Fraunhofer ICT

Reactive PA6 pultrusion

A process for manufacturing high-performance, cost-effective and recyclable profiles

For decades, pultrusion has been the most economical process for producing fiber-reinforced profiles with diverse cross sections. By utilizing reactive thermoplastic matrices like ε-caprolactam, which polymerizes to polyamide 6, new possibilities arise in various applications. These profiles offer competitive mechanical properties, the potential for thermoforming and functionalization through overmolding, and easy mechanical recycling, making them an ideal choice for energy- and resource-saving components across industries.

Photo above: Track-and-trace solutions for inline profile labelling.

Reactive processing is the key

The remarkably low viscosity of ε-caprolactam (approx. 10 mPa*s) ensures optimal impregnation of reinforcing fibers. By adjusting the concentration of activator and catalyst in the commercially available materials, the polymerization rate can be controlled, enabling high haul-off speeds and cost-effective production. The anionic polymerization of the matrix, combined with selected fibers, creates a chemical bond between the matrix and the fiber, resulting in properties comparable to thermoset matrices. Matrix modification is also possible with additives such as colors and flame retardants.

Industrial applications

Extensive efforts have been made to overcome the challenges posed by moisture during the reactive processing of ε-caprolactam, which hindered polymerization. As a result, we have developed techniques to avoid and compensate for moisture influence, ensuring stable production of high-quality profiles even in harsh environments.

PA6 profiles can directly replace thermoset profiles or be used as local reinforcement in combination with short-fiber-reinforced polymers in LFT-D or injection molding processes. Automotive parts like battery housings, dome struts, intrusion beams, and stiffening elements are just a few examples of their versatile applications.

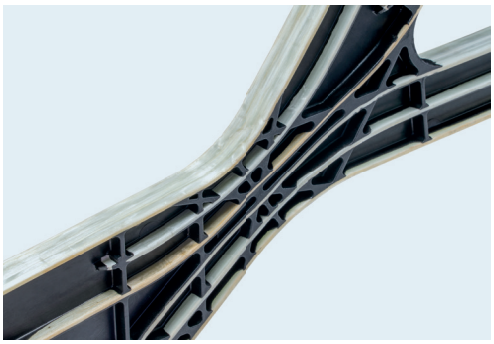
JEC WORLD INNOVATION AWARDS WINNER 2024

Left:
User-friendly and fully digitized HMI with extensive data acquisition.

Right:
Reinforcing fibers for high-performance profiles.

Key benefits

- Cost-effective processes and raw materials
- Sustainable – easy mechanical recycling and reusability
- Functionalization through LFT-D or injection overmolding
- Exceptional strength with up to 73% fiber volume content
- Flexible use in diverse applications



Röchling

JEC Innovation Award Winner 2024
Cooperation project: Röchling Automotive, Röchling Industrial, Fraunhofer ICT.

Our research focus

- Evaluation and optimization of process parameters and materials
- Design and comparison of different injection chambers
- Process digitalization (real time analysis, prediction, tracking)
- Functionalization and co-molding of thermoplastic profiles
- End-of-life processes and recycling
- Development and adaption of new reactive TP matrices
- Development of methods for fast and cost-efficient characterization (quality management)

Our service

We support you in realizing your profile or product with our expertise and diverse industrial-scale equipment. Whether you need assistance in design, prototyping, or validating full-scale production capability our team is here to help you every step of the way.

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