

Fraunhofer Project Centre @ Western

Fiberforge RELAY® Station



Lay-up of Unidirectional Fibre Reinforced Thermoplastics (UD-Tape) for Local Load Adjusted Reinforcements in Composite Parts

The Fraunhofer Project Centre @ Western possesses a RELAY® Station 1000 from Fiberforge which makes it possible to manufacture continuous fibre reinforced thermoplastic components with the dimensions of 1m to 1m. With the technology, different part thicknesses and fibre orientations can be realized to create load adjusted lightweight structures.

After an automated lay-up of UD-Tape, which is tack-welded with ultrasonic welding heads, the different layers need to be consolidated to reach a global conjunction. The consolidation itself is an independent step in this process and can be transcribed with different processing routes that should be chosen according to the application and subsequent boundary conditions. The consolidated lay-up is then the point of origin for proper component manufacturing.

The first step is then to preheat the tailored blank dependent on the material to reach a flexible state. There are two ways at the Fraunhofer Project Centre @ Western to realize an appropriate heating: infrared oven or air circulating oven. Specifications of all mentioned systems are listed on the back under 'Equipment and Facilities'. To handle and transfer the laminate, special construction for the appropriate application needs to be established.

The forming step technology and various subsequent processes enable the production of a part that is composed of UD tapes (thermoformed organic sheet) or combined with short or long-fibre reinforced thermoplastics (injection moulding, foaming and LFT) that are partly reinforced by UD tapes. The additional MuCell® injection unit allows the production of fibre-reinforced parts with an integral foam design: a foamed core inside the part surrounded by skin layers made out of UD tapes. An integrated 6-axis robot is able to load the tapes and sheets in the oven and to transfer them into the mould. With the injection moulding machine these reinforcements can be over or back moulded.

Thermoplastic lightweight technologies offer a wide process window to meet the requirements for different applications: unidirectional reinforced tape to meet requirements responding to required stiffness and strength in combination with injection moulding and LFT to realize functional elements by implementation of ribs, connection points and special surface requirements (design principle 'integration and functionalization').

in cooperation with

Key Research Topics in the Field of Tape Laying

- Process development for processing of continuous fibre reinforced thermoplastics
- Using UD tapes in adjacent technologies as injection moulding and LFT:
 - Development and construction of handling and transfer systems for UD tapes
 - Integration of automated handling and transfer systems to process UD tapes with LFT and injection moulded parts
- Mould and part design for simultaneous local reinforcements and foaming
- Formulation and process development for manufacturing of in-situ sandwich structures for high stiffness and high strength applications
- New rules for designing parts and moulds will be derived and know-how for the resin and fabric selection will be created

Equipment and Facilities

- Fiberforge RELAY® 1000
 - Lay-up size up to 1m x 1m on a two zones vacuum table
 - Double creel system: tape width range continuously variable between 50mm and 150mm using a tape thickness between 0.1mm and 0.4mm
 - Welding process: ultrasonic spot welding
- KraussMaffei injection moulding machine KM 1,600/12,000/4,300 MX L:
 - Different, replaceable injection units (Ø = 120 mm)
 - Pressure accumulators for higher injection speed
 - Long fibre screw
 - MuCell® process with long fibre screw and standard screw
 - Injection compression moulding with parallelism control
 - Clamping unit with 16,000 kN
 - Negative embossing (foam injection moulding with decompression)
- Fully automated manufacturing cell for continuous-fibre reinforced parts:
 - Circulating hot air furnace (paternoster principle)
 - 6-axis-handling robot for handling of organic sheets (fabrics / UD tapes)
- Pre-heating systems
 - IR-oven (size of consolidated blank: 700mm x 450mm, temperature range max. 350°C)
 - Air circulating oven (size 1350mm x 450mm, temperature range max. 280°C)
- LFT-D line and Dieffenbacher hydraulic high-speed press with a maximum clamping force of 25,000kN, parallelism control and a table size of 3m x 2m

Fraunhofer Project Centre @ Western

Western University and the Fraunhofer Institute of Chemical Technology ICT have partnered to provide joint expertise for industry needs.

Together, Western and Fraunhofer will develop lightweight composites for the transportation and building materials sectors, focusing on applied research in the fields of methods, materials and manufacturing technologies for composite materials.

Collaborations

With Industry

- Develop industrial processes
- Apply developed innovative processes
- Optimize existing processes and materials

With Fraunhofer

- Process and material development
- Scientific research at intermediate level
- Transfer from basic research to industrial scale

With Universities

- Basic research on fibre matrix phenomena
- Simulation and design
- Investigation of fundamental interests