

**Projecttitel:** Ultra-sonic consolidated bio-based hybrid tapes  
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**Partner:** EM-Systeme GmbH (DE), Safilin (FR), Sofila (FR)

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#### Problem definition:

Due to political demands car manufactures are forced to increase the sustainability of their fleets. This implies a reduction of fuel usage, exhaust gas emissions and CO<sub>2</sub>-footprint while maintaining the same costs. Usage and emissions can be reduced by a reduction of the overall weight of a car. This leads to an increased lightweight construction with composite materials. Established composites are based on thermosetting or thermoplastic matrix systems with imbedded glass or carbon fibres. Substitution of aluminium and steel components can lead to a weight reduction of up to 60 %. The CO<sub>2</sub>-footprint however still lies outside the required range, due to the high energy demand of the production process and the lacking of recyclability. One possibility to improve the CO<sub>2</sub>-balance is the use of complete bio-based lightweight materials. These bio-based materials are made up of a composite of chemical fibres (viscose) or nature fibres (flax) in combination with a bio-based matrix (PA 11). They come in the form of short-fibre-reinforced injection moulding components and long-fibre-reinforced components, which however do not present a high resilience.

Typical applications for these materials are interior lining of doors. For high load application of these composites, fibres have to be aligned in load direction and need to have a good fibre-matrix adhesion. In contrary to glass or carbon fibres, natural fibres are always staple fibres. For the economic processing of natural fibre rovings a sufficient roving strength has to be implemented by twisting. The twisting inside the rovings however can have negative impacts on the properties of the manufactured component. So far no economic manufacturing process for quasi-endless-fibre-reinforced bio-composites based on natural fibres and drop-in-polymers exists.

#### Aim:

The aim of this project is the development of a production chain for an economic manufacturing of completely bio-based quasi-endless-fibre-reinforced thermoplastic composites. The hybrid tapes generated hereby are based on flax fibre/PA 11 prefixed carded bands, allowing the usage of fully aligned flax fibres. This results in maximized mechanical performance and enables the economic manufacturing of completely bio-based structural composite components. These structural components are supposed to have identical strength properties and a similar weight as current thermoplastic fibre reinforced plastics of the Bond Laminates GmbH, Tepex. The aspired goal is a complete bio-based lightweight solution while maintaining competitive production costs.

#### Approach:

The core of this endeavour is the manufacturing of a completely bio-based hybrid tape made of flax fibres and PA 11. In order to stay profitable, indus-

trial grade flax fibres and PA 11 will be used. Flax and PA 11 fibres are blended and oriented during carding. Afterwards the hybrid sliver is drawn and partially fixed using ultrasonic heating. The hybrid tapes will then be processed into woven textiles. For demonstration purposes a fuel tank cap will be pressed out of the hybrid tape woven textile. Finally an economic evaluation of the manufacturing process of this hybrid bio-tape is performed.

#### Economic necessity:

This project is part of the megatrend “Green economy”. Through technological innovation in the field of bio-based composites an economic manufacturing process for structural components will be provided while conserving resources. Through this innovative boost of bio-based composites, producers along the whole process chain will benefit:

- Farmers who grow natural fibres for technical application as well as the fibre recyclers, because the natural fibres will gain in value by up to 70 % due to their application in composites.
- The chemical industry due to the increased demand for bio-based polymers with high mechanical properties.
- The Machine builders in the field of harvest and special machinery.
- The spinning and weaving mills through the expansion of their portfolios with technical products and thereby strengthening Europe as a production location against countries with cheap labour.
- Composite manufactures will be able to provide bio-based structural components with better properties than the former less resilient ones and thus generating a higher margin for the product.
- The environment will be spared due to the use of resources, which can be regrown while the manufacturing of the product displays a neutral CO<sub>2</sub>-footprint.

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