Institut für Textiltechnik und Lehrstuhl für Textilmaschinenbau
RWTH AACHEN UNIVERSITY

Project title:	UltraFiber: Development of a novel process using 3D printing (FDM) and Tailored Fiber Placment (TFP) to produce a high-quality safety spectacle based on natural fibers and a bio-based resin matrix.
Partner:	Stickerei Keinath GmbH
Duration:	01/2023 – 12/2024
Funding Agency:	Bundesministerium für Wirtschaft und Klimaschutz (BMWK)

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Ref.: TML
14.02.2023

Mission Statement

The use of natural fibers and biobased resin can significantly improve the recyclability while conserving resources. In the present project, the use of renewable raw materials and biobased matrix material should lead to a significant improvement in the mechanical properties of protective eyewear. Compared to conventional safety eyewear made of carbon or glass fibers, the use of natural fibers leads to significantly lower energy consumption and a better CO2 balance. Natural fibers are also economically more advantageous, as they require less energy to manufacture and later thermally recycle, and are therefore likely to be more cost-effective than carbon fibers. Another key aspect of the project is to increase the service life of protective eyewear, as natural fibers are recyclable and cutting, grinding or punching waste can be reused materially or thermally. Compared to glass fibers, natural fibers are also superior in material recycling because they do not break and can therefore be used in new components without any great loss of quality. The material composition used contains neither halogens nor heavy metal compounds and is overall very environmentally friendly and harmless to humans and the ecosystem. By using bio-based matrix material, a composite material consisting entirely of bio-based materials is achieved for the manufacture of the spectacle frame.

Approach

The planned research project "UltraFiber" aims to develop a new process route for the manufacture of protective equipment, especially goggles made of novel materials, using tailor-made fiber placement (TFP) (see Figure 1) and 3D printing (FDM). The combination of both technologies is expected to enable a novel manufacturing route for PPE products using sustainable raw materials. For this purpose, the use of natural fibers, e.g. flax, hemp or jute, is being investigated for the TFP embroidery process.

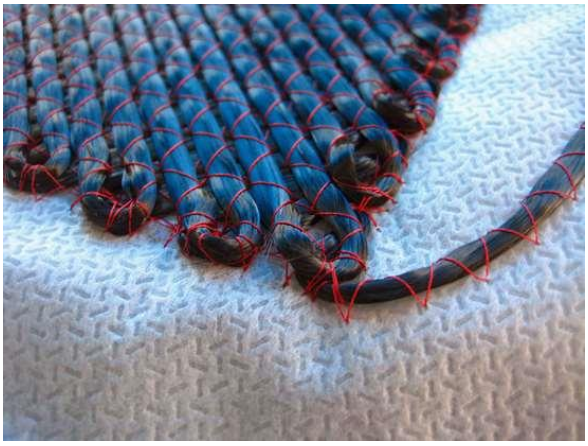

Figure 1: TFP-Design. Source: https://www.compositesworld.com/articles/tailored-fiber-placement-besting-metal-in-volume-production

As a prototype for a first product, safety goggles will be designed in the course of the project. Safety goggles lend themselves to the novel process because they represent an important part of PPE in the medical and chemical sectors and can be highly customized using additive manufacturing processes. In addition, the use of low-quality materials often leads to the single use of safety goggles, which consequently results in considerable waste production. The aim is to produce a three-part preform from the nanofibers using the TFP process. When printing the embroidered preform, the challenge is to achieve sufficient adhesion. The TFP semi-finished product must then be impregnated with matrix material, which is then consolidated and thus responsible for the final contouring.

Acknowledgement

The research project is funded by the Bundesministerium für Wirtschaft und Klimaschutz within the framework of the Program for the Promotion of Research and Development Projects (R&D Projects) Sustainability and Circularity based on a resolution of the German Bundestag.

Gefördert durch:

Bundesministerium
für Wirtschaft
und Klimaschutz

aufgrund eines Beschlusses
des Deutschen Bundestages

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