FiberForm-Technology: Thermoforming Meets Injection Molding in the OsTOS Project

Sustainable Lightweight Solutions through Component Reinforcement

More and more industries are demanding lightweight components that are both resource-efficient and high-performance. KraussMaffei's FiberForm-technology, which combines thermoforming and injection molding, has been established for years. As part of the OsTOS research project, the process has now been further developed: new materials, high-resolution radiant heaters, and intelligent process control enable customized, CO_2 reduced components, even in small quantities.

The new generation of IR furnaces for the FiberForm-technology, shown here in use during pilot production on a GX 650–4300 injection molding machine. © KraussMaffei

FiberForm-technology combines two consecutive process steps: the forming of organic sheets and subsequent back injection molding. The composite material, usually an endless fiber-reinforced thermoplastic semi-finished product, is first brought to forming temperature in an IR oven, then placed in a forming tool, where it is formed and back-injected with a thermoplastic. This technology, which is also suitable for large-scale production, combines the advantages of both technologies: high rigidity with low weight, functional integration, and short cycle times.

With the OsTOS (Oven System for Tailored Organo Sheets) project, a consortium (**Infobox p. 72**) has pursued the goal of making the FiberForm-technology fit for the next generation of sustainable lightweight components. As a long-standing user of FiberForm-technology, consortium leader Centrotherm Systemtechnik contributed valuable market requirements to the project. The focus is on the processing of so-called tailored organo sheets, load path-optimized organic sheets that are often inspired by bionics. They can be made from recycled or bio-based materials and can be specifically tailored to the desired property profile, for example in terms of mechanical requirements, resource efficiency, or carbon footprint.

One of the project's objectives is to advance lightweight construction. Design studies have already shown that locally reinforced organo sheets can reduce the thickness of the carrier material by up to 20 %. This saves component weight and thus also valuable resources throughout the entire process chain. With the further development of FiberForm-technology by the OsTOS project, it is now possible to process these tailored organo sheets professionally.

OsTOS Project: Oven System for Load Path-Optimized Organic Sheets

The process chain for the production of tailored organo sheets is already established, and numerous suppliers of tape laying processes have successfully positioned themselves on the market, especially in the aviation sector, where this technology is increasingly gaining a foothold. The ITA (Institut für Textiltechnik Augsburg, Germany) has contributed its expertise in closed material cycles, known

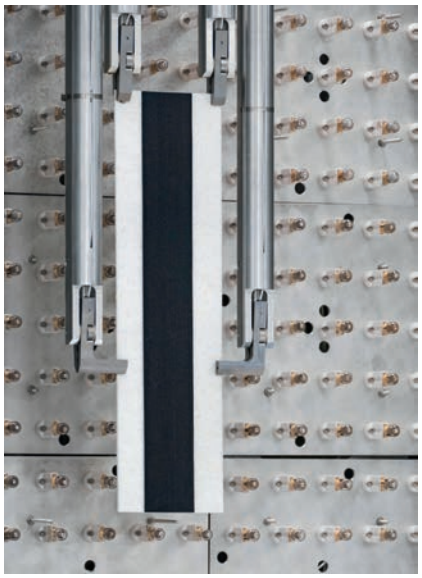

Fig. 1. The high-resolution emitter module (detailed view) enables targeted heating of local amplifications. © KraussMaffei

as closed-loop recycling, to the project. For the first time worldwide, the process chain was implemented using the so-called 3D Lofters (manufacturer: Dilo Systems), a machine that can be used to locally reinforce non-woven fabrics during production by selectively applying a fiber mass. This principle is also known as "additive textile manufacturing."

Technology Adaptations for the Material of the Future

Technological enhancements were necessary for the new generation of materials. The central element is a high-resolution IR emitter array, which was developed in collaboration with Infratec and is controlled locally. It only applies heat where it is needed, such as in areas with thick reinforcements (**Fig. 1**). The quality of the heating process is monitored live by a full-surface thermographic image (**Fig. 2**), for which Optris provided its solutions. This creates a digital image of each cycle with precise temperature distribution.

The system is controlled by AI-supported process control, which provides recommendations for temperature profiles and cycle times. Unlike classic black box solutions, explainable AI is transparent: an intuitive dashboard allows the operator to review, validate, or adjust the suggestions, with decision-making authority remaining with the human operator (**Fig. 3**). Explainable AI and the user-friendly interface were developed in collaboration with software partner DatenBerg.

The thermographic analysis of the heated semi-finished product created for each individual cycle significantly increases the depth of documentation. The pictorial visualization gives the user a high level of confidence in FiberForm technology. The evaluation of the heating quality based on its homogeneity creates an additional parameter. This can be defined both as a quality feature and as a rejection criterion. The process can thus be additionally validated and certified. This paves the way for applications with very high process monitoring requirements.

Another technical milestone is the new furnace design (**Title figure**), developed by project partner Elektroschmiede in close cooperation with KraussMaffei. The system has a modular design and can be retrofitted into existing production lines. This means that existing plants can also be easily modernized, with full compatibility with different component geometries and batch sizes. This reduces investment risks and promotes industrial scaling.

Safety Included: Also for Bio-Based Materials

Bio-based semi-finished products in particular place increased demands on fire protection and process safety. As part of

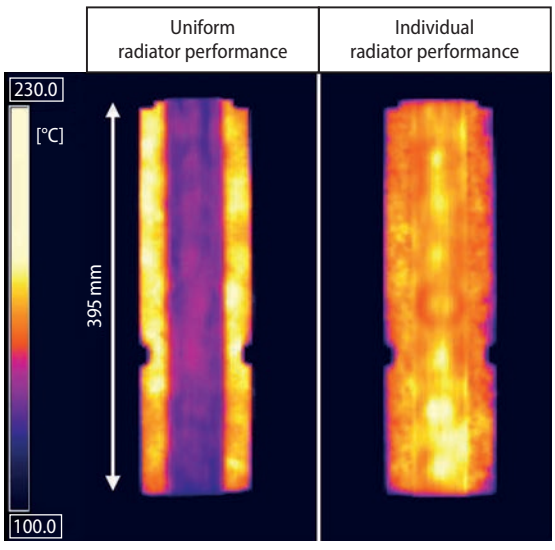

Fig. 2. As the thermographic image shows, the new radiator array allows the local amplification to be heated in a targeted manner. © KraussMaffei

Info

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Live at K 2025

The OsTOS project has already led to its first industrial application. The system will be presented live at K 2025 on a KraussMaffei GXW 650 (reversible plate) injection molding machine. The Leonhard Kurz booth will offer a practical insight into the new generation of ovens with increased flexibility in heating geometry:
Hall 5, booth A19

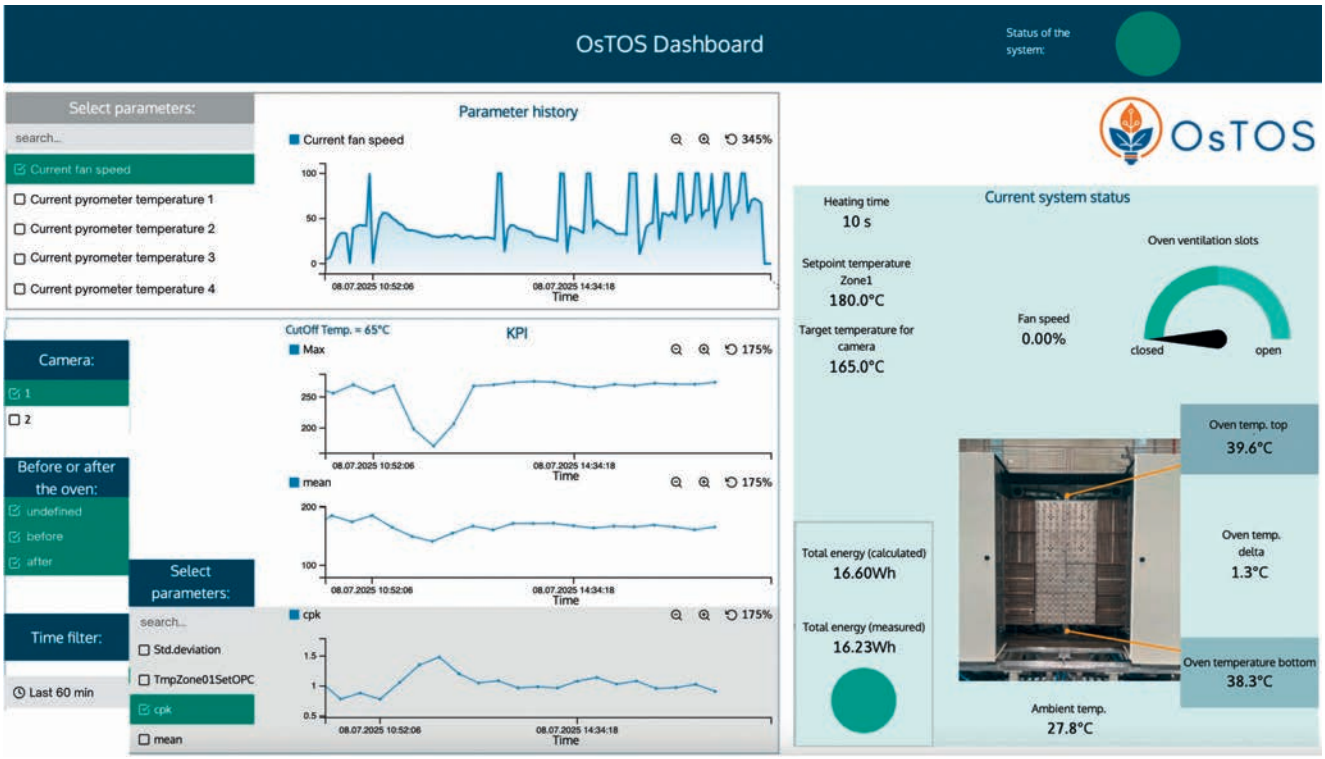

Fig. 3. The dashboard provides workers with a constant overview of the machine settings suggested by the AI. © KraussMaffei

the OsTOS project, additional fire detection and early warning functions were integrated. The system detects anomalies in the temperature profile and can automatically intervene or stop the process, an important safety feature for industrial applications.

Wide Range of Applications: From Cars to Sports Equipment

The combination of sustainable materials, local lightweight construction, and intelligent process design opens new fields of application in various industries.

The automotive industry benefits from space optimization and the use of bio-based materials while keeping costs under control. In aviation, the technology meets the highest requirements for quality, reproducibility, and weight reduction. There is also potential in recreational sports, for example in a demonstrator skateboard that combines functionality and design requirements through local reinforcement between the axles **(Fig. 4)**.

Conclusion

The OsTOS project has specifically expanded the potential of FiberForm technology. New materials, digital process control, and intelligent heating pave the way for sustainable, economical, and flexible production of lightweight components, from batch size 1 to large series. Thanks to its modular design and retrofit capability, the system can be quickly integrated into existing lines. ■

Project Consortium

- Centrotherm Systemtechnik GmbH
- DatenBerg GmbH
- Elektroschmiede GmbH & Co. KG
- Infratec Infrarot Strahler GmbH
- Institut für Textiltechnik Augsburg gGmbH
- KraussMaffei Automation GmbH
- KraussMaffei Technologies GmbH
- Optris GmbH
- Project sponsor Jülich
- Federal Ministry for Economic Affairs and Energy (BMWE)

Fig. 4. Cruiser skateboard as a demonstrator component with local reinforcement between the axles.
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