**PRODUCTION OF “TAILORLED COMPOSITES”**

The Fraunhofer WKI’s Application Center HOFZET in Hanover carries out research on (bio/hybrid) fiber-reinforced composites (FRC) with thermoplastic and thermosetting matrix, production of additives, technical textiles and the recycling of diverse composite materials. The high-quality use of natural fibers and their derivatives for technical applications in small and large-scale series production forms a particular focus of ongoing research. For the creation of innovative components from FRC, a fiber injection system is used which produces so-called “tailored composites”. The researchers hereby specifically adjust the grammage and the fiber cutting length to suit the component geometry. With the aid of the fiber injection system, the employees develop and realize innovative (bio/hybrid) FRC and the corresponding process chains in co-operation with project partners from industry and research.

**Fiber spraying**

With fiber spraying, continuous fibers and yarns are cut to a specific length by a cutting unit, simultaneously wetted in the air stream with a resin and curing agent mixture from the spray head and sprayed onto a shaping tool. The robot-mounted fiber spray head, which is divided into fiber feed, fiber cutting unit and fiber injection unit, enables the automated manufacture of components from (bio/hybrid) FRC and the strengthening of technical textiles or finished components. In addition to the conventional high-performance fibers such as carbon, glass or aramid, cellulose-based fibers such as viscose, flax, hemp, etc. can also be cut and sprayed using the fiber injection system. Simultaneously, the technology offers a wide choice of materials with respect to the polymer matrices which are to be processed.
The unlimited radius of movement of the 6-axis robot in combination with the component holder on a 2-axis rotary/swivel table enables the creation of both flat and geometrically-complex components. In addition to a continuous 2D spraying, a 3D reinforcement can also be realized here. Through the application of different types of fibers or by changing the fiber length in the running process, diverse gradient properties can, for example, be introduced into a material. Furthermore, the production of (bio/hybrid) components with a selective reinforcement of load-critical zones through the precise accumulation of material in areas of stress peaks forms a focus of the research.

Through fiber spraying, the properties of existing fiber-reinforced materials and their production processes can be optimized. This resource-saving technology is characterized by savings in time and material as well as a significant reduction of the process stages, such as production of a semi-finished product, cutting and draping. This manufacturing technology is therefore particularly well-suited for small and large-scale series production. Furthermore, due to its simple structure, the system can be easily integrated into existing production lines.

### Technical data and features

- Reproducible, industrial cutting of natural fibers, carbon fibers, hybrid fibers, brittle fibers (glass, basalt), tough elastic fibers (thermoplastic fibers), etc.
- Transport of four rovings simultaneously via separate hoses
- Cutting capacity, depending on the type of fiber: 5 to 25 kg/h
- Process-reliable fiber length: 10-100 mm
- Infinity-variable cutting length “on the fly” during the running process
- Application of commercial and “newly-developed” polymer matrices (epoxy, polyurethane, etc.)
- Processing of 2C resin systems
- Viscosity: < 3000 mPas
- Component weight: up to max. 90 kg
- Component size: up to approx. 1000 x 1000 mm

### Benefits

- Resource-conserving and low-waste production
- Production of large-scale and complex components
- Cost savings through near-net-shape production
- Process steps such as “creating a textile, cutting and draping” can be omitted
- Unique component properties through targeted adaptation of the grammage and fiber cutting length to the component geometry (“tailored composites”)
- Local, specific property profiles of a component in accordance with the component load
- Unique combination of previously non-cuttable fibers with a variable cutting length and simultaneous “resin impingement” (spraying with wet fibers) in 2D, 2½ and 3D applications
- Introduction of inserts into the component, for example connecting elements, threads, etc.
- Reduction of investment and production costs
- Simple integration into existing production lines