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CTI Project: High performance natural fibre thermoplastic composites

Authors

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Motivation

Composites are increasingly used in mobility applications as e.g. in aerospace (Airbus A350) or in automotive (BMW i3) for weight reduction and therefore energy consumption saving. The composites are usually carbon or glass fibres combined with a thermoset epoxy resin matrix. While the challenges for serial production of these materials are mostly solved, there are two major drawbacks of these materials: the high energy needed for the manufacture of the fibres and the recycling of the thermoset composites at their end of life. These drawbacks could be addressed by using natural fibres in combination with thermoplastic matrix materials which have near neutral carbon emission for manufacture, and are extremely tough with high specific stiffness.

BMW i3

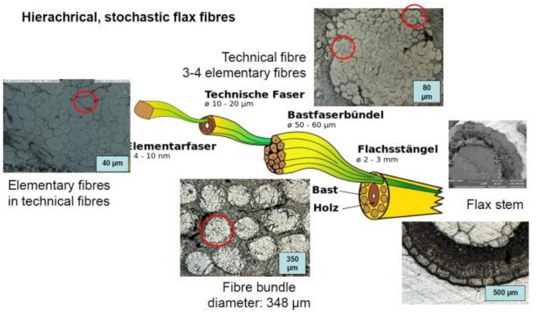
Carbon composite car body of the BMW i3

Bicycle saddle (flax composite)

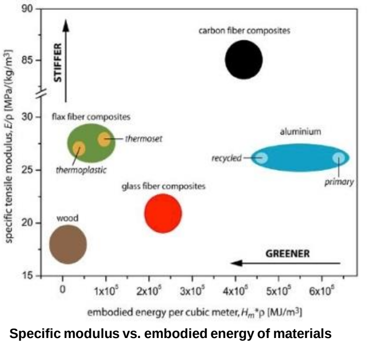
Suitcase (flax/carbon composite)

Natural fibre composites

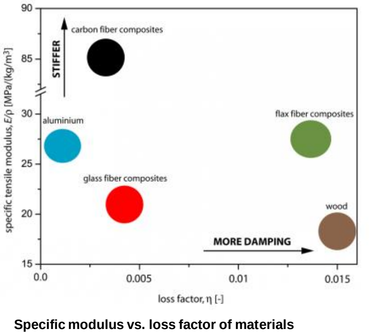
By the use of natural fibres the energy reduction during the fibre manufacturing may be drastically reduced. The hierarchical, stochastic nature of the flax fibres bring unique properties such as high damping. These natural fibre composites have the potential to replace glass fibre composites and aluminum in some applications, but many challenges in the fibre manufacturing and the composite processing must still be solved.



Structure of a flax stem



Specific modulus vs. embodied energy of materials

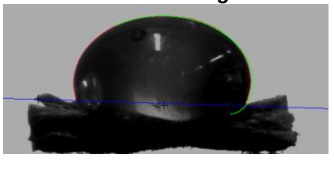


Specific modulus vs. loss factor of materials

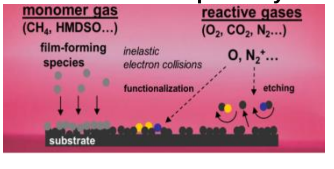
Aim of the project

This work tries to replace resource intensive engineering materials by bio-based (recyclable) materials in some engineering applications without sacrificing performance. Added value of low cost production, recyclability and increased toughness may also gained when a thermoplastic instead of an epoxy matrix is used. The main topics investigated are the project are fibre wetting, interface compatibility of the fibre and the matrix and the processing of the composite.

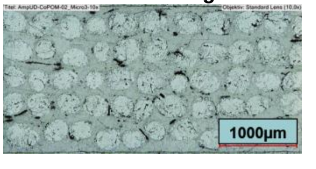
Fibre wetting



Interface compatibility

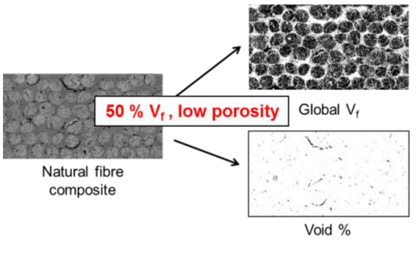


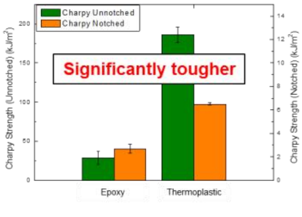
Processing

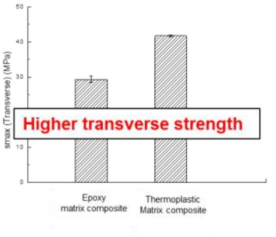


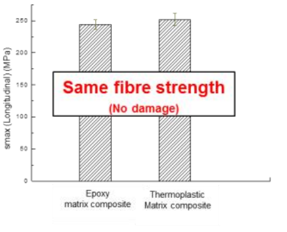
Results

The results so far show that a good impregnation with the thermoplastic is possible with a (high) 50% fibre volume content and low void content (<3 %). The thermoplastic composite shows a significantly higher toughness and a higher transverse strength. The fibre strength is maintained after thermoplastic composite processing, suggesting that the fibres are not damaged during the processing procedure.









Future work

The project will focus increasing the interface compatibility further, followed by creep and environmental testing, then on the development of a demonstrator part.

Project partners:

Bcomp

Fachhochschule Nordwestschweiz
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EMPA
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