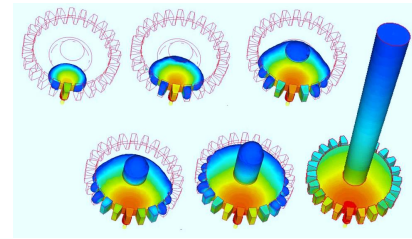
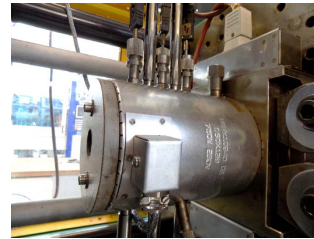
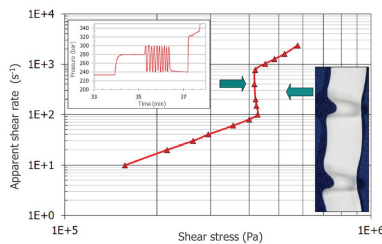


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Material Data Determination

Complete Thermodynamic and Rheological Material Datasets
for Injection Moulding- and Extrusion Simulation



The working group **Material Data Determination** at Institute of Polymer Processing deals with the measurement of **rheological** and **thermodynamic** material data for complete **material datasets** for **precise simulations with all simulation programs**. Furthermore we do failure analysis of polymer parts.

Scope of Measurements

Rheological Measurements:

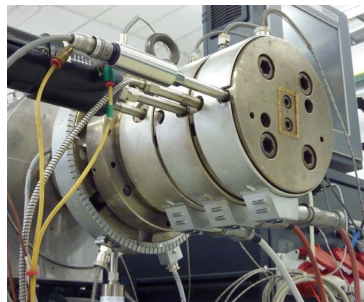
- Shear viscosity as function of shear rate, temperature and pressure (ISO 11443)
- Complex viscosity (ISO 6721)
- Transient elongational viscosity (ISO 20965)
- Extensional behaviour and melt strength (RHEOTENS)

Thermodynamic material data:

- Thermal conductivity as function of temperature (ASTM D5930, ASTM D7984) and pressure (ASTM D5930)
- Specific heat capacity (ISO 11357)
- Specific volume as function of pressure and temperature (ISO 17744)

Materials:

- Thermoplastics, elastomers, feedstocks for Shaping Debinding Sintering SDS (PIM, PEM, AM MEX), WPC, reactive systems ...



Full Service

Data ⇒ Analysis ⇒ Interpretation ⇒ **Technical Report with Management Summary**

- Scientific expertise for industrial applications
- Consulting and technical support
- Tailor-made offers
- Post-project support



Equipment

- Rotational rheometer: MCR 702 MultiDrive (Anton Paar)
- High pressure capillary rheometer: RG50, RG2002 (Göttfert)
- Machine rheometer:
 - Leistritz inline rheometer
 - PIM-injection moulding machine rheometer
- Extensional tester: RHEOTENS 71.97 (Göttfert)
- Thermal conductivity measuring device: K-System II, TCi
- Differential scanning calorimeter: DSC1, Flash DSC2+
- pVT-apparatus: pVT100 (SWO Polymertechnik)
- Measuring mixer: Lab Station EC, W50 EHT, W350 E (Brabender)



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Ivica Đuretek

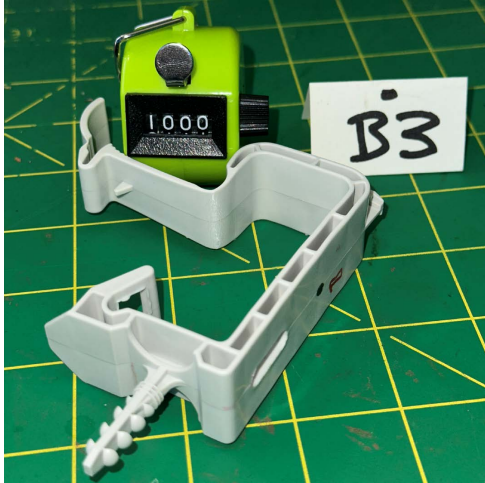
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CircularBioMat

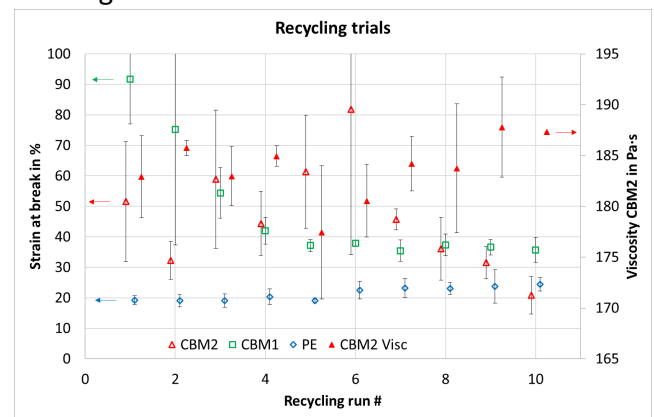
Recyclable biogenic materials for building equipment and building services engineering

- Substitution of oil-based polymers with bio-based materials
 - Fastener for cables and pipes
 - Barrier films building insulation
- Evaluation of the properties
- Production of the existing geometries
- Evaluation of the CO₂ footprint and comparing them
 - Similar material and energy input during processing
 - Lower CO₂ footprint during production of the polymer
- Testing of the products (e.g. 1000 Cycles of opening and closing)
Pull out of a drilled hole

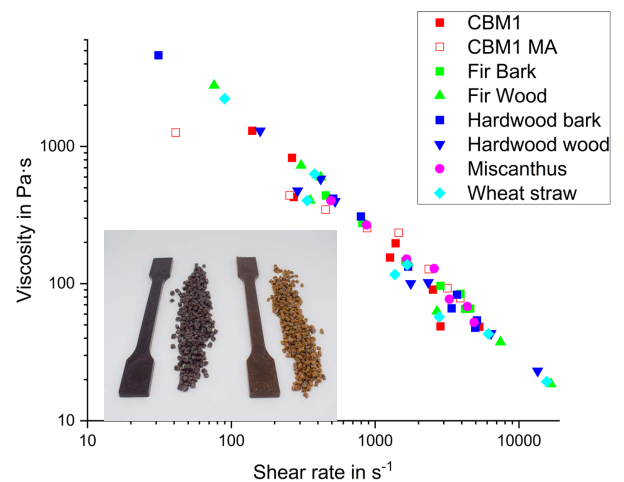


- Challenges:
 - Durability
 - Mechanical properties
 - Flame retardancy
 - Vapor retarders and barriers
 - Different additives necessary

- Recycling trials:
 - How are the properties influenced if the materials are recycled?
 - Mechanical properties
 - Viscosity as a property related to the molecular weight



- Wood fibre reinforcing of bio based polymers
- Bio-PE and PHA (PHA much to brittle)
 - Natural based fibres (15 wt.%)
 - Conifer fibre from fir wood and bark
 - Hardwood fibre from beech wood and bark
 - Miscanthus fibre
 - Wheat straw fibre



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The project CircularBioMat, FFG Number F0999907643, is funded by the Austrian Federal Ministry of Transport, Innovation and Technology (BMVIT), through the Austrian Research Promotion Agency (FFG).

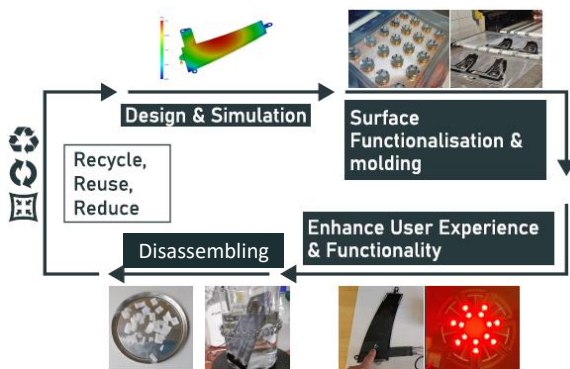
MULTIMOLD

Unlocking the future of injection molding for manufacturing

MULTIMOLD SCOPES

In-mold electronics (IME) products with

- Piezoelectric forces sensitivity
- Complex geometries and microstructures
- Robust, weather-resistant material concept
- Inherent recyclability by design



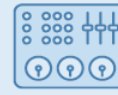
CURRENT IME CHALLENGES AND LIMITATIONS

- Lack of capacitive touch sensors to be operated with gloves or cold fingers
- Missing haptic feedback
- Low yield and high tool manufacturing costs
- Multi-material compounds
- Technical obstacles in product manufacturing
- Local heating of molded plastics for embedded LEDs

APPLICATIONS



Automotive user interfaces



Industrial control panels



Wind turbine condition monitoring

1ST GEN DEMONSTRATORS

1. Automotive HMI

- ✓ Successful user interaction at the exterior of a car in highly humid conditions and with gloves.



2. Industrial HMI

- ✓ Designed with the integration of
 - Haptic actuation
 - Piezoelectric sensing
 - soldered electrical components in 3D shape.



3. Condition monitoring

- ✓ Overmolded system survived lab & field testing - harsh conditions on the rotor blade of a wind turbine.



4. Test-bed for end-of-life Scenarios

- ✓ Recycling of multimaterial device by dissolution and reuse of PC validated



5. FEM Simulation and Optical design

- ✓ Manufacturing process supported by FEM simulation.



SCIENTIFIC RESULTS

- Integration of piezoelectric sensing in injection-molded components
- Overmolding of sensitive electronics (batteries, solar cells)
- 3D-formed flexPCBs within IME technology
- New material combinations for IME
 - Designed for material reuse

IMPACTS

- Fabrication of electronic products in one injection molding step
- European competitiveness and sovereignty
- Establishes pathway for next-generation electronics fabrication within the EU



DI

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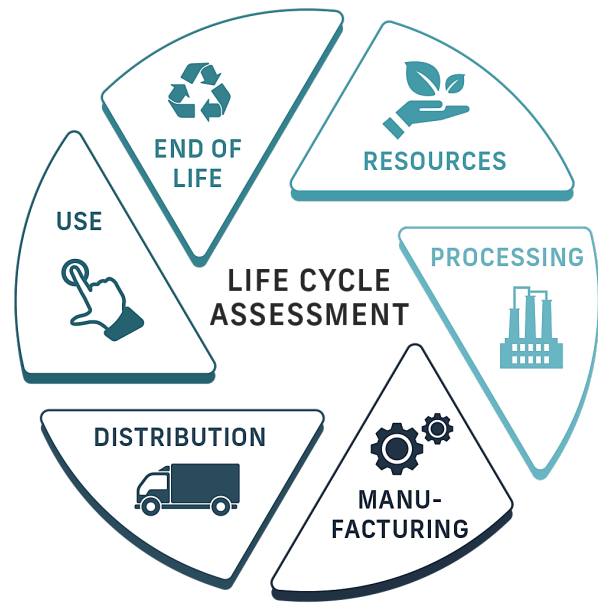
WINTRUST

WINTERSPORT RESOURCE EFFICIENCY AND IMPROVED CIRCULAR ECONOMY

MOTIVATION

How can an **ecological, economical & social sustainable**, cross-brand circular **economy** for the Austrian **winter sports industry** be successfully **implemented and optimized** for selected ski sport articles?

DURATION: 01.11.2023 – 30.10.2026



PROJECT GOALS

- Establish **Recycling Routes** for **Five Use Cases**
- **LCA** with real data (technical, logistical & economical processes)
- Cooperation over the **entire life cycle**
- Identifying adjustment options & optimization potentials
- Ecological, economical & social sensible approaches & solutions

CONSTANT PROGRESS

- Determined **Recycling Routes** in Pilot- and Industrial-Scale for all Use-Case
- **Closed Loop Applications** for Ski-Helmet Soft-Shell, Ski-Boot Shell, Ski-Bindings and PU-Core of Skies
- **Open Loop Applications** for Metals, Wood Cores from Skies, Composites from Poles and Skies
- **LCA data acquisition** in every step of Logistics and Processing
- Strong **Media Presence** via LinkedIn, Newspapers and TV



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Mechanical Recycling of Plastics for High-Value Circular Applications

Enabling closed material loops for packaging, automotive and technical products

Research Area 1 – Food Contact & Premium Packaging

High-quality recyclates for closed-loop packaging

- Mechanical recycling of post-consumer packaging
- Quality assurance for food contact applications
- Contaminant analysis & material characterization
- Design for Recycling / Design from Recycling
- Closed-loop PP, HDPE, PS packaging

Project: Pack2theLoop

Goal: Quality-assured recyclates from post-consumer packaging for closed-loop packaging systems.

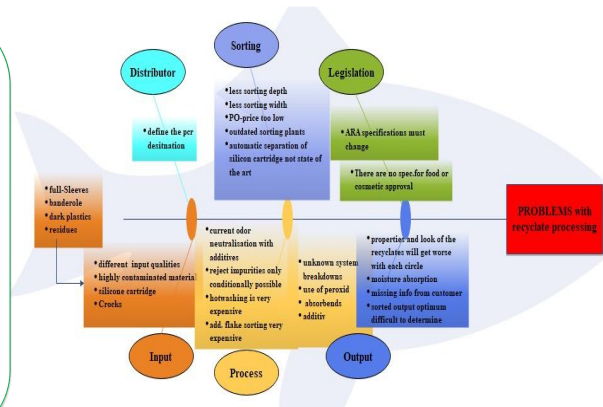


Figure 1: Cause-effect diagram illustrating challenges in the recycling industry.

Research Area 2 – Fiber-Reinforced Polymers

Recycling of glass-fiber reinforced thermoplastics

- GF-reinforced polypropylene recycling
- Mechanical recycling of composites
- Fiber length & property retention
- Processing of recycled compounds
- Lightweight & automotive applications

Project: LightCycle

Goal: Upcycling of regenerates and injection moulding into high-quality lightweight components using a new technological approach.

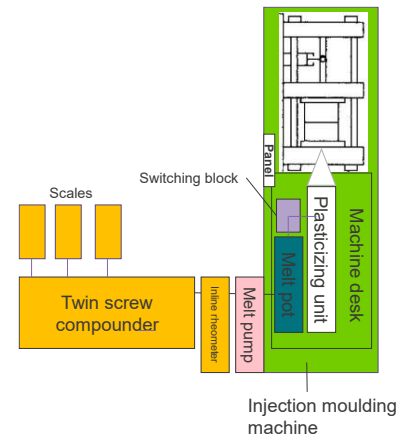


Figure 2: Schematic diagram of the new LightCycle processing plant

Research Area 3 – Recycling of Complex & Multi-Materials

Recycling of technical and sports products

- Recycling of multi-material systems
- Disassembly & material separation
- High-performance plastics recovery
- Circular economy for technical products
- Ecological & economic assessment

Project: WINTRUST

Goal: Closed-loop recycling of winter sports equipment and multi-material products.

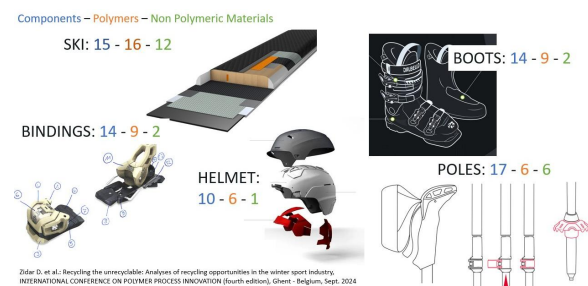


Figure 3: Multi-component, multi-material design showing the materials used in production.



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Research Focus

- Mechanical recycling of high-value plastics
- Recycling process development
- Extrusion & injection moulding of recyclates
- Material characterization & sensor analysis
- Packaging, automotive and fiber-reinforced polymers
- Closed-loop circular applications