DEVELOPING ADVANCED BIO-BASED COMPOSITES

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Potential of continuous hemp fibers for the weight reduction and CO2 emissions neutrality of automotive semi-structural parts

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TREVES PSI

BBI JU Bio-based Industries Consortium
Horizon 2020 European Union Funding for Research & Innovation

Final Event *– Videoconference – 9th February 2022*

TREVES GROUP

550M€

Worldwide sales
In 2021 (estimated)

4 000

Employees worldwide
“One Trèves” mindset

24

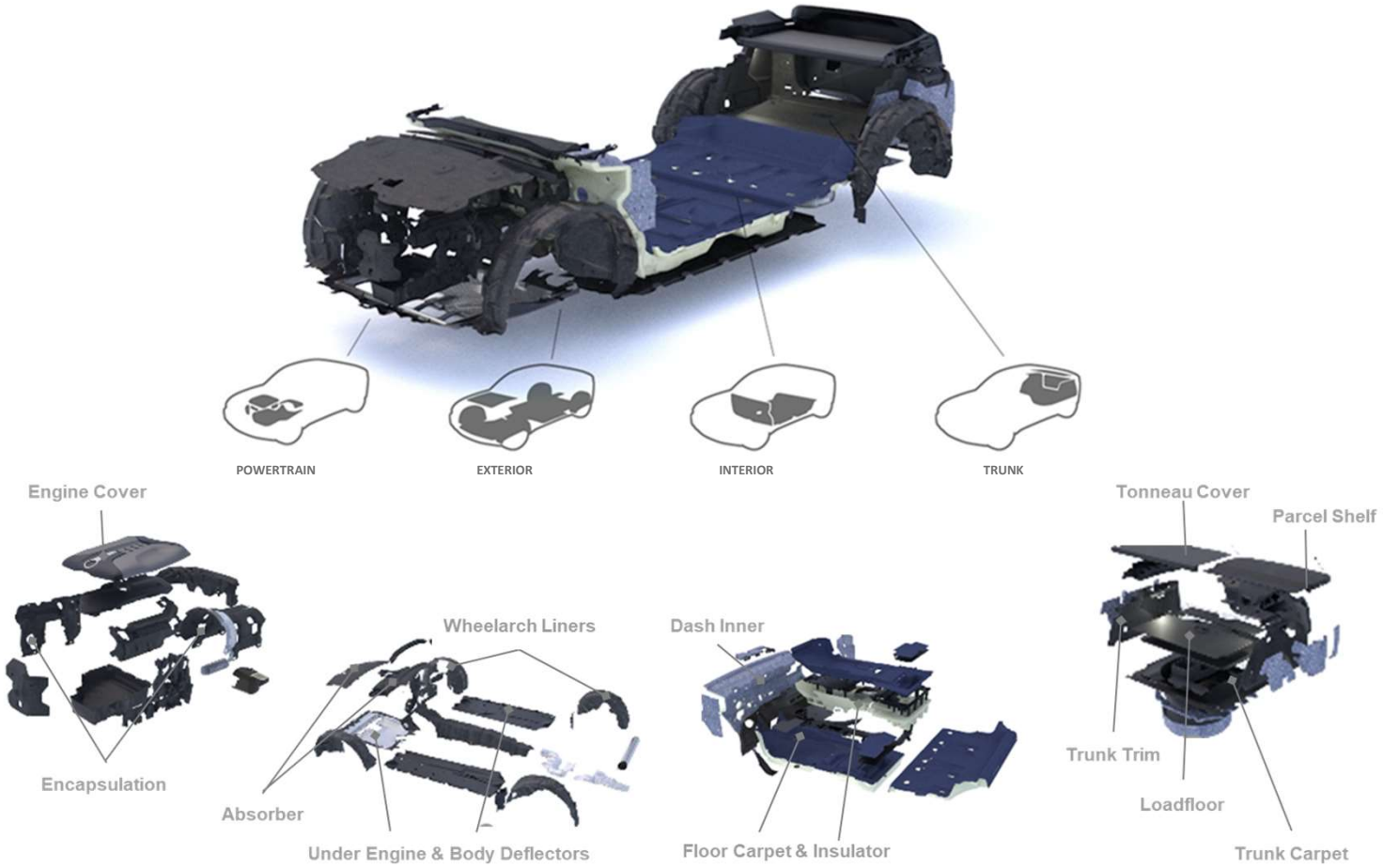
Production sites
In 16 countries

A **family owned** Company established in 1836

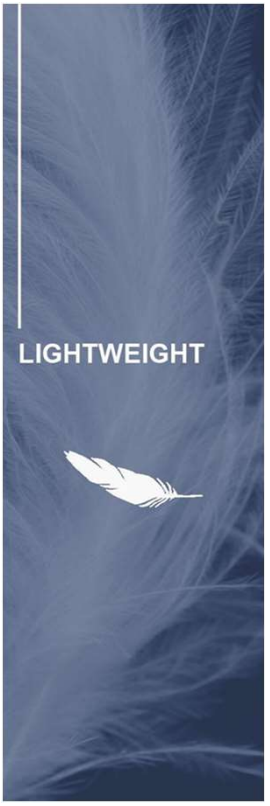
Global automotive **Acoustic and trim specialist**

Powertrain - Exterior - Interior -Trunk

TREVES PRESENTATION



TREVES'S OBJECTIVES IN SSUCHY PROJECT



Targets :

- A 100% BIO based solution for load floor and parcel tray applications
- Save weight by 25 %
- To define a BIO based binder compatible with the automotive cycle time.
- To define a natural Fibers reinforcement Skin
- Economical solution suitable for the automotive market
- To collaborate with innovative European research groups
- To bring the completely bio-based composites value chain: from the sourcing of raw materials to the end of life of the products via their recyclability.

Natural fibers currently used in the automotive industry

Flax

Hemp

Kenaf

Jute

- Currently, these fibers are used as non-woven form, short cm fibers without specific alignment (Side trims, parcel shelves, door panel applications..). The technical properties like flexural and tensile modulus are depending on the weight of the monolayer material, so need to increase the weight to achieve the automotive technical specifications.

Natural fiber Non-woven

Side Trim

Parcel Shelf

Problematic : getting long dm fibers

The harvesting and processing for flax allow long dm fibers, but it's not the same for the hemp. Currently, the hemp is more used for cigarette paper and animal litter.

Thanks to the study in WP4, it's possible to produce long fibers via a flax scutching/hackling processing or a carding approach.

In the Ssuchy project, it was decided to study the long hemp fibers as a woven textile form, but an other way could be also investigated like the unidirectional tapes.

Automotive constraints

- Raw material at competitive price
- Simple process :
  - Less handling as possible,
  - Short circuit
- Short cycle time:
  - < 90 s
- Technologies available:
  - Thermocompression (one shot)
  - Thermoforming (2 shots maxi)
  - Spraying

Bio based available resins

	Thermoplastic binder	Thermoset binder	Mono or bi component	Bio based	Curing time < 90s	Compatible with automotive economic, process and technical specifications
Furan	-	x	Mono	Yes	yes	No (odor pb and tools pollution)
Biogenol (epoxy)	-	x	Bi	Yes	No	No
Greenpoxy (epoxy)	-	x	Bi	Yes	No	No
PA12	x	-	Mono	No	Yes	No
PA11	x	-	Mono	Yes	yes	No
Acrylic	-	x	Mono	Could be	yes	Yes
PLA	x		Mono	yes	yes	No (Tg too low)

- **For the composite Treves as decided to used an Acrylic binder, mono component thermoset resin compatible with hemp fibers, and with economics, process time and technical specifications fulfilling automotive constraints.**
- **This binder choice involves to use a thermocompression process (one shot). It is the most efficient in cycle time as well.**

CURRENT SANDWICH PRODUCT

The goal, is to replace the Glass Mat and the Polyurethane used in the current product.

Current product

- Composition :
  - Glass MAT / PU / Honeycomb paper/ PU/ Glass MAT

TREVES EXPLORATION AND TESTS DONE

During the study, different material where explored and tested, like :

- For the core material :

Balsa wood

Paper Honeycomb

PET Foam

- For the skin :

Commingled woven Hemp/ PA12

Unbalanced woven Hemp textile

- And different type of glue system were tested to solved the main problem : the adhesion of the skin to the core material.

TREVES EXPLORATION AND TESTS DONE

Some tests were done at scale Laboratory on different configurations:

- 4 points flexion tests (ASTM C393-00 and ME NFT 54 606)
- This test allowed us to define the flexural modulus regarding each composition tested:

- Observation :
  - A cohesion problem was identify between the core and the skin without specific glue. The resin alone is not sufficient to achieve the bonding
  - Solution : specific Glue compatible with the thermocompression process

- The best compromise regarding the target weight and the mechanical performance is :
  - **Honeycomb paper and unbalanced hemp textile**

Results analysis

- At room temperature, the result is not so far from the target, but the target weight reduction isn’t achieved.
- The 2 other mechanicals results show that the temperature and the humidity have an important impact on the behaviour of the sandwiches tested.
- The problem comes very probably from the impregnation : The fibers in the woven yarns aren’t completely encapsulated by the binder (drawback of the spraying).
- To solve the humidity and impregnation issues, a solution may consist to encapsulate the sandwich. But this solution will have an impact on the price of the final part.

TREVES'S CONCLUSION AND PERSPECTIVES

- At this time, the price of the unbalanced woven textile is too expensive for an automotive application, and the complete process with the acrylic binder is too long.
- The target weight is not achieved in the automotive context.
- An economical solution to solve the humidity problem need to be investigated.

Thus Treves has started to work on these issues by studying other skin reinforcements like non-crimped Unidirectional hemp tapes.

The first results with acrylic binder show a potential weight reduction of more than -15%. Process remains complex and to be challenged for automotive business future applications: To be continued …..

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