

# High-Performance Tapes Made From Recycled Carbon Fibers for Lightweight Construction - INFINITY

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## Introduction

The aim was to develop, establish and demonstrate a sustainable process cycle for carbon fiber composite materials using novel recycling technologies, material and processing methods as well as the substitution of the carbon fiber primary material with high-quality recycled materials for significant CO<sub>2</sub> reduction in lightweight construction.

### Demonstrator Manufacturing

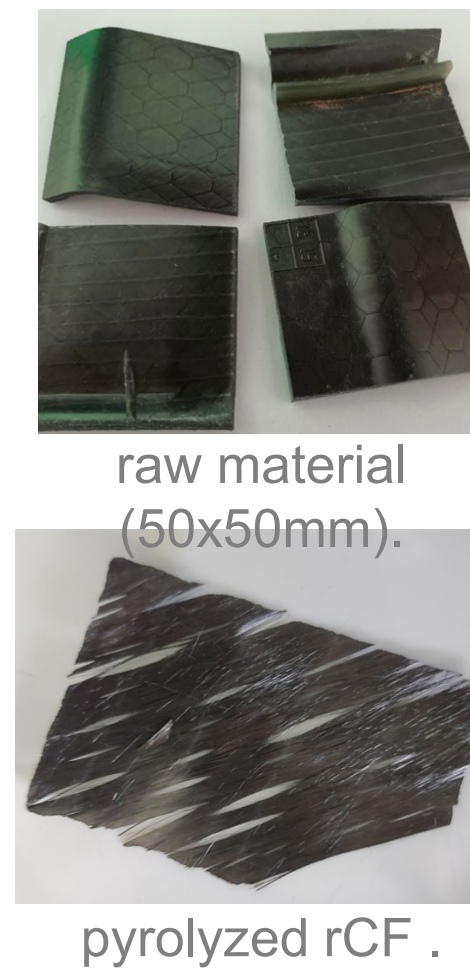
- production of a demonstrator in fiber-reinforced load-path-compatible design
- transversing cross bar from driver's seat
- back-injection-molded and functionalized



back-injection-molded demonstrator part.

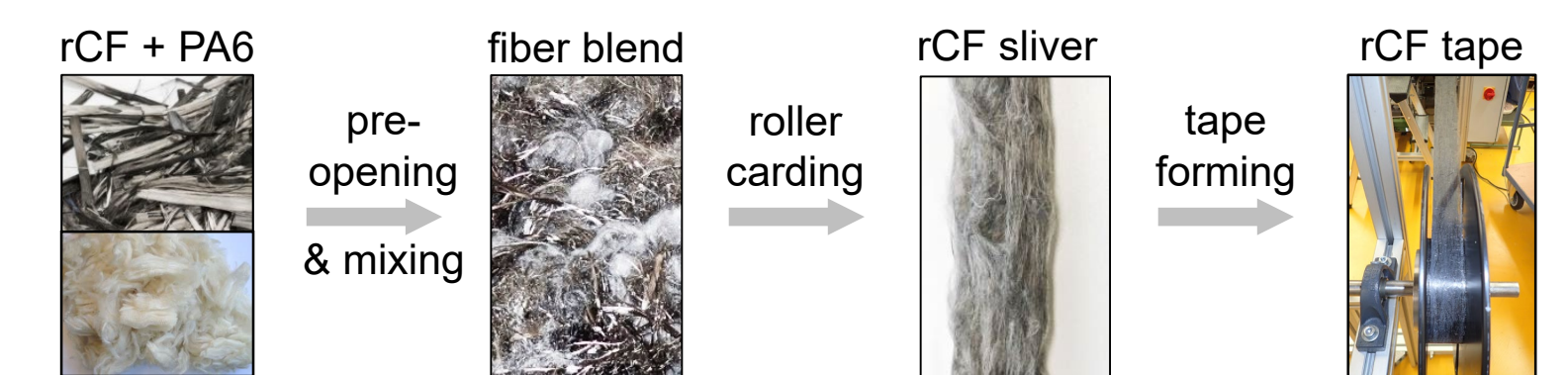
### Recovery of Carbon Fibers

- two-stage pyrolytic process for the gentle recovery of rCF from CFRP
- the CF are freed from the polymer matrix in a CO<sub>2</sub> atmosphere in absence of oxygen
- any remaining residues are then removed in low oxygen atmosphere

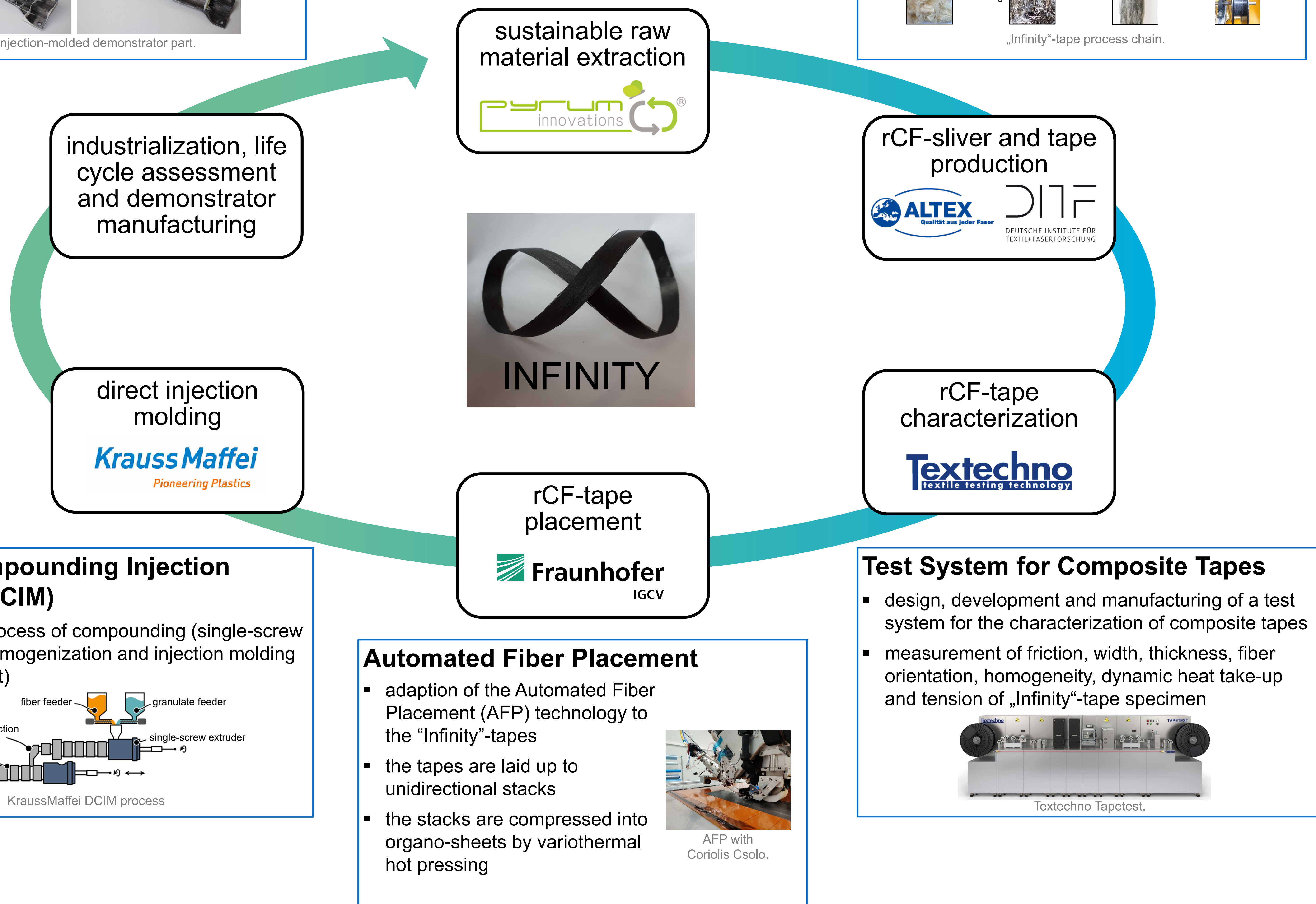


### Development of the „Infinity“-Tape

- production of an rCF/polymer hybrid sliver by roller carding technology
- formation of a highly oriented „Infinity“-rCF-tape by drawing and consolidation

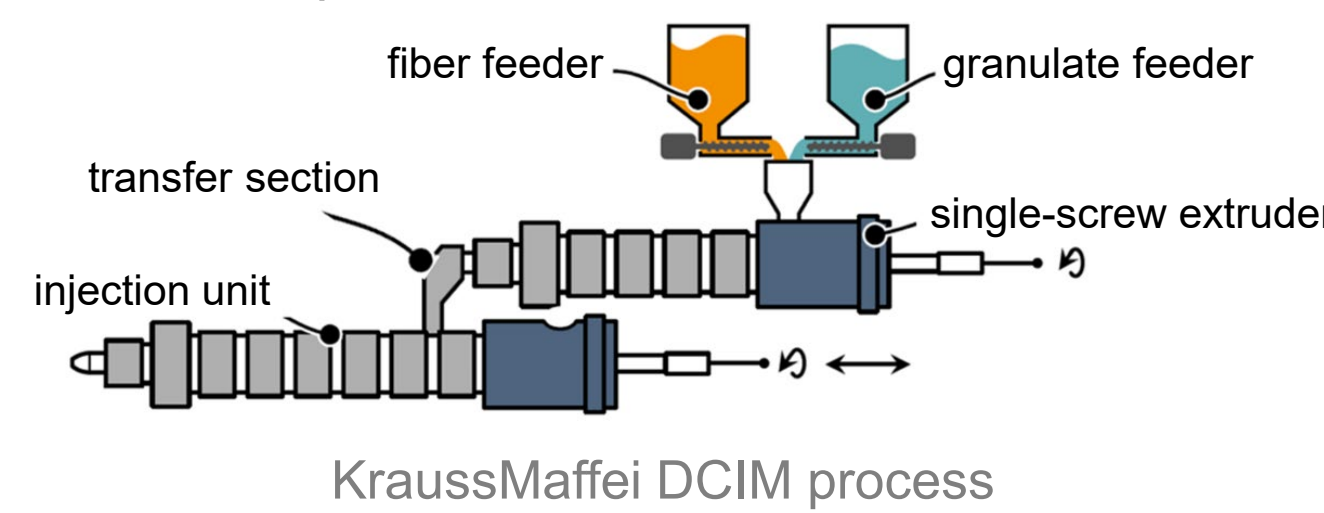


„Infinity“-tape process chain.



### Direct Compounding Injection Molding (DCIM)

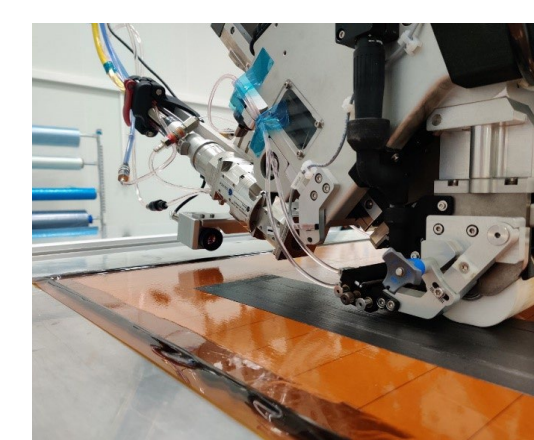
- combined process of compounding (single-screw extruder), homogenization and injection molding (injection unit)



KraussMaffei DCIM process

### Automated Fiber Placement

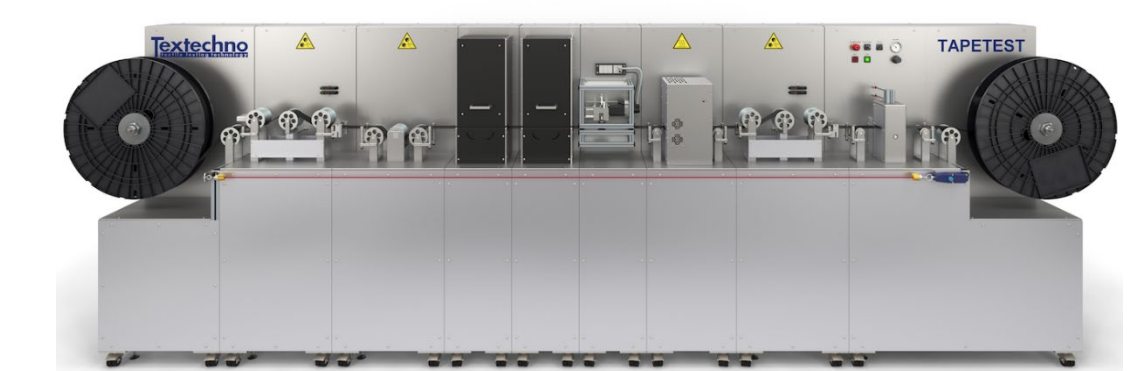
- adaption of the Automated Fiber Placement (AFP) technology to the „Infinity“-tapes
- the tapes are laid up to unidirectional stacks
- the stacks are compressed into organo-sheets by variothermal hot pressing



AFP with Coriolis Csolo.

### Test System for Composite Tapes

- design, development and manufacturing of a test system for the characterization of composite tapes
- measurement of friction, width, thickness, fiber orientation, homogeneity, dynamic heat take-up and tension of „Infinity“-tape specimen



Textechno Tapetest.

## Results

- The developed rCFRP achieved about 88% of vCFRP's tensile strength and 89% of its tensile modulus.
- A reduction in global warming potential of 49.3% for pyrolysis fibers and 65.9% for production waste fibers can be achieved according to a mass-based comparison.

## Summary

- Recycled carbon fibers can be reprocessed into high-quality CFRP with a noteworthy CO<sub>2</sub> reduction compared to virgin material.
- The technologies applied in the process cycle were successfully adapted to the needs and characteristics of the recycled fiber material.
- Illustration of a way towards true substitution of virgin CFRP instead of downcycling to low-oriented materials and the associated loss of mechanical properties.

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