LASER-ASSISTED PROCESSING OF FIBER-REINFORCED THERMOPLASTIC COMPOSITES
Composite engineering is regarded in many fields of industry as one of the key technologies to achieve sustainable and green production in sectors such as aerospace, the automotive industry, power plant building, machinery and plant engineering, renewable energy as well as in oil and gas extraction. By the utilization of continuous fiber-reinforced plastics up to 70 percent of weight can be saved in comparison to classical engineering materials. In addition to this, the rigidity, strength, damping, energy absorption and chemical resistance properties are of higher quality.

The use of uni-directional, continuous fibre-reinforced semi-finished products (tapes, prepregs), which are pre-impregnated with a thermoplastic matrix system, opens up a whole range of additional advantages over traditional thermosetting FRP manufacturing processes (using fabrics, preforms, resin impregnation, curing):

- Outstanding automatability
- Non-crimped, continuous fiber-reinforcement with high fiber-volume contents of between 60 and 65 percent
- Recyclable material
- No contamination of the production facilities caused by non-cross-linked matrix material, lower maintenance and cleaning costs, reduced downtime
- Higher level of material damping, energy absorption and chemical resistance
- High operating temperatures (in the cases of PEEK, PEKK, PES, PEI, PPS, for example)
- Weldability of the FRP-parts using established plastic welding processes
- Unrestricted storage possible under standard conditions
- No error-intensive impregnating processes

The optimum processing method for these materials is the laser-assisted tape laying/winding process. This permits open and closed, weight-optimised, load bearing structures to be manufactured in resource and energy efficient processes.

**Advantages of laser-assisted tape laying/winding operations**

- Fully automatable
- In-situ consolidation, out-of-autoclave processing, no curing, short cycle times
- Precise and swift temperature control, no increase in ambient temperature
- High lay-up rates of approx. 1 m/s
- Near-net shape part manufacture with minimal waste
- High opto-electrical energy efficiency of diode laser sources (up to 40 percent)
- Load-optimised laminate structure (angle continuously variable between 0° and 90°)
- Low tool costs
Application

The outstanding process characteristics are surpassed only by the versatility of the process. The laser-assisted tape laying/winding process is particularly suitable for the following applications:

- Manufacture of open structural parts (e.g. wings, vertical and horizontal tailplane, fuselage units)
- Manufacture of closed, load-bearing parts (pylons, pressure vessels, pipes, risers, shafts, rotor blades)
- Manufacture of load and waste-optimised tailored blanks
- Localised reinforcement of FRP, metal and plastic components and semi-finished products
- Joining FRP and plastic components
- Repair of FRP structures

Our strengths

Our years of experience and engineering excellence in the field of laser-assisted processing of thermoplastic prepregs, enable us to offer our clients customized solutions, which exploit the potential of this technology to reduce the cost of FRP component manufacture to the full. This is achieved via automation, higher throughput, material economies, waste reduction, energy saving, reduced requirement for maintenance as well as enhanced reproducibility and process stability.

Our interdisciplinary team comprising experts in the fields of fibre composite engineering, plastics engineering, laser system engineering as well as design and development, production machinery und automation ensures that each of our clients obtains technology developments tailored to meet their own individual needs.

Our service

- Dimensioning, concept, design, set-up, design qualification and certification of customised, turnkey tape laying/winding systems and commissioning of these at the premises of the client
- Concept and feasibility studies, component designs and profitability analyses
- Development and optimisation of material, component and batch-size oriented process and plant development
- Individual solutions for the first layer challenge as well as mould and die production
- Manufacture of test and demo parts as well as localised reinforcement of existing structures
- Development and integration of systems for online-quality monitoring and assurance for optimum part quality
- Development of new individual function modules (for example, consolidation systems capable of adapting to suit the shape required, external tape feeds, adaptations to new material types and specifications) and further development of the same
- Enhancing the performance of existing tape laying/winding systems via laser integration
- Customised design of closed-loop control systems for tape laying/winding systems, programming control algorithms and implementing decentralized control systems
- Implementation of hardware and software-interfaces
- Provision of hardware and software required in order to integrate tape laying/winding systems within existing and new plants and robot systems
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