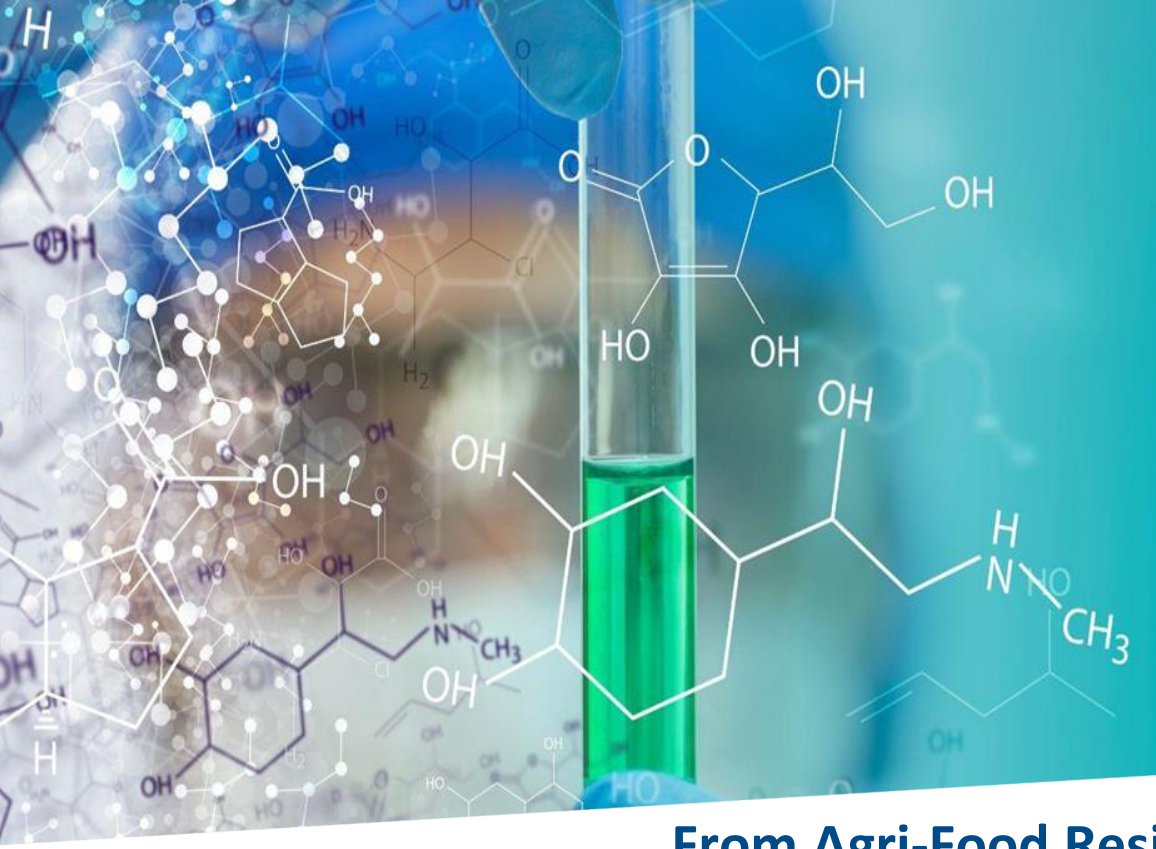

5B POLYMERS

November 6, 2025

From Agri-Food Residues to Sustainable Plastics

The POLYMERS-5B Journey

Funded by the European Union

"The project 101157840 — Polymers-5B — HORIZON-JU-CBE-2023 is funded by the European Union and supported by the Circular Bio-based Europe Joint Undertaking and its members."

Prof. Luís Joaquim Pina da Fonseca

IST ID · iBB Institute for Bioengineering and Biosciences

5B POLYMERS

Project partners

Project lead: IST-ID (PT)

6 RTOs and 1 HES

4 SMEs

2 Large Companies

BOBO CHOSES

eurecat

ISQ CTAG automotive technologies

IBER-OLEFF

Centimfe Technological Center for the Mouldmaking, Special Tooling and Plastic Industries

ISTID

iBB Institute for Bioengineering and Biosciences

idener.ai

LATVIAN STATE INSTITUTE OF WOOD CHEMISTRY

ChiralVision innovative biocatalysis!

MAX-PLANCK-INSTITUT FÜR POLYMERFORSCHUNG

FACULTY OF TECHNOLOGY NOVI SAD

Bonlex Europe

NSB project

PARTNERS

Funded by the European Union

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Circular Bio-based Europe Joint Undertaking

ECOSYSTEX Member Project

Bio-based Industries Consortium

Key features of the POLYMERS-5B project

Developing **novel alternative of bio-based polymers** synthesised **from bio-renewable monomers.**

Consortium of 13 partners led by IST-ID with the Institute for Bioengineering and Biosciences – iBB.

Use **of food side streams** and **wood processing residues as a feedstock.**

Biocatalysis and Green Chemistry according to **SSbD** and combined with **AI** and **Machine Learning tools.**

The bio-based polymers deliver solutions **for textile, automotive, furniture, and polymeric resin markets.**

Unlocking a wider range of **bio-based products that meet market demands.**

Funded by the European Union

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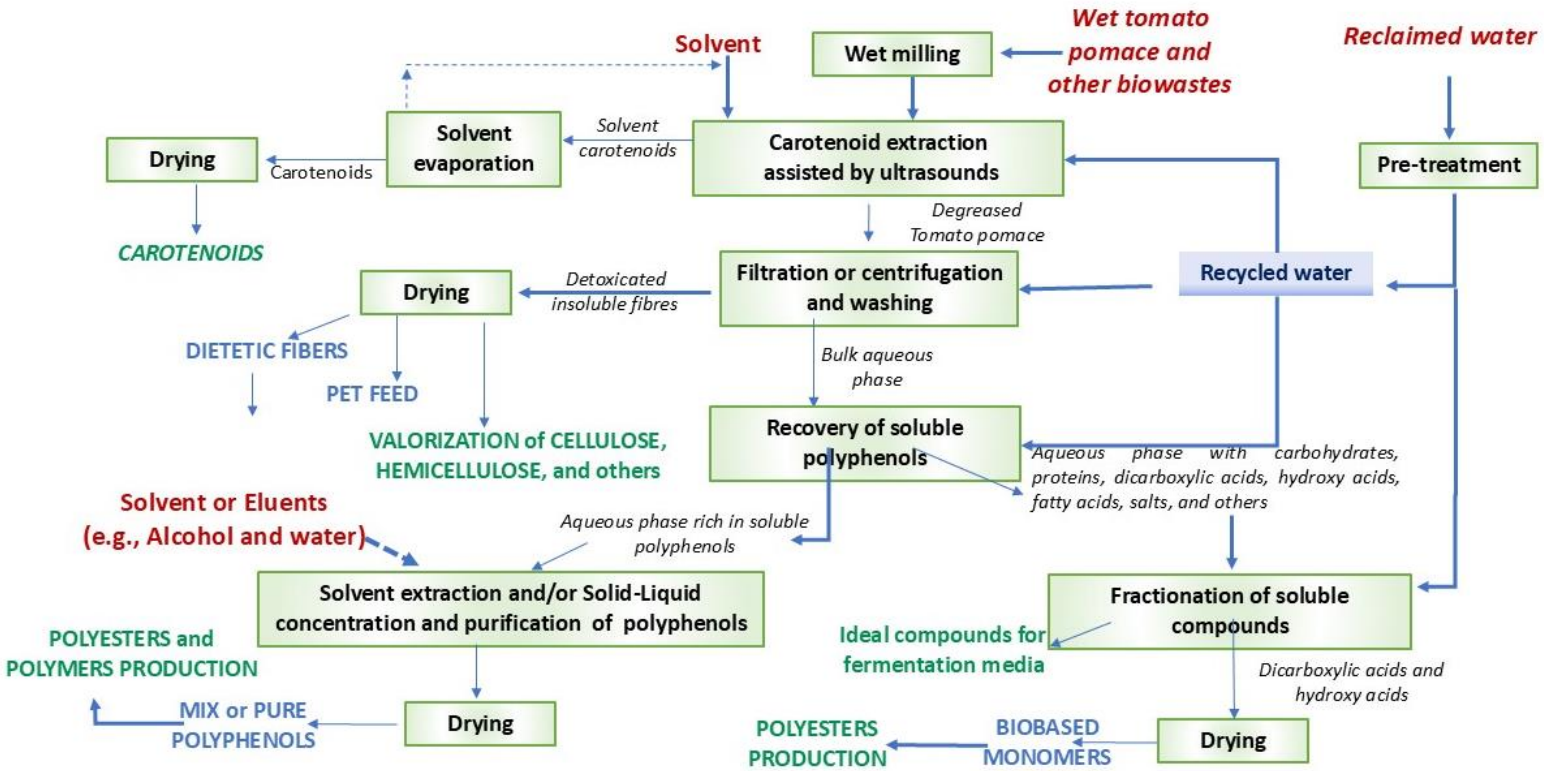
Extraction of functional and bioactive compounds from subproducts of TOMATO processing and their valorisation into high-value products



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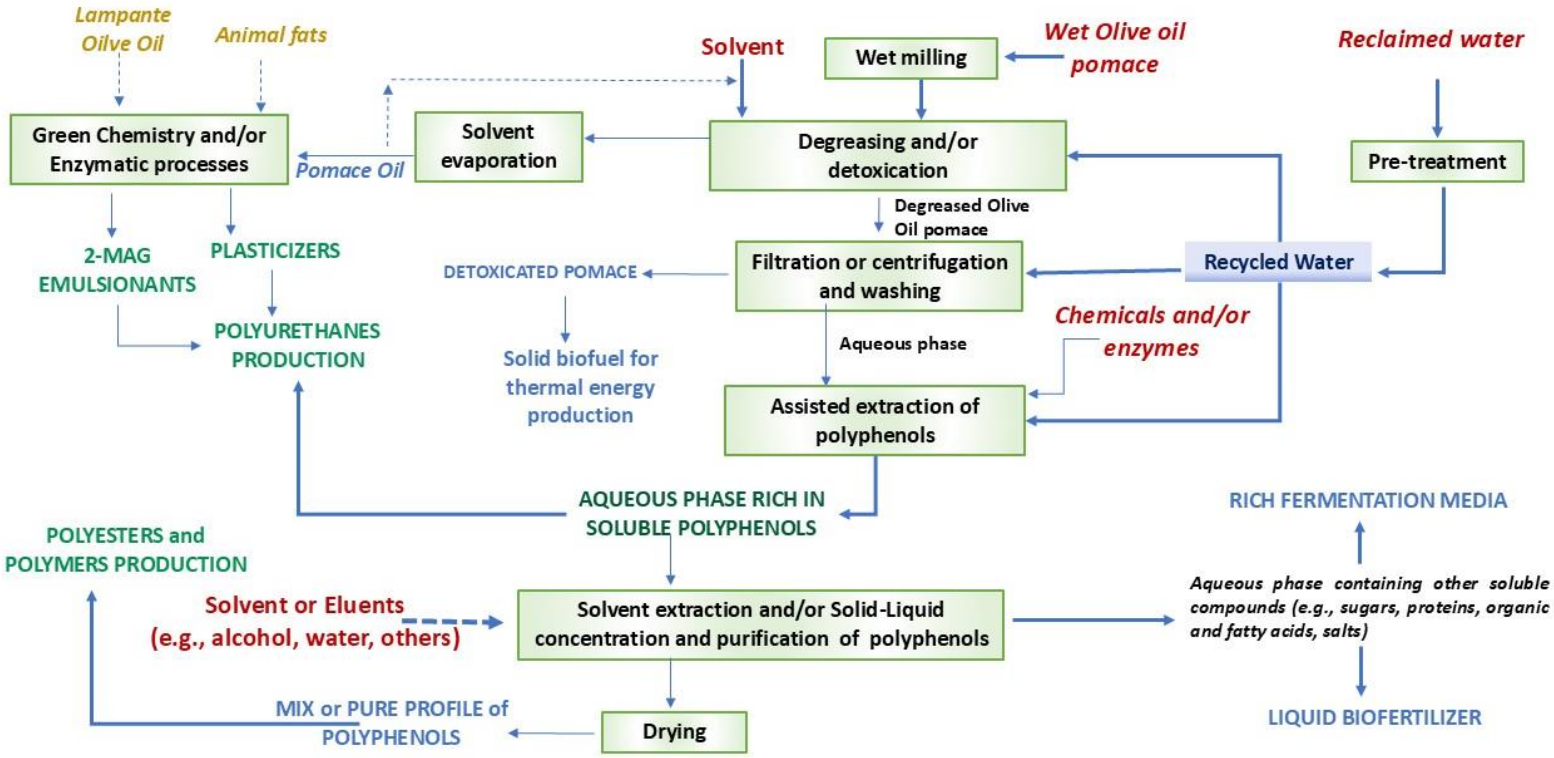
Extraction of functional and bioactive compounds from subproducts of OLIVE OIL processing (pomace and stones) and their valorisation into high-value products



WP2 – Task 2.2.1

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Subtask 2.2.1: Extraction of functional chemical compounds and characterization from skin and seeds of tomato and olive oil biowastes

Leader: **IST-ID, IDENER [M1 – M30]**

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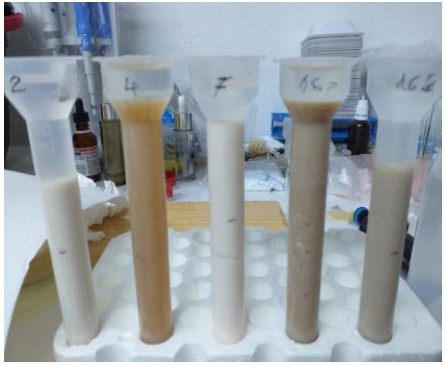
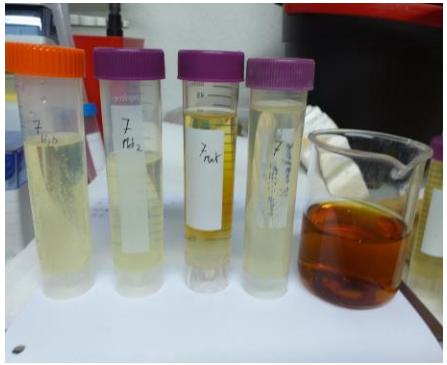
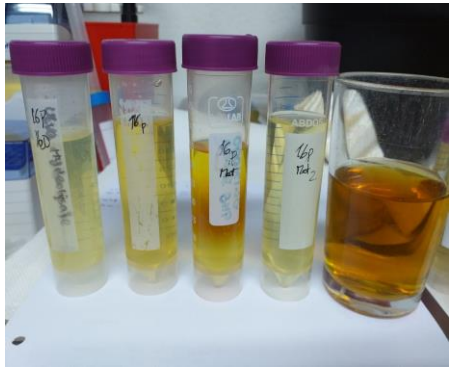






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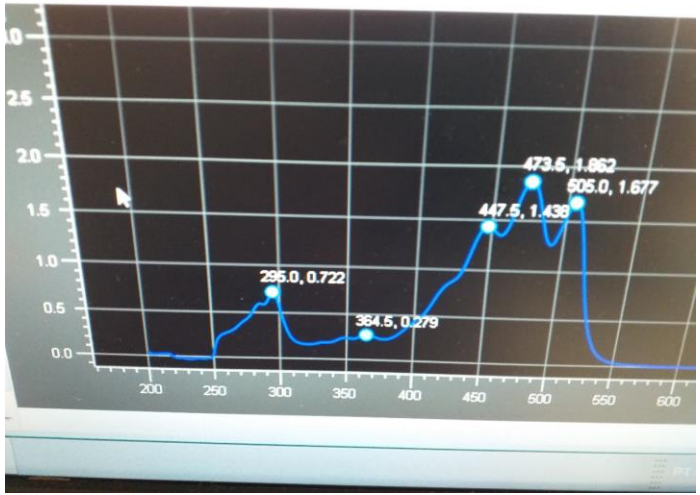

High purity of carotenoids (e.g.: lycopene)

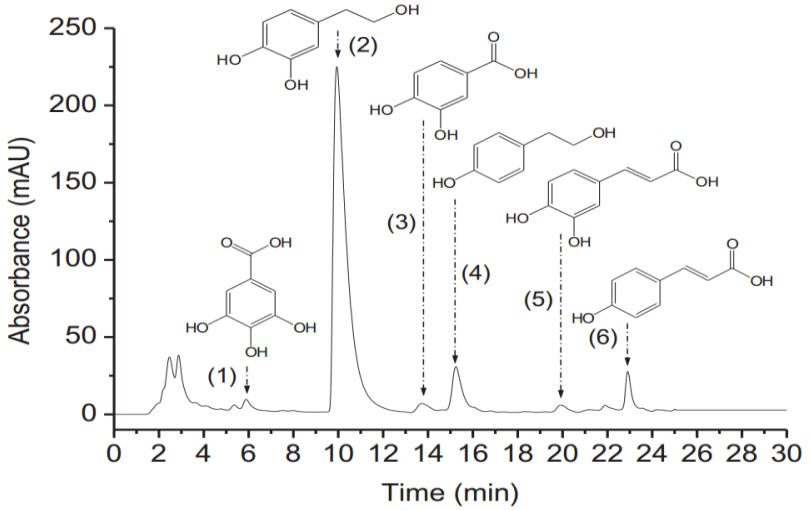

Figure. Chromatographic profile of polyphenols extract: (1) Gallic acid, (2) Hydroxytyrosol, (3) 3,4-Dihydroxybenzoic Acid, (4) Tyrosol, (5) Caffeic Acid and (6) pcoumaric Acid.

Polyphenol compounds profile extracted from Olive pomace

Funded by the European Union

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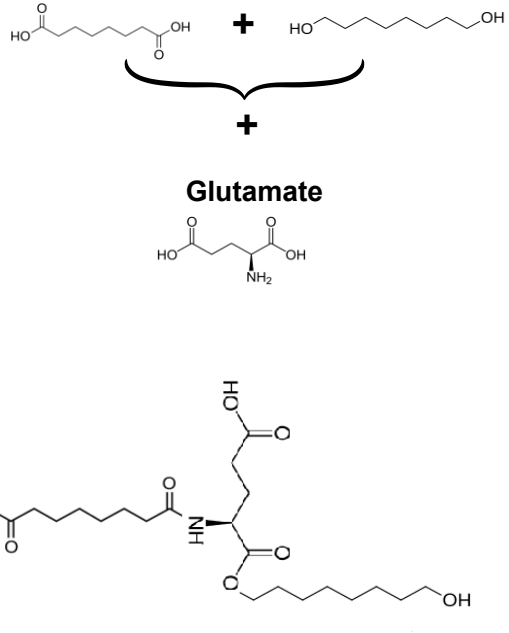
Task 4.1 Synthesis of building blocks and bio-based polymers

Polyesteramide Synthesis – Incorporation of α-aminoacids

Suberic Acid + **Octanediol** + **Glutamate**



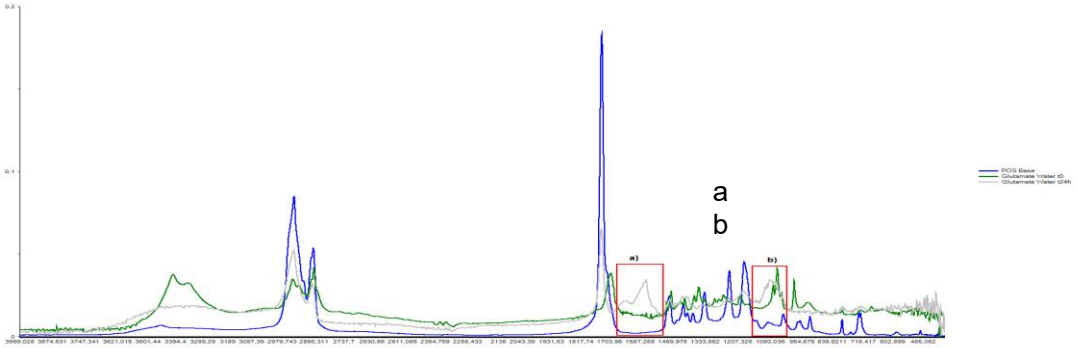


Figure - FTIR spectra of glutamate-based polyesteramide reactions showing potential amide bond formation regions (a, b)

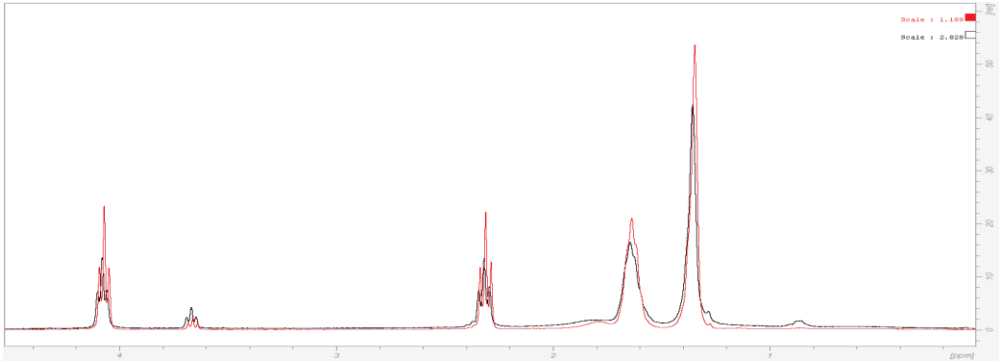


Figure - 1H NMR spectra overlay of glutamate-based polyesteramide reaction with standard POS showing structural characterization

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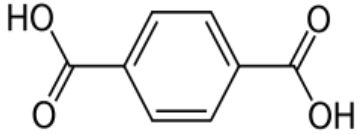
Task 4.1 Synthesis of building blocks and bio-based polymers

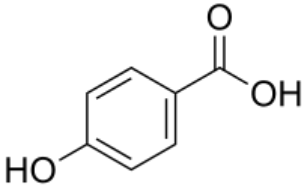
Synthesis of semi-aromatic polyesters via Biocatalysis in water, miniemulsions, solvente-free

Running work

Terephthalic Acid (TA)

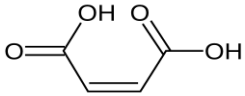


4-hydroxybenzoic Acid (4HBA)

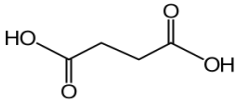


Hydroquinone (HQ)

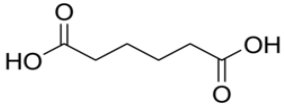
Dicarboxylic Acids



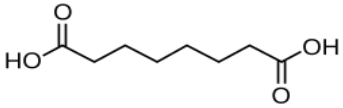
Maleic Acid



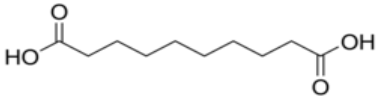
Succinic Acid



Adipic Acid

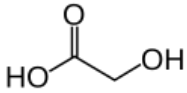


Suberic Acid



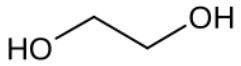
Sebacic Acid

Hydroxy Acids

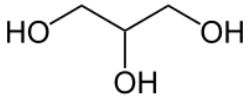


Glycolic Acid

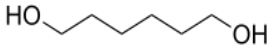
Diols / Polyols



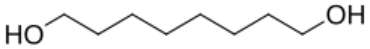
Ethylene glycol



Glycerol



1,6-hexanediol



1,8-octanediol

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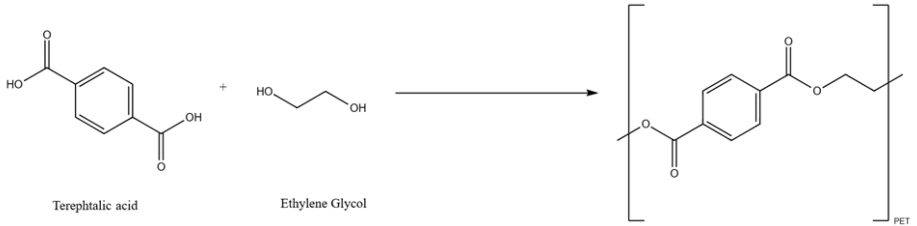
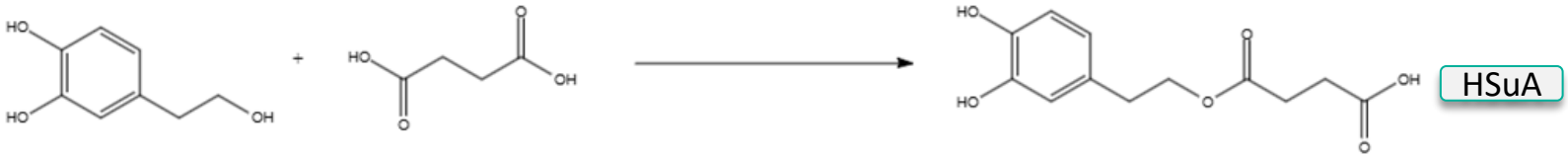
AI and Digital Tools

Modeling and simulation of polymer and polymeric prototypes

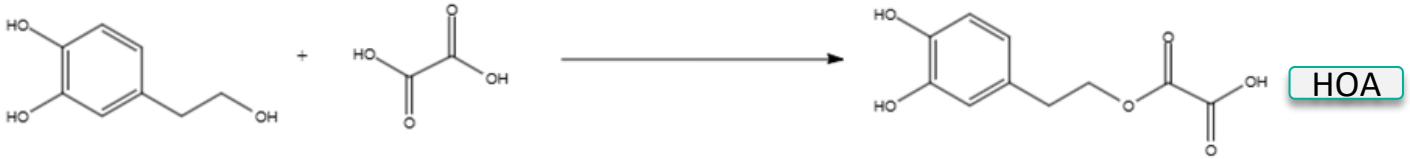
Molecular Dynamic Simulation - Polymers



PET



HSuA



HOA

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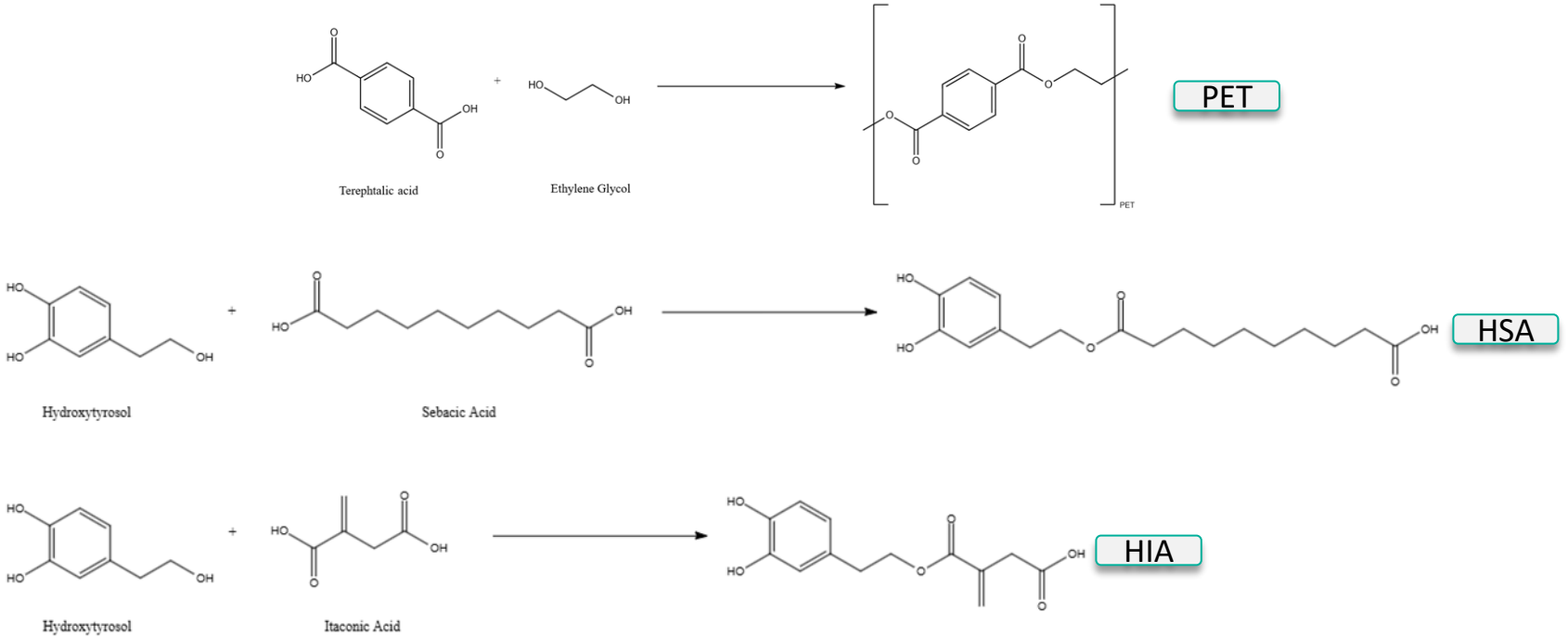
Modeling and simulation of polymer and polymeric prototypes

Molecular Dynamic Simulation - Polymers



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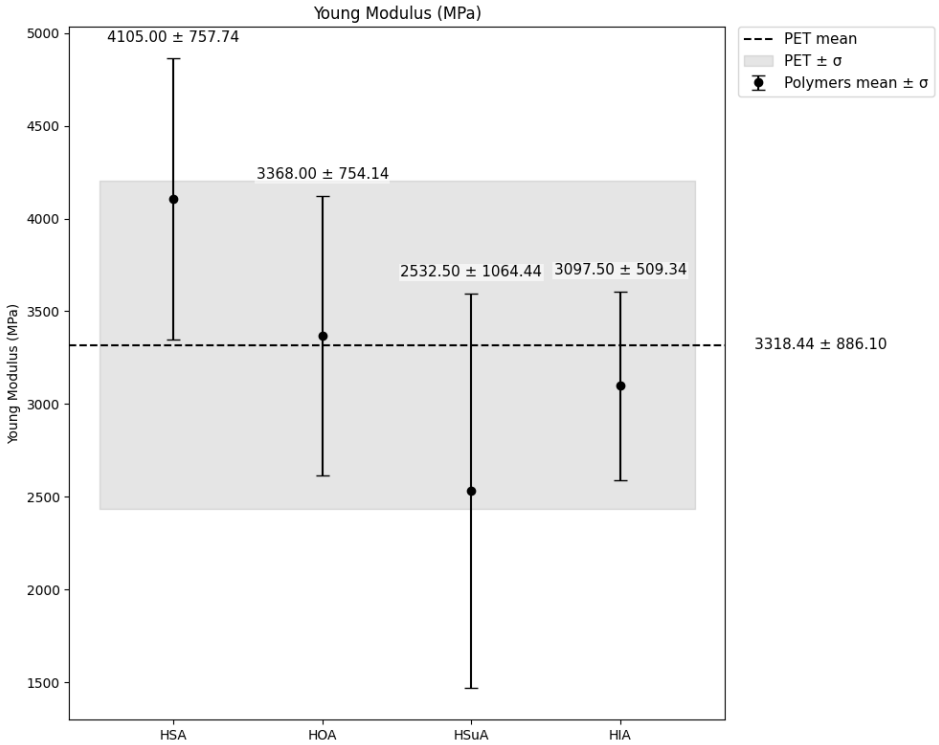
AI and Digital Tools

Modeling and simulation of polymer and polymeric prototypes

Molecular Dynamic Simulation - Results

Young Modulus(MPa)



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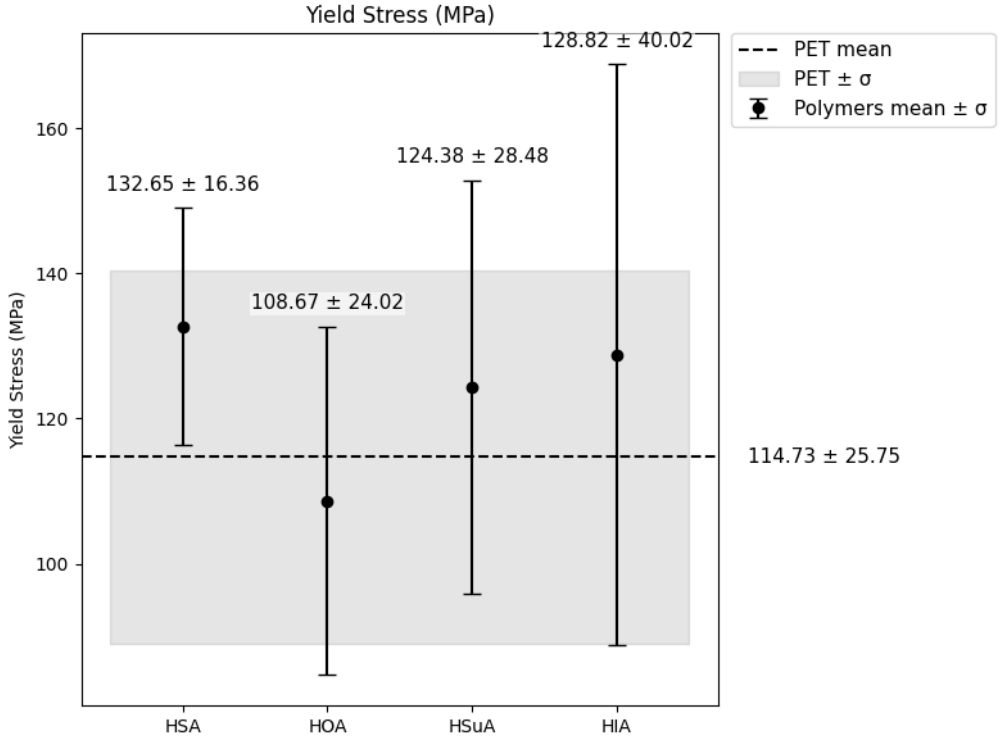
AI and Digital Tools

Modeling and simulation of polymer and polymeric prototypes

Molecular Dynamic Simulation - Results

Yield Stress (MPa)



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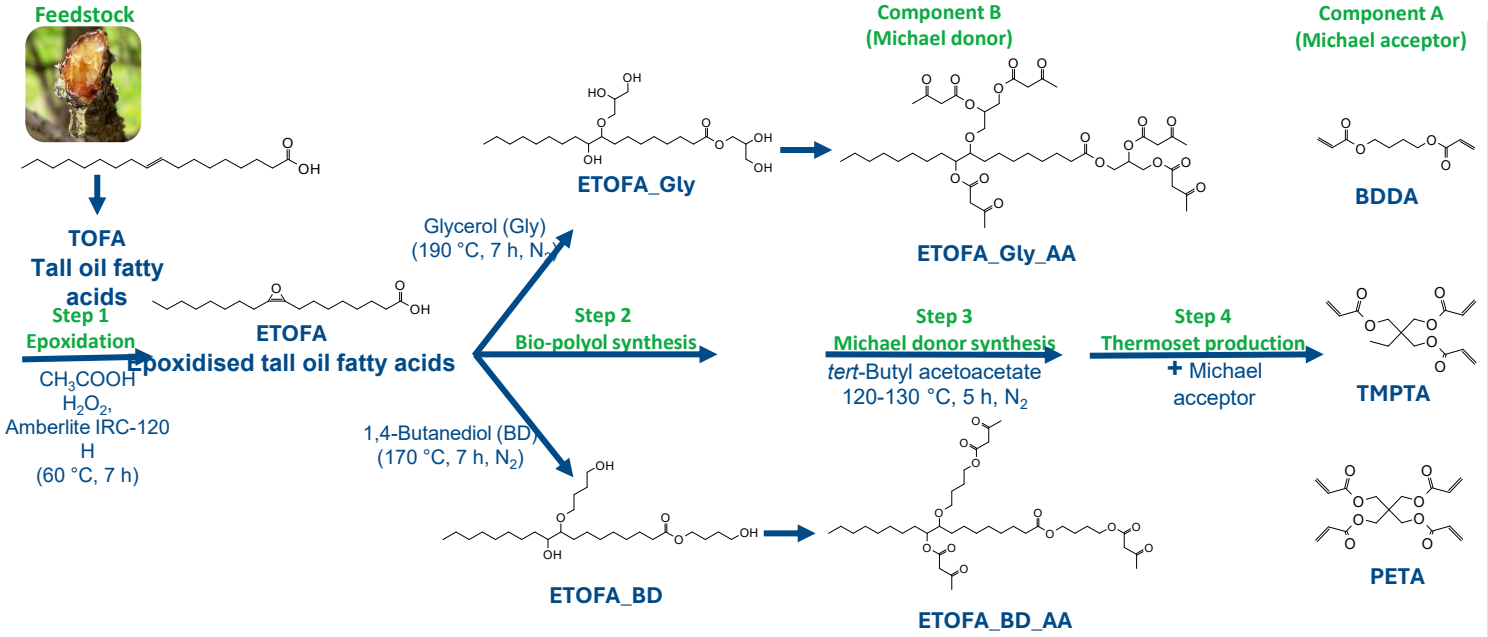
Thermoset development from the wood processing side stream



WP4 - T4.2

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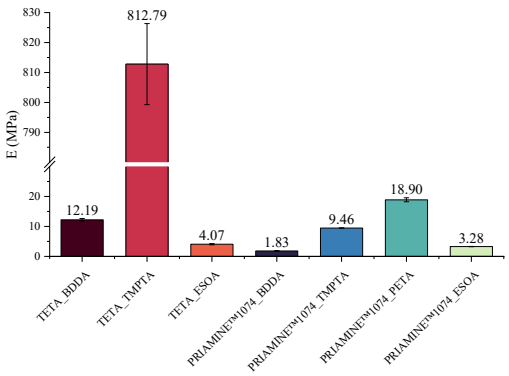
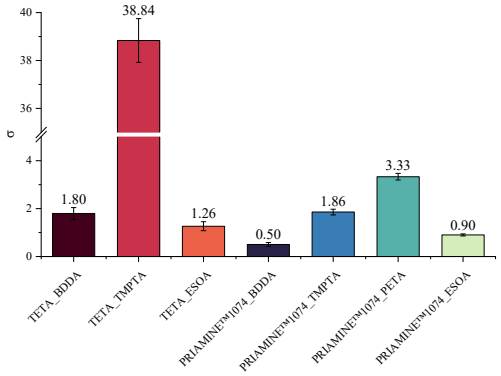
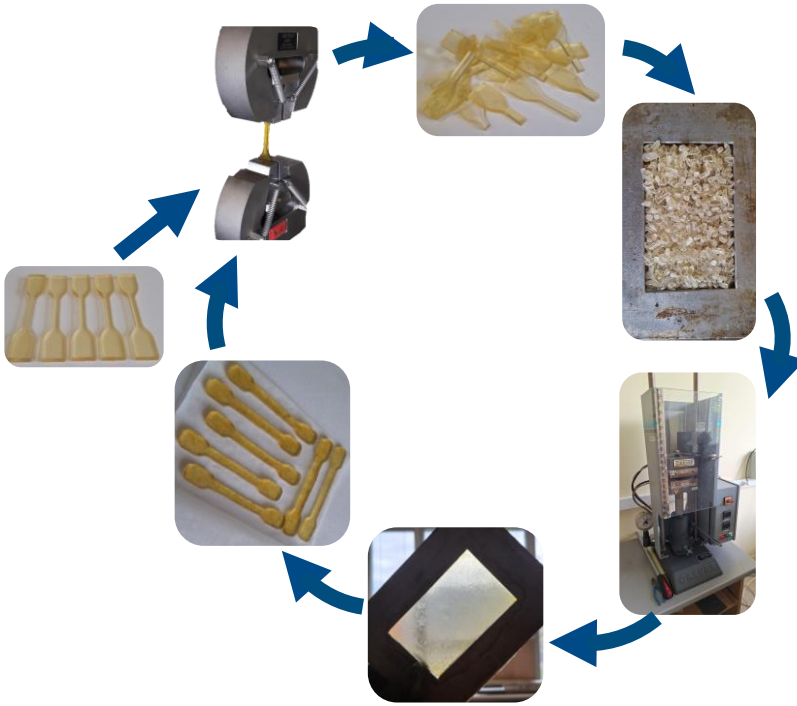
Recyclabe bio-based thermoset resin development

Bio-based carbon content for thermoset resins

Amine	Acrylate				Variations of io-based components in formulations
	ESOA	BDDA	TMPTA	PETA	
Priamine™1074	-	64.3%	64.3%	67.9%	Priamine™1074 is 100% (According to ASTM D6866 and EN 16640)
	90.3%				Amine+ ESOA, assuming it contains 3 non-bio acryl groups
	100%				Amine + ESOA synthesized with bio-oacrylic acid







Increase in mechanical properties with an increase in crosslinking density

WP4 - T4.2

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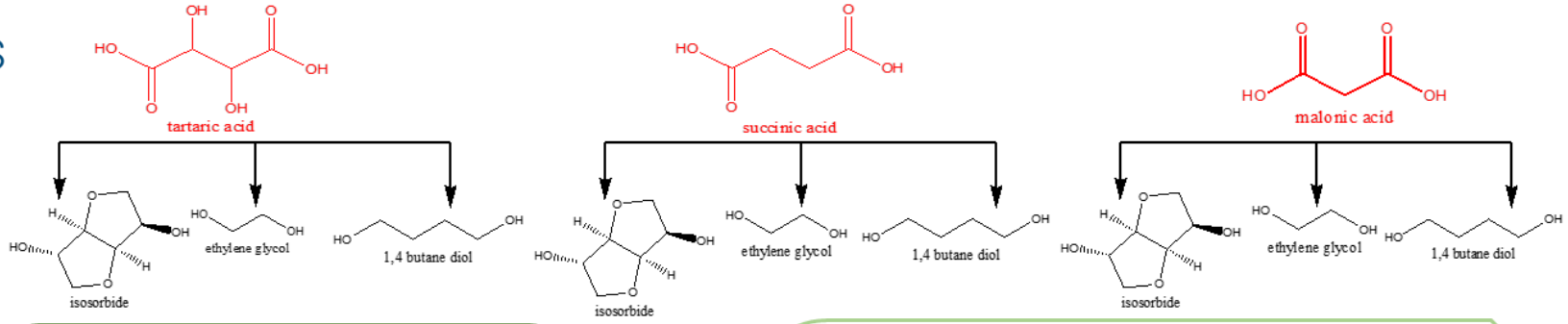
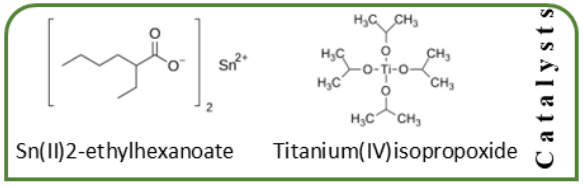
Combination of 3 acids, 3 diols and 2 catalysts





The amount of added catalyst was 1 wt%.

The molar ratio between monomers was 1:1 mol/mol

Reaction time for polyesters based on tartaric acid was **3min**; on the base of succinic acid **15min**; and on the base of malonic acid **20min**.

RESULT - 56 successful samples of polyesters

Advantages of microwave-assisted synthesis

- **Time-efficient –** reactions complete within 5 to 30 minutes, significantly faster than conventional methods.
- **Eco-friendly & waste-free –** minimal or no waste (solvent freee), aligning with green chemistry principles.
- **Economical –** Reduces costs related to energy consumption, solvents and reaction time.
- **Improved yields and purity –** Results in higher yields and fewer by-products.
- **Energy-saving –** requires less energy due to shorter reaction times and direct heating.

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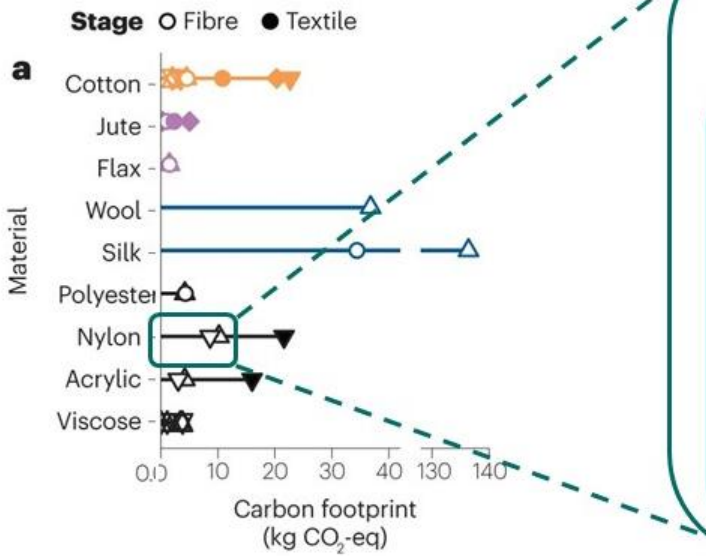
Reduce Environmental Impact of Polyamide



A Complete Method for Sustainable Transformation

Monomer

Production from Bio-Waste

=>Positive carbon Footprint

Polymerization

Green Synthesis

Electrified and green Solvent

=>Zero carbon Footprint

Processing

Eco-Conscious

Reduces heating / melting cycles

=>Reduce carbon Footprint

Z. Zhang, *et al.*, *Nat Rev Earth Environ*, **2023**, *4*, 703–715

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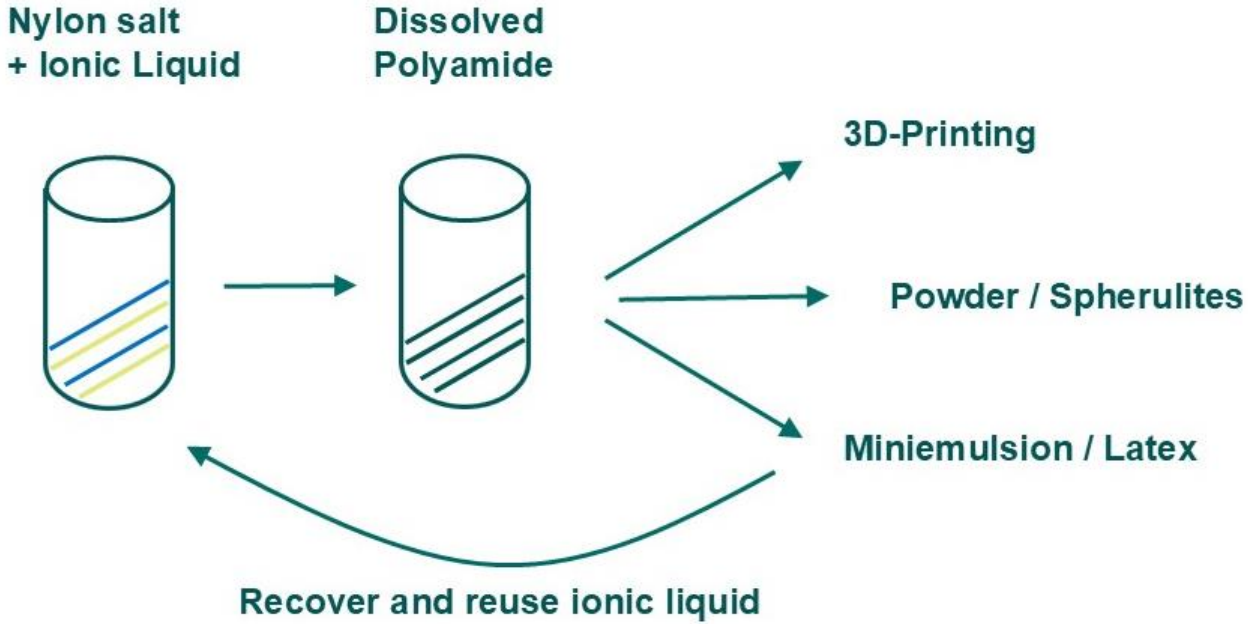
Microwave-assisted Green Polymerization & Processing

Polymerization

- Homogenous & rapid < 1min
- Directly from nylon salt (6,6)

Processing

- Low temp. blending
- Fiber production
- Thin film production
- Analysis (GPC)



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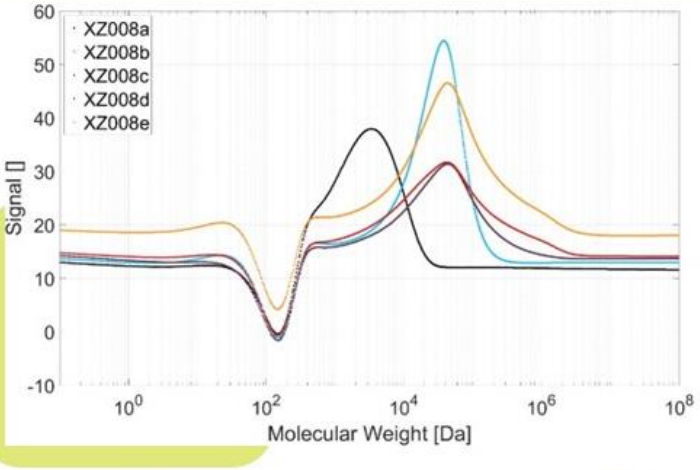
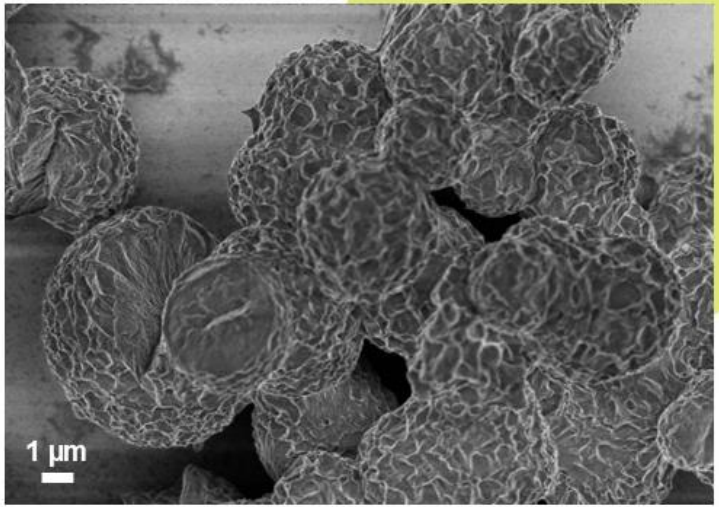
Optimize Synthesis & Processing Parameters

- Increase the higher molecular weight fraction
- Reduce particle size distribution
- Ensure steady fiber production





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ECOSYSTEX Member Project

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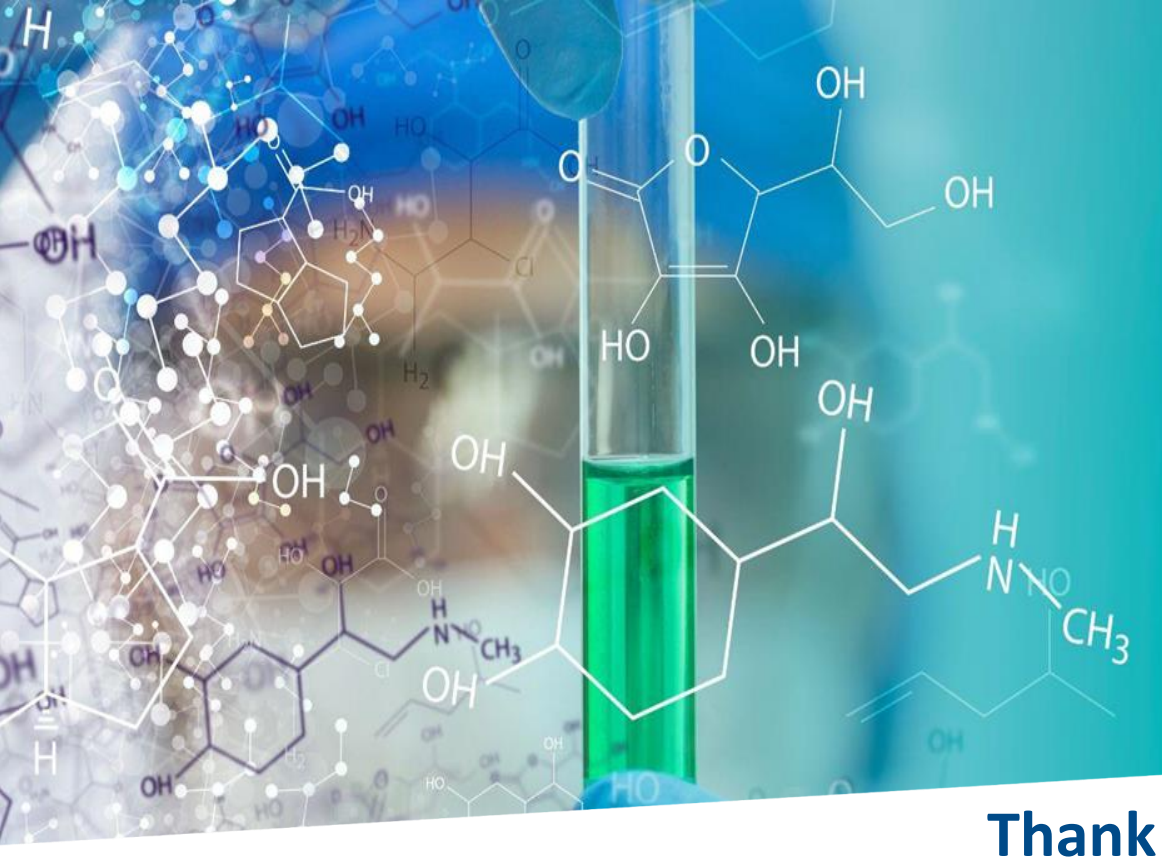

5B POLYMERS

Thank you for your attention

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https://polymers-5b.eu/

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