

Modular Production Plant

Economical Manufacturing of High-Performance Hybrid Structures

Hybrid structures have significant potential for lightweight applications. However, this material class places the highest demands on manufacturing processes, resulting in cost-intensive manufacturing solutions. Due to the growing demand for individualized component, variant diversity and therefore small batch sizes, this currently leads to a lack of economical manufacturing solutions.

Together with 13 partners from industry and R&D, Fraunhofer ICT has developed a modular production plant concept to overcome this obstacle. The new control system is based on a "plug & work" architecture featuring unified hard- and software interfaces. The OPC Unified Architecture (UA) communication protocol is used to ensure future-oriented communication independent of the manufacturer and platform. A fully functional pilot plant on industrial scale has been installed at Fraunhofer ICT to demonstrate the full potential of this new approach. The focus is on retooling options to achieve an enhanced variety of parts, which are manufactured by replacing individual production modules.

Project facts:

- Research project funded by the Federal Ministry of Education and Research (BMBF)
- Project executive organization: Projektträger Karlsruhe (PTKA)
- Project duration: 1.10.2015 – 31.1.2019

Integrated production modules combining different process technologies

- Siemens basic module, centralized control unit
- Dieffenbacher Fiberforge tape-laying module, thermoplastic UD tape-laying
- Bold-on Arburg SPE4600 injection molding module with integrated FPC unit in combination with Dieffenbacher hydraulic press module, co-injection molding
- KIT-wbk IR-heating module, heating of semi-finished products
- Kuka handling module with flexible gripper technology from J. Schmalz and KIT-wbk, automated handling
- A. Raymond highly flexible feeding of metallic load-introduction elements
- Vitronic quality assurance modules
- Trumpf metallic reinforcing elements module



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Seat backrest – process route 1

- Glass-fiber-reinforced organo-sheet with PA-6 matrix, locally patched with carbon-fiber-reinforced UD tape
- Glass-fiber-reinforced ribs and functional elements produced in co-injection molding using Arburg’s FDC direct compounding process
- Metallic inserts for load introduction and reinforcement

Car underbody segment – process route 2

- Carbon-fiber-reinforced UD tape structure PA-6 matrix produced with automated tape-laying in most highly loaded areas within underbody segment
- PA-6 glass-fiber-reinforced rib structure produced in compression molding using Dieffenbacher’s D-LFT direct compounding process

Validation of concept

To validate the new plant and control architecture, two different process routes have been developed. A special focus was the demonstration of the retooling capabilities of the overall set-up. Two demonstrator parts were used: a seat backrest, for which injection molding is the main intrinsic hybridization process, and a car underbody segment manufactured in co-compression molding. Both process routes require a change of production modules to manufacture the desired parts. The retooling from one process route to another could be achieved within a few hours.

Associated partner support

- A. Raymond
- ARBURG
- ADIENT
- DIEFFENBACHER
- KUKA
- PORSCHE
- SCHMALZ
- SIEMENS
- TRUMPF
- VDMA
- Fraunhofer ICT
- VITRONIC
- wbk



Combination of Arburg bold-on injection mold module and Dieffenbacher hydraulic press module



- 1 Hybrid seat backrest
- 2 Metallic load-introduction element
- 3 Metallic reinforcement element
- 4 Car underbody segment

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