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Prototype of a fridge truck panel

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UBS & INRAe

Partners

PP Leaders: UBS et INRAe

Partners involved: Ecotechnilin

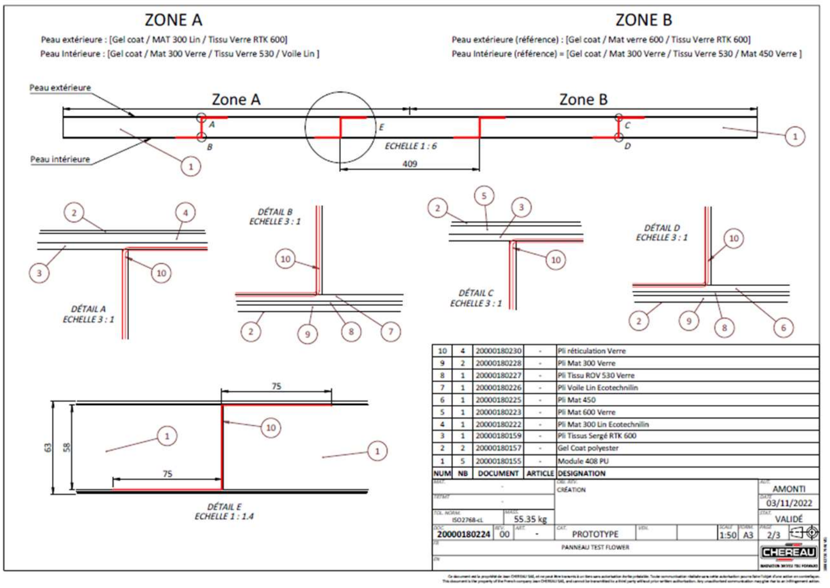
Content

- <u>Objectives :</u>

This deliverable is dedicated to the characterisation of composite panels with a sandwich structure for refrigerated trucks developed by the company CHEREAU. Only the composite skins of this structure, reinforced in part by a mat or flax fleece supplied by Ecotechnilin, are tested and compared with current reference materials. To do this, mechanical and morphological tests were carried out on an initial prototype panel produced by CHEREAU.

- <u>Composition of a panel :</u>

Panels are made up of three layers: an outer skin, a polyurethane foam core and an inner skin. The two skins are conventionally made of glass fibres (mat or fabric) bonded by a polyester resin, and an external appearance coating (gel coat). UBS and INRAE carried out tests on these skins, replacing the glass mats with linen products.



Moulding plan for the sandwich panel and its components (Zone A: composites reinforced with natural flax fibres and Zone B: composites reinforced with conventional glass fibres)

Final sandwich panel

- Materials:

For these tests, the 400 g/m² glass mat (reference) was replaced by 150 g/m² linen voile (test) in the panel's inner skin. For the outer skin, the 600 g/m² glass mat (reference) was replaced by a 300 g/m² linen mat. The different laminate stacks are shown in the tables below:

Table 1 : Stacking of inner skins

Référence	Test
Gel coat	Gel coat
Mat de verre 300 g/m²	Mat de verre 300 g/m²
Tissu de verre ROV 530 g/m²	Tissu de verre roving 530 g/m²
Mat de verre 400 g/m²	Voile de lin 150 g/m²

Table 2 : Stacking of outer skins

Référence	Test
Gel coat	Gel coat
Mat de verre 600 g/m²	Mat de lin 300 g/m²
Tissu de verre rtk 600	Voile de lin 150 g/m²

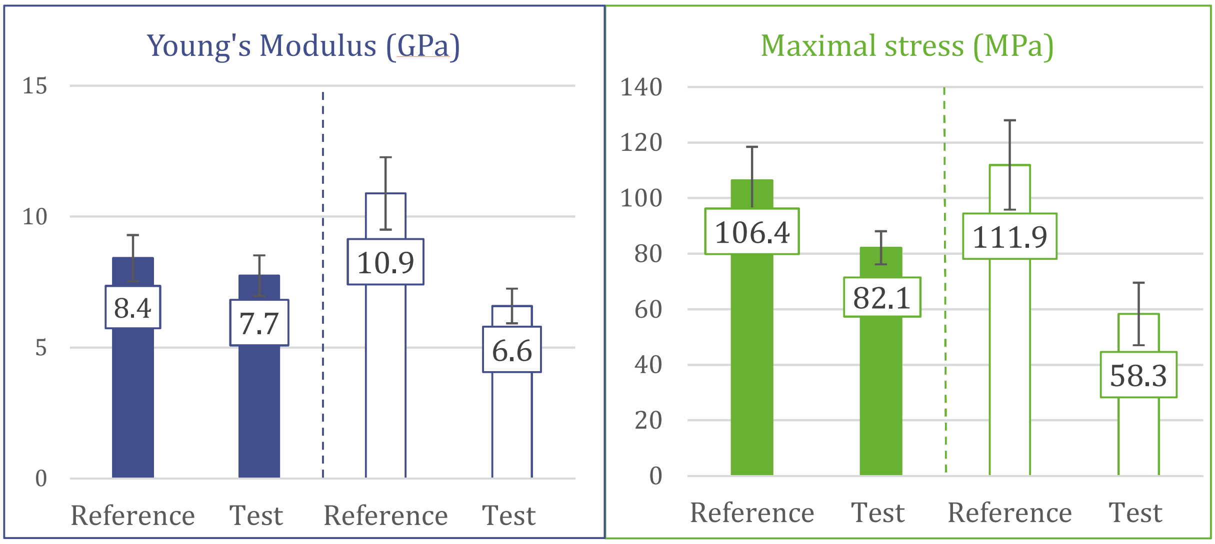
- Tests carried out:

After preparing the samples, observations were made using a Scanning Electron Microscope (SEM) to validate the impregnation quality of these materials and to define their porosity levels. Tensile and bending tests were also carried out on all the laminates using the parameters specified in the following table:

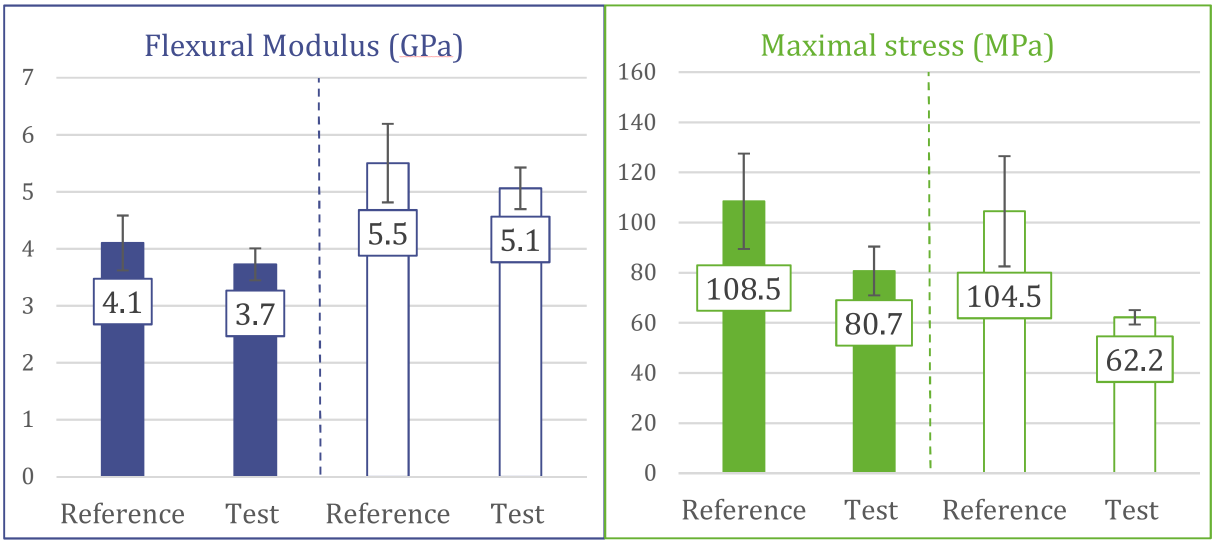
	Essais de traction	Essais de flexion
Normes ISO	14125	527-4
Conditions climatiques	RH = 50 ± 5% ; T = 23 ± 2°C	
Vitesse d'essai	1 mm/min	
Nombre d'éprouvettes	10	

- Mechanical properties:

Tensile mechanical properties are obtained. The coloured histograms on the right represent the results for the inner composite skins, in contrast to the white histograms for the outer skins.



Ainsi, les propriétés en flexion sont également définies :



The mechanical properties of the inner skins incorporating the flax mat are very interesting, with stiffness close to that of the reference composite. This is in contrast to the behaviour of the outer skins, where the replacement of the glass ply by the flax mat considerably reduces mechanical performance, with a 39% reduction in Young's modulus and a 48% and 40% loss of maximum permissible stress in tension and bending respectively.

➢ <u>Morphological properties:</u>

These results can be explained by morphological analyses. In fact, the porosity rates of the various composites are obtained following SEM observations.

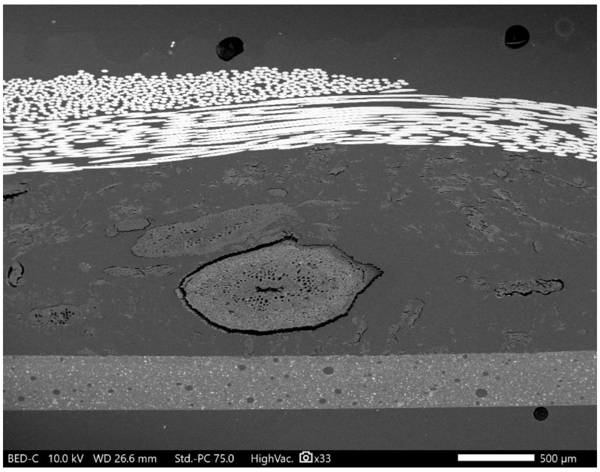
% surface area	External skin		Internal skin	
	Reference	Test	Reference	Test
1	0.33	2.17	0.93	1.95
2	0.67	8.08	1.13	4.17
3	1.17	1.26	5.27	1.91
Moyenne	**0.72**	**3.84**	**2.44**	**2.68**
SD	**0.42**	**3.70**	**2.45**	**1.29**

It was found that for the samples tested (2 cm zone in the edge of the material), a porosity rate of around 8% could be achieved in the outer composites compared with the reference zone, where these values did not exceed 1%. It is also interesting to note that the porosity levels in the inner skins (test and reference) are virtually the same. These porosities are actually located in the glass mat in contact with the gel coat.

CONCLUSION

In conclusion, these initial tests provide information on the mechanical and structural performance of these new materials incorporating semi-finished flax products.

The lower mechanical performance obtained for these composites can be explained by several factors: higher porosity rates, especially for the outer skins, and an architecture with plies of lower weight: from 400 to 150 g/m² and from 600 to 300 g/m² in the inner and outer skins respectively. In addition, as seen in the SEM image opposite, the non-uniformity of natural fibres can have an impact on the final performance of the composite material.



This work has made it possible to validate the use of linen for certain parts of the panels and to create a prototype of an optimised refrigerated truck panel; it constitutes a solid working base for future developments that Chéreau will carry out. It has also put Flower's partners in touch with this company and has led to plans for future joint projects.