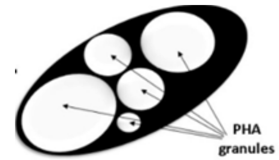
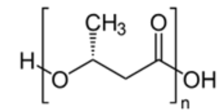
BIOPHA-COMFPACK

Osijek, 17th – 18th September 2025





Funded by the European Union

*This research was conducted as part of the project „Production and development of compostable packaging from waste biomass for the packaging of industrially processed food products" (**NPOO.C3.2.R3-Il .04.0059**) funded by National Recovery and Resilience Plan (funded by the European Union, NextGenerationEU).*

https://bio-pha-com-f-pack.eu/

PROJECT - Production and Development of Compostable Packaging from Waste Biomass for the Packaging of Industrially Processed Food Products

1. Production of PHA from secondary generation biomass – agroindustrial waste using solid state fermentation

- *Physical and cehmical characterisation of waste*
- *Examine pure and mixed culture*
- *Examine different extractions methods*
- *Optimization of process via SmF and SSF*

2. Production of biodegradable and compostable packaging materials

Development of biofilms – PHA, PLA, TPS, PBS

- *Using compostable coatings*
- *Biodegradable additives*

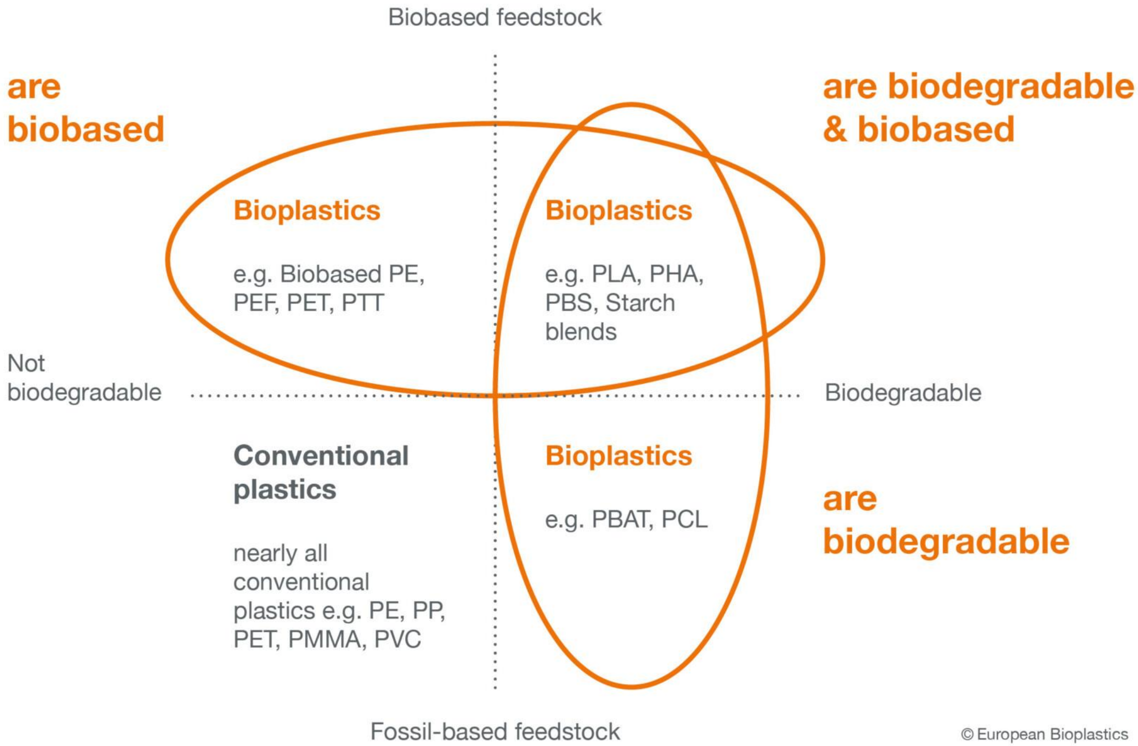
Examine of produced biofilms:

- *biodegradability*
- *Ecotoxycity*
- *Compostability*

Financira Europska unija
NextGenerationEU

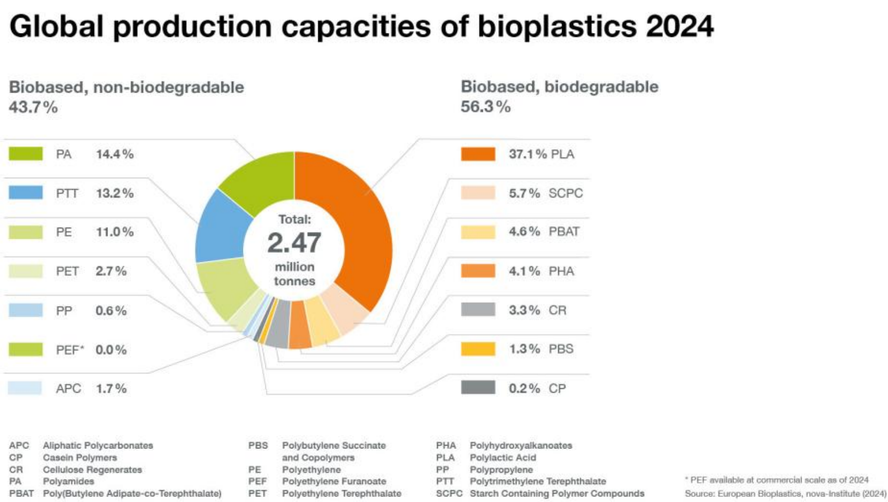
Material coordinate system for bioplastics

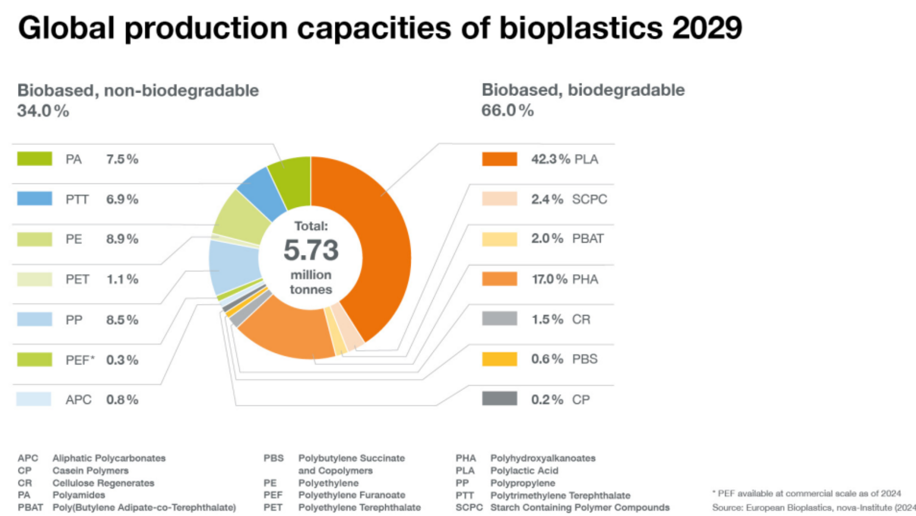
Bioplastics are biobased, biodegradable, or both.

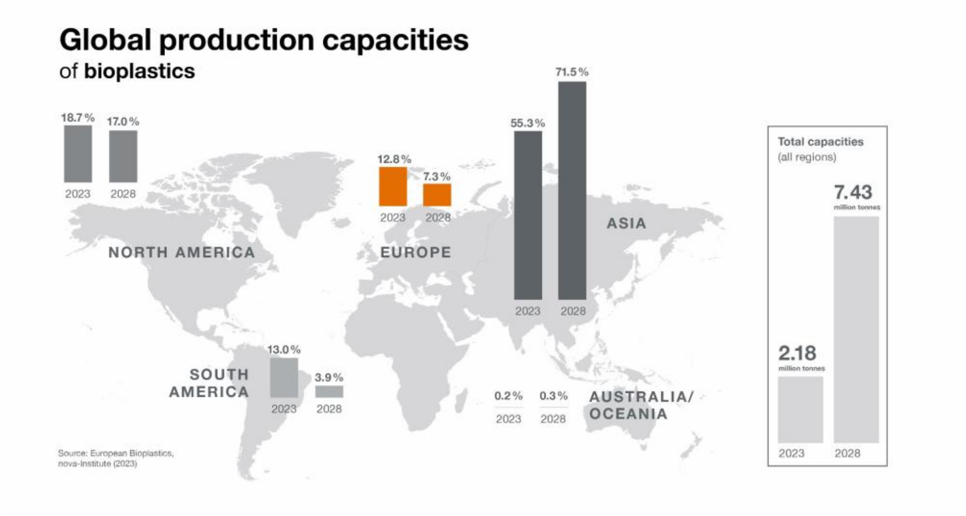


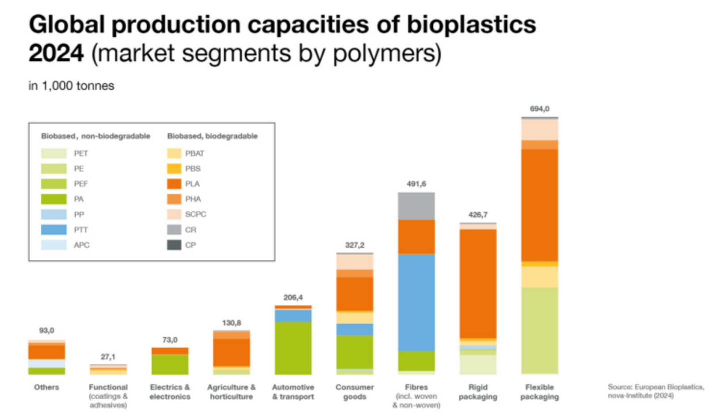
Source: Institute for Bioplastics and Biocomposites (ifBB) and European Bioplastics (EUBP)

Bioplastics

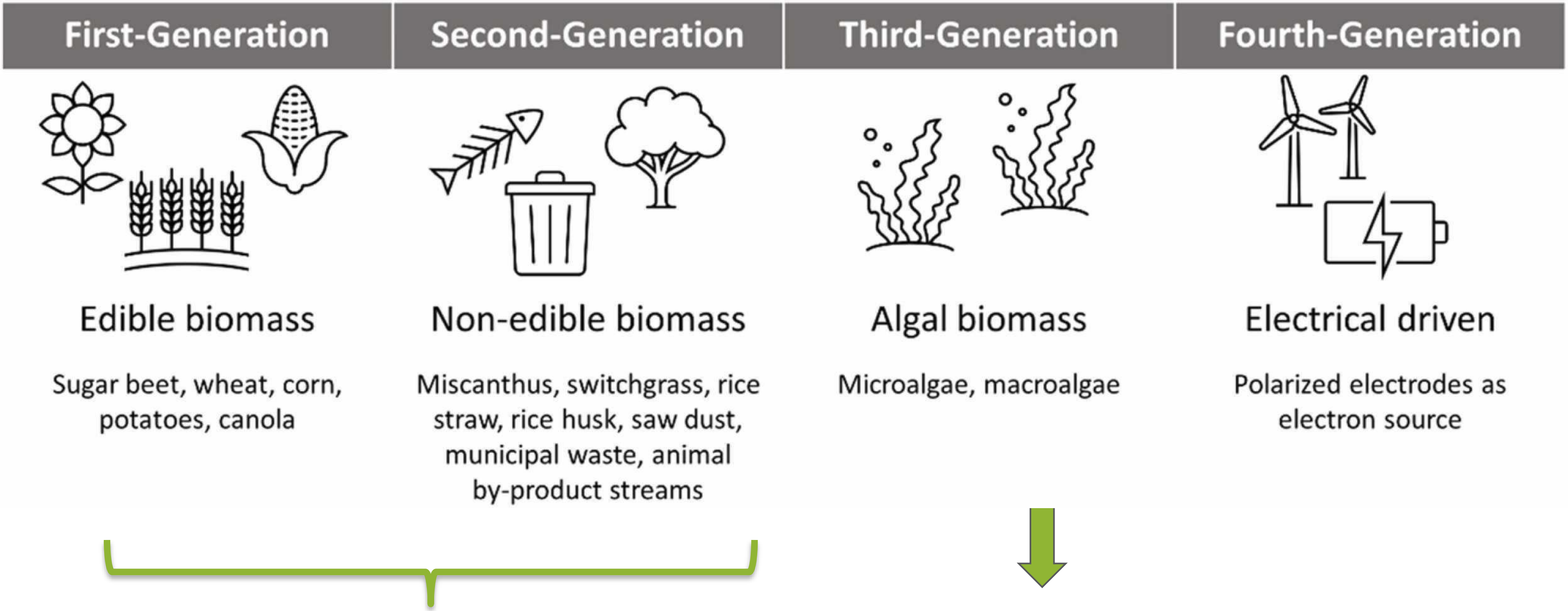








Production of bioplastics from biomass



There is a clear trend in research showing a shift to second-generation feedstock usage, due to concerns about available quantities and food prices.
High abundances of second-generation feedstocks and lower market competition lead to lower prices.

***Potential problems**: the economic feasibility of microalgae production, such as difficult culture conditions, high contamination risks, complex cleaning processes as well as low cell densities and productivities*

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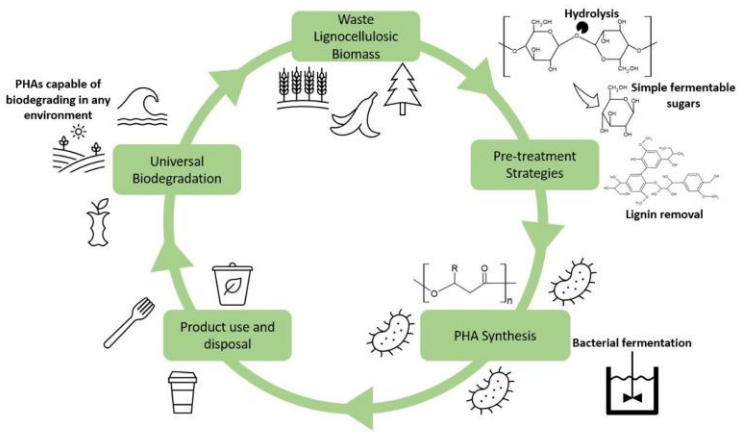
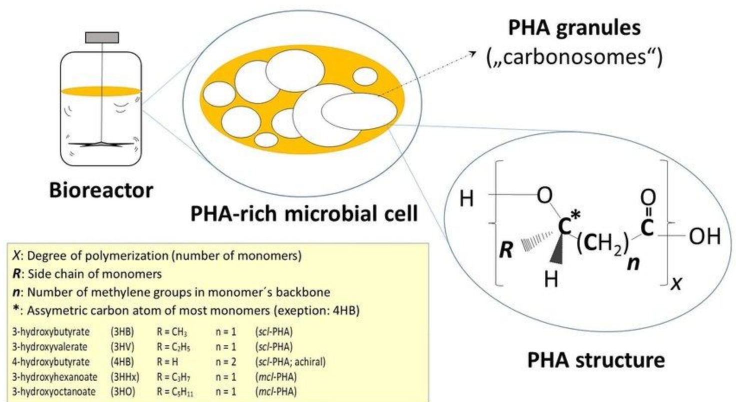
Polyhydroxyalkanoate





- *Polyhydroxyalkanoates polyesters are **synthesized and accumulated in various microorganisms**, usually when **entering the stationary phase of growth.***
- *PHAs form **intracellular inclusions** and can be synthesized to store carbon and energy, and can reach 80% of cell weight.*
- *They are synthesized intracellularly as insoluble cytoplasmic inclusions in the presence of **excess carbon, when other essential nutrients such as oxygen, phosphorus, or nitrogen are limited**.*
- *These polymeric materials may be stored at high concentrations inside the cell, since it does not substantially alter its osmotic state.*

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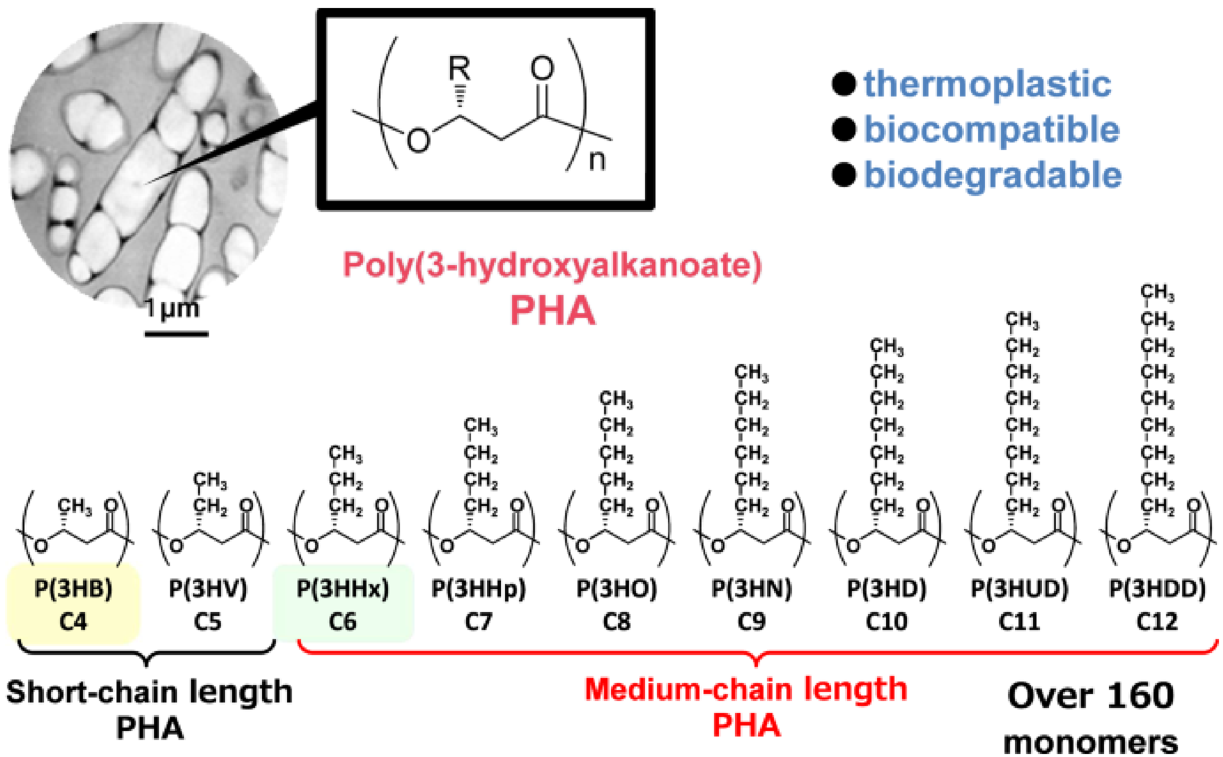
University of Zagreb Faculty of Chemical Engineering and Technology

Polyhydroxyalkanoate



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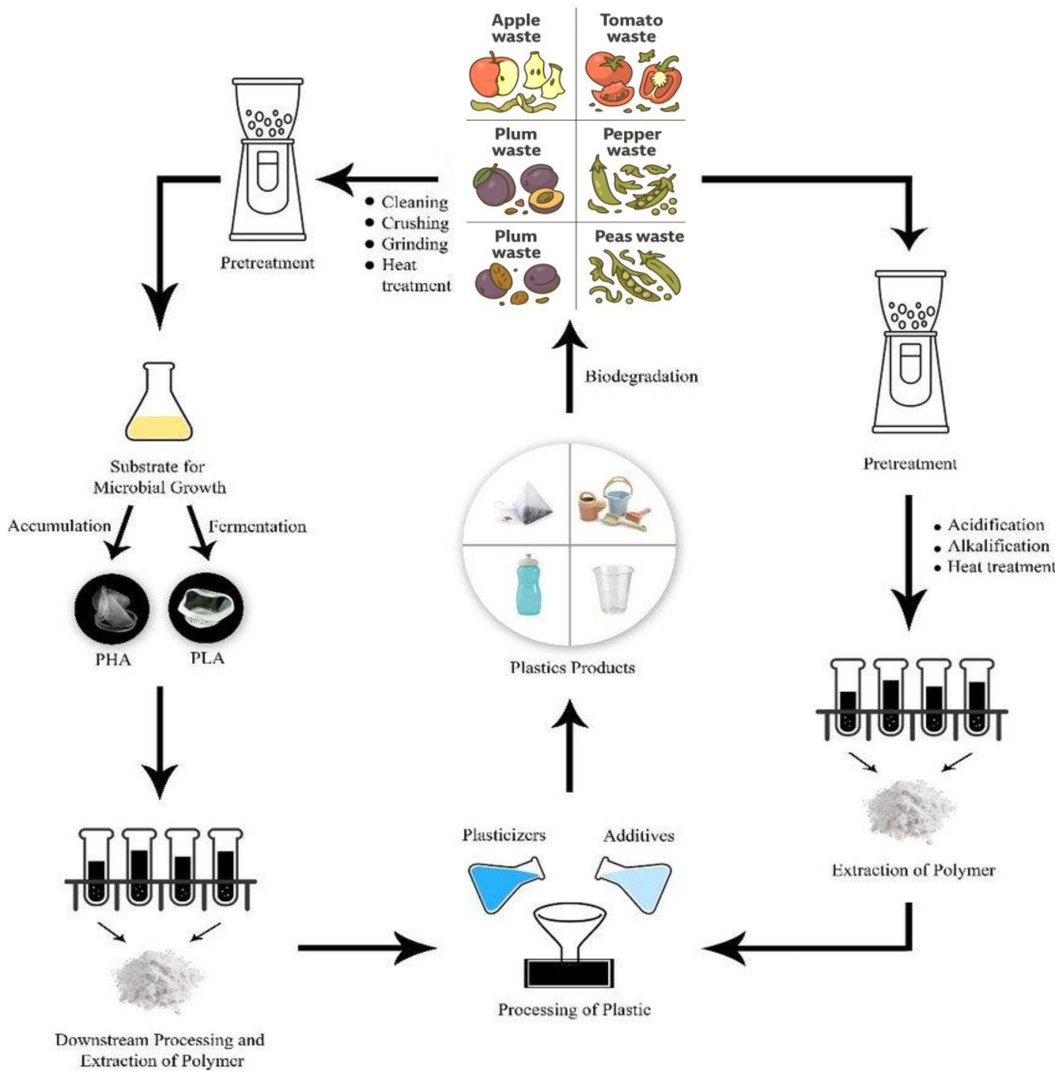
Production of PHA by SmF



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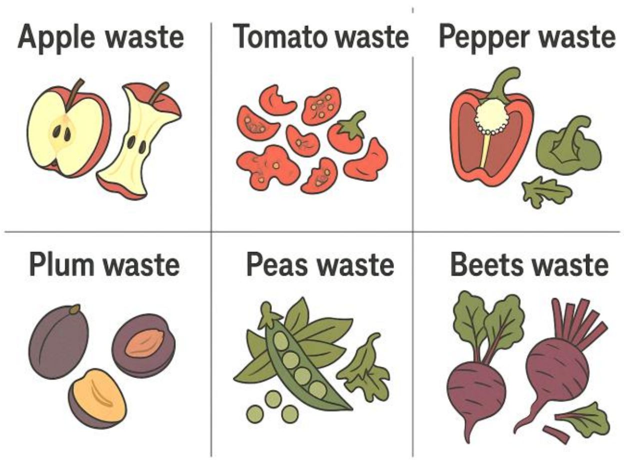
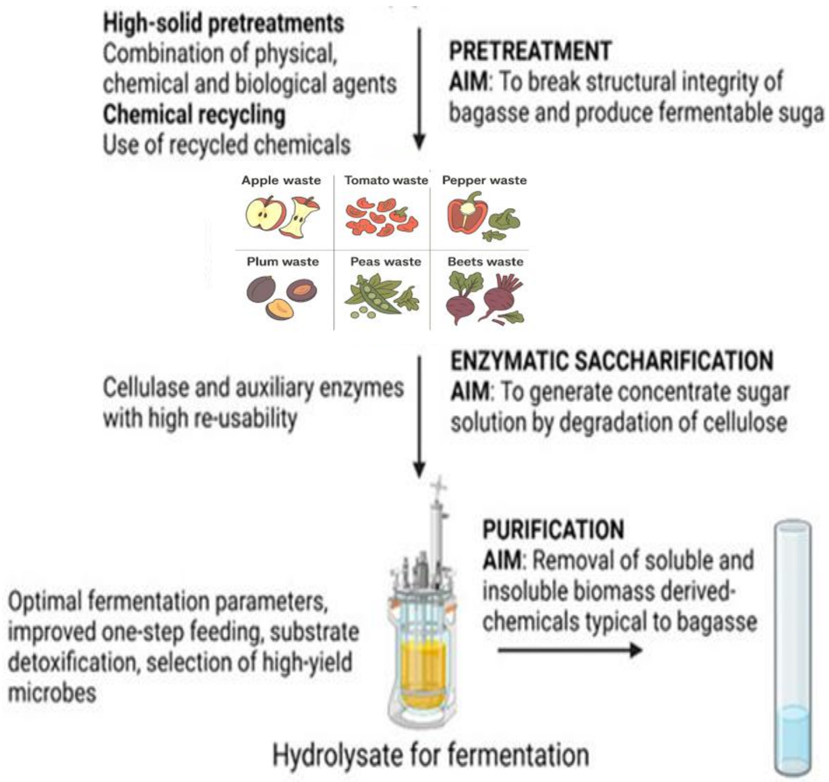
Production of PHA by SmF





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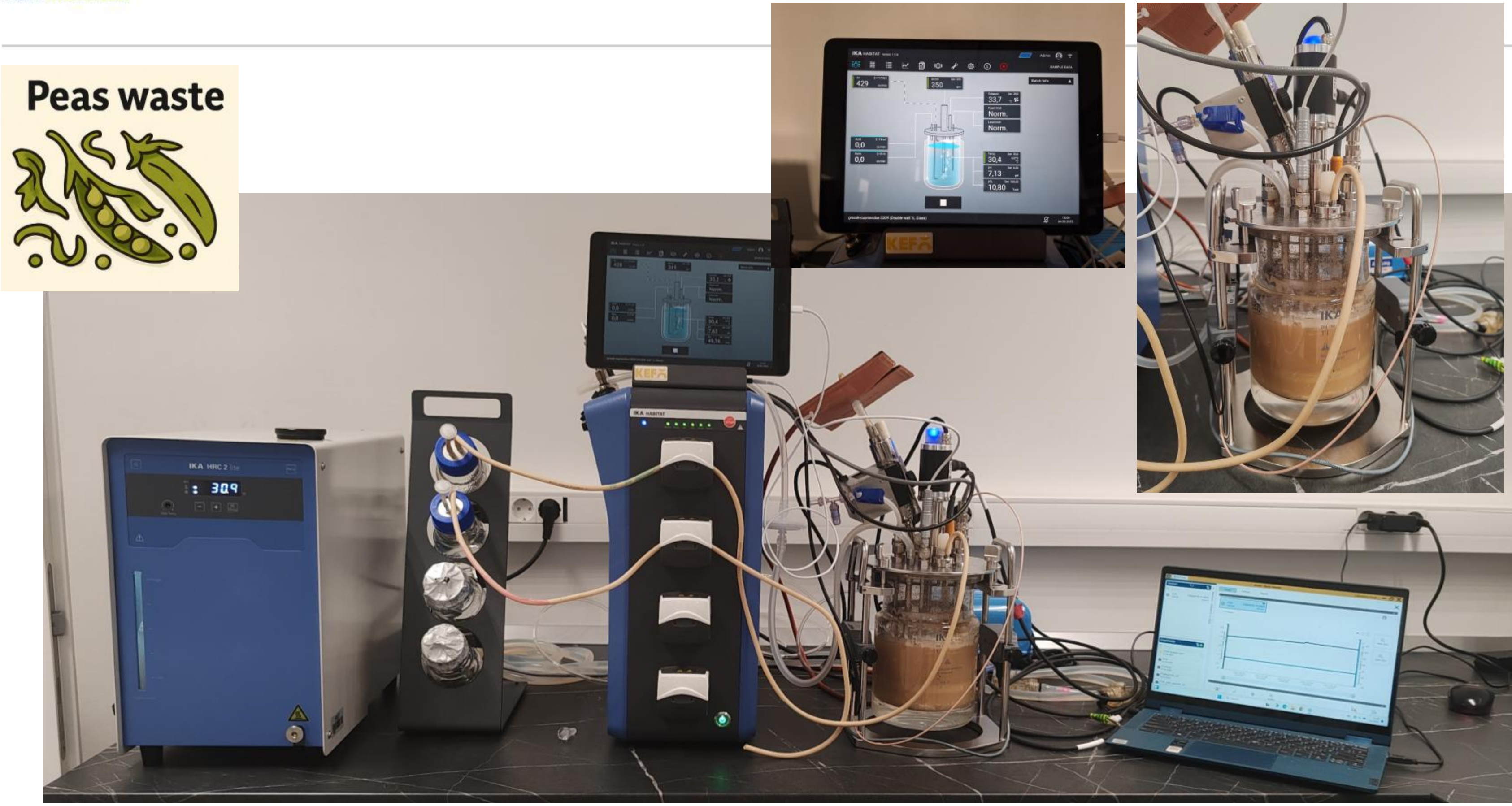

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Production of PHA by SmF

Initial conditions (duration 6,5 days)_Experiment 1	
$\gamma_{initial}$ (reducing sugars (fructose, glucose, and sucrose) / g/L	15.0
pH-value / -	6.9
Culture	Mixed culture of C. necator and P. putida
Optical density$_{600nm}$ / -	0.9
T / °C	30.0
rpm	250.0
Air / mL/min	300.0

Initial conditions (duration 2,5 days)_Experiment 2	
$\gamma_{initial}$ (reducing sugars (agroindustrial waste - peas) / g/L	15.0
pH-value / -	6.9
Culture	C. necator
Optical density$_{600nm}$ / -	0.9
T / °C	30.0
rpm	350.0
Air / mL/min	400.0

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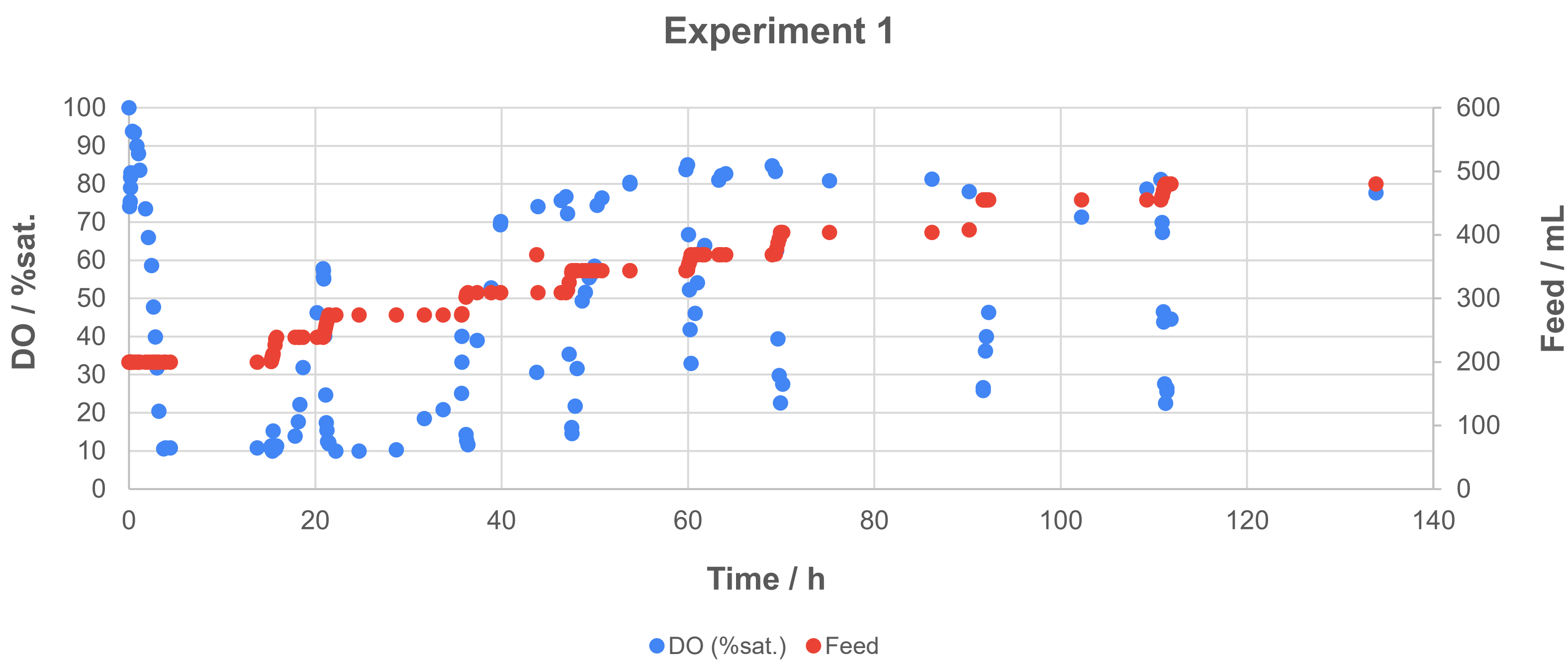
Production of PHA by SmF



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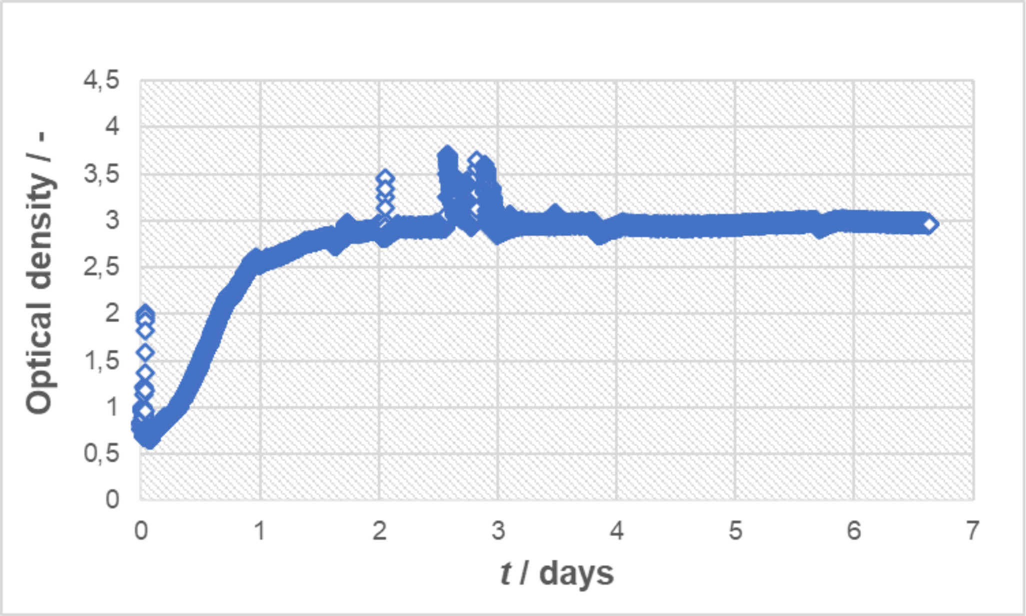
Production of PHA by SmF



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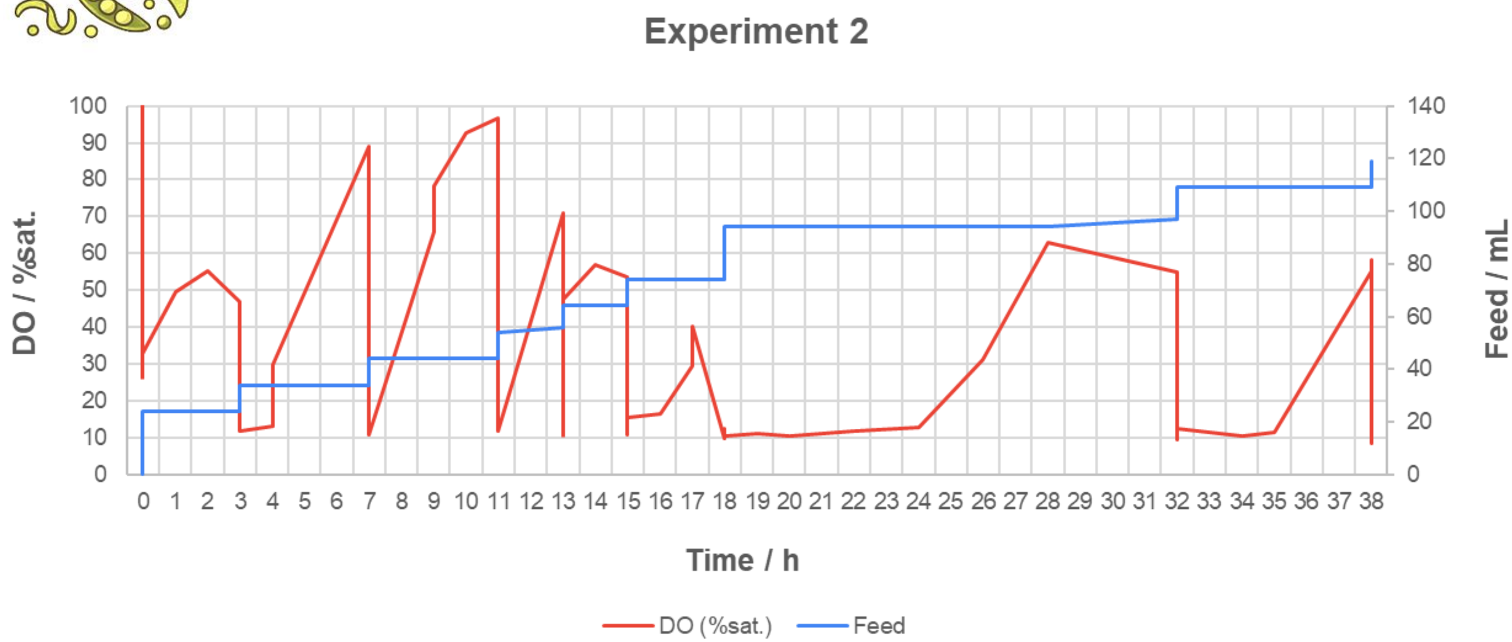
Production of PHA by SmF

Peas waste



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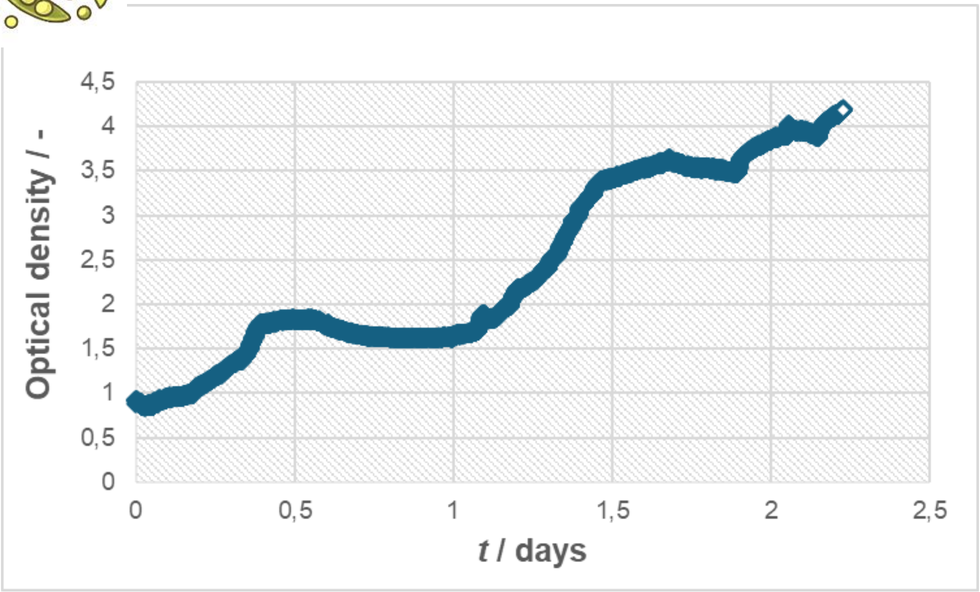
Production of PHA by SmF

Peas waste



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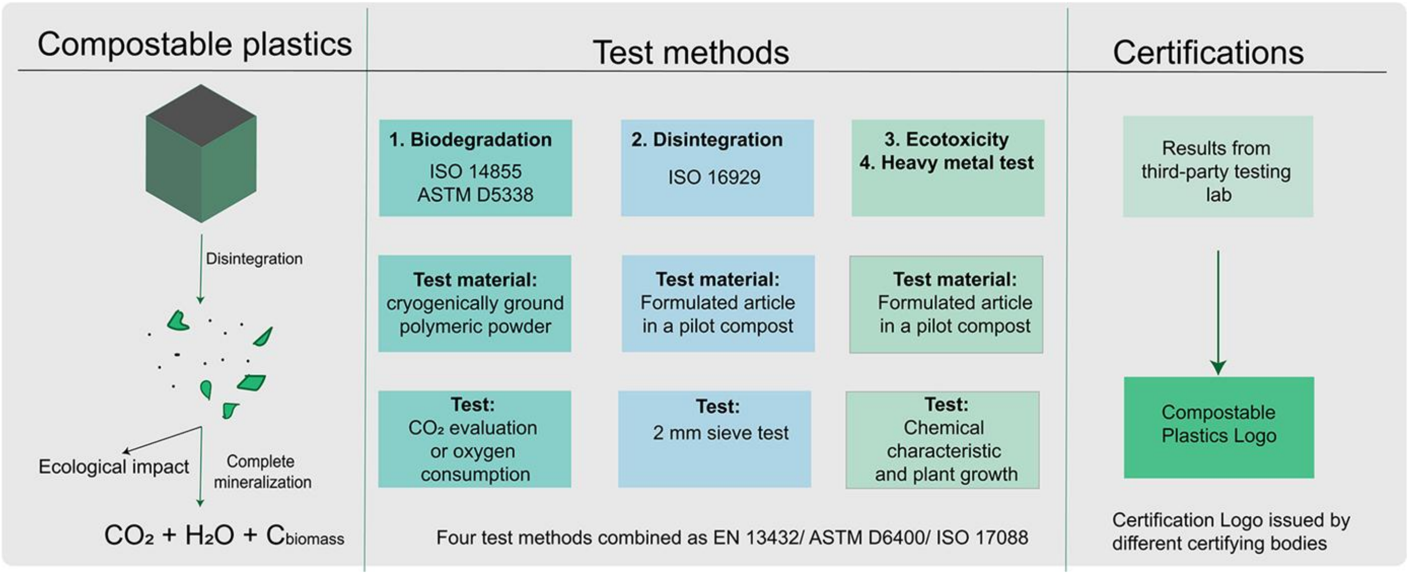
DETERMINATION OF BIODEGRADABILITY



ISO 17556:2019
Plastics — Determination of the ultimate aerobic biodegradability of plastic materials in soil by measuring the oxygen demand in a respirometer or the amount of carbon dioxide evolved

ISO 14852:2021
Determination of the ultimate aerobic biodegradability of plastic materials in an aqueous medium — Method by analysis of evolved carbon dioxide

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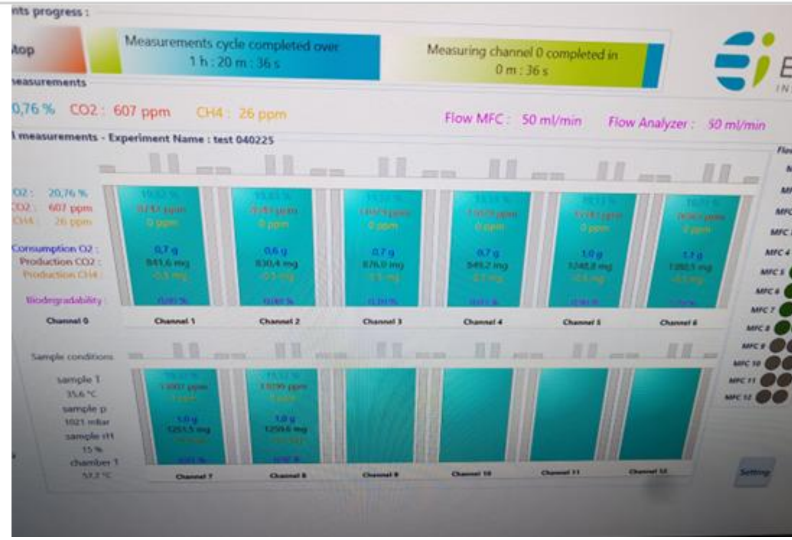
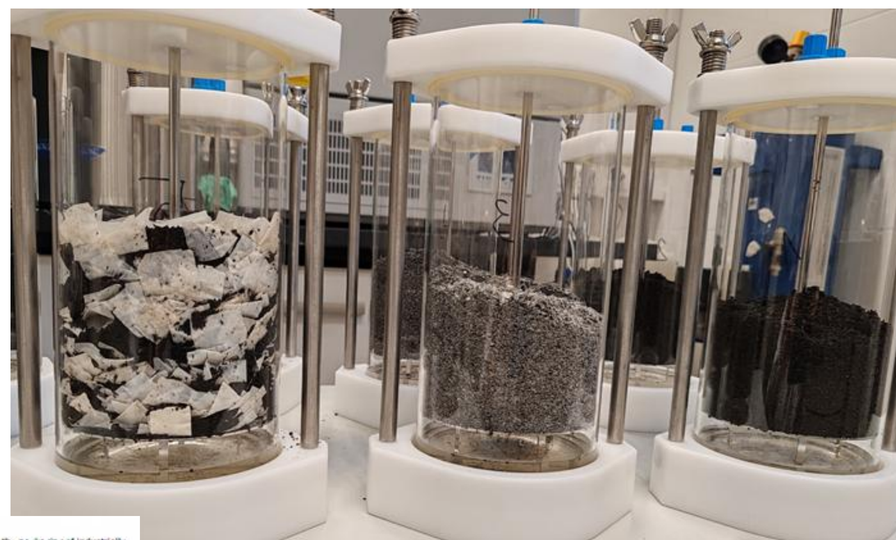
Determination of biodegradability of bioplastics





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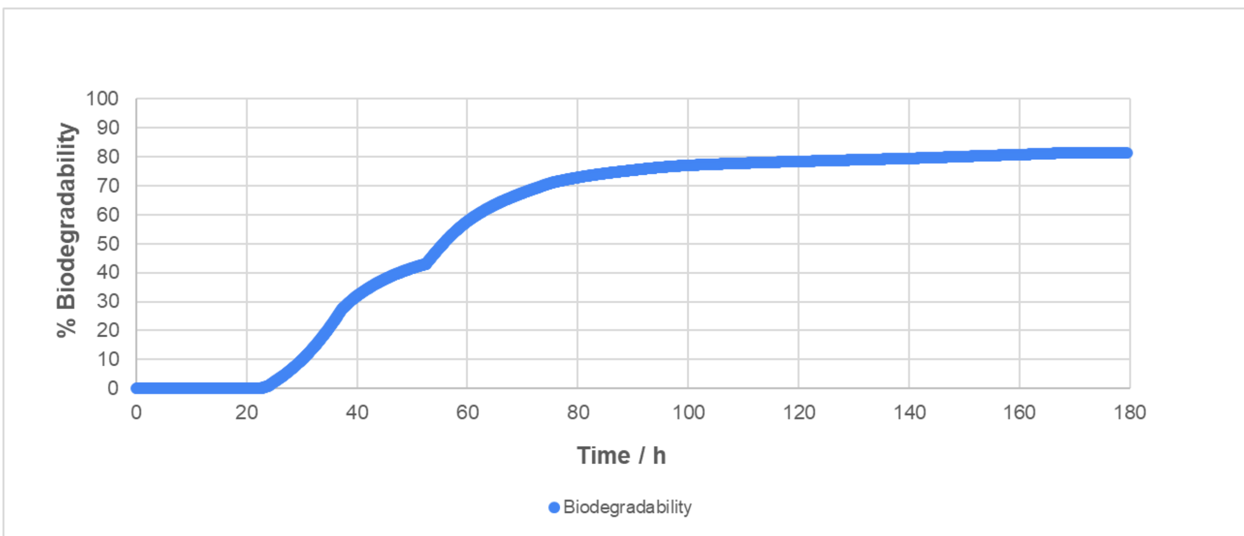

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Engineering and Technology

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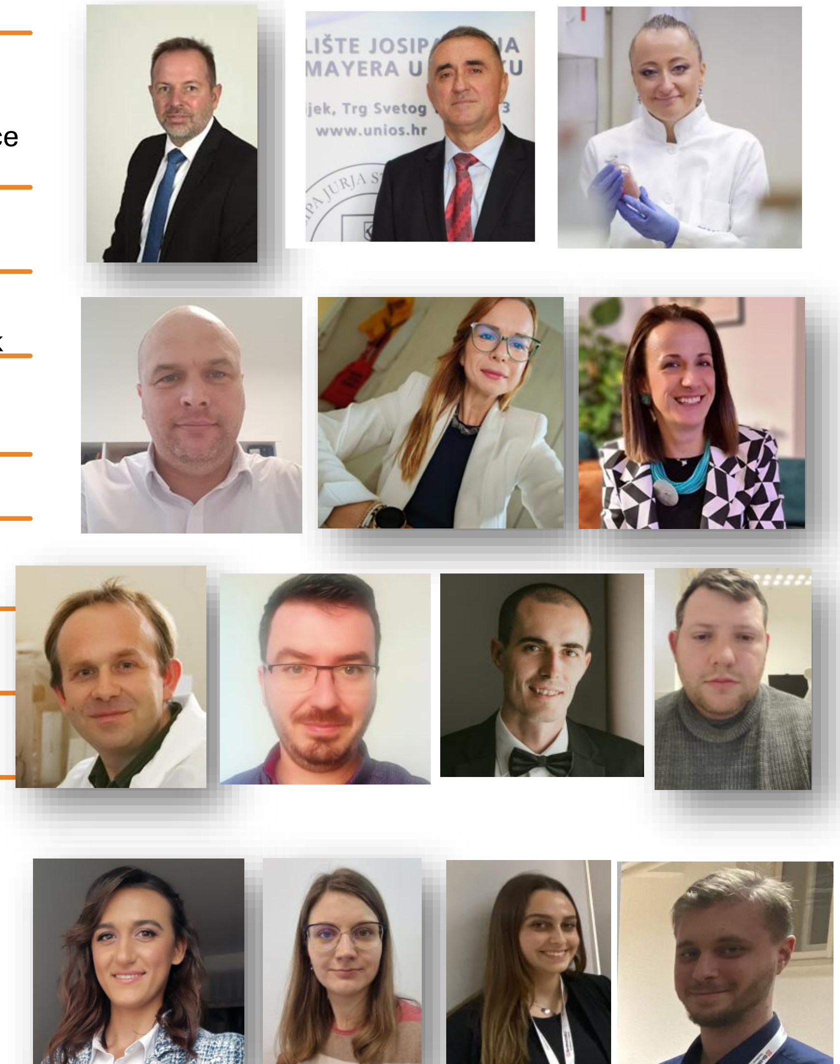


Thank you
for your
attention