**Project title:** Hyper-NFK - Development of a high-performance natural fibre reinforced composite material for structural parts

**Partner:**
- Institut für Textiltechnik (ITA) of RWTH Aachen University
- Institut für Polymerwerkstoffe und Kunststofftechnik (PuK) of TU Clausthal

**Duration:** 03/2017 – 08/2019

**Funding:** AiF (Arbeitsgemeinschaft industrieller Forschungsvereinigungen "Otto von Guericke" e.V.)

**Mission Statement**

Non-crimp fabrics (NCF) are often used for the reinforcement for mechanically highly stressed fibre based composite structures. NCF are mainly produced from continuous glass, carbon or aramid filament rovings. The usage of these materials, however, requires a high amount of energy in the fibre production and thus leads to high CO₂ emissions. Compared to glass fibre reinforced plastics, natural fibre reinforced plastics save about 40 % energy and emit about 30 % less CO₂. For this reason, natural fibre reinforced composites (NFRP) are already being used for non-structural components with low mechanical properties (EU 2015: 120.000 t). Due to the additionally necessary process step of yarn production, natural fibre NCF are very expensive (flax NCF: 16 - 20 €/kg). In addition, the maximum achievable mechanical properties are reduced by the fibre twist in the yarns.

The objective of the project is to reduce the manufacturing costs for natural fibre NCF by 25 % and at the same time to increase the mechanical properties of the composite components by at least 15 %. The interaction of both effects makes the use of NFRP in load-bearing structures possible and more attractive.

The main approach consists in the development of a process for the production of NCF out of twistless natural fibre slivers on conventional NCF machines. For this purpose, ITA is investigating consolidation and transport mechanisms for flax fibre slivers and developing a novel feeding device. Based on this technology, biaxial NCF (+/-45°) with a basis weight of 600 g/m² are produced. These NCF are qualified in regard of their drapability and permeability by PuK. The NCF are furthermore impregnated with a duromer matrix and the resulting mechanical properties are determined. Based on the new NCF technology, a demonstrator part is produced.
Conventional process chain

<table>
<thead>
<tr>
<th>Natural fibre slivers</th>
<th>Natural fibre yarn</th>
<th>Natural fibre NCF</th>
<th>Natural fibre-reinforced composite part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yarn production</td>
<td>NCF production</td>
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</tr>
</tbody>
</table>

- Full recyclability
- High pricing
- High cycle times
- Low impregnability
- Limited applications
- Highly oriented fibres
- Lower cycle times
- Lower pricing (-25%)
- Higher mechanical properties (+15%)

Novel process chain

<table>
<thead>
<tr>
<th>Natural fibre slivers</th>
<th>NCF production with novel feeding and weft-insertion device</th>
<th>Natural fibre NCF</th>
<th>Natural fibre-reinforced structural composite part</th>
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</tbody>
</table>

- Full recyclability
- High impregnability
- Suitability for structural applications
- Lower pricing (-25%)
- Higher cycle times
- Highly oriented fibres

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