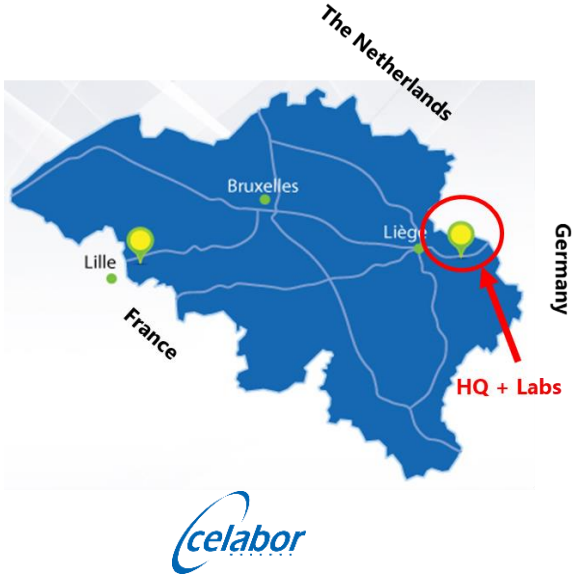
Your multi-skilled scientific and technical partner

Expertise – Quality – Speed – Confidentiality

CELABOR scrl. is a Belgian scientific and technical center located in Wallonia

As an **SME** accredited ISO 17025 by BELAC**,** CELABOR is offering scientific and technical support to companies involved in all sectors of **circular-economy** and **bioeconomy** including agri-food, green processes, packaging, textile and environment.



- **A multidisciplinary team of 50 people**
  Scientific backgrounds (PhD, Engineers, Masters, Bachelors…)
- **Activities**
  Testing & analyses / R&D

Four departments in the heart of the bioeconomy sectors

Environment	Extraction	Materials	Food
Testing & Analyses: Analytical analyses of - **water samples** (industrial effluents, surface water) - **waste samples** (sludges, composts, biocombustibles …) **R&D** Developments of new analytical methods depending on new legislation and/or industrial needs **Life cycle analyses** for new products and process	**R&D:** **Extraction**, fractionation and purification of **high value biomolecules** (antioxidants, fatty acids, proteins, etc…) from various feedstocks (e.g., woody & lignocellulosic residues, biopolymer team) Characterizations of extracts (HPLC-DAD, GC-MS-MS, ICP-MS	**Testing & Analyses:** Textile, Packaging, paper **Barrier** properties of packaging (OTR, WVTR CO2 TR) **Physicochemical properties** (sealing, adhesion, mechanical…) **Food contact approval** (migration tests) **Paper/cardboard characterization** CEPI-CTS > 60 tests, paper recyclability **R&D:** Production and functionalization of (nano)cellulose and nano(chitin) + materials	**Analyses and Expertise:** Chemical analyses in **food and feed** : Nutriments Contaminants Additives Specific parameters for oxidation monitoring (…) **Shelf life extension** by non thermal technologies (High Pressure Processing) Improvement of food stability, accelerated ageing tests

Biomass valorization platform ⟷

Effect new packaging on expiration date ⟷

Flexible Pilot Platform for Biomass Valorisation

Green extraction & purification platform for biomolecules recovery

Advanced biopolymers production & green functionalization

From a selected **biomass** ...

Extraction department

Extraction and purification of **biomolecules** → building blocks - bioadditives

Biopolymer and fiber extraction → Lignin, cellulose, hemicellulose, chitin, proteins…

Fiber processing and **functionalization** → nano fibrillated products

Green surface modifications → functional surface

material department

… to **Application sectors**

cosmetic
packaging
pharmaceutic
food
building
textile
feed
nutraceutical

Barrier coating for fibre-based packaging

Oxygen barrier

Water vapor barrier (water resistance)

Grease (oil) resistance

Funtional Barrier (Food contact)

While keeping recyclability (harmonised recyclability tests)

Active fibre-based packaging

Antimicrobials, antioxidant, water absorbing properties…

Medium-long time development

Based on biopolymer extracted from biomass waste

(Ligno)cellulose, chitin, lignin…)

Eventually structurally and/or chemically modified (nanofiber)

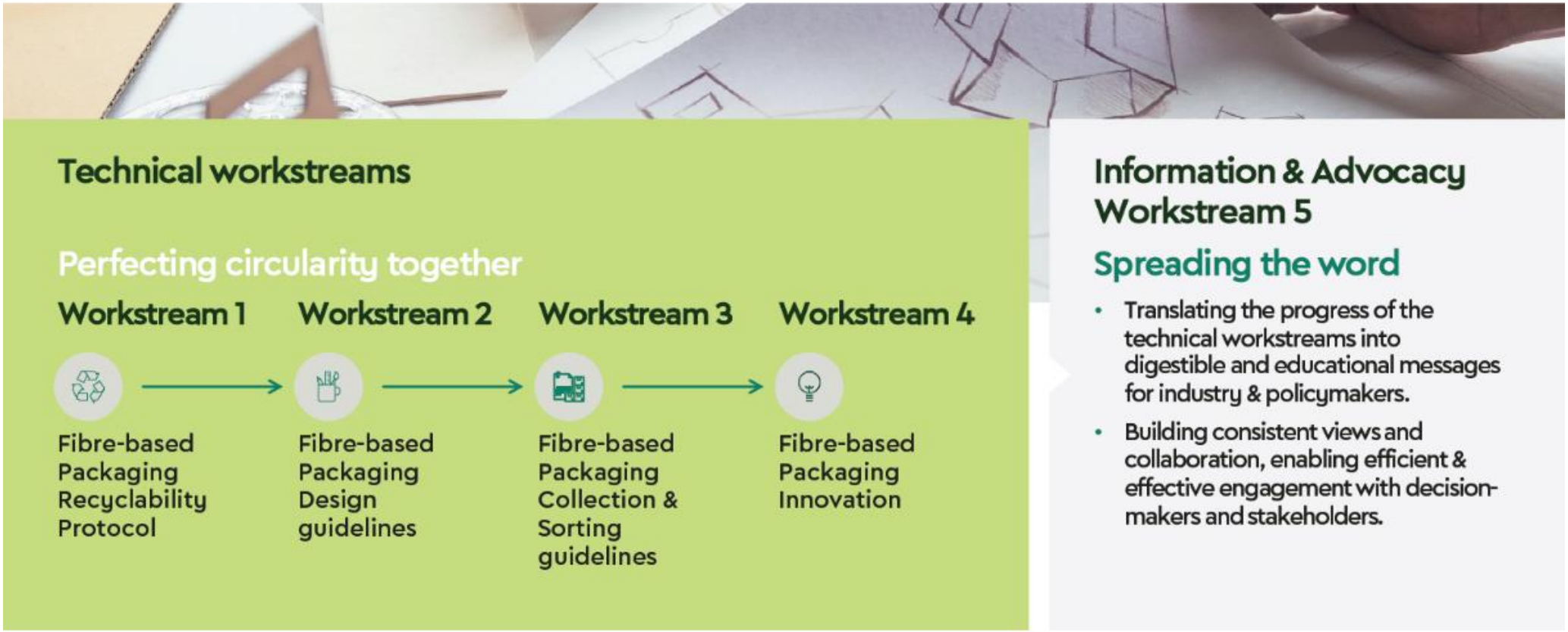
Bio-based Industries Consortium

BIO-BASED INDUSTRIES Public-Private Partnership

Horizon 2020
European Union Funding
for Research & Innovation

Perfecting circularity in fiber-based packaging

4evergreen workstreams



Technical workstreams

Perfecting circularity together

Workstream 1	Workstream 2	Workstream 3	Workstream 4
Fibre-based Packaging Recyclability Protocol	Fibre-based Packaging Design guidelines	Fibre-based Packaging Collection & Sorting guidelines	Fibre-based Packaging Innovation

Information & Advocacy Workstream 5

Spreading the word

- Translating the progress of the technical workstreams into digestible and educational messages for industry & policymakers.
- Building consistent views and collaboration, enabling efficient & effective engagement with decision-makers and stakeholders.

prospects | 15

Celabor is willing to join initiative for the introduction of European project

Horizon Europe calls

Don’t hesitate to contact me

Dr. Jean Michel Thomassin
Project leader
Materials department (Textile, Packaging and bio-sourced applications)

Email : jmt@celabor.be

LaMPo
Laboratory of Materials and Polymers

LaMPo
Laboratorio Materiali e Polimeri

Marco Aldo Ortenzi, Ph.D.

POLYMERS AND POLYMERIC MATERIALS

COMPOSITE MATERIALS

WHAT IS LaMPo?

LaMPo IS UNIVERSITY OF MILAN'S REFERENCE LABORATORY FOR POLYMERS AND POLYMERIC MATERIALS

IT HAS BEEN CREATED BY THE DEPARTMENT OF CHEMISTRY TOGETHER WITH 3 OTHER DEPARTMENTS HAVING EXPERTISE IN THE FIELD

DEFENS
DEPARTMENT OF FOOD, ENVIRONMENTAL AND NUTRITIONAL SCIENCES

DIPARTIMENTO DI CHIMICA

Dipartimento di Scienze della Terra "Ardito Desio"
UNIVERSITÀ DEGLI STUDI DI MILANO

Dipartimento di Scienze Farmaceutiche - DISFARM

LAMPO Core Business

The core businness of LaMPo is

HIGH LEVEL R&D CONSULTING

Synthesis
Control of molecular architecture
Scale Up (up to some Kg) of the process

R&D on polymeric materials

Precursors - Monomers
Additives-Masterbatches
Polymers
Composite Materials

Technical-Analytical Counseling

Alternative Formulates
New Products
Optimisation on existing products

Development on alternative additives

Search for alternative distributors
Quality test on the alternative additives provided

Commercial Counseling

LAMPO activities

1) ***Scientific Research***
2) ***Training of young graduates and specialized personnel***
3) ***R&D and services for companies***

RESEARCH

Network with other Departments and Labs

Grant requests with companies and other Labs

IP generation

TRAINING

Bachelor Training

Master Degree training

Specializing Training

Master Training

SERVICES

Synthesis/Characterization

Analytical Service

Counseling

R&D on request

Know Hows – **Characterisation**

LAB CHARACTERIZATION

- *THERMAL CHARACTERISATION*
- *MOLECULAR CHARACTERISATION*
- *RHEOLOGICAL CHARACTERISATION*
- *MORPHOLOGICAL CHARACTERISATION*

INDUSTRIAL CHARACTERIZATION

- *MECHANICAL CHARACTERISATION*
- *THERMAL CHARACTERISATION*
- *MATERIAL CHARACTERISATION*
- *COMPOSITION CHARACTERISATION*

Compounding and injection molding

Since the beginning of 2015, LAMPO has acquired a twin screw extruder (11 mm) and a Babyplast, for injection molding

Two feeders, suitable for industrial Glass Fiber and industrial polymers chips

Tmax = 450°C

L/D = 40

Injection molding of ISO 527-5A specimens, suitable also for PEEK and HT-PA

Know How– **Examples of case histories**

UNIMI Polymeric Materials team always works with an «industrial feseability» approach

Development of ***Technylstar® Rhodia*** Nylon

Study of **PLA** with **improved gas barrier** and **thermal properties**

Pre-existing Contract with Rhodia

Rhodia wants a nylon with lower melt viscosity and good mechanical properties

- Mathematical Modelation
- Lab scale development
- Pilot scale Development
- Industrial Production
- Patent defence vs Basf and Bayer

Know How– **PLA with low permeability to gas**

GRUPPO MOSSI & GHISOLFI contacts us for an interest in **PLA bottles**

Study of the issue «Permeability-mechanical properties»

Polymer	O_2	CO_2	H_2O
Nylon 6	**2.5**	**11**	**22**
PET	**5 - 9**	**15 - 25**	**1.8**
PVC	**5 - 20**	**20 - 50**	**2.2**
PLA	40	180	22
PP	**150**	**500 - 800**	**0.6**
LDPE	**350**	**1000 - 2000**	**1.4**
PS	**350**	**700 - 1500**	**7**

O_2 and CO_2 at 23 °C: cc(stp).mil/100in².day.atm
H_2O at 38 °C: gm.mil/100in².day

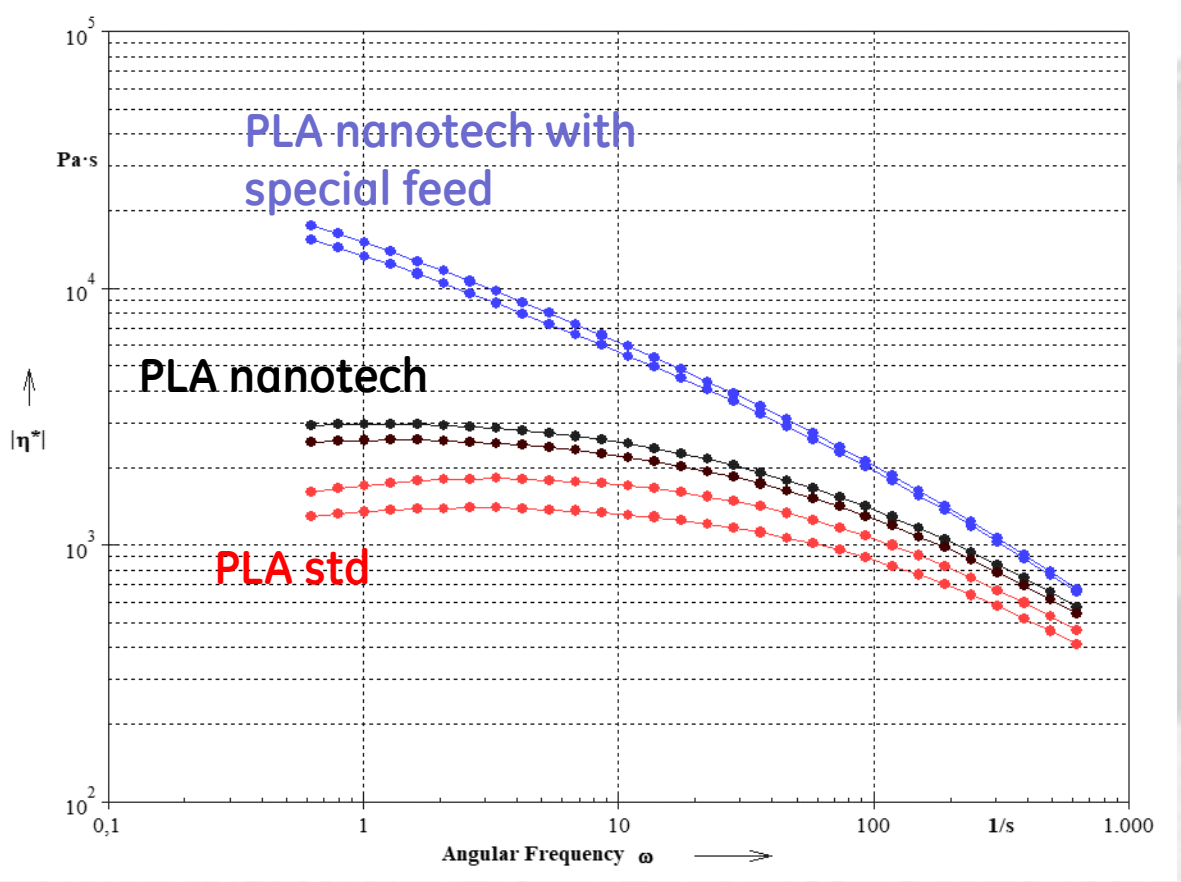
	PLA	GPPS	PET	PP
Tensile Strength, MPa	**53.1**	**45.5**	**58.6**	**35.9**
Elongation at Break, %	**4.1**	**1.4**	**5.5**	**350**
Tensile Modulus, GPa	**3.45**	**3.03**	**3.45**	**1.31**
Izod Impact, J/m	**16**	**21.4**	**26.7**	**48.1**
Glass transition temp., °C	**60**	**102**	**74**	**-20**
Melting Point, °C	**170**	**none**	**270**	**165**
Density, g/cm³	**1.25**	**1.05**	**1.35**	**0.9**

Ref: Peter Wollman,Natureworks, 28-06-2007, Alessandria

Know How– **PLA with low permeability to gas**

UNIMI starts an experimental research auto-funding the research

Pat. WO2013008156



For each sample 2 cycles at 180°C in N_2

Know How – **Low permeability PLA**

H_2O PERMABILITY DATA

CRYSTALLINITY INFLUENCE

PLA-N *(amorphous)*	4154,65 (g*µm)/(m²*day)	10,55 (g*mil)/100in²*day)
PLA–std *(Average cryst.)*	3767,12 (g*µm)/(m²*day)	9,57 (g*mil)/100in2*day)
PLA-std *(High cryst.)*	2796,51 (g*µm)/(m²*day)	7,10 (g*mil)/100in2*day)

PLA-CN *(low cryst.)*	**1560,4** (g*µm)/(m²*day)	**3,96** (g*mil)/100in²*day)

Development of polymers from renewable sources

Synthesis of PBAT copolymers

Improvement of ***Tg***

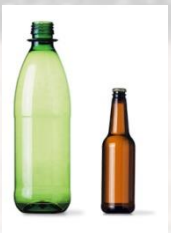
Lowering of ***Permeability***

Improvement of ***Mechanical Properties***

Packaging

Bottles

Textile Yarns



Know How – **Scientific Papers – PLA/CNC**

Since its foundation, about 50 scientific papers were published involving LaMPo expertise in different fields

Some examples with PLA – CNC (a total of 16 papers from 2013 to 2020)

Gazzotti, S.; Ortenzi, M.A.*; Farina, H.; Disimino, M.; Silvani, A., "Carvacrol- And Cardanol-Containing 1,3-Dioxolan-4-ones as Comonomers for the Synthesis of Functional Polylactide-Based Materials", Macromolecules, (2020), 53(15), 6420-6431 DOI: 10.1021/acs.macromol.0c01537

Ortenzi, M.A.*; Gazzotti, S.; Marcos Muntal, B.; Antenucci, S.; Camazzola, S.; Piergiovanni, L.; Farina, H.; Di Silvestro, G.; Verotta, L., "Synthesis of Polylactic Acid Initiated through Biobased Antioxidants: Towards Intrinsically Active Food Packaging", Polymers, (2020), 12(5), 1183 DOI: 10.3390/polym12051183

Fotie, G.*; Gazzotti, S.; Ortenzi, M.A.; Luciano Piergiovanni, L., "Implementation of High Gas Barrier Laminated Films Based on Cellulose Nanocrystals for Food Flexible Packaging", Applied Sciences, (2020), 10, 3201 DOI: 10.3390/app10093201

Gazzotti, S.; Todisco, S.A.; Picozzi, C.; Ortenzi, M.A.; Farina, H.; Lesma, G.; Silvani, A.*, "Eugenol-Grafted Aliphatic Polyesters: Towards Inherently Antimicrobial PLA-Based Materials Exploiting OCAs Chemistry", European Polymer Journal, (2019), 114, 369-379 DOI: 10.1016/j.eurpolymj.2019.03.001

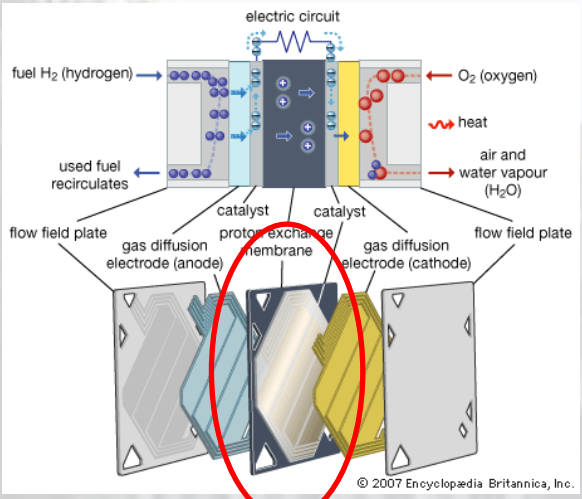
Gazzotti, S.; Farina, H.; Lesma, G.; Rampazzo, R.; Piergiovanni, L.; Ortenzi, M.A.*; Silvani, A. "Polylactide/cellulose nanocrystals: the in situ polymerization approach to improved nanocomposites", European Polymer Journal, (2017), 94, 173-184 DOI: 10.1016/j.eurpolymj.2017.07.014

Rampazzo, R.; Alkan, D.; Gazzotti, S.; Ortenzi, M.A.; Piva, G.; Piergiovanni, L.* "Cellulose Nanocrystals from Lignocellulosic Raw Materials, for Oxygen Barrier Coatings on Food Packaging Films", Packaging Technology And Science, (2017), 30, 654-661 DOI: 10.1002/pts.2308

Mascheroni, E.; Rampazzo, R.; Ortenzi, M.A.; Piva, G.; Bonetti, S.; Piergiovanni, L.*, "Comparison of cellulose nanocrystals obtained by sulfuric acid hydrolysis and ammonium persulfate, to be used as coating on flexible food-packaging materials", Cellulose, (2016), 23, 779-793 DOI: 10.1007/s10570-015-0853-2

Ortenzi, M.A.*; Basilissi, L.; Farina, H.; Di Silvestro, G.; Piergiovanni, L.; Mascheroni, E., "Evaluation of crystallinity and gas barrier properties of films obtained from PLA nanocomposites synthesized via "in situ" polymerization of L-lactide with silane-modified nanosilica and montmorillonite", European Polymer Journal, (2015), 66, 478-491 DOI: 10.1016/j.eurpolymj.2015.03.006

Synthesis of polymers for membranes for PMFC



Fluorine-based polymers are the state-of-the-art (ex. Nafion®)

Development of non fluorinated polymers

Improvement of operating T (>90°C)

Modulation of conductivity and water sorption

Possible use for biosensors

Know How – **Intrinsically Flame Retardant Polymers**

Development of non halogenated FR Polyamides

Patent WO2012080304
Patent WO2015000995

Patent Literature Search

↓

Synthesis of new special Polyamides

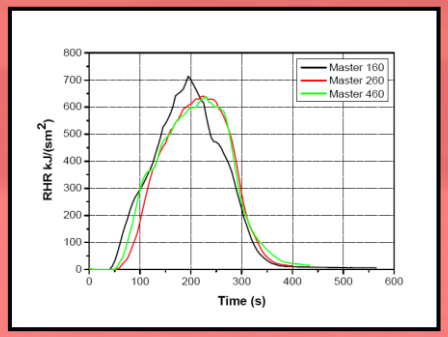
↓

Characterization of behaviour in **FR industrial tests**

UL-94 – *V0 at 3,2-1,6 - 0,8 mm*

GLOW WIRE – *OK at 960°C – 0,8 mm*

RHR



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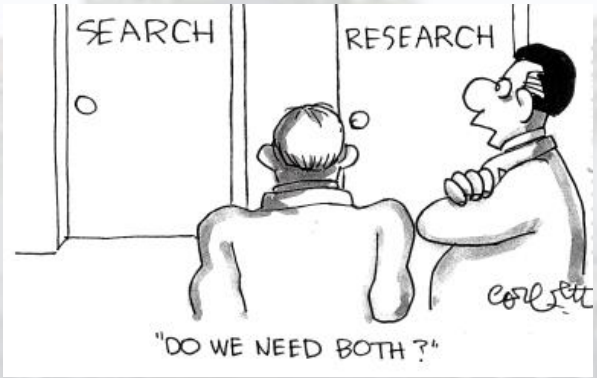

FRESH PRODUCE PACKAGING: RESEARCH AT ATB

Dr.-Ing. NAMRATA PATHAK

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DEPARTMENT OF HORTICULTURAL ENGINEERING
LEIBNIZ INSTITUTE FOR AGRICULTURAL ENGINEERING AND BIOECONOMY

EMAIL: NPATHAK@ATB-POTSDAM.DE

LEIBNIZ INSTITUTE FOR AGRICULTURAL ENGINEERING & BIOECONOMY POTSDAM, GERMANY (ATB)

- Non-university research institution
- ATB acts in close collaboration with universities, agriculture / horticulture industry
- Partner in National / International Networks
- Total budget of 27.9 Mio Euro (2018)

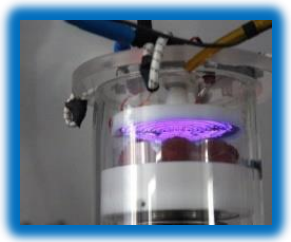
  - Core funding by Federal Government (50 %) and State (50 %)

  - Third-party funding of approx. 30 %
- Average 100 publications in international journals
- Excellent scientific infrastructure (labs, pilot plants, experimental fields)
- About 250 staff members

➢ 3 Research Programs:

Precision farming & livestock production


Quality & safety of food and feed

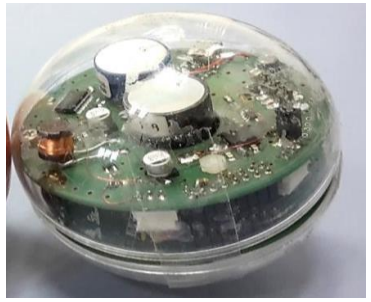
Material & energetic use of biomass

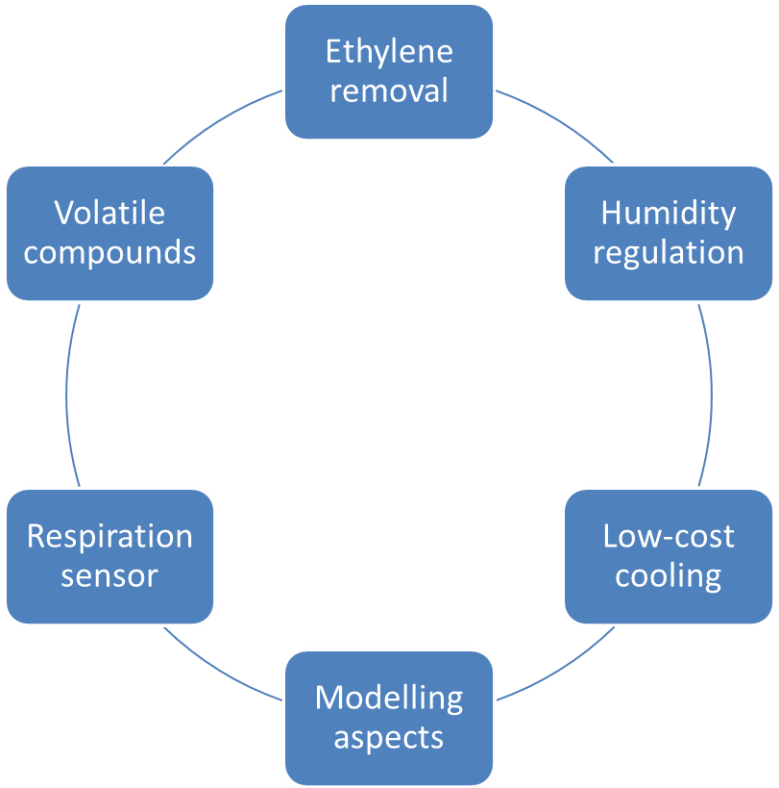

➢ 6 Scientific Departments:

Dept. Horticultural Engineering/ *Technik im Gartenbau*

- About 40 employees
- Physiological aspects
- Sensors for quality analysis
- Microbial aspects
- Packaging & storage


Packaging and Storage Group: Research areas



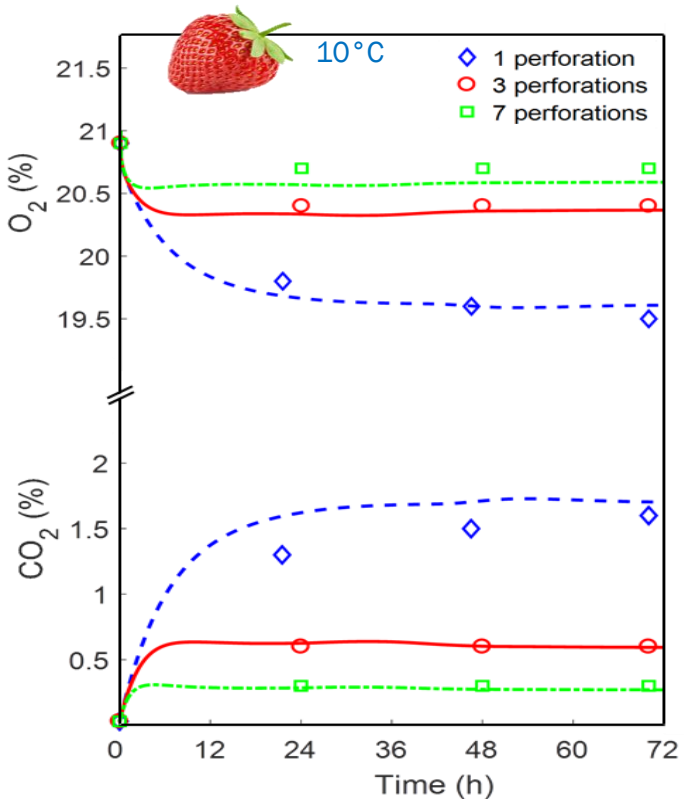


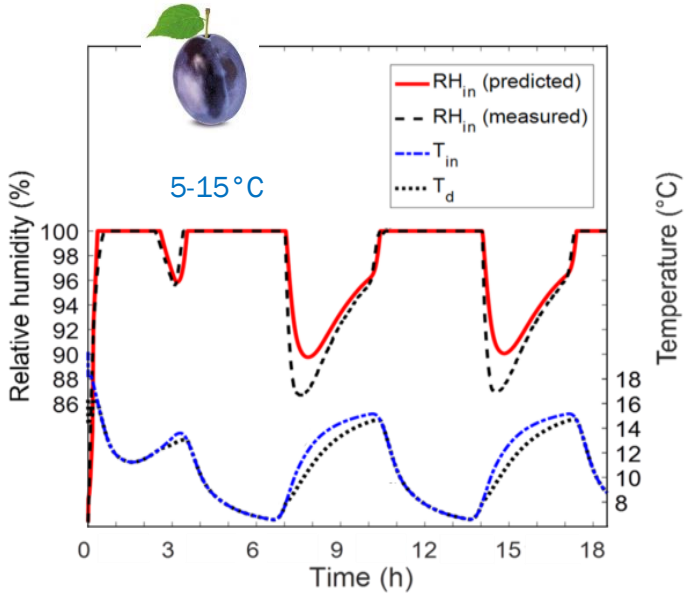
1. Maintain quality and improve shelf life of fruit and vegetables
2. Optimize packaging and storage along the supply chain

MODELLING

- Design packaging
- Predict shelf-life

To make sure O_2, CO_2 and humidity within optimal range.





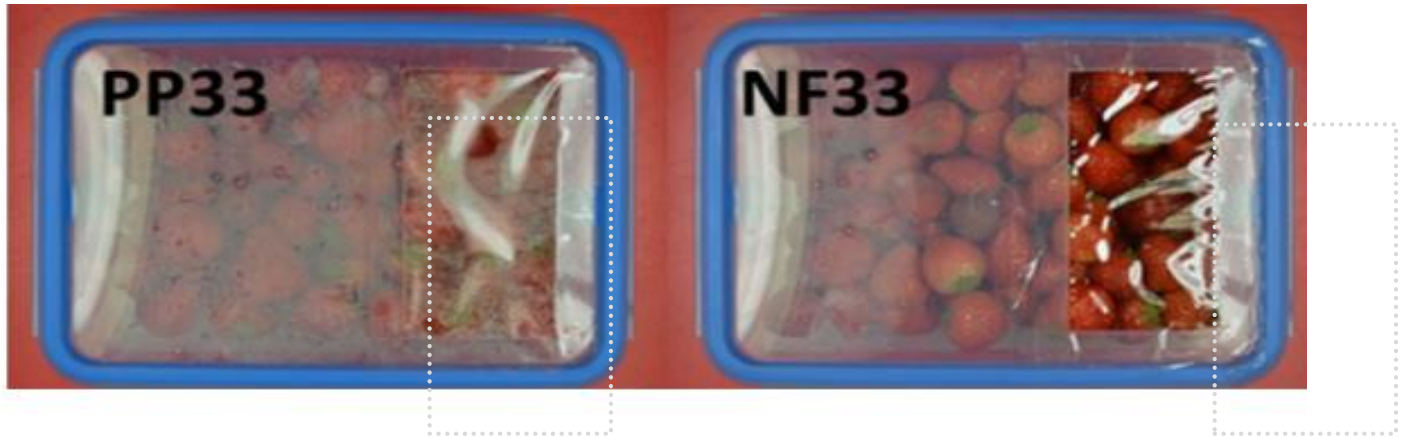
Jalali, Mahajan et al. (2017). Journal of Food Engineering, 206, 88-97

MODIFIED ATMOSPHERE AND HUMIDITY PACKAGING

Package with a window of highly permeable film

Low permeable film
PP Polypropylene

Highly permeable film
NF: Nature Flex

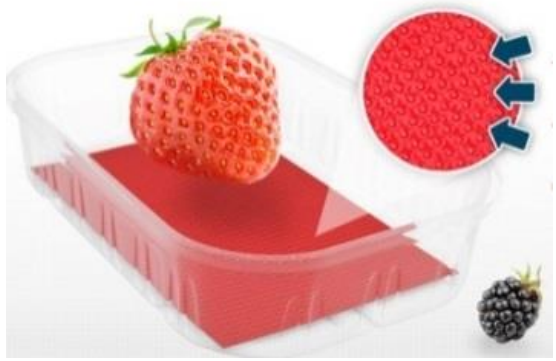


NatureFlex™ RENEWABLE & COMPOSTABLE FILMS

Xtend®

Inner layer: water vapor permeable

Use of humidity absorption pads/trays

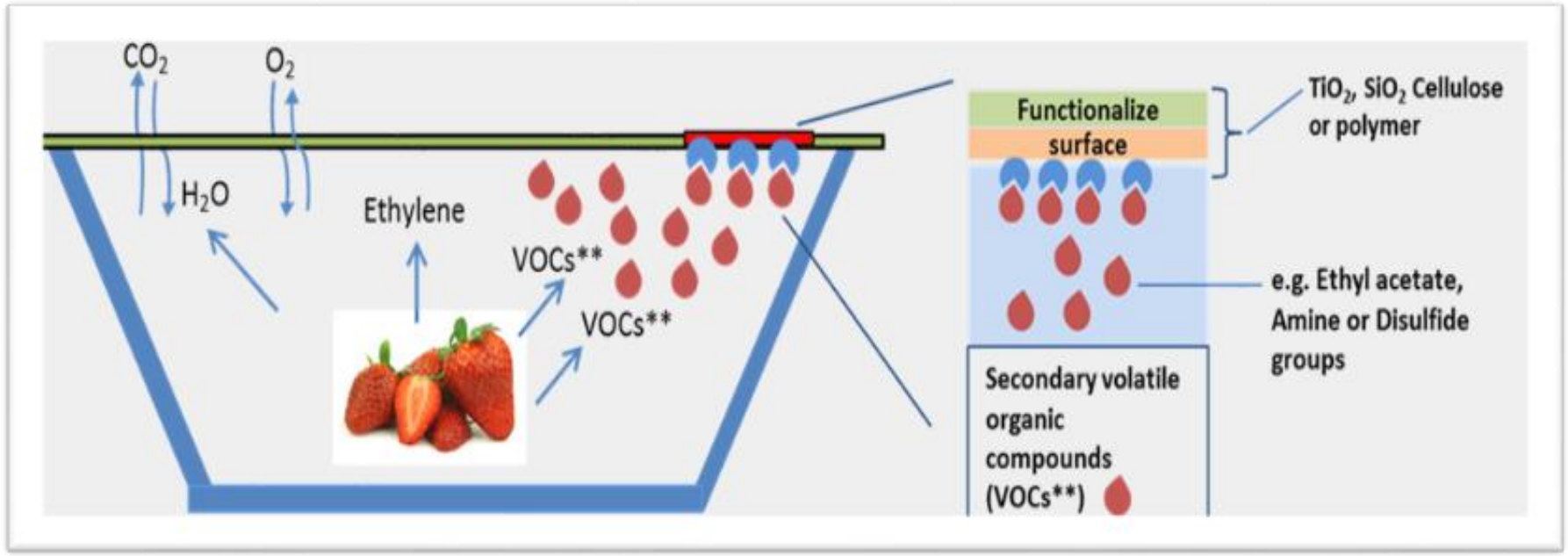


Active layer: hygroscopic NaCl

Outer layer: high barrier

ACTIVE PACKAGING

- For ethylene removal (Project FreshInPac)
- For selective volatile organic compounds (Project REMOPACK)

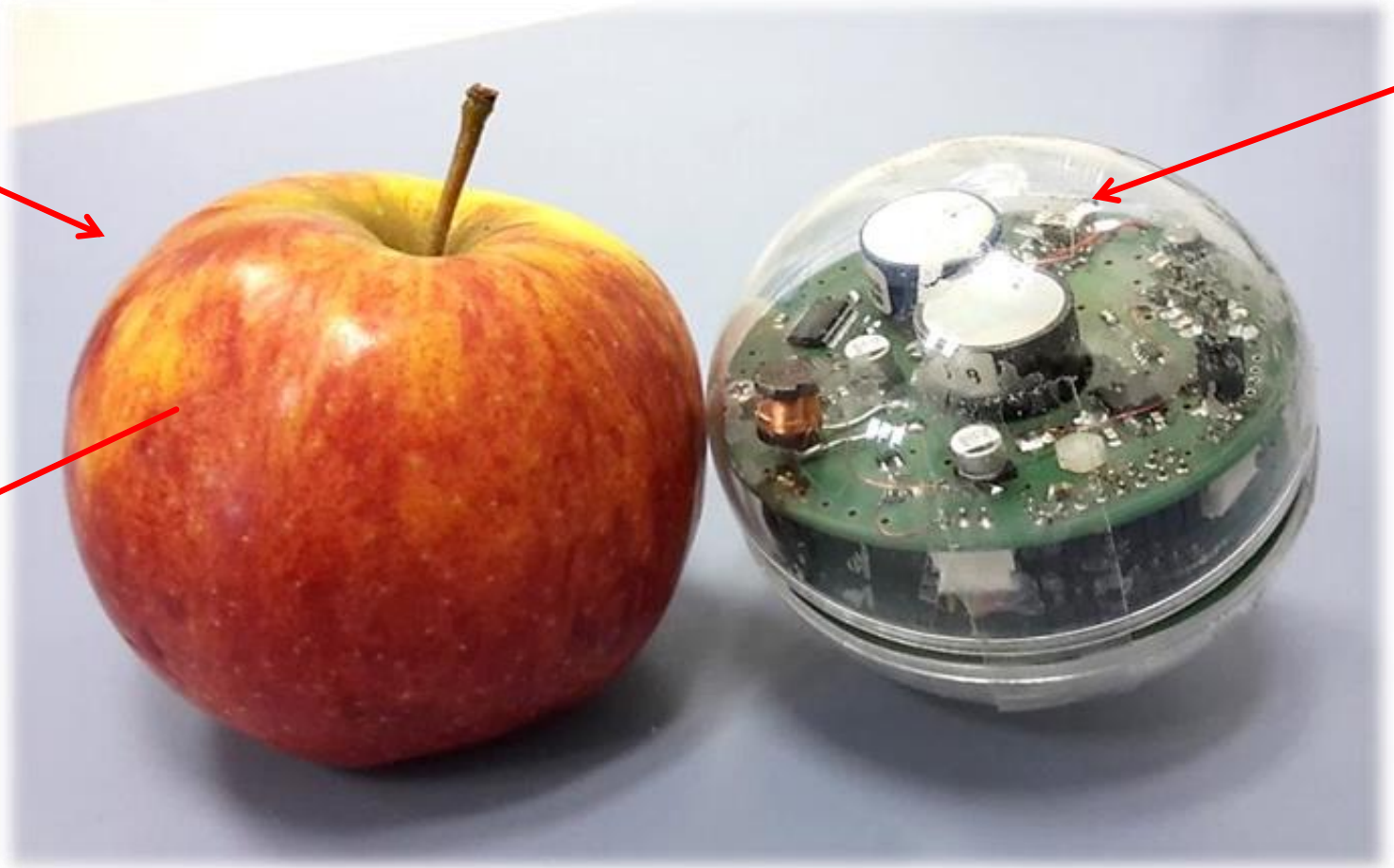


SENSOR DEVELOPMENT: TO MONITOR GAS CONCENTRATION

O_2

Respiration

CO_2



Sensor elements:

- ✓ O_2
- ✓ CO_2
- ✓ Temperature
- ✓ Humidity

Developed by ATB

- ✓ Everything together in one piece, standalone, & modular
- ✓ The entire unit is fitted into a plastic enclosure of 8.8 cm diameter

SENSOR

Features:

- Portable and versatile
- Fluorescence based optical O2 sensor (0-25%)
- Non-dispersive infrared (NDIR) absorption CO2 sensor (0-20%)
- Data memory
- Real time clock

Applications:

- Monitoring gas concentration
- Measuring respiration rate
- Development of a DCA system based on respiration quotient

Thank you for your attention

Excellence in Plastics

AIMPLAS

FEBRERO 2021

What is AIMPLAS?

A **technology centre** with more than 30 years' experience in the plastic sector.

Our Mission

Add value to companies to generate **wealth** and create **employment**.

Add value to society to improve quality of life and ensure environmental sustainability.

The Institute's Management Model

Associated companies

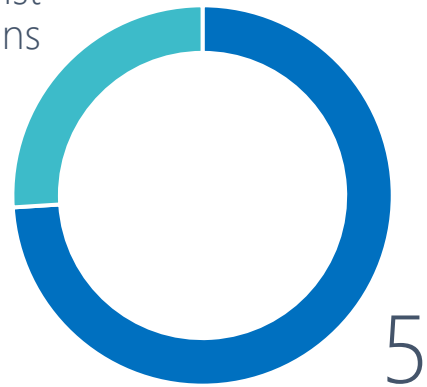
General Assembly

Governing Board

AIMPLAS

Our team is made up of more than **180 highly qualified professionals**

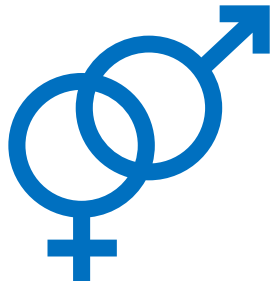
26% specialist technicians



56% university graduates

18 PhDs

62% women



38% men

average age: 39

2020 DATA

More than **10,500 m²** of cutting-edge facilities

- Pilot plants (6,000 m²)
- Laboratories (4,500 m²)

EUR **14.6**M

revenue

2,600+

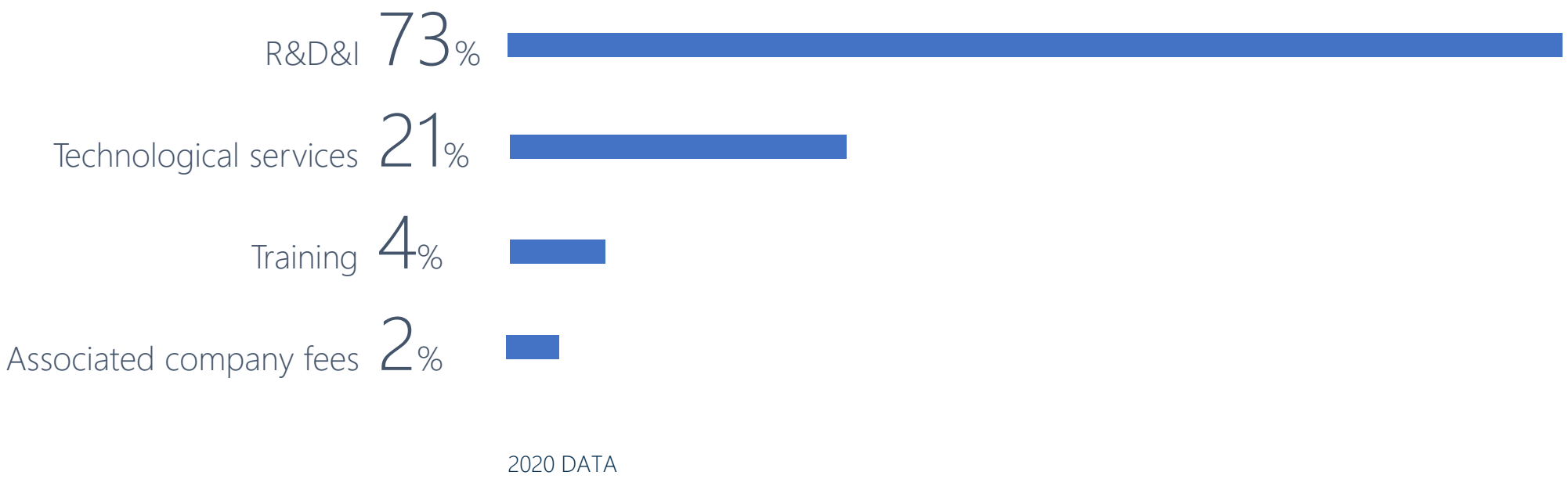
clients

700+

member companies

2020 DATA

Revenue by Activity



Market Orientation

Packaging

Construction

Automotive and transport

Recycling

Printing

Aeronautics

Agriculture

Electrical and Electronics

Energy

Health

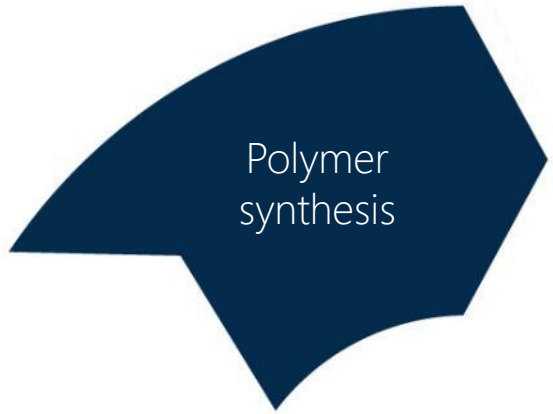
Navigation

Aerospace

Furniture

Sports and Leisure

Expertise across the entire plastics value chain



Raw materials

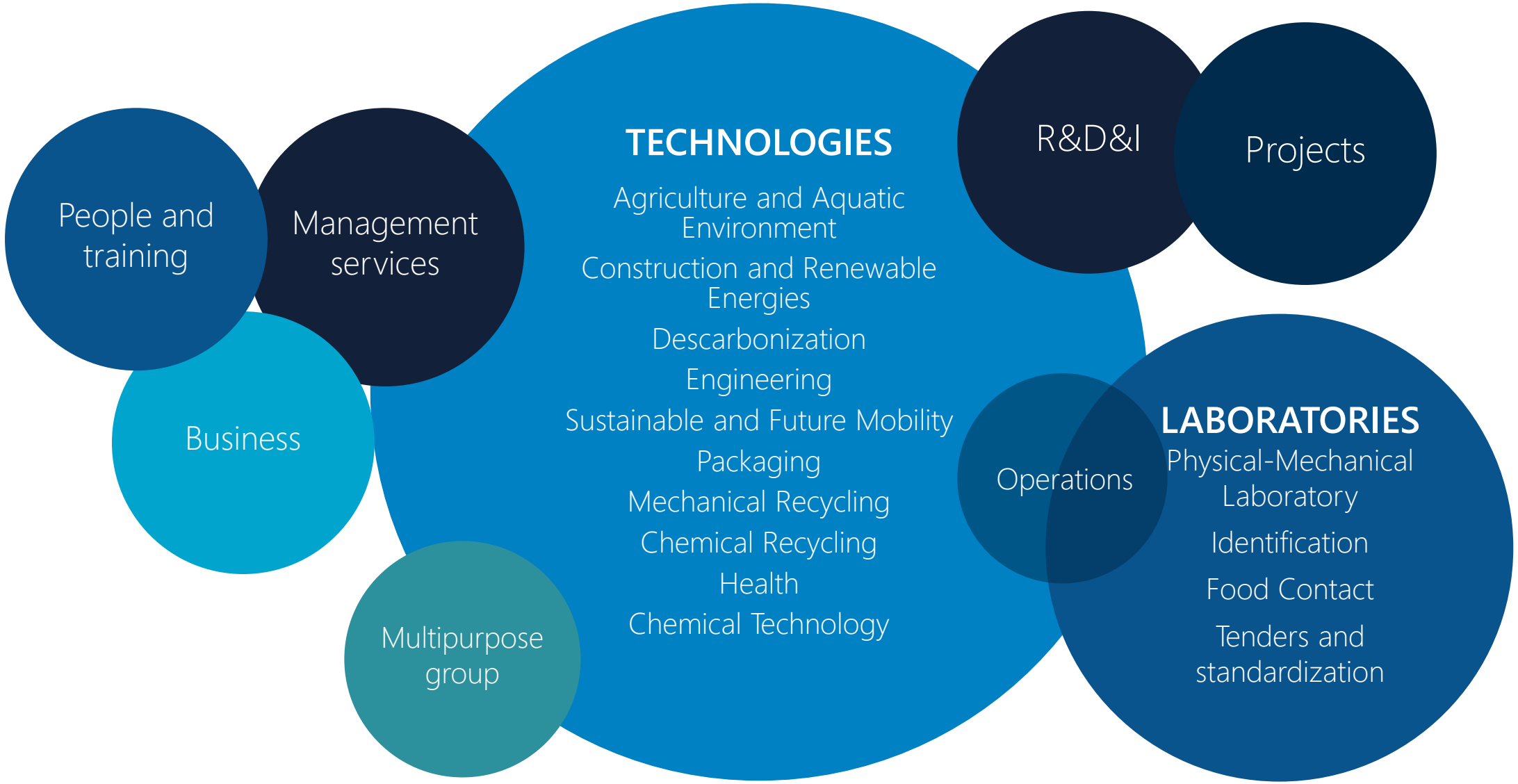
Compounding

Manufacturing / Processing

End users

Recovery of plastic waste

Comprehensive management to provide global solutions



We work with industry leaders

And SMEs committed to R&D&I and **quality**

Solutions for Plastics

1. R&D&I

2. Technology services

3. Training and events

R&D&I Projects

Innovative solutions accessible to companies

218
R&D&I projects

59
international

159
national

2020 DATA

512
companies

237
SMEs

Return of over **€40.1** million to companies

Projects according to technology readiness level

0%	40%	30%	30%

Technology readiness level (TRL)

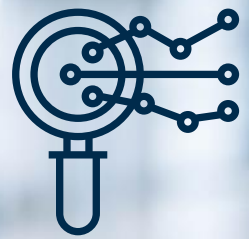
1	2	3	4	5	6	7	8	9

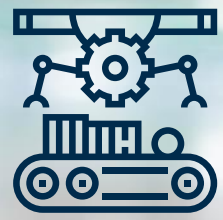
Early innovation and research

Applied research and development

Validated technology

IDEA





PRODUCT

RESEARCH AREAS ORGANIZED BY KETs

Key Enabling Technologies

Nanotechnology

Biotechnology

Advanced materials

Sustainable development. Industries of the future

Plastic product development

RESEARCH AREAS
ORGANIZED BY

Societal Challenges

Health

Industry 4.0

Circular economy

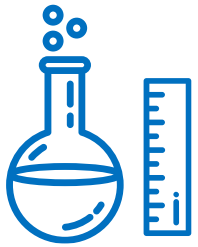
Climate change. Decarbonization of the economy

Food safety

Sustainable agriculture and silviculture

Sustainable mobility

Technological Services

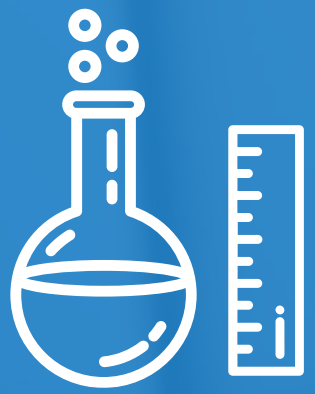


Analysis and testing

Processing and prototyping

Technical assistance

Competitive intelligence and technology watch



Analysis and Testing

Value creation for top quality

5,129
services

2,595
clients

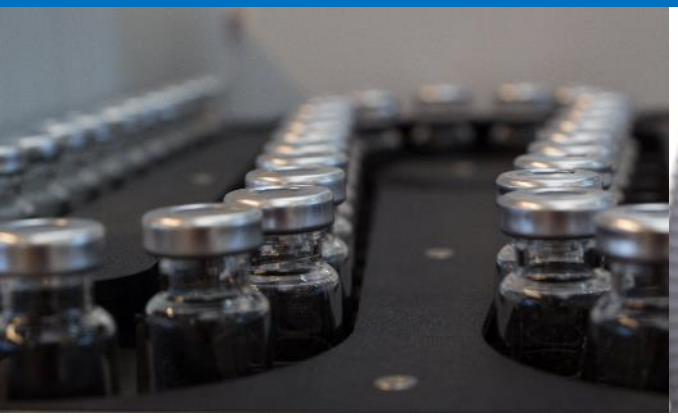
2020 DATA

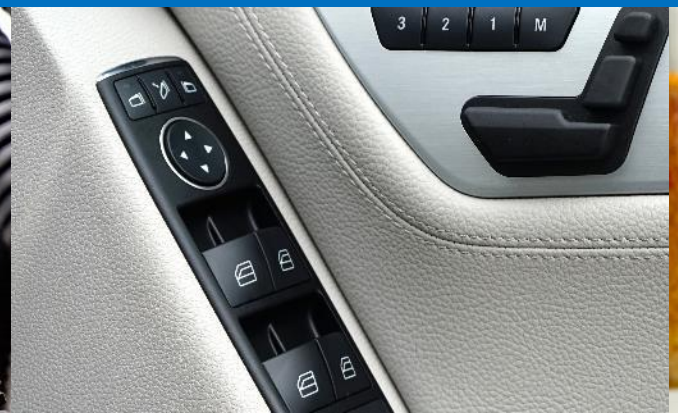
We provide value through results

- Identification and characterization
  - Polymers
  - Additives and fillers
  - Residual substances
- Mechanical properties
- Optical properties
- Rheological properties
- Physical and thermal properties
- Performance against external agents
- VOC emissions testing

AIMPLAS laboratories have earned the most accreditations for plastics in accordance with **UNE-EN ISO/IEC 17025 standard**

Sector Laboratories






Packaging

Packaging characterization tests and product-packaging interaction studies:

- Permeability (O_2 and H_2O vapour)
- Sensory analysis
- Leakage detection
- Migration tests
- Compatibility
- NIAS

Construction

Characterization and assessment of compliance with regulations for plastic products for construction (waterproofing, conduction, insulation, etc.).

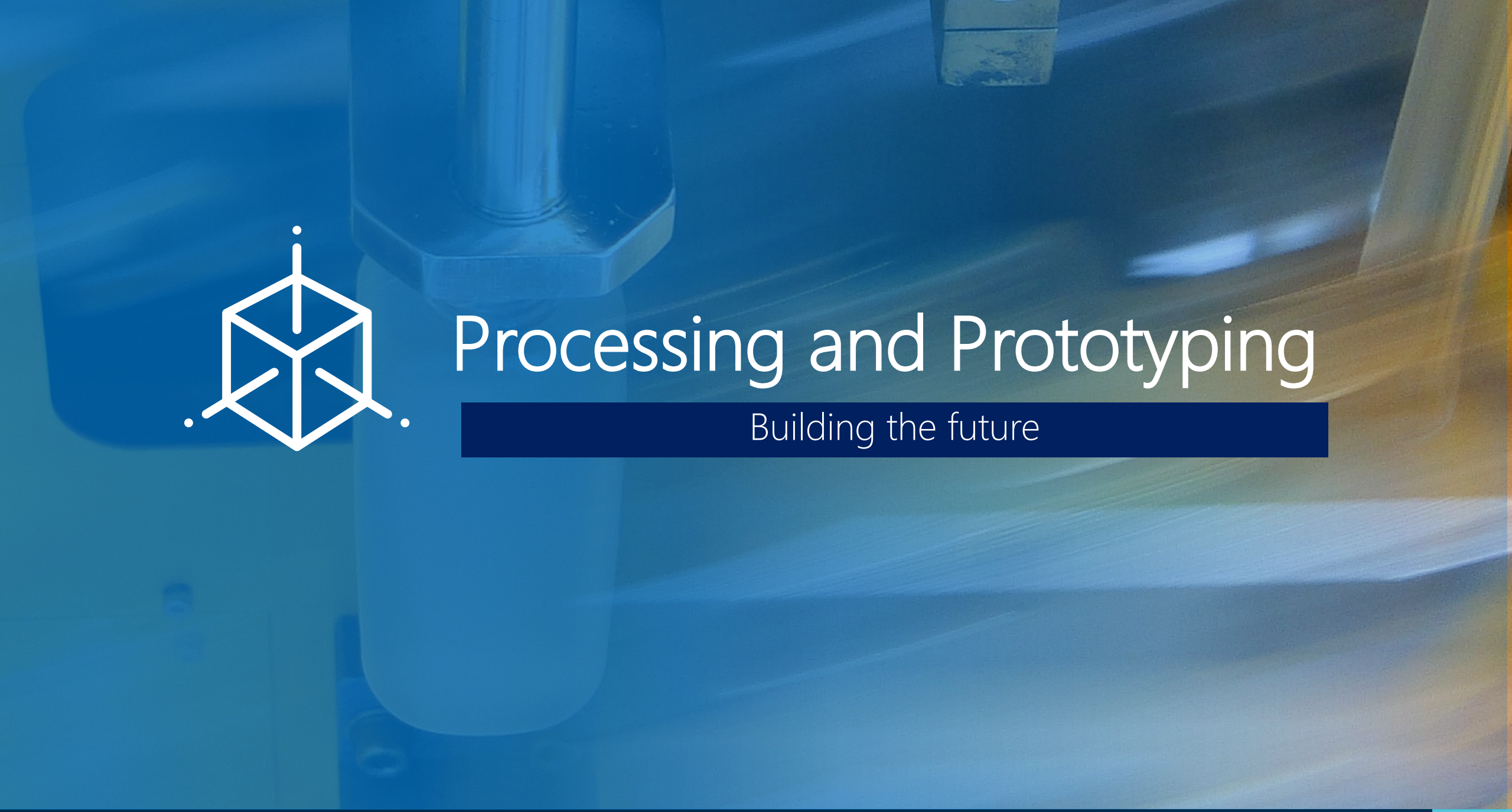
AIMPLAS is a Notified Body (no. 1842) authorized by the Spanish Ministry of Industry to assess conformity of thermoplastic tanks, prefabricated septic tanks and domestic sewage treatment plants.

Automotive

Specific tests certified by the main car manufacturers: emissions (VOC, formaldehyde, odour and fogging) and combustibility, among others.

Biodegradation

Biodegradation in controlled composting conditions, biodegradation in soil, disintegration of plastic materials under simulated composting conditions in laboratory-scale, determination of the ultimate anaerobic biodegradation under high-solids anaerobic-digestion conditions and Aerobic Biodegradation of Plastic Materials in the Marine Environment. *Standards: UNE-EN ISO 14855-1, UNE-EN ISO 17556, UNE-EN ISO 20200, ISO15985:2014 and ASTM D6691-17 .*



Processing and Prototyping

Building the future

Materials Processing: THERMOPLASTICS

Compounding

Extrusion

Injection Moulding

Blow Moulding

3D Printing

Synthesis

Recycling

PLASTICS PROCESSING
PILOT PLANTS
by AIMPLAS

Materials Processing: COMPOSITES

Synthesis

Pultrusion
RTM – Infusion
PU Foaming RIM
Solid Surface
Microwave Curing
SMC

Recycling

PLASTICS PROCESSING
PILOT PLANTS
by AIMPLAS

Technical Assistance

More than a supplier: a technology partner

Specialist Advice on Plastics

Eco-design

Product and process development

Improvement of product properties

Failure analysis

Cost optimization

Technology audits

Compliance with legislation and standards

Expert reports

Competitive Intelligence and Technology Watch

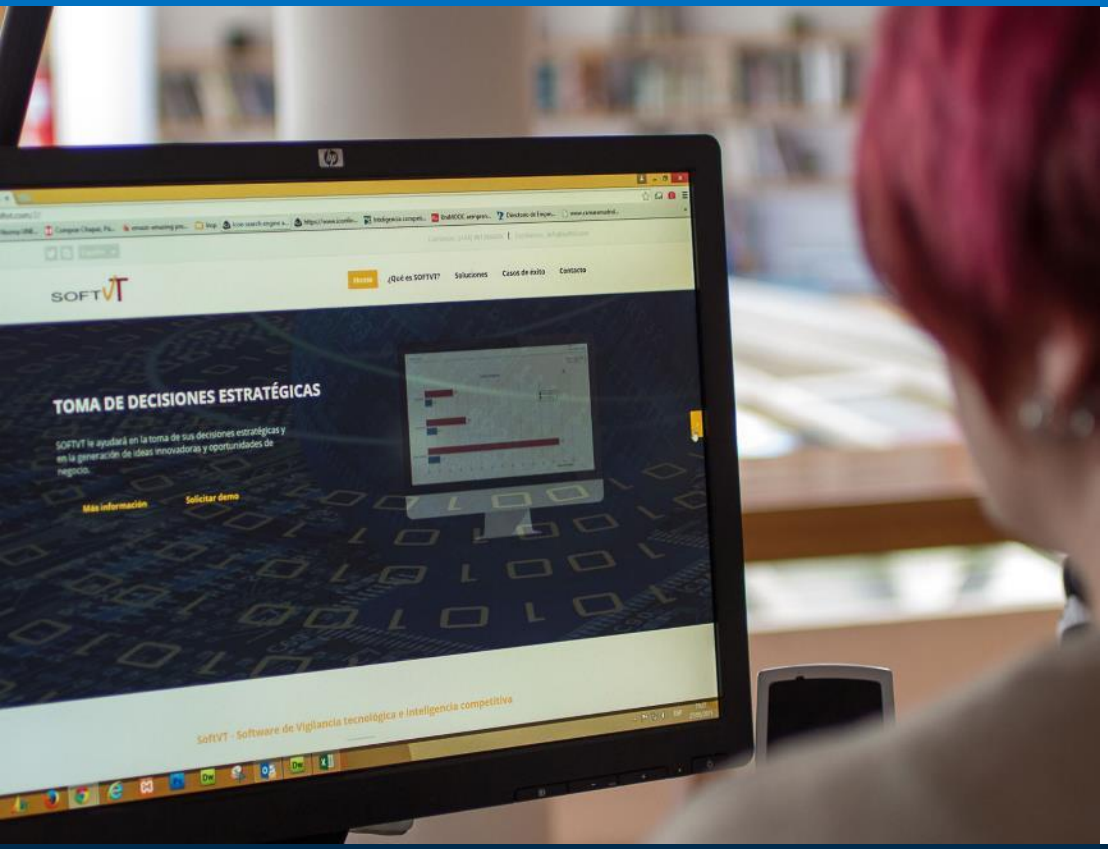
New business opportunities for your company

Plastics Observatory

www.observatorioplastico.com

The most complete technology watch system

TECHNOLOGY · MARKET · ECONOMIC ENVIRONMENT



Information for innovation

Information to manage innovative ideas and business opportunities

Competitor monitoring

Trend detection

State-of-the-art reports

Technology watch reports

www.softVT.com

Training and Events

We promote professional excellence in the sector

158
training activities

4,421
professionals

964
companies

3,877
hours

8.7
satisfaction rate

2020 DATA

The most complete training in the plastics sector

Tailor-made training for companies

Face-to-face training

Online courses and webinars

AIMPLAS certification: Expert in Plastics

Official training:

- Advanced Training Cycle
- Master's Degree in Polymer and Composite Technology

CÁTEDRA AIMPLAS

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

We organize key conferences and seminars for the plastics industry

PLASTICS ARE FUTURE

meetingPACK

BIOPolymers Meeting

dkPLAST 2018

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AIMPLAS

REDIT
INNOVATION NETWORK

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IVACE
INSTITUTO VALENCIANO DE COMPETITIVIDAD EMPRESARIAL

Fedit
Centros Tecnológicos de España

DANISH
TECHNOLOGICAL
INSTITUTE

Welcome to DANISH TECHNOLOGICAL INSTITUTE, Center for Plastics and Packaging Technology!

DANISH
TECHNOLOGICAL
INSTITUTE

Processing technology recently developed at Danish Technological Institute to enhance the circularity of packaging materials

DANISH
TECHNOLOGICAL
INSTITUTE

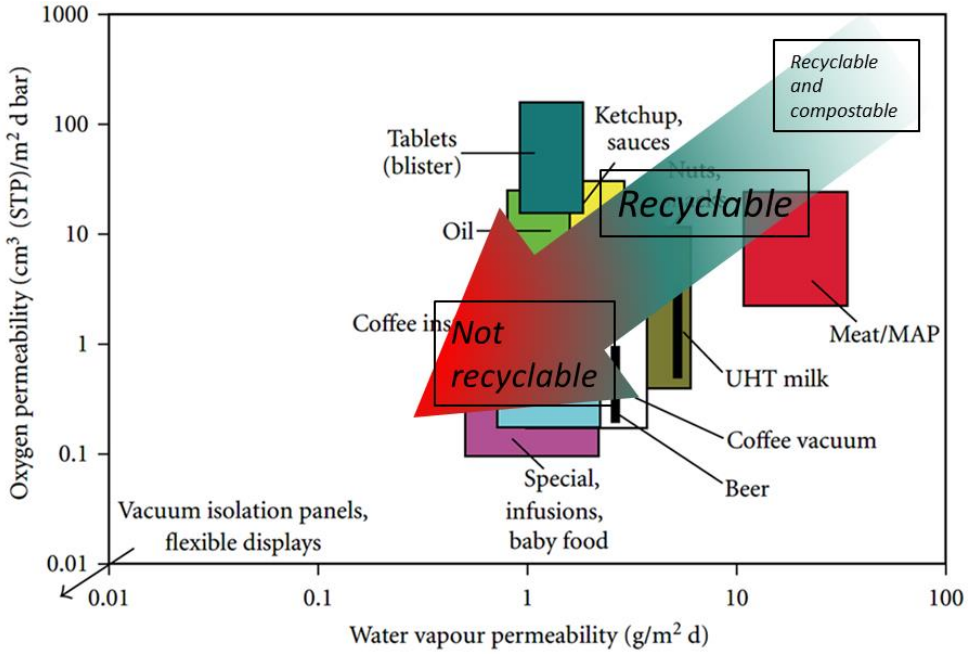
Enhanced separation and cleaning of multilayer packaging materials by selective plasma and super-critical CO_2 processing

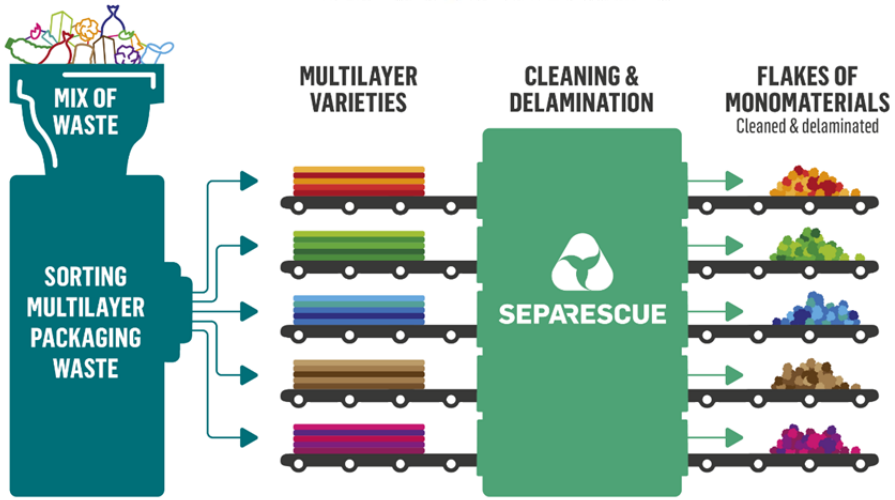
SEPARESCUE

Why developing SEPARESCUE?

- Multilayer packaging materials present the greatest technical challenge for existing recycling technologies. It is difficult to retain the purity of the constituent materials…
- Ca. 2 million tones of multilayer packaging with an approximate value of more than €2.5 billion is annually manufactured in the EU. Most of it is now neither recycled nor is recyclable…
- Existing mechanical, chemical and physical recycling technologies cannot sufficiently address the problem…
- SEPARESCUE addresses it by cleaning, deinking, and delamination of virtually any kind of multilayer packaging materials implementing both physical, chemical, and mechanical recycling technologies within the same processing unit…

Performance vs. Recyclability

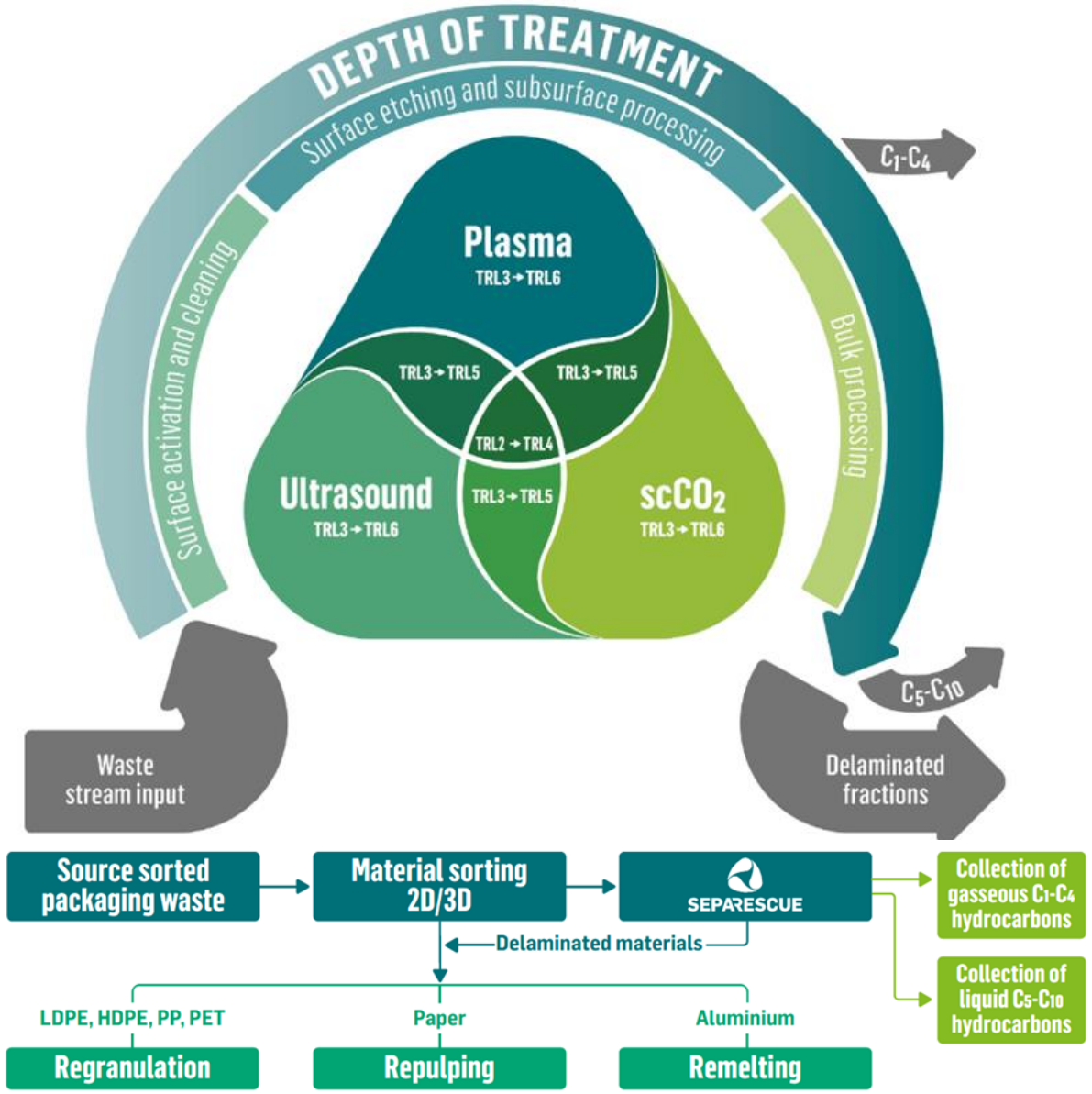




DANISH TECHNOLOGICAL INSTITUTE

What is the SEPARESCUE technology?

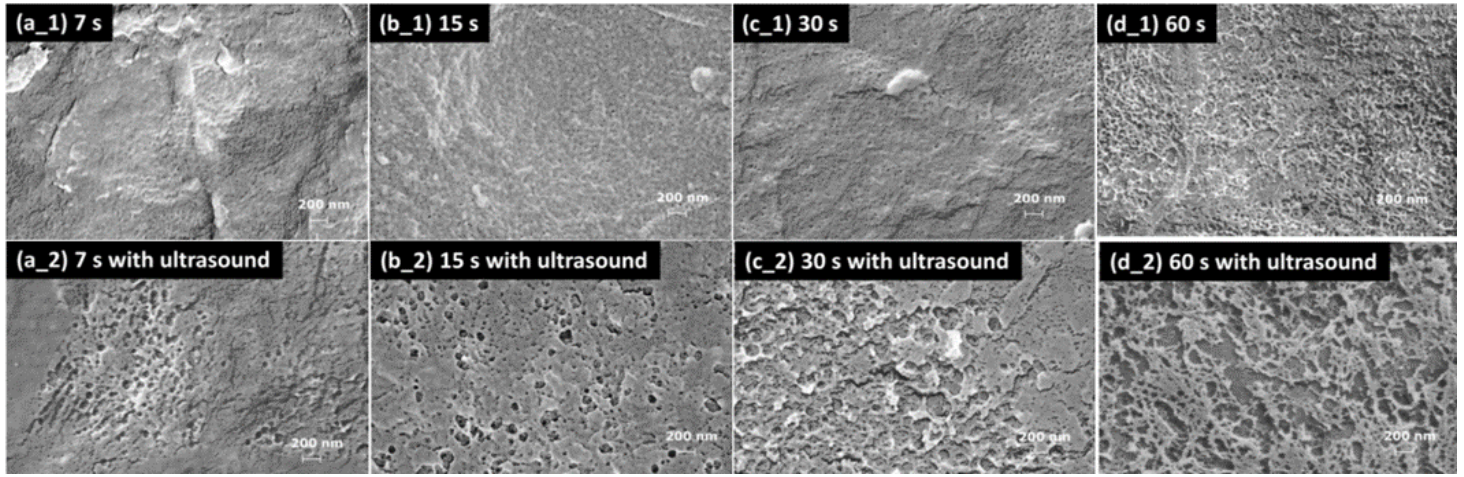
- The **hybrid processing** is achieved by combining
  - environmentally friendly solvent - super-critical carbon dioxide (scCO2)
  - plasma processing
  - ultrasonication
- **Selective plasma processing assisted by ultrasound** cleans and etches the surface and subsurface layers - sealing and printing layers, inks, and contaminants
- **scCO2 processing accelerated by plasma and ultrasound** delaminates the layers and extracts food-related contaminants from the bulk



SEPARESCUE: scCO2 + plasma + ultrasound → selective processing

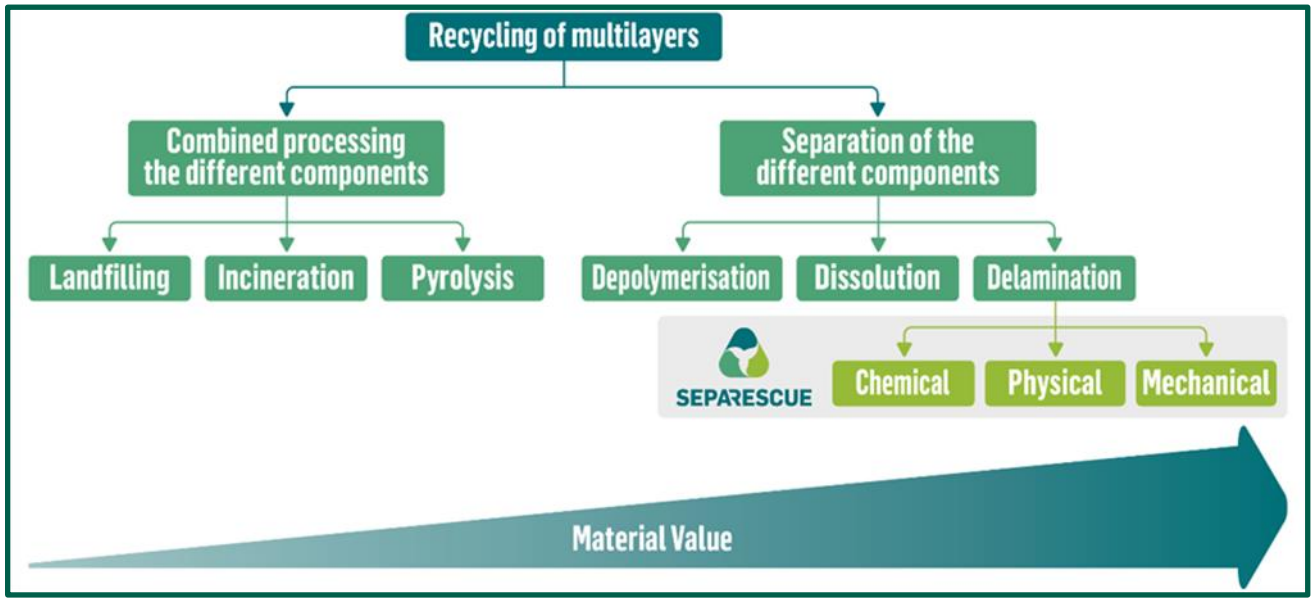
DANISH TECHNOLOGICAL INSTITUTE

SEPARESCUE

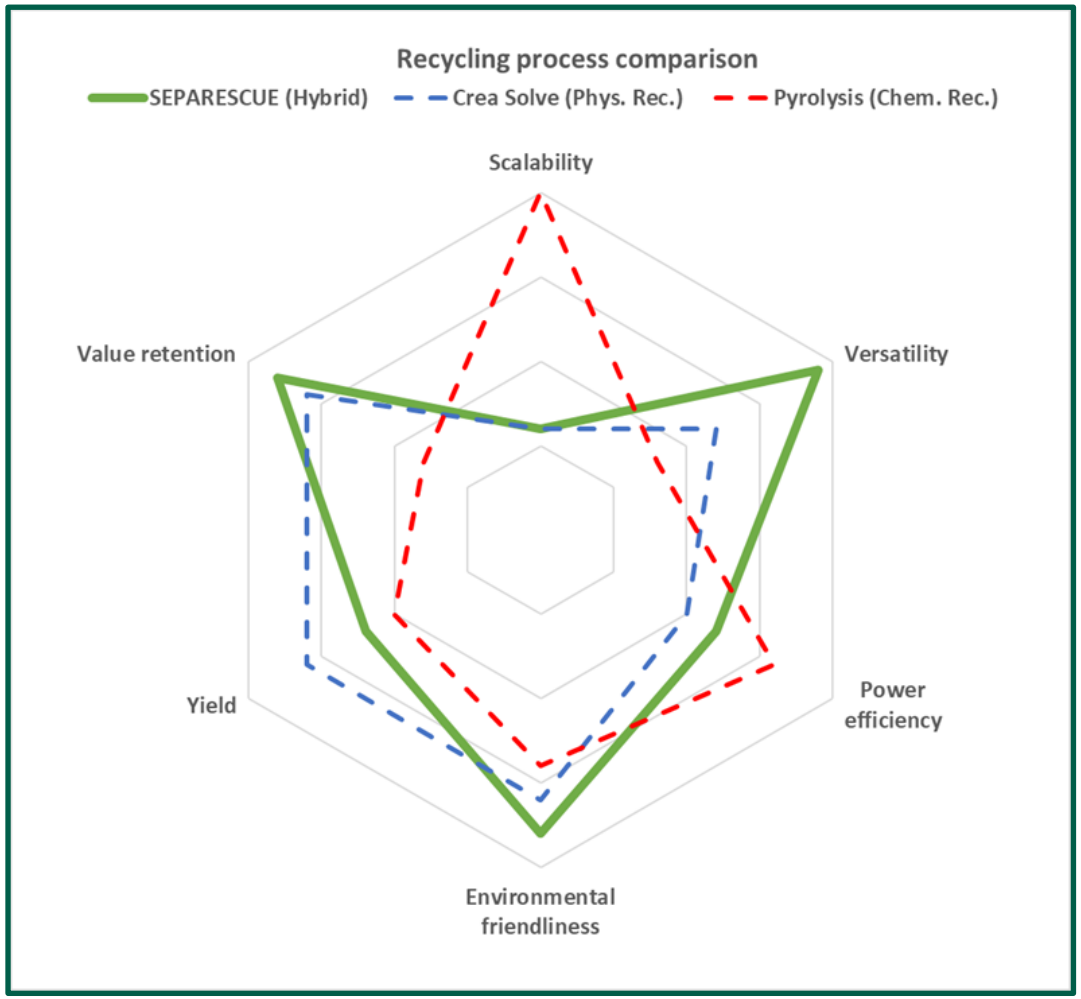


DANISH TECHNOLOGICAL INSTITUTE

SEPARESCUE versus existing technologies…



Recycling methodologies for multilayer packaging waste								
	Scale (tonnes/year)	Unit price (€Million)	Versatility	Energy/ton	Cost/ton	Yield	Product	Value retention
SEPARESCUE	365	1.0	High	2296 KWh	1000 €	*60%	Delaminated	High
CreaSolve	365	0.75	Medium	2850 KWh	1400 €	*80%	Regranulated	Medium
Pyrolysis	20000	15	Medium	Low	100 €	50%	Naphta	Low



DANISH
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INSTITUTE

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Plastics and Packaging Materials
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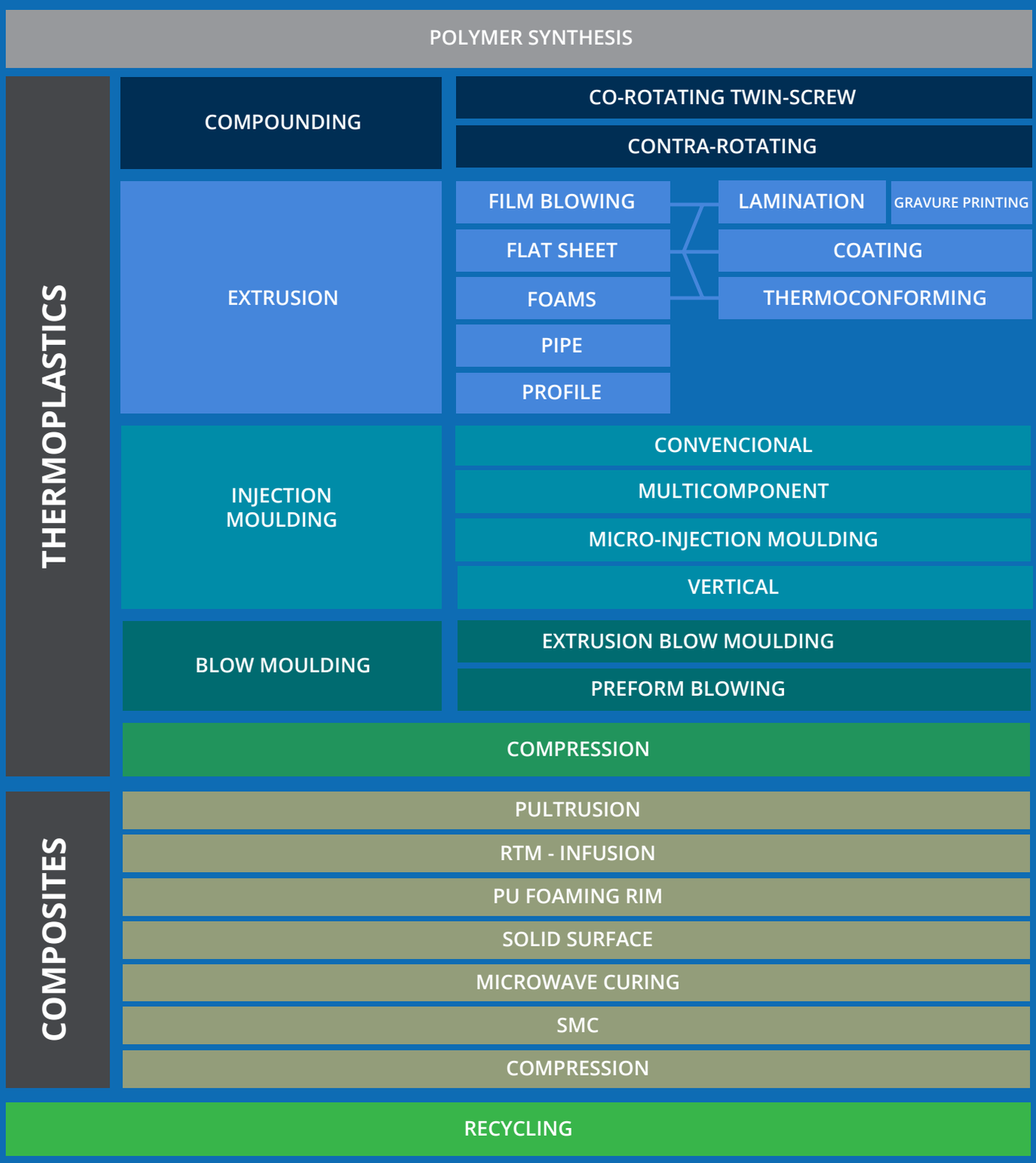
AIMPLAS
PLASTICS TECHNOLOGY CENTRE

PILOT PLANTS

More than 30 pilot plants for processing plastic materials

TRANSFORMATION PROCESSES

AIMPLAS boasts more than **30 pilot plants** for carrying out research, formulating new materials and improving existing processes. The plants are equipped to perform all plastic transformation processes for thermoplastics, thermosets and composites.



Polymer Synthesis

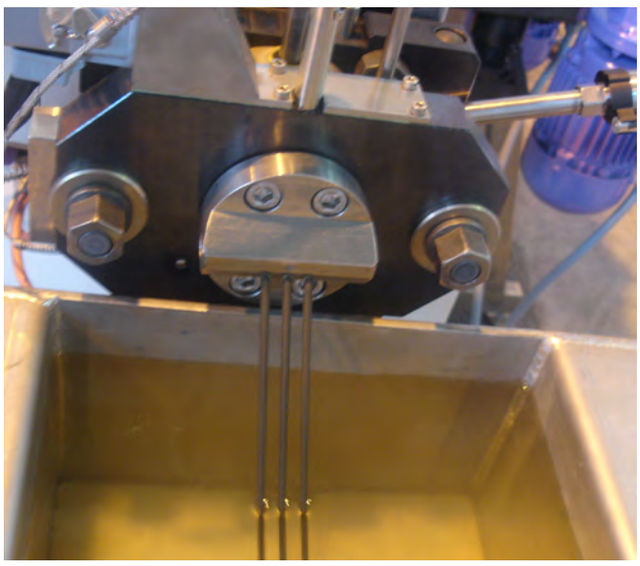
Polymer Synthesis

- Scale-up from 0.1 to 50 kg.
- Process development by solution synthesis and reactive extrusion.
- Process optimization, including purification steps.
- Polymer synthesis strategies:
  - » Ring-opening polymerization (ROP).
  - » Radical polymerization.
  - » Ionic polymerization.
  - » Polycondensation.

Nanoparticle Synthesis

- Scale-up from 0.1 to 1 kg.
- SOL-GEL synthesis/ SiO_2, TiO_2, Al_2O_3 emulsions.
- Formation of two-phase and multi-phase emulsions.
- Process optimization, including purification steps.
- Functionalization:
  - » Oxidation treatment using O_3, peroxides, acids.
  - » Silanes (e.g. perfluoroalkyl, amino and alkyl silanes).
  - » Crosslinking of active, antibacterial and fungicidal substances.

Compounding



MASTERBATCH, REACTIVE EXTRUSION, BIOPLASTICS

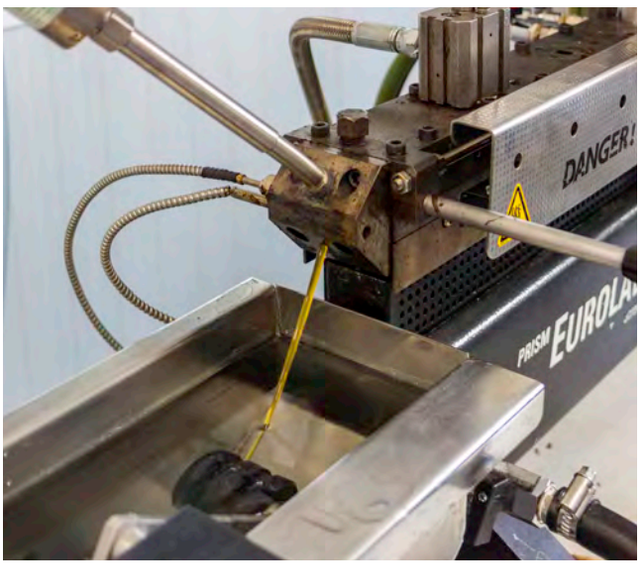
Pilot plant scale

Co-rotating twin-screw extrusion to obtain highly filled plastic compounds, formulate bioplastics, perform reactive extrusion and produce colour masterbatches and additives.

Screw design adapted to the materials to be processed and optimization of processing parameters by validating dispersion.

Multiple fillers / fibres can be used and liquids can be added.

Several degassing ports. Production of up to 50-70 kg/h.



FORMULATION OF PLASTICS

Pilot plant scale

Modular extruder with vertical gate (with forced feeding).

Designed to process small amounts of material based on price and availability.

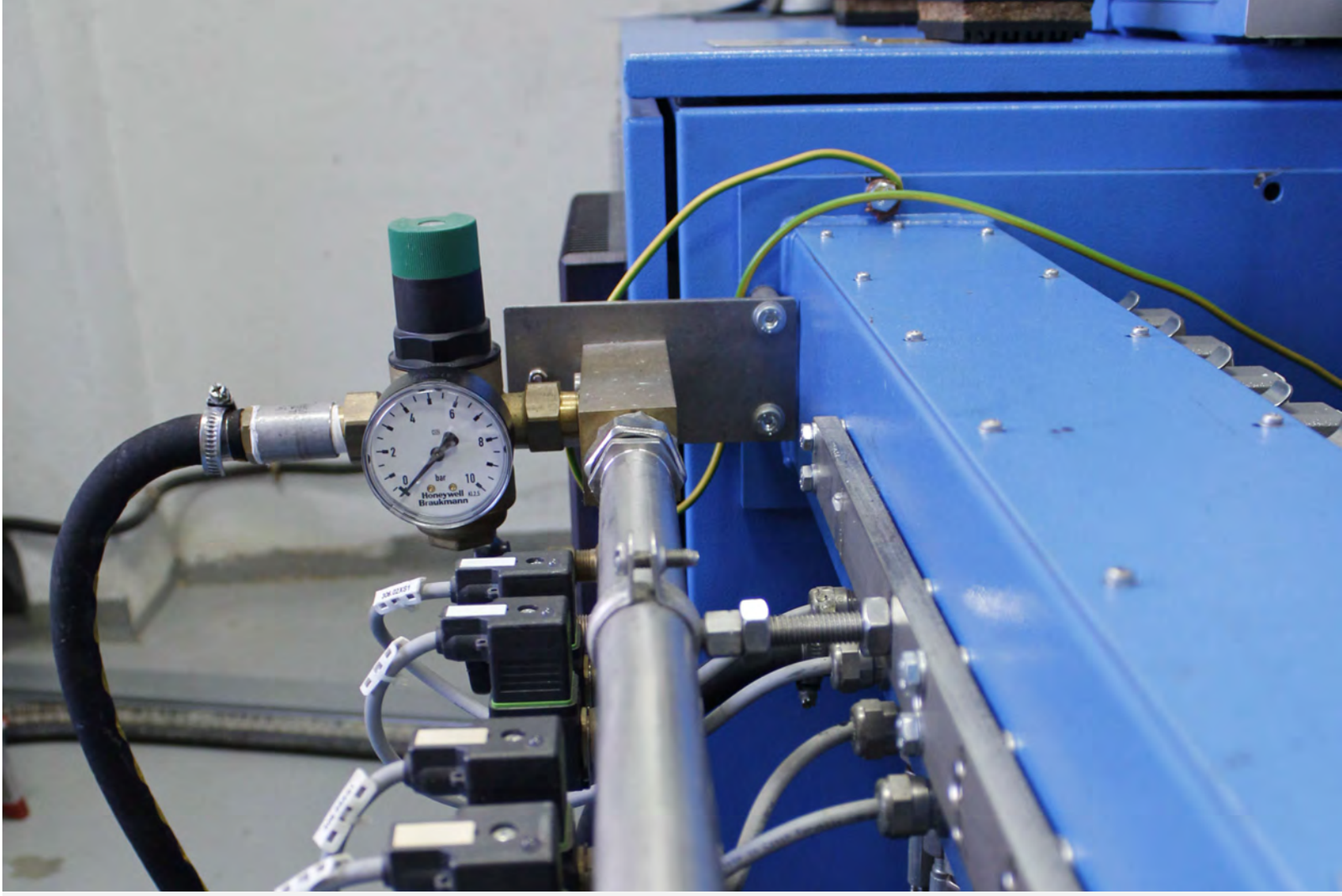
Production of 0.5 to 2 kg/h.

Equipped with high-precision gravimetric feeders, for pellets and powder, and materials with different apparent density and format.

NANOMATERIALS

Specially equipped rooms to work with nanomaterials and produce compounds with graphene, graphene oxides, carbon nanotubes, carbon nanofibres, nanoclays, nano metal oxides and others.

Feasibility validation of new nanomaterials such as additives in plastics.



FIBRES, FILLERS, FLAME RETARDANTS AND OTHER ADDITIVES

Pilot plant scale

Co-rotating twin-screw extrusion specially customized to work with nanomaterials (CNT, graphene, nanoclays) and obtain compounds with fibres, fillers, fire resistance, etc.

Screw design adapted to the materials to be processed and optimization of processing parameters by validating dispersion.

Multiple fillers/fibres can be used and liquids can be added.

Large stock of screw elements; screws can be designed with different shear rates to obtain excellent dispersion levels for all kinds of fillers and additives.

Production of up to 30 kg/h.

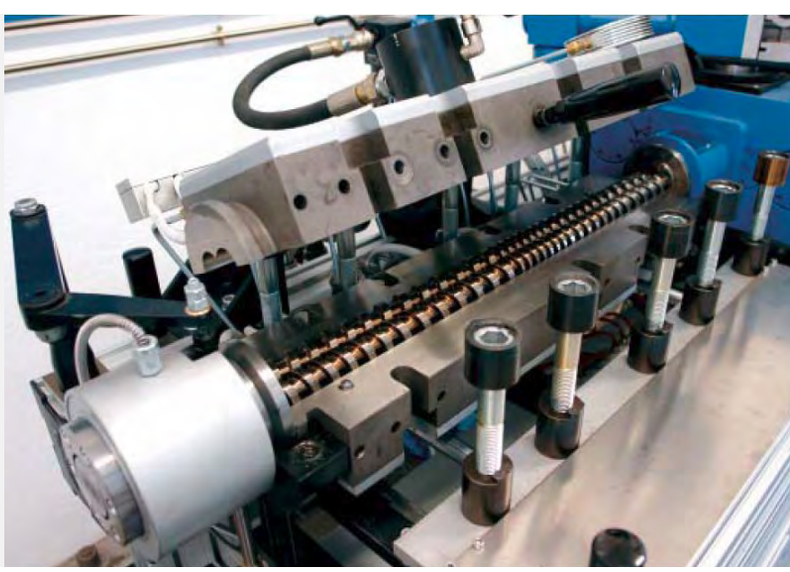
FORMULATION OF PVC & WPC

Pilot plant scale

Co-rotating and counter-rotating twin-screw extrusion for processing shear-sensitive materials such as PVC and obtaining wood plastic composites (WPC).

Direct extrusion of profiles, tubing and films by attaching different heads.

Production of 10 kg/h.



COMPOUNDING TO SCALE

Laboratory – Internal Brabender Mixer

The ideal machine for mixing 30 to 200 g batches of thermoplastic composites and elastomers.

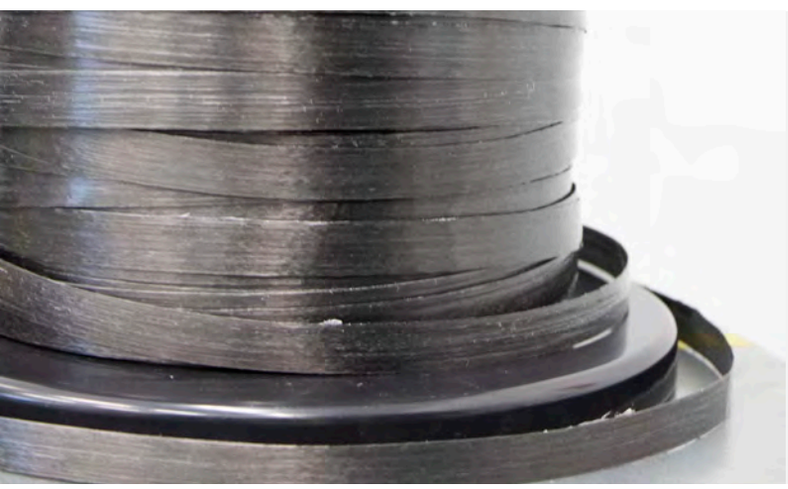
Validation of new materials (e.g. polymers, fillers, nanomaterials, additives) in the development and optimization processes.

Analysis of additive effectiveness and formula adjustment in: thermal stabilization, lubrication and plasticization.

Especially for PVC.

Previous reactive extrusion studies.

Adjustment of polymer fluidity for mechanical recycling processes.



UD TAPE AND LFT PELLET LINE

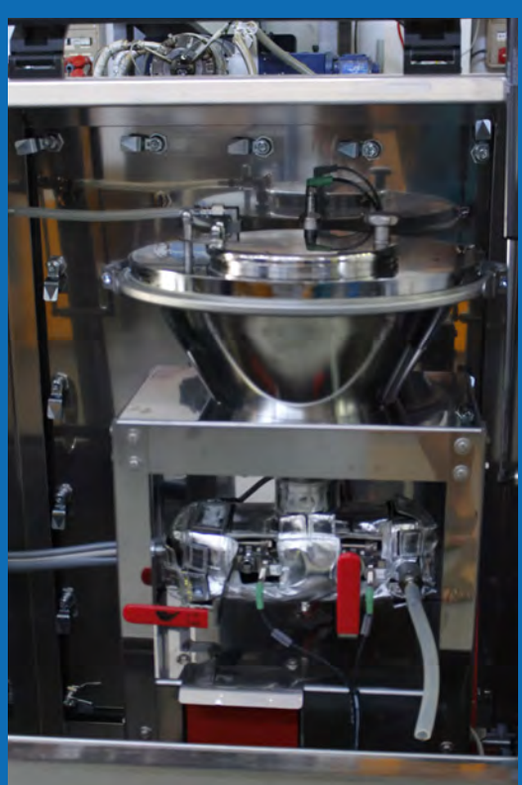
AIMPLAS has a long-fibre impregnation line at pilot plant scale. This pultrusion line is attached to a co-rotating twin-screw extruder.

The line produces unidirectional tapes for depositing fibres (AFP and ATL) and long-fibre pellets for injection and compression moulding.

PERIPHERALS

The compounding lines are also equipped with quenching baths and the following auxiliary equipment:

- Gravimetric dosing feeder for solids (0.1 to 80 kg/h).
- Gravimetric dosing feeder for liquids.
- Turbomixers.
- Pelletizer with cutting head (water-cooled).

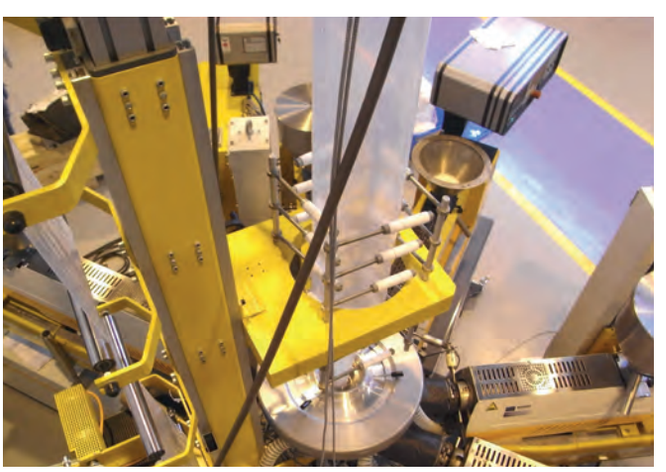


Clean Rooms

AIMPLAS has two separate ISO 7 clean rooms with a total area of 135 m^2 for developing pharmaceutical and healthcare products in accordance with GMP, and for synthesizing biopolymers and nanoparticles.

The rooms were designed to avoid cross-contamination and maintain a high level of safety at work.

Extrusion



BLOWN FILM EXTRUSION

Structures with one to five layers.

Vertical unit with maximum height of 4 m.

Maximum film width: 300 mm.

Film thickness: 30 to 200 microns.

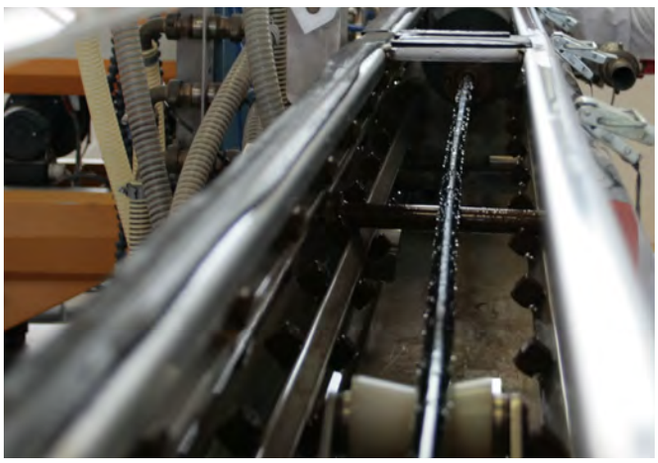
FLAT SHEET EXTRUSION

Structures with one to five layers.

Maximum film width: 480 mm.

Film thickness: 50 to 900 microns.

Calender roll temperature range: 5 to 90°C.

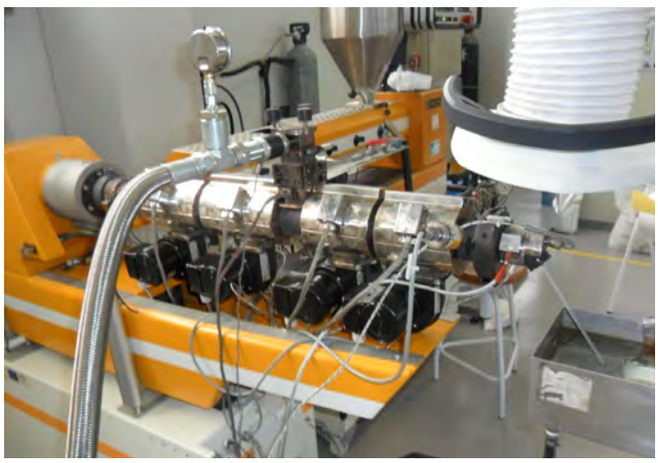


PROFILE AND PIPE EXTRUSION

Profile extrusion for working with amorphous polymers (PC, PMMA), semi-crystalline polymers (HDPE, PP) and PVC. Various dies with different shapes.

Production of single-layer and double-layer tubing (diameter: 16 mm) in different thicknesses.

Vacuum calibration and water bath for cooling.



TANDEM EXTRUSION LINE

Continuous chemical modification of polymers. Polymer functionalization. Solid-liquid mixtures. Long residence times.

Processing post-industrial scrap.

Improving the quality of recycled materials.

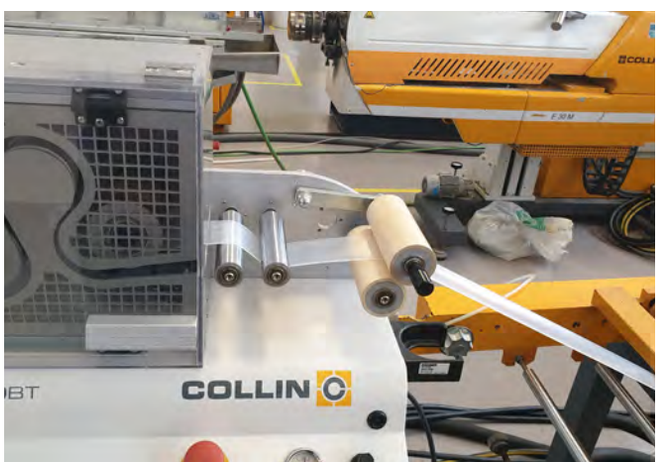
Removal of volatile compounds, including odours, by high-pressure gas injection and vacuum degassing.

Filtering to remove solid contaminants.

TECHNICAL POLYMER EXTRUSION

Extruder for processing technical polymers requiring temperatures over 300 and 350ºC (e.g. PEI, PEEK).

30 D extruder with an L/D ratio of 30 and a maximum working temperature of 450ºC.



MACHINE DIRECTION ORIENTATION SYSTEM (MDO)

The equipment consists of two stretching units: one before and one after the oven.

Characteristics: temperature control in different modules of the production line.

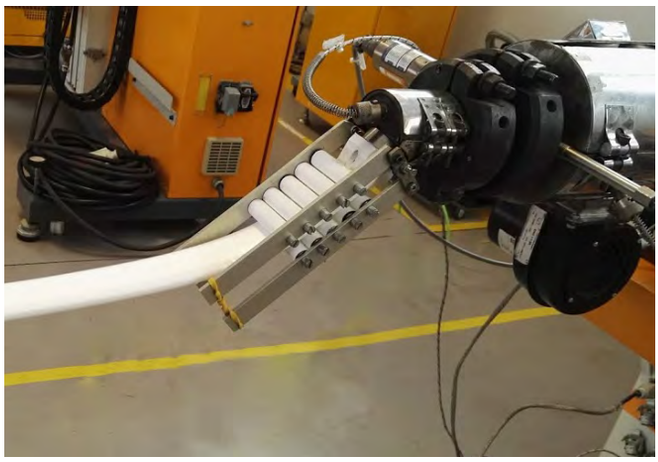
Adjustable oven heating system.

EXTRUSION COATING

Coating plastic films with different kinds of substrate (e.g. paper, aluminium foil, textiles, plastic films) as part of the film extrusion process.

Temperature and pressure are applied to bond the substrate to the film.

Maximum coating width: 450 mm.



FOAM EXTRUSION

Production of foamed plastic (rods, profiles and sheets) using chemical and physical foaming agents (supercritical CO_2).

AUXILIARY EQUIPMENT

PRESSING MACHINE AND TWO-ROLL MILL

Blend preparation in batches using a temperature-controlled two-roll mill.

Sheet manufacture in a hot platen press. Sample thickness: 0.2 to 4 mm; maximum area: 200 x 200 mm.

Converting and Packaging

THERMOFORMING

Thermoforming by blow moulding and vacuum forming.

Twin-sheet thermoforming (top and bottom sheet).

Moulding area up to 400 x 400 mm. Male and female moulds made of different materials.

SEALING MACHINE

Semi-automatic, pre-industrial equipment for preformed trays.

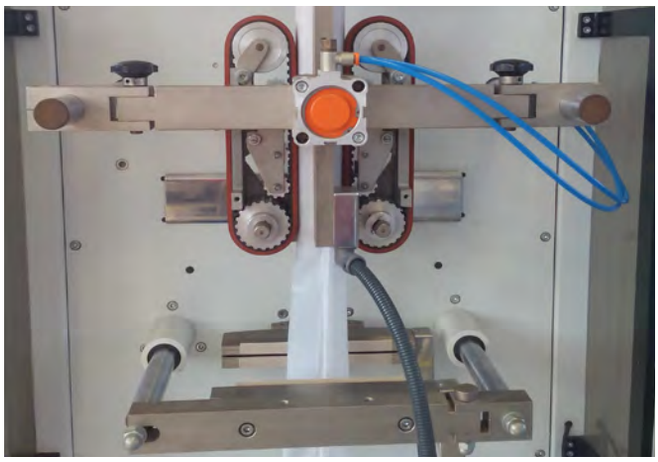
Wide range of films (top) and laminated, foam and monomaterial trays.

Different packaging options: vacuum and modified atmosphere packaging (MAP) with one gas or a customized gas combination.

LAMINATION UNIT

Semi-industrial laminator to obtain complex, multilayer structures using solventless and solvent-based adhesives in a drying tunnel.

Interchangeable modules for applying coatings and rotogravure and flexographic printing. Head for applying hot-melt adhesives.

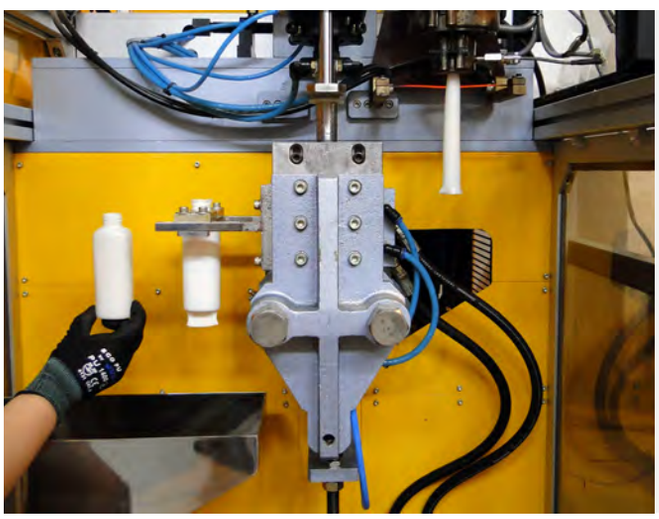


VERTICAL FORM-FILL SEALING SYSTEM (VFFS)

Using a roll of film to automatically and continuously make, fill and seal bags. Control of parameters such as temperature, sealing time and clamping pressure.

Two bag widths: 90 and 150 mm. Variable length of up to 250 mm. Options include vertical and flat welding, depending on material compatibility.

Blow Moulding



EXTRUSION BLOW MOULDING

Automatic blow moulding for 125 and 200 ml bottles.

Equipment for single-layer, two-layer and three-layer bottles.

Temperature-controlled mould.

The parison is cut with a hot cutter.

PREFORM BLOWING

Preform blowing from 0.5 to 5 l.

Preform thickness: 1 to 4 mm.

Carousel capacity: 58 preforms.

Standard mould dimensions: 260 x 220 mm.

Additive Manufacturing

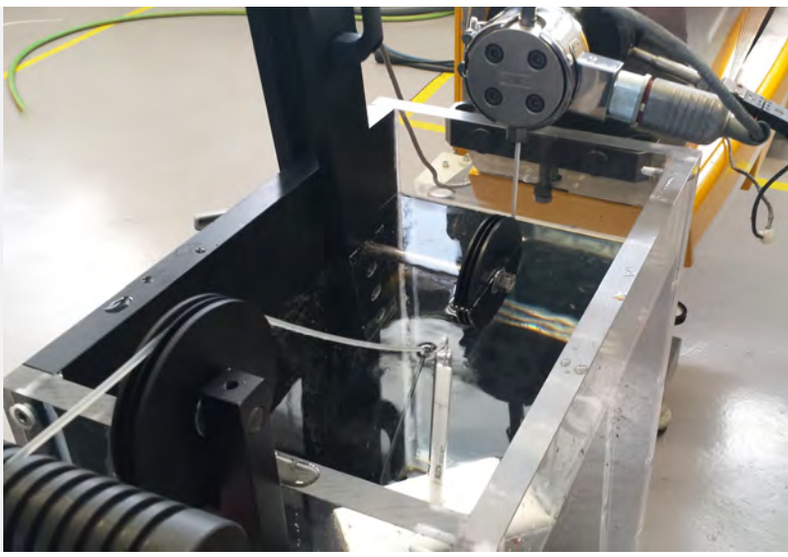
FILAMENT EXTRUSION FOR 3D PRINTING

Extrusion of filaments 1.75 and 2.85 mm thick.

Controlled filament cooling (air and water).

Automatic winding device.

A wide range of materials can be extruded and materials can be formulated to improve specific properties.



3D PRINTERS

AIMPLAS uses additive manufacturing equipment with different technologies from a number of manufacturers. We have SLA printers (FORMLABS FORM2), FDM printers (ULTIMAKER 2+, ULTIMAKER 3 EXTENDED, BQ WITBOX 2, SICNOVA JCR 600, MARKFORGED MARKTWO) and bioprinters (REGEMAT V1).

We work on:

- Developing biodegradable materials with added functionalities.
- Studying sacrifice and support materials for constructing prototypes/parts.
- Developing materials for medical/surgical use.
- Developing elastomeric composites for additive manufacturing.
- Developing high-performance materials and improving mechanical properties and electrical/thermal conductivity.
- Developing combinations of reinforcement fibres and resins to improve mechanical properties.
- Developing light-cured resins.
- Desarrollo de resinas fotocurables.

Inyection moulding

CONVENTIONAL INJECTION MOULDING

Three injectors with clamping forces of 50, 100 and 160 t.

Different type of nozzles, depending on the mould. Maximum plasticization capacity (in PS): 343 g; intrusion moulding is also available.

Maximum mould size: 520 x 520 mm, with heights of 160 to 450 mm.

Temperature regulation systems for mould temperatures from -5 to 250°C.

More than 15 moulds for tests and prototypes.

MULTI-COMPONENT INJECTION MOULDING

Injection machine with a clamping force of 100 t and two plasticization units.

Part injection capacity of up to 182 g (in PS).

Maximum mould size: 420 x 420 mm, and minimum heights of 250 mm. Different nozzles can be attached to the machine. Temperature regulation systems for mould temperatures from -5 to 250°C.

Also performs conventional injection. bi-injection, co-injection and overmoulding.

STANDARDIZED TEST PIECE MOULDS

Moulds with quick-change plates.

Geometries available: ISO A, ISO B, ISO F, ISO A2, ISO D2. UL-94 standardized test part moulds for flammability tests with thicknesses of 3.2, 1.6 and 0.8 mm.

Standardized spiral mould for determining en route flow/ thickness ratios.

MICRO-INJECTION MOULDING

Maximum clamping force: 12 t.

Maximum part weight (in PS): 9.64 g.

Temperature regulation systems for mould temperatures from -5 to 250°C.

Maximum mould size of 259 x 259 mm.

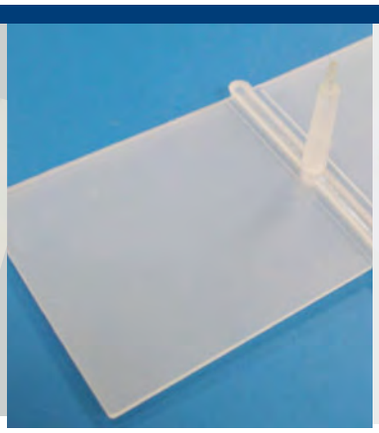
VERTICAL INJECTOR

Vertical injection machine for overmoulding, injection with inserts and low-pressure injection moulding.

Performance of IML, IMD and IME tests. It has a clamping force of 100 t and a foldable injection unit with a capacity of 85 cm3 (77 g in PS).

Maximum mould size: 400 x 400 mm.

Temperature-controlled system for mould temperatures from -5 to 250ºC. Equipped with a CFZ COBOTS collaborative robot.



Composites

MICROWAVE CURING PILOT PLANT

Microwave curing of large-scale parts: 6,000 x 2,000 x 1,500 mm.

Maximum power: 6,000 W.

Irradiation with six robot arms.

Power control depending on laminating temperature.

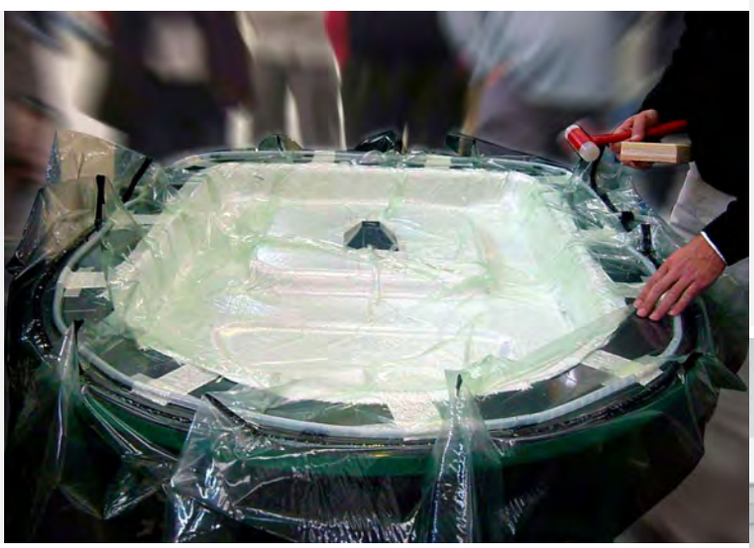
Different types of antennae.

Laminations obtained by infusion and manual lamination.

PILOT PLANT FOR RESIN TRANSFER PROCESSES

[RTM, RTM-Light, Infusión]

750 W two-level vacuum unit with accumulator.



FOAM REACTION INJECTION MOULDING POLYURETHANE DOSING AND MIXING

Manufacturing of polyurethane prototypes; integral and flexible foam, elastomers and compacts.

Setting up new polyurethane formulations (two or three components).

Circuit prepared for working at high temperatures (up to 120°C).

Connections for vacuum and dry air or nitrogen lines.

AUXILIARY EQUIPMENT

Dispermat with ball mill and three-roll calender.

SOLID SURFACE FORMULATION

Intensive mixer; capacity: 5 L.

Programmable control of mixing times, speed and temperature.

Manufacture of prototypes by injection and moulding.

SMC PILOT PLANT

Equipped with a hot plate press.

Maximum plate temperature: 500°C.

Maximum clamping force: 1,000 kN.

Programming and recording of power surges and temperature.

PULTRUSION PILOT PLANT

For obtaining constant section composite profiles.

Resin injection and impregnation. Special resin injection.

Maximum profile width: 350 mm.

Pulling system based on pressing.

STUDYING AUTOCLAVE ALTERNATIVES

Hot plate press with vacuum chamber.

Maximum plate temperature: 300°C.

Plate dimensions: 450 x 450 mm.

Maximum clamping force: 800 kN.

Programming of press cycles (clamping force and plate temperature).

Recycling

ADAPTATION AND REDUCTION OF PARTICLE SIZE

Crushing capacity and ability to reduce particle size of all kinds of films and plastic parts. Grinding mills of different capacities and configurations for reducing particles from conventional size to micron size (1, 5, 8, 12 and 25 mm).

MATERIAL CLEANING AND SEPARATION (WET AND DRY)

Cleaning, spinning and drying system

Equipment for cleaning plastic waste in a hot water chamber and variable stirring. Separation in water by density depending on the density of the materials.

Centrifuge module.

Cyclone/centrifugal fan with single axial suction.

SEPARATION BASED ON ELECTROSTATIC AND TRIBOELECTRIC PROPERTIES

Electrostatic and triboelectric separation

Applicable to plastic and non-plastic waste. Dry separation process.

Process parameter adjustment for specific mixes.

Applicable to all plastics sectors and ideal for separating technical plastics and PVC from cables.

AIR SEPARATION (ELUTRIATION)

Zigzag air-separator system using combined differences in particle density, size and shape.

Mass flow: 20 to 400 kg/h after initial material mixing.

OPTICAL (NIR) PLASTIC MATERIAL IDENTIFIER AND SEPARATOR

Identification and separation of waste using NIR and VIS technologies both with a hyperspectral camera.

Can be adapted to different waste types and shapes.

PORTABLE MATERIAL IDENTIFIER

Plastic waste analyser / identifier

On-site identification of plastic materials.

Detection of halogenated materials.

Works using near infrared technology (NIR).

METAL SEPARATION

Detection and separation of ferrous and non-ferrous metals.

PELLETIZER

Pelletizer production: 40 to 70 kg/h.

Pellet diameter: 6 mm.

CHEMICAL RECYCLING

Different capacity reactors for:

Depolymerization/solvolysis.

Using waste to produce chemical substances of interest.

Eliminating legacy substances. Separation of layers.

Fibre recovery.

THERMAL TREATMENT: CRACKING

5 L pyrolysis pilot plant for:

Using waste to produce chemical substances of interest.

Fuel production.

Fibre recovery.

BIOLOGICAL/ENZYMATIC TREATMENT: CRACKING

Different capacity reactors for:

Using waste to produce chemical substances of interest.

Accelerating polymer biodegradation.

Removing layers and coatings for subsequent recycling.

PILOT PLANTS

AIMPLAS
PLASTICS TECHNOLOGY CENTRE

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GENERALITAT VALENCIANA
IVACE INSTITUTO VALENCIANO DE COMPETITIVIDAD EMPRESARIAL
UNIÓN EUROPEA Fondo Europeo de Desarrollo Regional
Una manera de hacer Europa
REDIT INNOVATION NETWORK

Wageningen University & Research

"To explore the potential of nature to improve the quality of life"

WAGENINGEN
UNIVERSITY & RESEARCH

Wageningen Campus:

Wageningen University & Wageningen Research

WAGENINGEN
UNIVERSITY & RESEARCH

Wageningen University

Wageningen University

Wageningen Research

- 12.337 BSc/MSc-students from > 100 countries
- About 2.000 PhD candidates
- 3.228 faculty and staff (2.838 fte)
- Revenue in 2019: € 385 million
- WUR-ranking in Higher Education Selection Guide in full-time university education 2020: 1 (15 years running)

WAGENINGEN
UNIVERSITY & RESEARCH

Wageningen Research

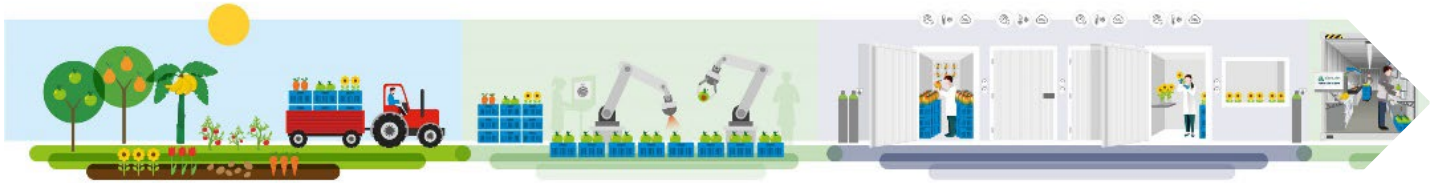
Wageningen University

Wageningen Research

- 3.047 staff (2.787 fte)
- Revenue in 2019: € 344 million

WAGENINGEN
UNIVERSITY & RESEARCH

Postharvest Technology



Our research helps our customers:

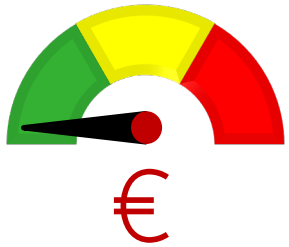
- *to increase their efficiency*
- *to reduce their food waste*
- *to provide the best quality*

Complexe choice

The optimal packaging concept:

- Shelf life: create optimal conditions
- Limit food waste: portion size, prevent mechanical damage
- Safety: cross contamination, microbial growth
- Convenience: material, marketing
- Logistics: reuse, transport
- Sustainability: extra requirement

Find sustainability balance



How to find the optimal balance?

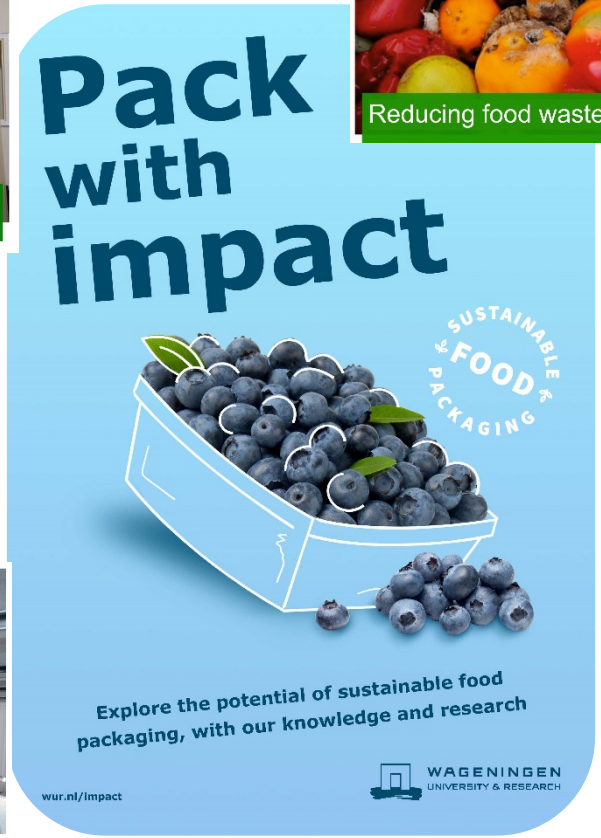
Integrated approach

Sustainable plastics technology

Reducing food waste

Applied Food Microbiology

Properties of packaging materials



Predicting quality and shelf life

Recycling of packaging materials

Supply Chain Development and logistic design of fresh food chains

Thank you for your attention!

ir. FIDG (Fatima) Pereira Silva

Researcher and project leader post-harvest

fatima.pereiradasilva@wur.nl

ir. MJM (Maxence) Paillart

Scientist Potstharvest physiology and Technology

maxence.paillart@wur.nl

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AIMPLAS

PLASTICS TECHNOLOGY CENTRE

PACKAGING

INNOVATION in PLASTICS

At AIMPLAS, we work to meet the packaging challenges of companies in the food, hygiene, cosmetics, medical, pharmaceutical, cleaning and industrial chemistry industries.

SUSTAINABLE PACKAGING

Development of packaging adapted to single-use plastics legislation.

Development of packaging with less environmental impact through eco-design and using methods such as carbon footprint and life cycle analysis (LCA).

Product recyclability.

Use of sustainable materials (from renewable sources, recycled, bioplastics). Biodegradability and compostability studies.

Product certification. Ecolabels.

Control of marine waste, minimization of waste, collection, characterization and applications for marine waste.

Workshop for adapting packaging to the circular economy. Training on recycling, recyclability, bioplastics and carbon footprint.

INCREASED SHELF LIFE TO REDUCE FOOD WASTE

Development of materials with better properties for use in applications with single-material, multilayer packaging.

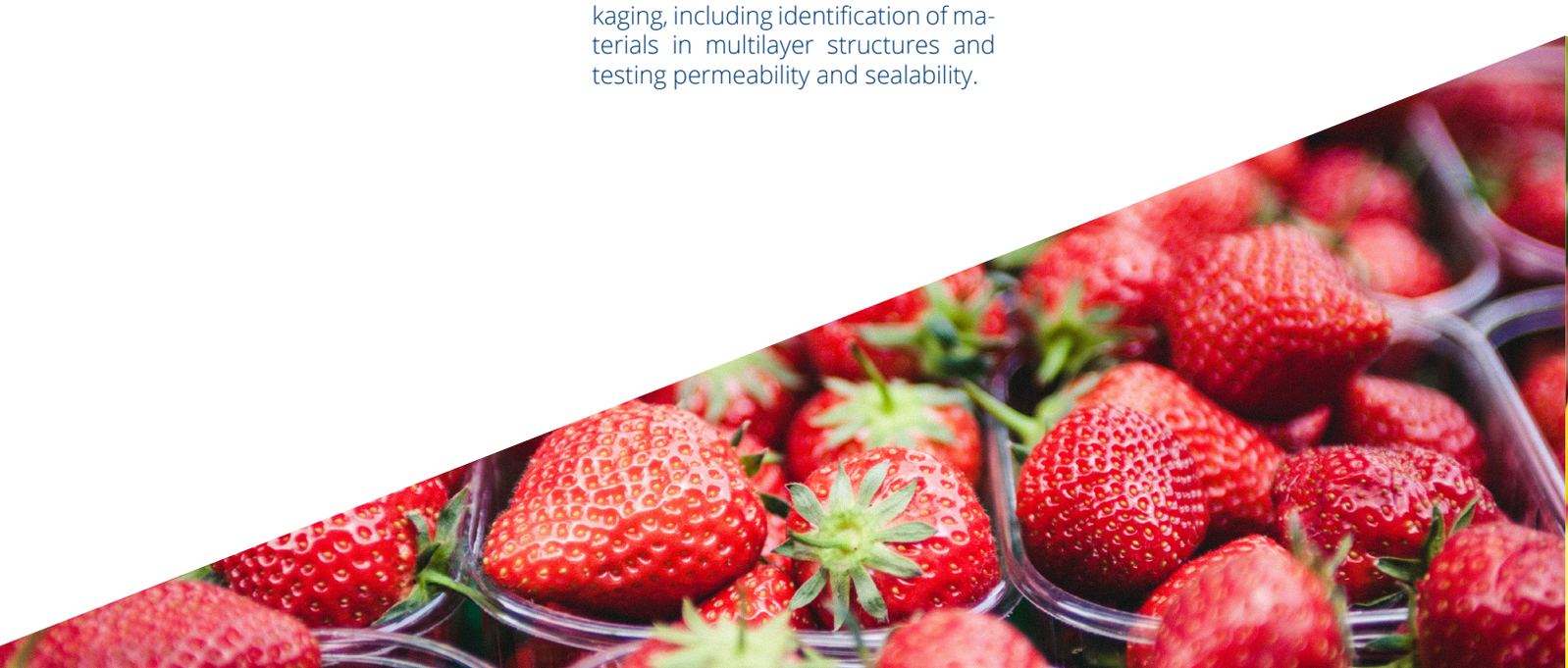
Development of materials with high barrier properties for application in multilayer structures by coextrusion, printing and lamination.

Control and characterization of packaging, including identification of materials in multilayer structures and testing permeability and sealability.

Development of smart packaging systems for expiration dates to reduce food waste.

Use of waste to obtain biopolymers and additives suitable for food contact.

Development of active packaging to extend the shelf life of packaged products.



SAFE PACKAGING

Validation to ensure packaging complies with food contact plastics legislation.

Overall and specific migration control of substances, additives, inks and adhesives.

Studies to identify and minimize non-intentionally added substances (NIAS).

Compliance with standards and legislation (e.g. pharmacopoeia, FDA, cosmetic packaging).

Compliance with legislation on recycled products used for food contact in the authorization and product development processes based on the use of functional barriers.

Basic and advanced workshops on legislation to help businesses guarantee safety and comply with legislation on food contact material.

PACKAGING ADAPTED TO THE CONSUMER

Design and development of packaging adapted to user habits of the elderly, childproof packaging, easy-opening systems, dispensers, labels, smart visual indicators, etc.

Development of customized packaging using digital and 3D printing.

Development of materials with high thermal resistance for microwaveable and ovenproof containers.

Development of packaging with hydrophobic and oleophobic properties.

ASSISTANCE AND IMPROVEMENTS IN PROPERTIES

Advice on the analysis of causes of failure, breakage and malfunctioning.

Packaging control and characterization: leaks, breakage, watertightness, chemical compatibility, sealability, etc.

Enhanced properties by combining polymers, additivation and/or polymer modification and processing conditions.

Training on materials, processes and characterization of plastic materials and processes: compounding, extrusion, injection moulding, printing and lamination.

Expert reports and technical reports for arbitration.

AIMPLAS

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Wageningen University
Food Quality and Design Group

Matthijs Dekker and Jenneke Heising

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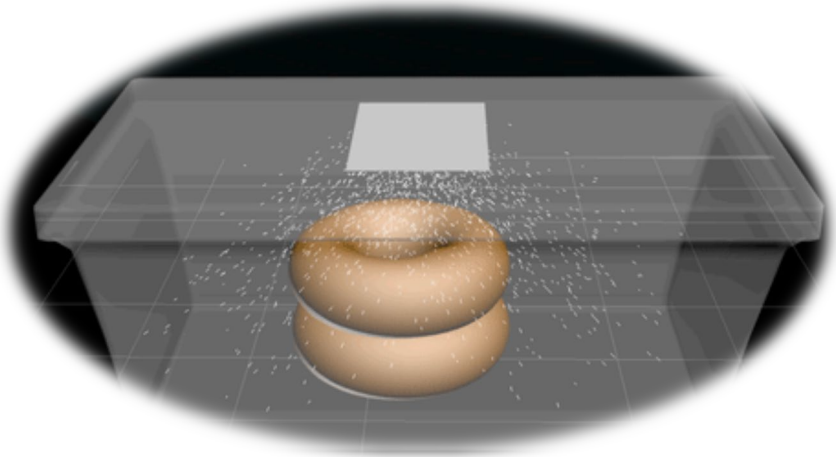
Research themes

- Intelligent packaging
  - Quality Controlled Logistics
  - Sensor prototyping
  - Food Waste Reduction
- Active packaging
  - Antimicrobial packaging (volatile/non volatile)
  - Antioxidant packaging
- Mathematical modelling



Intelligent Packaging

Critical Reviews in Food Science and Nutrition, 54:645–654 (2014)

ISSN: 1040-8398 / 1549-7852 online
DOI: 10.1080/10408398.2011.600477

Taylor & Francis
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Monitoring the Quality of Perishable Foods: Opportunities for Intelligent Packaging

JENNEKE K. HEISING,[1] MATTHIJS DEKKER,[1] PAUL V. BARTELS,[2] and M. A. J. S. (TINY) VAN BOEKEL[1]

[1]Food Quality and Design Group, Department of Agrotechnology and Food Sciences, Wageningen University and Research Centre, Wageningen, The Netherlands
[2]Fresh, Food & Chains, Business Unit of the Department of Agrotechnology and Food Sciences, Wageningen University and Research Centre, Wageningen, The Netherlands

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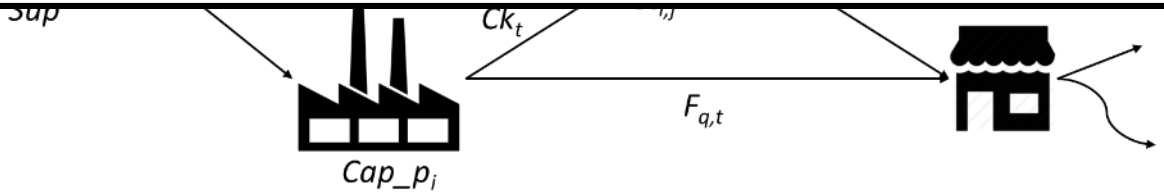
Optimising routing policy

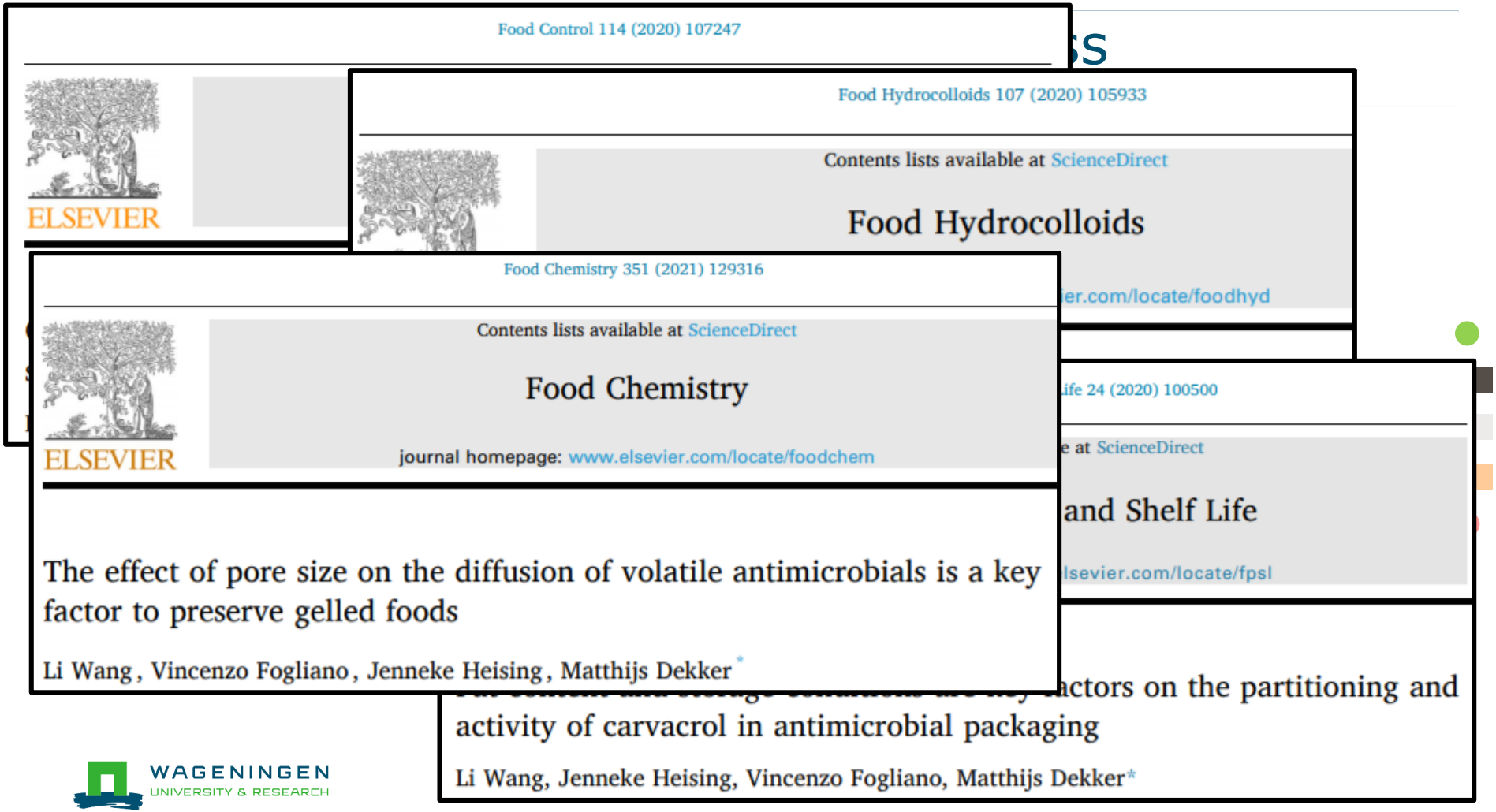
FOOD ADDITIVES & CONTAMINANTS: PART A, 2017
VOL. 34, NO. 10, 1672–1680
https://doi.org/10.1080/19440049.2017.1315776

Options for reducing food waste by quality-controlled logistics using intelligent packaging along the supply chain

Jenneke K. Heising[a], G. D. H. Claassen[b] and Matthijs Dekker[a]

[a]Food Quality and Design Group, Department of Agrotechnology and Food Sciences, Wageningen University, Wageningen, the Netherlands;
[b]Operations Research and Logistics, Department of Social Sciences, Wageningen University, Wageningen, the Netherlands





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Journal of Food Engineering 300 (2021) 110539

Contents lists available at ScienceDirect

Journal of Food Engineering

journal homepage: http://www.elsevier.com/locate/jfoodeng

Modelling the effect of food co
absorption and degradation in

Nur Alim Bahmid [a,b], Matthijs Dekker [a]

Food Chemistry 308 (2020) 125573

Contents lists available at ScienceDirect

Food Chemistry

homepage: www.elsevier.com/locate/foodchem

Water u

Fat pl

Antimicrobial:
of *Pseudomona*

Nur Alim Bahmid [1,2], Jen

(b)

Time: upon rehydration

Water uptake by the seed, formation of AITC

yl
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enneke Heising[a]

Contents lists available at ScienceDirect

Journal of Food Engineering

journal homepage: http://www.elsevier.com/locate/jfoodeng

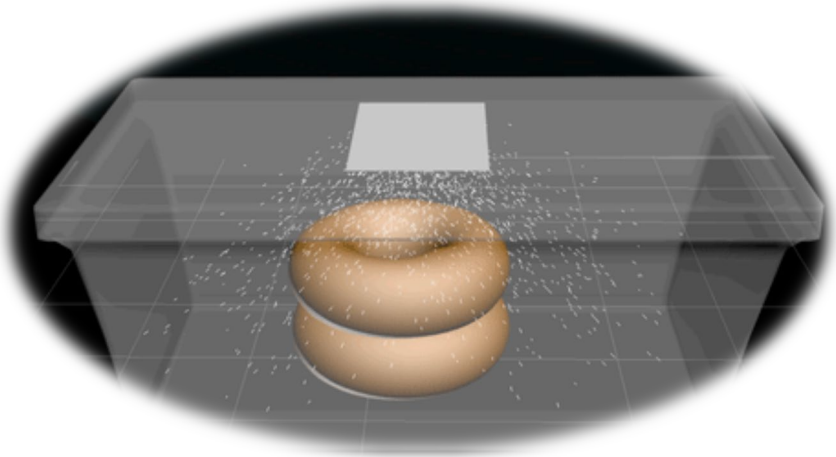
Journal of Food Engineering 292 (2021) 110370

Multiresponse kinetic modelling of the formation, release, and degradation of allyl isothiocyanate from ground mustard seeds to improve active packaging

Nur Alim Bahmid [a,b], Jenneke Heising [a], Matthijs Dekker [a,*]

Research themes

- Intelligent packaging
  - Quality Controlled Logistics
  - Sensor prototyping
  - Food Waste Reduction
- Active packaging
  - Antimicrobial packaging (volatile/non volatile)
  - Antioxidant packaging
- Mathematical modelling



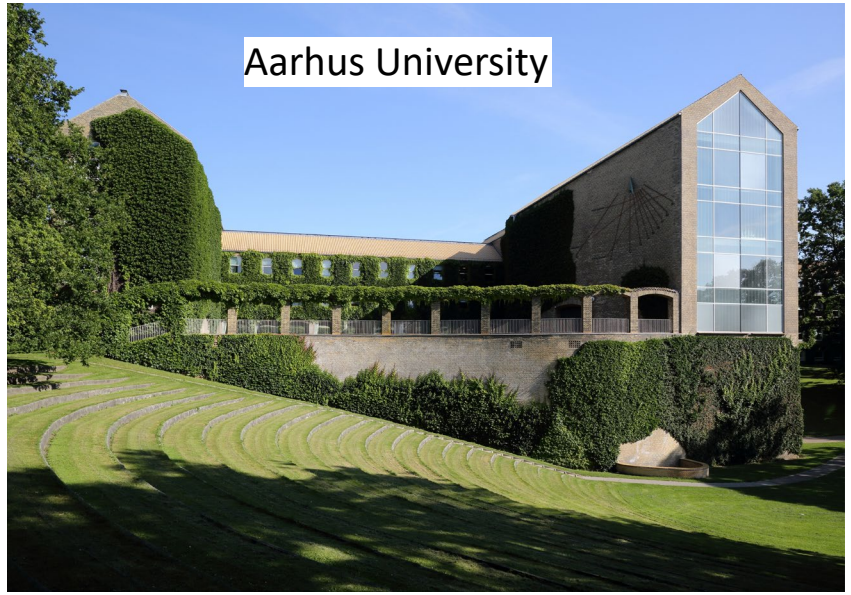
Thank you,

We are open for collaboration!

matthijs.dekker@wur.nl
jenneke.heising@wur.nl

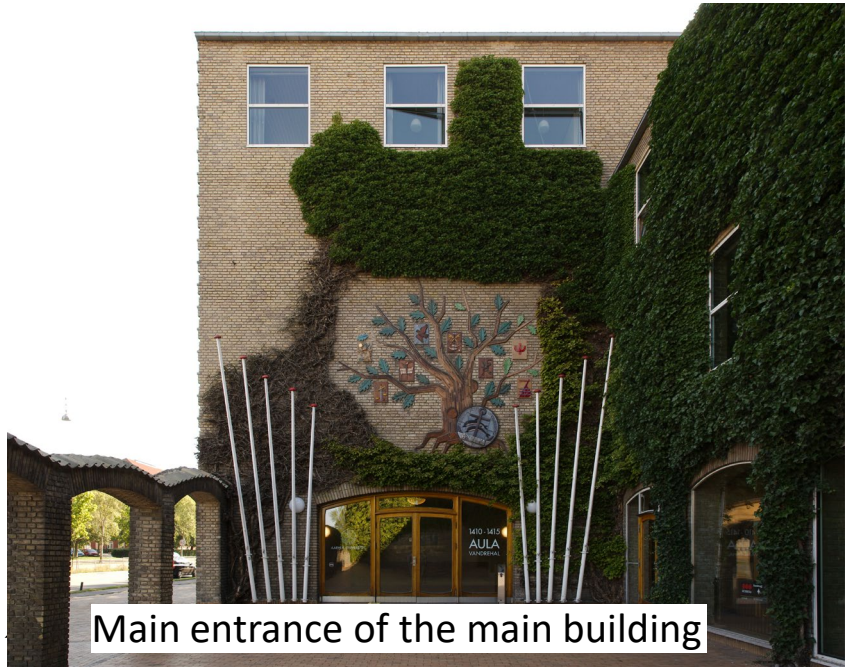
AARHUS – THE LARGEST 2ND CITY OF DENMARK

Aarhus University


Aarhus University

- established in 1928
- is affiliated with three Nobel Prize winners
- campus is in top 10 of Europe's most beautiful universities
- ranks among the top 100 in the world in several international rankings

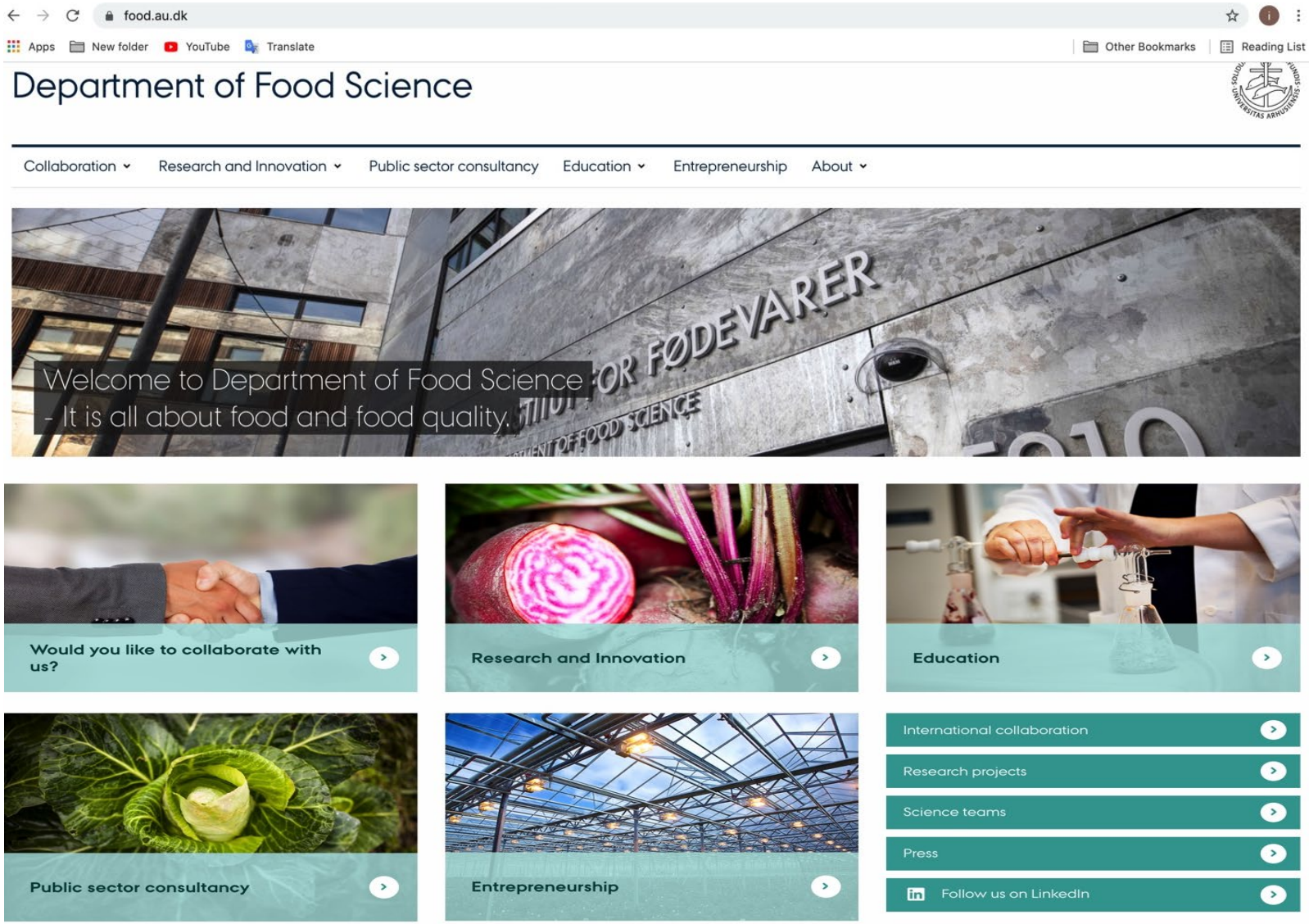

Ivy around windows on a building


Main entrance of the main building

Aarhus University is a campus university and located in the area around the University Park , but also has other locations in Aarhus as well as departments around Denmark.


University Park

The Department of Food Science at Aarhus University



PACKAGING SOLUTIONS TO INCREASE SUSTAINABILITY AND PROLONG SHELFLIFE OF FRESH AND FRESH-CUT PRODUCE

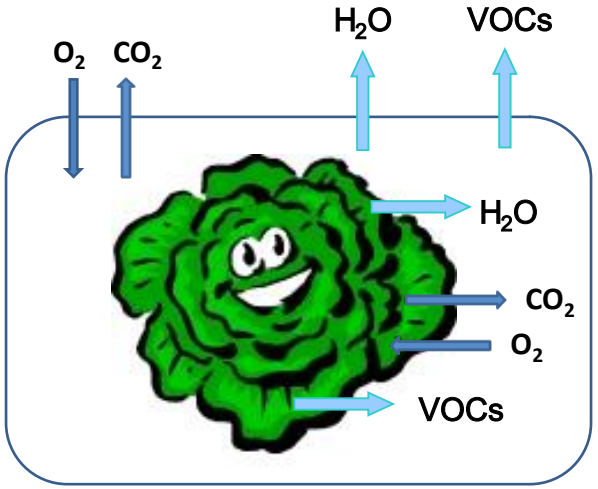
Merete Edelenbos

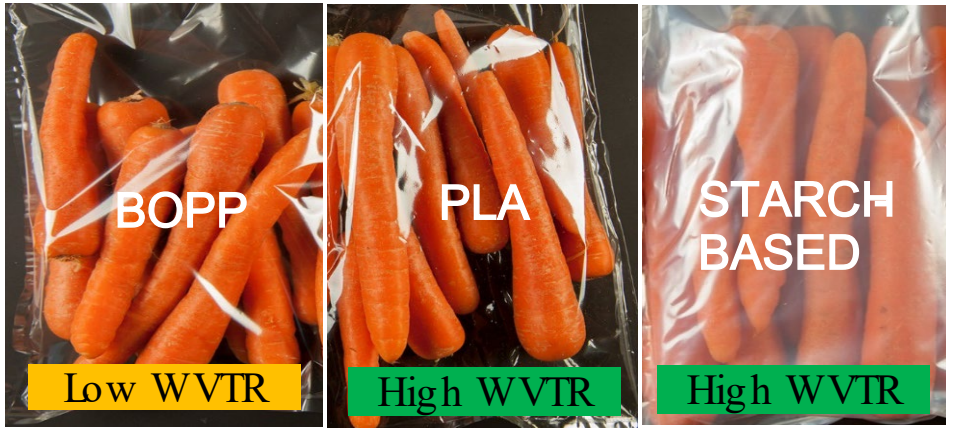
Associate Professor

merete.edelenbos@food.au.dk

RESEARCH TOPICS

- Modified humidity packaging (MHP) and modified atmosphere packaging (MAP)
- Understanding packaging microclimate, product volatile release, and shelf life
- Active packaging
- Biomaterials, consumer perception, and food waste



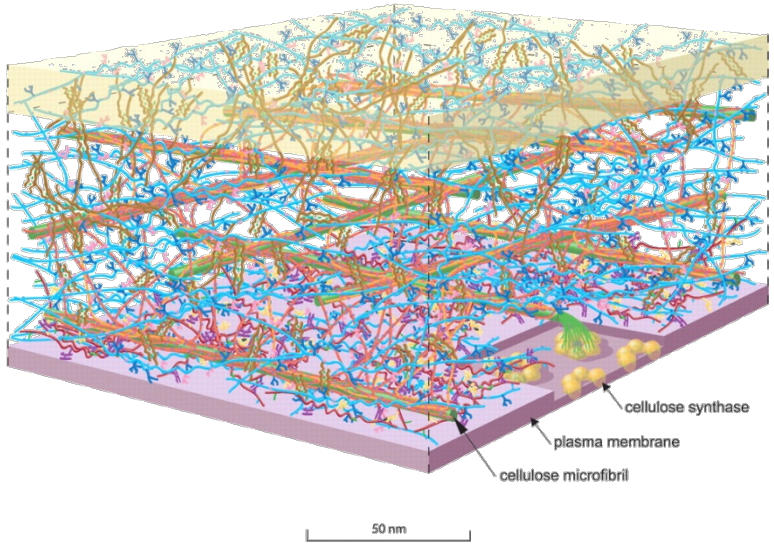


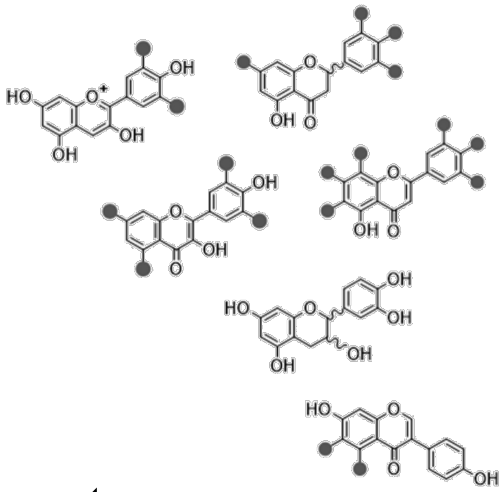
GLYCANS AND ASSOCIATED METABOLITES A
BUILDING BLOCKS FOR FUTURE BIOMATERIA

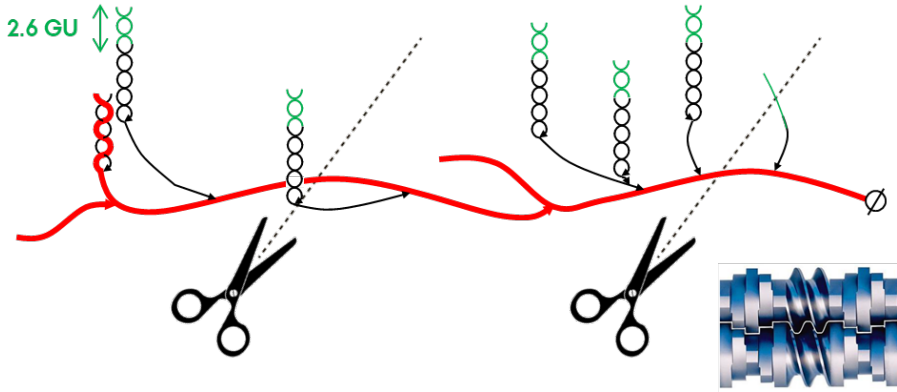
Mario M. Martinez
Assistant Professor
mm@food.au.dk

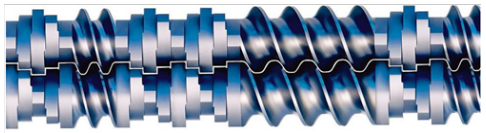
SOME ONGOING RESEARCH

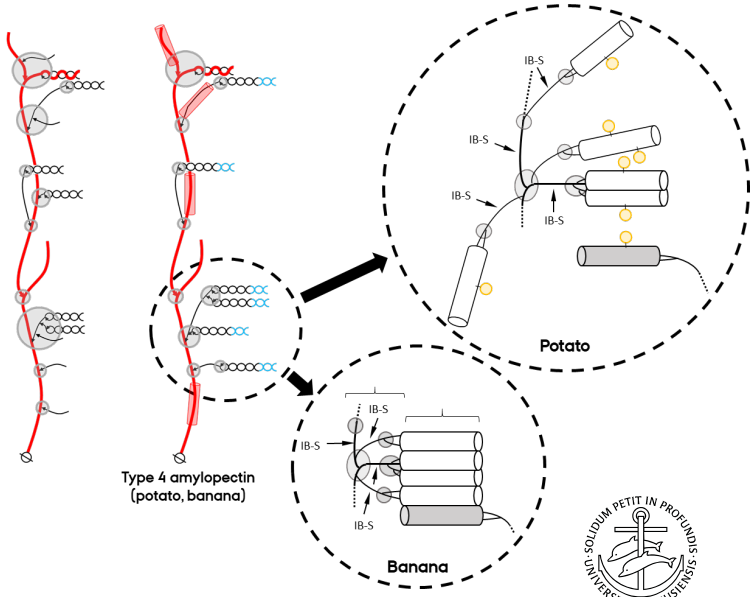
- Isolation of polymers from starchy and/or lignocellulosic biomass
- Glycomic profiling and molecular hydrodynamics of biopolymers
- Derivatization of glycans for improved barrier properties
- Reactive compatibilization of biopolymers during extrusion processing
- (Poly)phenolics: structure, interactions and bioactivity







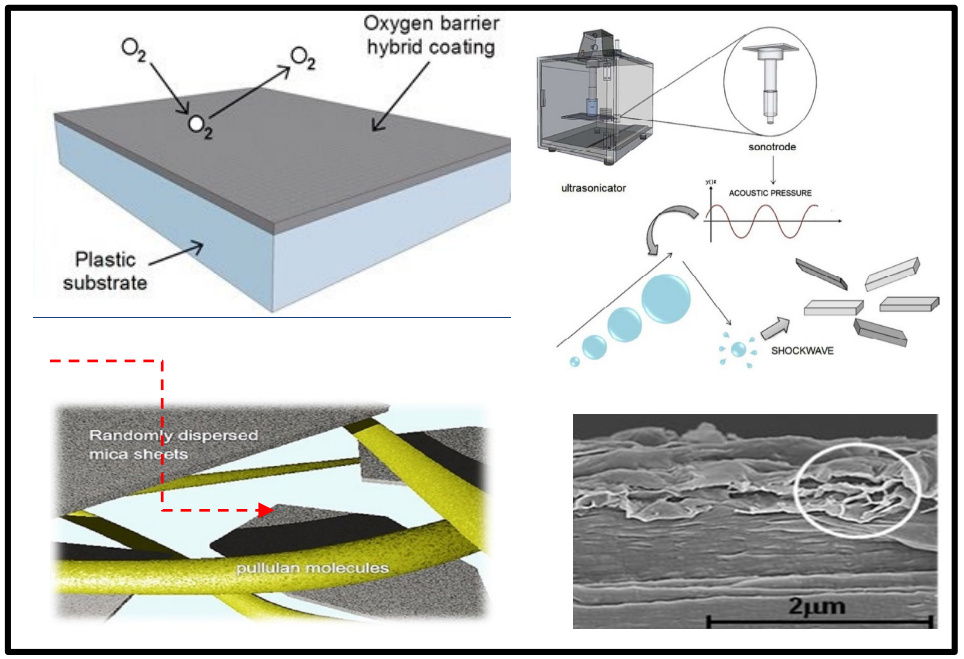




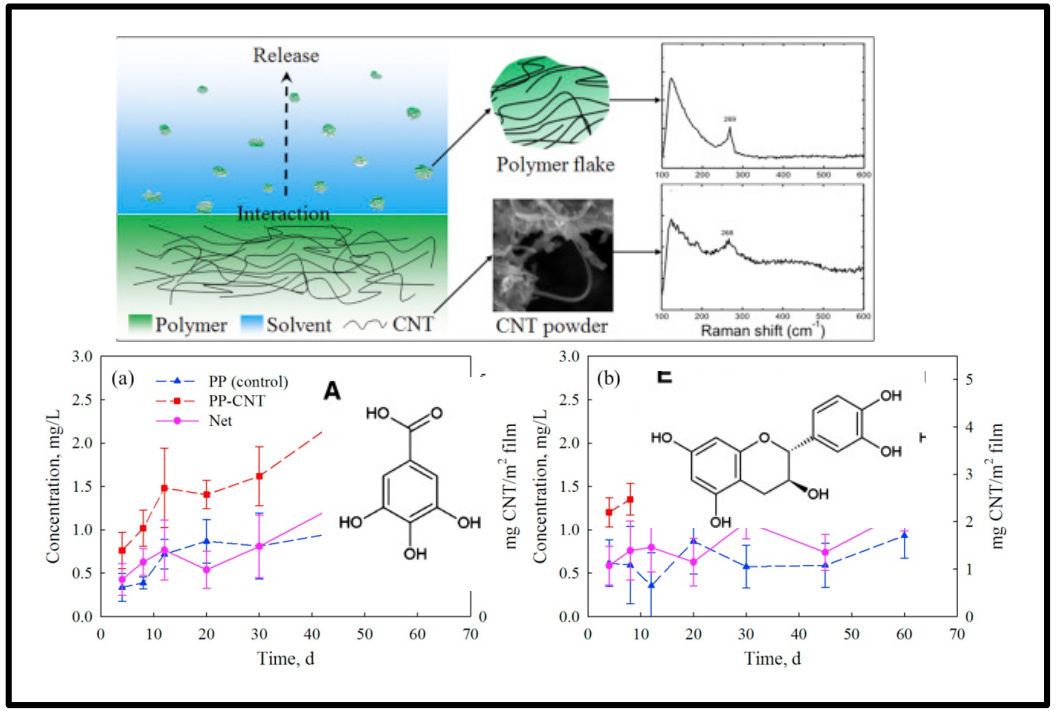
SUSTAINABLE PACKAGING DESIGN WITHOUT COMPROMISING THE FOOD QUALITY

Ilke Uysal Unalan
Assistant Professor
iuu@food.au.dk

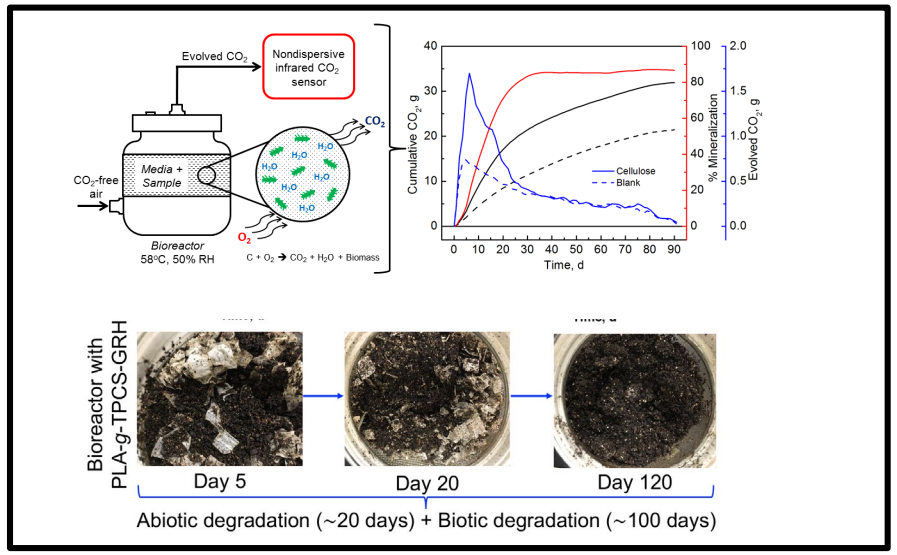
High Performance Barrier Nanocomposite Films and Coatings



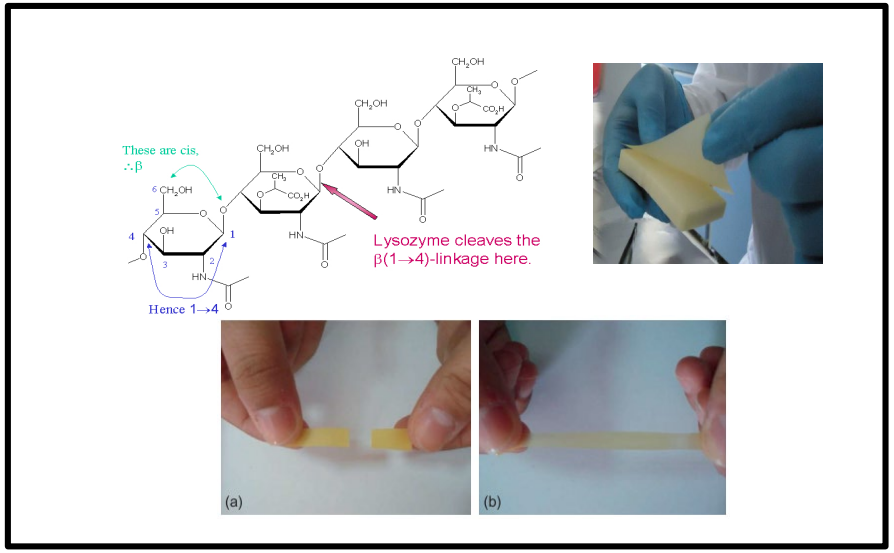
Release Mechanism from Nanocomposites to Food Matrix



Compostable Packaging



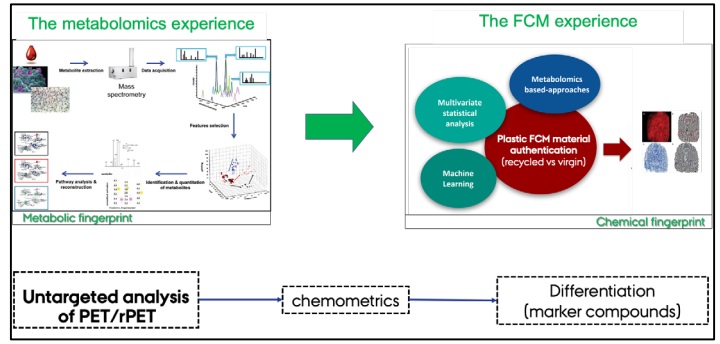
Active Packaging



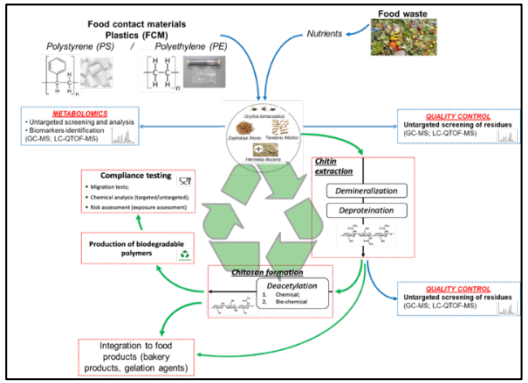
FOOD CONTACT MATERIALS

Emmanouil Tsochatzis
Postdoctoral Researcher
emmanouil.tsochatzis@food.au.dk

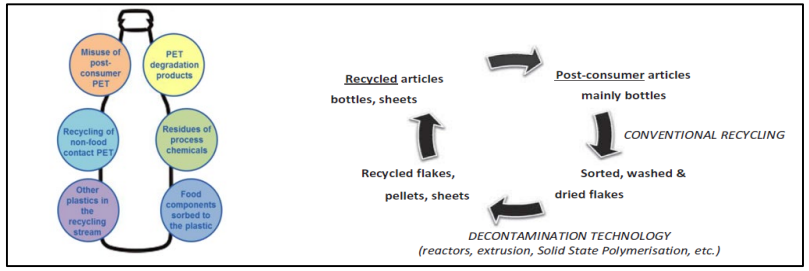
1. Chemical fingerprint of food contact materials (FCM), recycled or non-recycled.



2. Bio-recycling of food packaging plastics and food waste



3. Possible contamination sources of rPET plastic and of PET decontamination technologies



4. Toxicity of FCM substances toxicity by *In vivo* testing and metabolomics

5. Development of IT tool for NIAS (semi)quantitative, using in-house HR-MS.