FRAUNHOFER INSTITUTE FOR STRUCTURAL DURABILITY AND SYSTEM RELIABILITY LBF

PRESS RELEASE

More Efficient Manufacturing Technology: Integrated Sensors Secure and Monitor the Manufacturing of Thick-Walled CFK Structures

“Infusion 4.0,” a project funded by the Federal Ministry of Economics and Energy, shows how effective fiber-optic sensors are in monitoring the vacuum infusion process during the production of large composite components. Together with its project partner, MT Aerospace AG, the Fraunhofer Institute for Structural Durability and System Reliability LBF has made the previously-hidden process steps visible and digitally controllable, thereby increasing process reliability. This new, efficient manufacturing technology supports reliable and fast development of aerospace products.

Using CFRP booster housings, MT Aerospace AG in Augsburg, Germany, manufactures large CRFP components (carbon fiber-reinforced plastic) using vacuum infusion processes. In vacuum infusion, a dry-wrapped pre-form is inserted in a vacuum bag and is infiltrated with resin while slowly rotating in an oven. Intelligent sensors are required in order to monitor the flow front of the in-flowing resin and to optimize processes. Scientists from Fraunhofer LBF and their industrial partners are embedding fiber-optic sensors into the component as early as the winding process in various 3-dimensional positions. These then control resin distribution during this important production step.

The Digital Twin Plays an Important Role

Each sensor fiber contains several of the more than 60 glass fiber sensors. The flow front is the line when the resin first gets in contact with the dry fibers. The signals are transmitted from the rotating part in the oven to an outside computer in situ in order to digitally monitor the process. A digital representation of the sensor position on the component shows when the flow front reaches the sensor. “We are receiving transparent information for the manufacturing process of these thick-walled parts for this first time. This increases process reliability for vacuum infusion processes,” explains Martin Lehmann, Research Associate at Fraunhofer LBF.

The new manufacturing process makes previously hidden processes visible and digitally controllable, thereby increasing process stability. Information gained by resin flow monitoring ensures reproducibility and quality of the new product, enabling timely intervention if required during production. Production ramp-up can be accelerated with this improved control. This increases the company’s competitiveness.

Editorial office
Anke Zeidler-Finsel | **Fraunhofer Institute for Structural Durability and System Reliability LBF**| Institute Director: Prof. Dr.-Ing. Tobias Melz
Bartningstraße 47 | 64289 Darmstadt | www.lbf.fraunhofer.de | anke.zeidler-finsel@lbf.fraunhofer.de | Telephone +49 6151 705-268

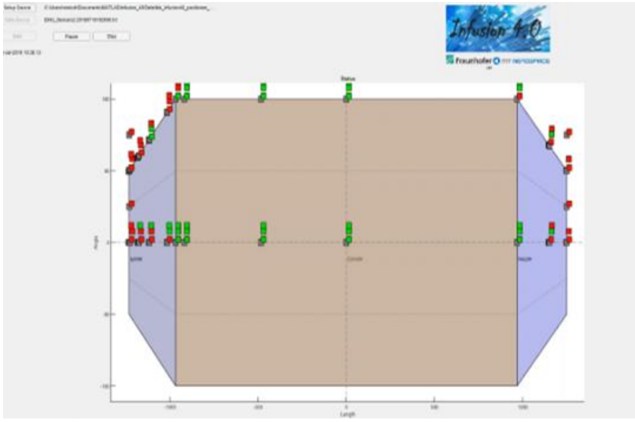
Integrated sensors monitor the flow front process and reduce manufacturing costs

In addition, the new technology makes future automated control of manufacturing processes in Industry 4.0 possible. Integrated sensors provide structural monitoring (structural health monitoring, or SHM) even from the earliest phase of the product lifecycle.

This "Infusion 4.0" project idea won third place in the Innospace Masters Challenge offered by the German Aerospace Center (DLR) in 2017. It was a finalist at the 2018 German Aviation Innovation Award for research needs in this environment. The project's successful completion in October 2019 confirmed the Darmstadt scientists' approaches as well as those of their Augsburg colleagues.

The "Infusion 4.0 – Flow front detection in the vacuum infusion process of a CFRP booster housing using fiber optic sensors" was funded by the Federal Ministry of Economics and Energy and approved by a resolution of the German Bundestag.

"CFRP Booster Housing," manufactured using a digitally-controlled vacuum infusion process. Photo: Fraunhofer LBF



Screenshot of the digital twin during flow front detection.
Photo: Fraunhofer LBF

Further Information / Video:

www.lbf.fraunhofer.de/infusion40

https://innospace-masters.de/mt-aerospace/

Fraunhofer LBF in Darmstadt has stood for the **safety and reliability of lightweight structures** for more than 80 years. Today, with its expertise in the areas of structural durability, system reliability, vibration technology and polymer technology, the Institute provides solutions for three of the most important cross-cutting issues of the future: lightweight design, functional integration and cyberphysical mechanical engineering systems. The focus here is on solutions to social challenges such as resource efficiency and emission reduction as well as future mobility, like e-mobility and autonomous, networked driving. Comprehensive skills ranging from data acquisition in real operational field use to data analysis and data interpretation, in addition to deriving specific measures to design and improve material, component and system properties form the basis for this. Customers come from automotive and commercial vehicle construction, railway transport engineering, shipbuilding, aviation, machine and plant construction, power engineering, electrical engineering, medical engineering and the chemical industry. They benefit from the proven expertise of about 400 employees and cutting-edge technology accommodated in more than 17,900 square meters of laboratory and experimental space.

Further press contact:
Peter Steinchen I PR-Agency Solar Consulting GmbH, 79110 Freiburg I Telephone +49 761 38 09 68-27 I steinchen@solar-consulting.de
Scientific contact: Dipl.-Ing. Martin Lehmann | Telephone +49 6151 705-416 | martin.lehmann@lbf.fraunhofer.de