Each individual carbon thread, thinner than a hair, is used first in a sophisticated manufacturing process to produce tear-resistant composite fibers, which are then used to create new materials for innovative applications. This extremely lightweight material, which weighs only 30 g/m², can be processed for many sectors. François Mordasini, managing director of North Thin Ply Technology (North TPT), says, “It can be used wherever weight counts, be it sails, bicycles, skis, cars, aircraft, or wind power plants.”

The Swiss company has been researching the new technology since the middle of the past decade and has developed it for use on an industrial scale – from drafting the materials in 3-D design and processing the carbon fibers to developing new production machines for fabrication. The original aim was to manufacture innovative sails for sailing’s top league. So in cooperation with the Alinghi sailing team, Gérard Gauthier, head of North TPT, and his team developed a material for ultralight, tough sails that would provide a crucial competitive edge in international ocean sailing competitions.
Chemistry replaces mechanics

The technology newly developed by North TPT, known as the 3Di process, revolutionized a centuries-old tradition in the manufacture of sailcloth. In this case chemistry replaces mechanical assembly. Instead of being woven symmetrically and pieced together, the microfine carbon fibers are now knitted together as a composite material and wound onto a bobbin. Following design templates from the computer, a plotter—a type of large-format printer—is then used to apply the continuous filament fibers as a laminate like a thin film onto oversized special paper. Specially developed software controls the CNC production machine and turns the design into fabric. The material is reapplied several times in areas that will subsequently be subject to particular stress to reinforce the cloth. Mordasini explains, “All reinforcements are seamless and integrated directly into the fabric. This fulfills every sailor’s dream of having a sailcloth that remains stable in every direction without any deformation, even under high tensile stress.”

Ready for series production

The plotters are fitted with a Sinumerik 840D sl CNC. Thanks to the excellent networking capabilities of this control and the compact Sinamics S120 drives, the entire control cabinet can travel on the plotter’s bridge. It is possible in a machine with such long traverse paths to keep the cables to the motors of the Simotics S series short, minimizing installation effort. The connection to the master computer and the operating panel, which is outside the traverse area, is via an Industrial Ethernet cable.

The basis of the manufacturing process is a worktop measuring approximately 22 m × 5 m, which can be adjusted in three dimensions to replicate the complex shapes of a sail. The production plotter developed by North TPT can thus produce 15 m² of sail area per hour and worktop. Each sail is unique with regard to its special geometry, structure, and aerodynamics, depending on whether it has been designed for ocean routes and long distances or for use in regattas and on lakes. North TPT has been working closely with the world’s largest sail manufacturer, North Sails, headquartered in the United States, since 2010.

3Di process has a future

The 3Di process is undergoing further refinement in Switzerland, where production machines are being developed, constructed, and validated for various sectors to suit customers’ needs. On the engineering side, North TPT is supported by Patrice Laflay and his company, Informatique & Technique Sàrl. North TPT has already gained experience outside the sailing world with ultralight touring and racing skis. Negotiations with other sectors such as Formula 1, the automotive industry, and wind and solar power look promising. Mordasini sums up: “In addition to excellent technology skills, a partner’s reliability and credibility are hugely important for projects of this type. This is why we decided on Siemens when developing our machines. Siemens also has experience in markets that are potentially important to us, such as aircraft construction, aviation, aerospace, and wind power.”

Technical highlights

- Sinumerik 840D sl CNC for control of the plotter’s five axes
- Sinamics S120 drive system with Simotics S servomotors for jolt-free movement of the portal over the sail’s surface
- Sinumerik OP 08T operator panel for operating the plotter outside the traverse area
- Sinumerik Operate user interface, which is edited on the CNC
- Master computer that calls up the plotter’s traversing programs using OPC and simultaneously records the production process for quality assurance