Institut für Textiltechnik und Lehrstuhl für Textilmaschinenbau
RWTH AACHEN UNIVERSITY

Project title:	NATUREPERFORMANCE - Modeling of the mechanical properties of components made of natural-fiber-reinforced plastics (NFRP)
Partner:	Leibniz-Institut für Verbundwerkstoffe, Kaiserslautern
Duration:	01.01.2021 – 31.12.2022
Funding Agency:	AiF/IGF

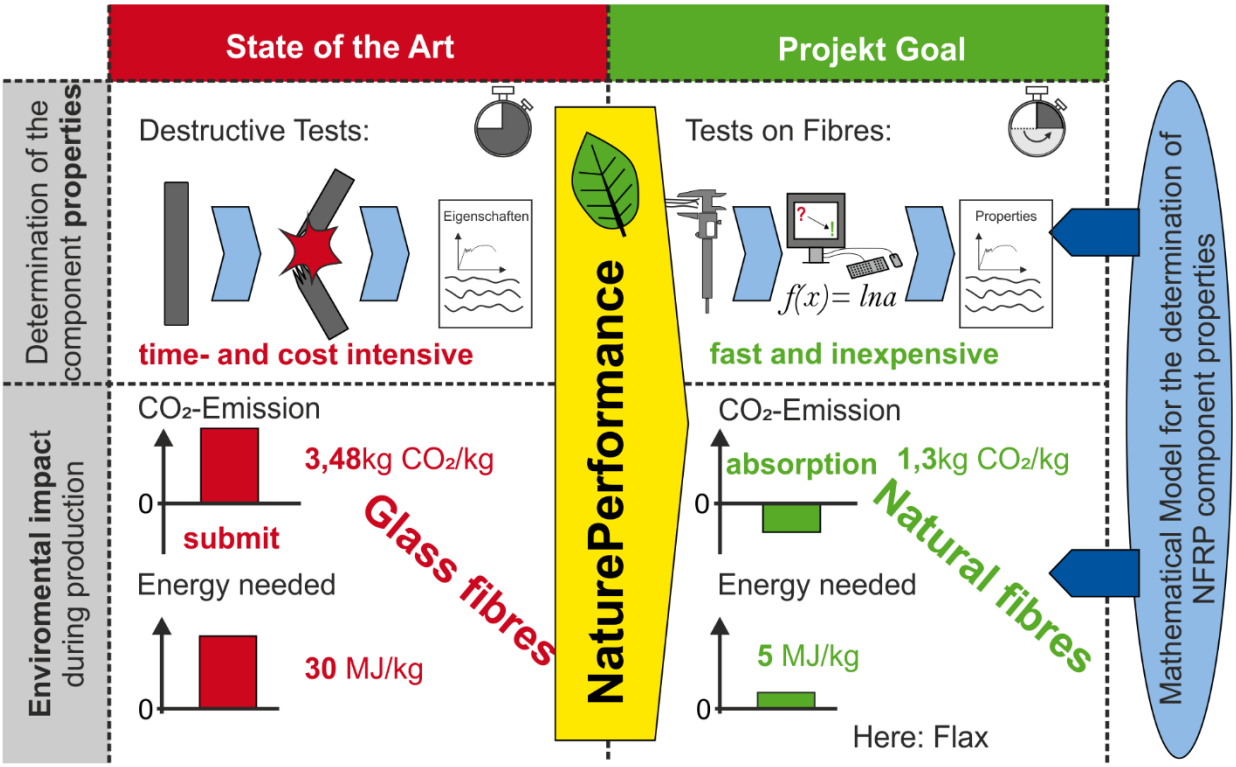
Univ.-Prof.
Prof. h.c. (Moscow State Univ.)
Dr.-Ing. Dipl.-Wirt. Ing.
Thomas Gries
Director

Jonas Broening
Scientific Researcher

Ref.: JB
11.03.2021

Mission Statement

Meeting emission limits and curbing the greenhouse effect are of central importance for today's economy and society. Currently, more than 10 million tons of composite materials are used worldwide each year. Natural fibers in natural fiber-reinforced plastics (NFRPs) could make an important contribution to the fight against global warming due to their neutral carbon footprint and the low energy required for processing. Due to fluctuating properties, natural fibers have so far been used far less than it would be possible. The deficits of the current state of the art and the goals of the project are shown below.



The variations in fiber properties are due, among other things, to different fiber types, roasting, growing regions, climatic conditions and growing years.

To compensate for the fluctuating properties of natural fibers, they are used as blends. The properties of the blend are kept constant by the proportions of different fibers. By means of elaborate destructive tests, the mechanical properties of the components are checked and the blend is iteratively adjusted. This procedure represents a major hurdle for small and medium-sized enterprises (SMEs) in particular to enter the NFRP market. Both the testing procedures and the oversizing lead to unnecessary consumption of energy, time and material, which makes processing unattractive, especially for SMEs. With an oversizing of 20%, NFRP worth about €40 million is produced unnecessarily per year in Europe alone.

Approach

As part of the NATUREPERFORMANCE project, a model is being developed that enables the feasible properties of components made of natural fiber-reinforced plastic to be calculated on the basis of properties of the natural fibers used that can be determined quickly and inexpensively. The aim is for fibers to be subjected to standard incoming goods inspections that can be carried out quickly on delivery. The results are then entered into the model. The model uses the fiber properties to calculate the component properties that can be realized. NFRPs are a potential alternative to glass fiber reinforced plastics (GFRPs) in many cases. In Europe, GFRPs have a market share of fiber composites of about 95% (as of 2018) with a production volume of 2.8 million tons per year [WSK18]. The market share of natural fiber-reinforced plastics (NFRPs) is comparatively low, with a forecast 120,000 tons per year for 2020 (as of 2012: 92,000 tons) [Car15]. Due to the sustainability of natural fibers, increasing use of natural fibers in composite components will make an important contribution to meeting climate targets [CP17]. Natural fibers absorb CO_2 from the atmosphere during growth and up to 77% less primary energy is required for fiber production compared to glass fibers, while maintaining comparable fiber properties [HC11]. Substitution of 5% of the global GFRP use with nonwovens by LFRP, generates additional sales of more than €390 million (estimated with a LFRP kilo price of €1.65, conservative estimate at the lower end) [GTM13, Nov11, FNR14]. In addition, substituting 5% of global GFRP demand with NFRP will save more than 2.2 million tons of CO_2 per year.

The economic benefits with increasing use of LFK go far beyond the pure manufacturers of NFRP components. In addition, there are the companies along the production chain, starting with the fiber grower and ending with the end processor. Most of these companies are SMEs. By means of the NATUREPERFORMANCE model, the entry hurdles and costs for the production of LFK components are considerably reduced. In addition, oversizing is prevented. The model thus eliminates a major uncertainty factor in the manufacture of LFC components. Market entry for new companies is facilitated, thus ensuring market diversification. In addition, the position of regional fiber suppliers is strengthened. The project will make the use of NFRP components more competitive with conventional materials such as GFRP. Compared to GFRP, the CO_2 footprint of NFRP is negative for the duration of its use and thus also contributes to the achievement of climate targets in the long term.

Acknowledgement

The IGF project 21240 N is funded by the Federal Ministry of Economics and Technology within the framework of the program for the promotion of industrial joint research and development (IGF) on the basis of a resolution of the German Bundestag.

Contact

Institut für Textiltechnik (ITA) der RWTH Aachen University
Jonas Broening, M. Sc.
Otto-Blumenthal-Straße 1, 52074 Aachen
Tel.: +49 (0241) 80 - 23479
Fax: +49 (0241) 80 - 22422
E-Mail: jonas.broening@ita.rwth-aachen.de