

**Project titel:** HotTube – Development of an individually adaptable consolidation technique for curved profiles made of FRP

**Partner:** **Up2-Tec Prototyping GbR, Aachen**  
**Muratec, Murata Machinery, Ltd, Japan**

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### Mission Statement

Due to their potential as a lightweight construction material, pultruded profiles made of fiber-reinforced composites (FRP) are suitable as substitutes for steel and aluminum, for example in roof structures of automobiles. The multifilament winding process offers an approach for the economical production of profiles. It is 81% higher in productivity than established radial braiding processes. According to the state of the art, complex or curved profiles are produced in sub-segments, which are then joined to form a complex overall profile. This means an additional process step, material accumulations at the joints and an interruption of the force flow of the reinforcing fibers. A machine developed by the Japanese project partner Murata Machinery Ltd. Allows to wind curved profiles without joining individual elements.

In current processes, the entire mould is heated up during consolidation. Complex and individual geometries require complex and expensive machine equipment. As part of the research project, the company Up2-Tec Prototyping GbR, Aachen, is developing an innovative consolidation technique. This technique confronts the challenges of homogeneity and complete consolidation of flexibly designed and three-dimensionally curved profiles. Up2-Tec Prototyping can draw on the experience of more than five years of successfully implemented innovations in the field of flexible consolidation techniques and systems.

At present, mainly thermosetting matrix systems are used. Due to the long curing times (>60 min), the manufacturing process is uneconomical for the series and forms a niche product in racing, for example. The use of ther-

moplastic matrix systems can significantly reduce the process time. In addition to plant engineering, material design will also be a focus of the research project. The cost-effectiveness of the entire process increases and rapid market penetration is favored.

#### Approach:

The aim of the research project is to develop an energy-efficient and economical consolidation method for the production of curved winding profiles from thermoplastic FRP.

A machine development by Murata Machinery Ltd, Japan, forms an innovative approach to winding three-dimensionally curved profile geometries.

The profiles are produced in one production step and the joining process step is eliminated. The flow of force within the reinforcing fibers is not interrupted by joints and the profile can be designed with low weight according to applied load and structure in mind.

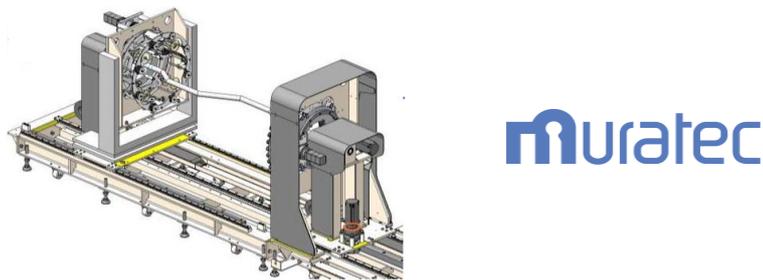


Fig. 1 Winding Machine [Source: Murata Machinery Ltd]

The company Up2-Tec Prototyping GbR from Aachen develops as a specialist in prototype construction and composites a new process technology for the consolidation of the profile components.

This technique comprises the three-dimensionally bent core to be wound on the one hand and variable methods for consolidating the profiles on the other. Depending on the requirements of the component, such as surface quality and profile accuracy, the process parameters pressure and temperature are individually controlled. The core is coated with a variothermal and elastic membrane and can be pressurized. This flexible core is set in a form that depicts the three-dimensional geometry and is then locked rigid for winding and consolidation. The central challenge of uniform consolidation of all wound layers is solved by this technology.

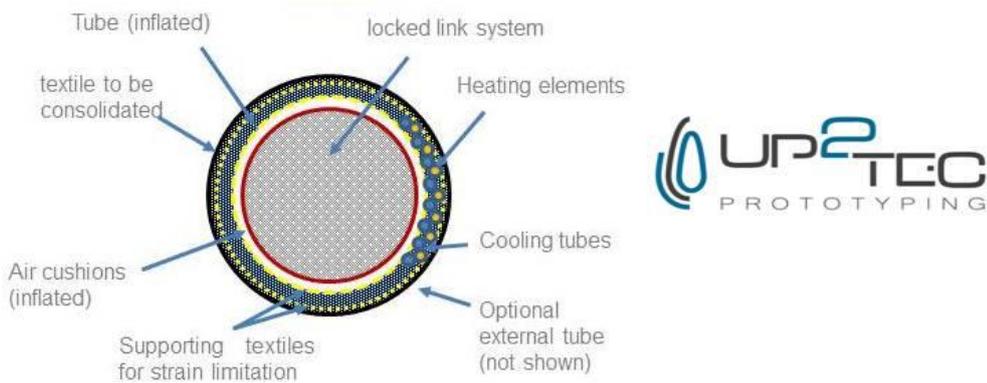


Fig. 2 Consolidation Method [Source: Up2-Tec Prototyping GbR]

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