Livrable n°T2.2

FICHES TECHNIQUES DES PLAQUES COMPOSITES

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KAÏROS

Partners

PP Leader : Kaïros

Partners involved : Portsmouth, UBS, Ecotechnilin

Deliverable N° & name :

- 2.2.2 Technical datasheet of the laminate

Content

1 Context of activity 2 – WPT2

In this activity, Kaïros has developed new composite materials, with a monolithic and sandwich structure, using the non-woven preform of slightly oriented flax fibres manufactured by Écotechnilin. These materials are intended for use in point-of-sale advertising. As a result, their surface finishes must be smooth and free of visible defects to meet the aesthetic challenges of this field of application. The environmental footprint of these new materials is reduced thanks to their high recyclability and compostability potential and the use of biosourced raw materials. Kaïros has to ensure that the materials meet the specifications imposed by the POP sector (machinability, aesthetic appearance, light weight, good mechanical strength) while at the same time checking that they can be recycled. These materials are produced using the thermocompression process, which ensures short manufacturing cycle times and low processing costs. Numerous tests, such as mechanical strength tests in different environments, UV ageing tests and scratch resistance tests, are carried out to characterise the new material. The results obtained enable a detailed technical data sheet to be drawn up for the material, enabling it to be compared with conventional petro-sourced materials. The manufacture of composite panels is also intended to produce a prototype of a typical POP product. The production of a piece of POS furniture will demonstrate the robustness of the material in this field of application.

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2 Technical data sheet of the plates

The technical data sheets bring together all the properties of the composite sheet characterised in activity 2, in particular mechanical strength, UV resistance, scratch resistance, etc. They also provide information to facilitate the installation of temporary advertising media, i.e. parameters for machining, gluing, folding, etc. They also give the necessary recommendations for managing the end of the project.

2.1 Example of datasheet

An example of a monolithic plate is shown in Figure 1.

Informations techniques

Kairlin® FLOWER 12 - 12 plis orientés dans la longueur

Description du produit

Le produit et son application
Le Kairlin® FLOWER a été imaginé en suivant une analyse de cycle de vie qui permet de proposer un produit limitant son empreinte environnementale à chaque étape de son existence : conception, fabrication, utilisation et fin de vie.

Le Kairlin® FLOWER est un matériau bio-sourcé conçu à partir de fibres de lin ou de chanvre, et de composants 100 % naturels.

Le Kairlin® FLOWER est produit en Normandie en circuit court, près des champs où est cultivé le lin.

Le Kairlin® FLOWER a des propriétés mécaniques élevées, c'est un matériau à la fois léger et rigide.

La surface poli miroir (rugosité Ra < 0,8µm) permet les impressions, sérigraphies, marquages à chaud et contre-collages directs sur le Kairlin® FLOWER.

Le Kairlin® FLOWER a été imaginé pour respecter le cahier des charges et répondre aux besoins de l'affichage publicitaire, du marketing de point de vente, des supports événementiels, de la signalétique ou encore du packaging.

La planéité de ce matériau peut évoluer en fonction de la température et de l'hygrométrie.

Conditionnement
Ce matériau doit être stocké à plat en intérieur à température et hygrométrie stable avec le conditionnement de livraison : panneau plan et rigide sur lequel sont empilés les panneaux de ce matériau, chacun séparé par des feuilles de carton, l'ensemble étant exactement aligné sur les champs des panneaux de ce matériau, recouvert d'un second panneau rigide et plan, puis cerclé. Du poids peut être rajouté sur le panneau rigide supérieur s'il est uniformément réparti sur toute la surface

Signalitique
Impression numérique, sérigraphie, contre-collage, peinture, marquage à chaud, autocollant

Sciage
Idéalement lame composite sinon lame bois

Usinage
Découpe laser, numérique (CN), jet d'eau, guillotine, perçage, gravure, ponçage, polissage

Fraisage
Idéalement : rotation 20 000 tr/min, avance 1000 mm/min, fraise 1 dent diamètre 4mm, coupe à droite - goujure à gauche

Pliage
Pliage idéal avec rainurage et chauffage à 60°C
Rainurage et pliage à froid, et pliage à chaud sans rainurage également possibles

Thermoformage
Thermoformable avec presse à membrane, moule contre moule, emboutissage
Température de transition vitreuse : [50 - 60]°C
Température de ramolissement : [110 - 130]°C
Température de fusion : [170 - 190]°C

Collage
Collage à chaud / froid, tout type de colles / colle végétale

Nettoyage
Nettoyage/dégraissage à l'alcool à brûler, alcool isopropylique, vinaigre blanc (éviter l'acétone)

Fin de vie
En fin de vie, le Kairlin® FLOWER peut être recyclé à 100%.
Grâce à sa composition 100 % naturelle, le Kairlin® FLOWER peut être composté en compost industriel. Cela permet une valorisation des déchets et de trouver une alternative durable à l'incinération dans le cas où le matériau est difficilement acheminable jusqu'au circuit de recyclage. La compostabilité du Kairlin® a été testée en condition réelle chez un composteur industriel et confirmée par des tests en laboratoire. Le certificat de compostabilité est en cours d'acquisition.

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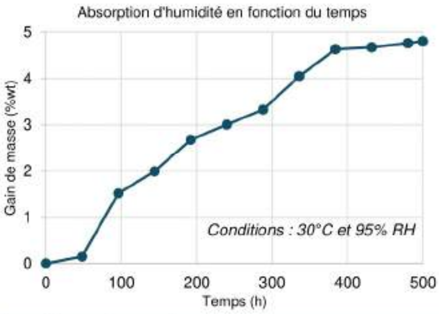
Les propriétés

Les propriétés sont données à titre indicatif pour des températures ambiantes.

Propriétés		Unité	Norme	Valeur		Tolérance
Propriétés physiques et dimensionnelles						
Fraction massique des fibres		[%]		23,2%		
Masse surfacique		[g/m²]		2070		
Épaisseur		[mm]		1,49	±	0,05
Masse volumique		[kg/m³]		1305	±	42
Propriétés mécaniques						
MD	Module de traction	[N/mm²]	ISO 527-5	8679	±	593
	Contrainte maximale en traction	[N/mm²]		82,4	±	3,1
	Allongement à la rupture	[%]		1,57	±	0,05
CD	Module de traction	[N/mm²]		5110	±	243
	Contrainte maximale en traction	[N/mm²]		38,5	±	0,3
	Allongement à la rupture	[%]		1,48	±	0,15
MD	Module de flexion	[N/mm²]	ISO 14125	4982	±	552
	Contrainte maximale en flexion	[N/mm²]		139,0	±	4,7
	Déformation à la rupture	[%]		3,13	±	0,10
CD	Module de flexion	[N/mm²]		3725	±	211
	Contrainte maximale en flexion	[N/mm²]		87,7	±	2,6
	Déformation à la rupture	[%]		3,23	±	0,12
Dureté Shore D			DIN 53505	87,3	±	0,3
Résistance au choc - Charpy		[kJ/m²]	ISO 179-1	29,8	±	6,6
Propriétés de surface						
Résistance aux rayures			EN 438-2-25	En cours	±	
Rugosité (Ra)		[µm]	NF EN 10049	0,57	±	0,06
Propriétés thermiques						
Température de service		[°C]		de -55 à 55		
Comportement au feu						
Résitance au feu			NF P92-501 & NF P92-504	M4		

Vieillissement

Le Kairlin® est biosourcé et conçu pour être compostable en compost industriel. Son vieillissement est une conséquence directe de la biodégradation des matières premières sélectionnées. Pour autant, il conserve en moyenne 80% de ces propriétés en flexion, 87% de ces propriétés en traction et sa dureté reste inchangée après 500 heures d'exposition aux UVB à 50°C. Lors d'une exposition de 500 heures avec 95% d'humidité et 30°C, le matériau conserve en moyenne 60% de ses propriétés mécaniques et 93% de dureté.



® = marque déposée   Kairlin® est une marque déposée par Kaïros environnement

Les informations contenues dans ce document sont susceptibles d'évoluer au fur et à mesure des optimisations. Ces informations sont données à titre indicatif et ne représentent en aucune façon ni une garantie ni un engagement contractuel de Kaïros Environnement et ses partenaires.

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Figure 1 : data sheet for monolithic sheet 1 (12 plies oriented lengthways)

These technical data sheets are available in both French and English.

The first page describes the product and informs printers on how to process the material in the best conditions. The second page lists the different properties of the material.

Mechanical properties depend on external conditions such as humidity and UV exposure. This influence has been characterised by the University of Portsmouth. The results given in this data sheet under the heading "ageing" are detailed in their report (Deliverable 2.1.2).

2.2 Characterisation method

In order to obtain these properties, several methods are used in accordance with different standards. These procedures are detailed for each property below.

2.2.1 Cutting

Samples of these sheets are cut into the shape of test specimens in order to carry out the various mechanical and physico-chemical characterisation tests required to produce the technical data sheets. Cutting is carried out on a digital milling machine where the cutter moves at 50 mm/sec and rotates at 25,000 rpm. The specimens are cut in two directions in the plane of the plate. One direction corresponds to the direction of unwinding of the coil, and is known as 'machine direction' (MD). The second direction corresponds to the opposite direction and is called "cross direction" (CD).

The tests are carried out at room temperature.

2.2.2 Tensile test

In each configuration (material and orientation), the mechanical tensile tests were carried out on 5 specimens, assumed to be homogeneous. Each value presented is therefore the average of a series of 5 values from 5 reproducible tests. The tensile tests were carried out using an MTS criterion 42 equipped with a 5kN cell and an extensometer with a displacement length of 25mm. A displacement speed of 1mm/min was chosen and the tests were conducted in accordance with the ISO 527 standard. The geometry of the specimens depended on a number of criteria, in particular the thickness of the plates. All the parameters selected are summarised in Table 1.

Tableau 1 : parameters of flexural tests

Type	Plaque 1	Plaque 2	Plaque 3	Plaque 4
Épaisseur (mm)	1,49 +/- 0,05	1,03 +/- 0,03	1,09 +/- 0,03	2,42 +/- 0,02
Largeur MD (mm)	15,19 +/- 0,04	15,03 +/- 0,03	15,16 +/- 0,01	15,05 +/- 0,01
Largeur CD (mm)	15,24 +/- 0,04			

2.2.3 Flexural tests

In each configuration (material and orientation), the mechanical bending tests were carried out on 5 specimens, assumed to be homogeneous. Each value presented is the average of a series of 5 values from 5 reproducible tests. The three-point bending tests were carried out using an MTS criterion 42 machine equipped with a 500N load cell. This machine records both force and displacement. The ISO 14125 standard is used for sandwich plates, while the NF 54-606 standard is preferred for sandwich plates.

The geometric parameters of the specimens depend on their thickness, in particular their length and width. Other parameters also depend on the thickness of the specimens, such as the span, the test speed and the radii of the support and the load punch. All the variable parameters are listed in Table 2.

Tableau 2 : parameters of flexural tests

Type	Plaque 1	Plaque 2	Plaque 3	Plaque 4	Plaque 5
Épaisseur (mm)	1,49 +/- 0,05	1,03 +/- 0,03	1,09 +/- 0,03	2,42 +/- 0,02	5,58 +/- 0,04
Longueur (mm)	80	45,04 +/- 0,05	45,06 +/- 0,09	50,03 +/- 0,03	170
Largeur (mm)	25,21 +/- 0,11	25,05 +/- 0,02	25,08 +/- 0,09	25,03 +/- 0,03	15,05 +/- 0,01
Portée (mm)	24	16,5	16,5	39	112
Vitesse d'essai (mm/min)	0,75	0,5	0,5	1,2	2,8
Rayons des supports (mm)	5	2	2	2	5
Rayon du poinçon (mm)	5	5	5	5	5

2.2.4 Rugosity

Surface roughness measures the degree of irregularity of the material surface. The roughness measurement can be assessed in two ways: by calculating the Ra or the Rz. While Ra gives the average roughness of the surface, Rz indicates the maximum values of deformations or holes. Surface roughness is measured using the TR 100 Surface Roughness Tester shown in Figure 2. The values used are Ra.

Figure 2 : rugosimètre utilisé

2.2.5 Shore D hardness

Shore D hardness measures a material's resistance to needle penetration under a defined spring force. It is determined by a number from 0 to 100. The higher the number, the greater the hardness. Tests are carried out in accordance with DIN 53505 using the durometer shown in Figure 3.

Figure 3 : duromètre utilisé

2.2.6 Impact resistance

The Charpy impact test is used to determine a material's resistance to fracture. In this test, the energy required to break the material is evaluated. This is obtained by comparing the difference in potential energy between the start of the pendulum and the end of the test. The machine is fitted with indexes that indicate the height of the pendulum at the start of the test and the highest position the pendulum will reach after the specimen has broken. A pendulum impactor is used to generate an impact on the material.

2.2.7 Scratch resistance

This test assesses the scratch resistance of the material's surface. A spring is placed in the sclerometer according to the desired force (from 0 to 30N). The sclerometer is a pencil with a tungsten carbide tip. The sclerometer is then placed on the plate perpendicularly. The tip then presses on the coating until a trace appears (marks, tears, etc.). The force is then measured. The greater the force required to produce marks, the more resistant the coating is to scratches.

2.3 Comparison with conventional materials

2.3.1 Flexural properties

The bending properties are virtually identical for all biocomposite sheets as shown in Figures 4 and 5. The properties of biocomposite sheets clearly outperform PVC. However, Dibond still has a much higher flexural modulus. Apart from this difference, the new materials are competitive with conventional petroleum-based materials.

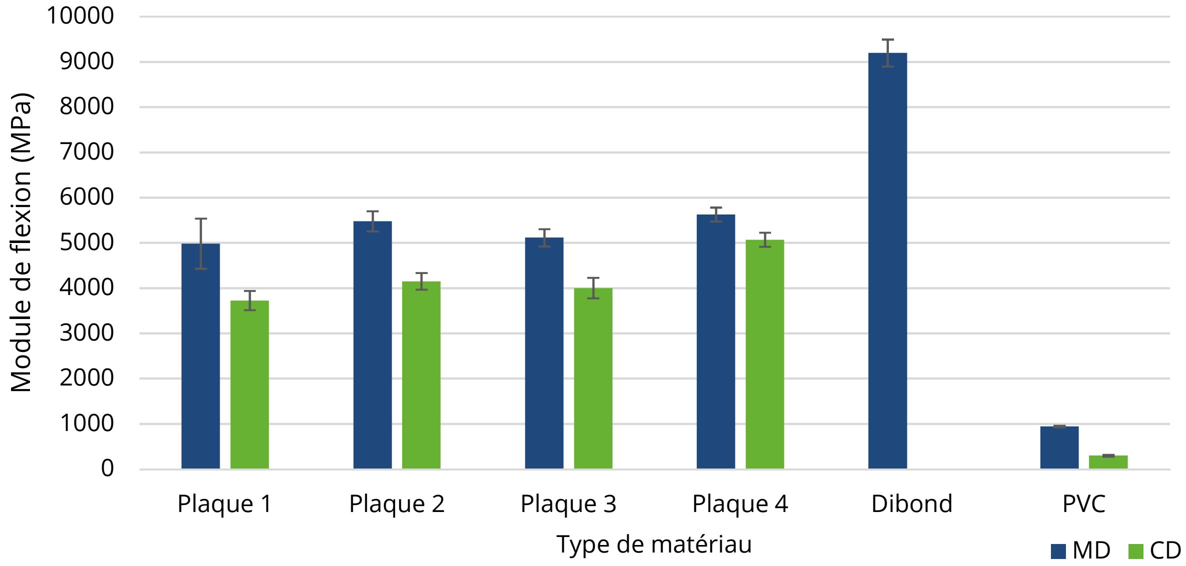

Figure 4 : bending modulus for the different sheets compared with Dibond and PVC

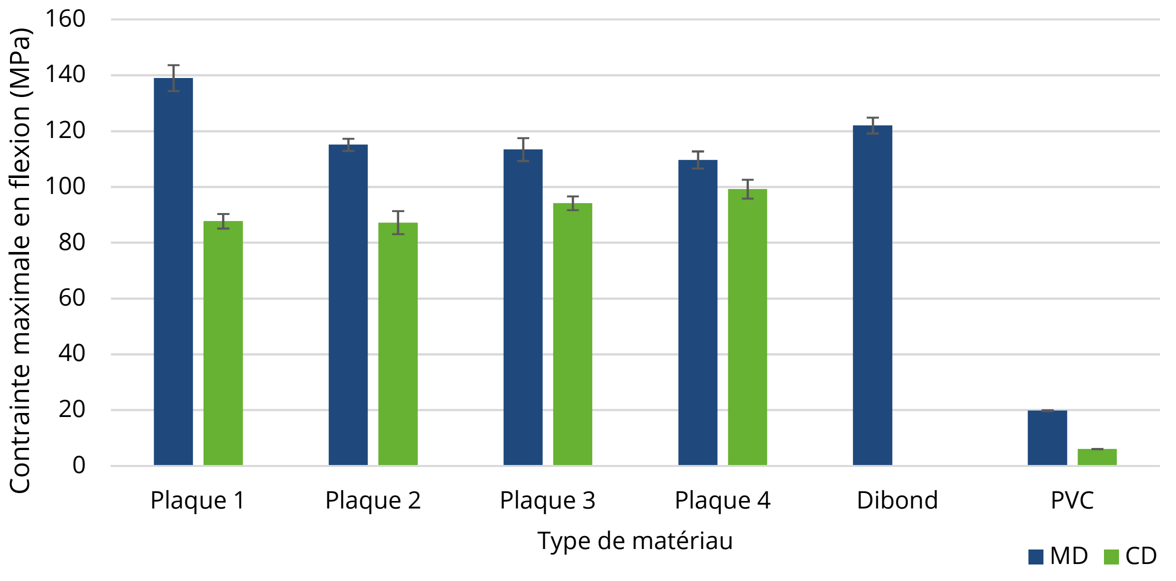

Figure 5 : maximum bending stress for the different sheets compared with Dibond and PVC

2.3.2 Surface properties

Figure 6 shows the Shore D hardness and roughness properties of the various biocomposite sheets and conventional products such as dibond and PVC. Biocomposite sheets are a very good alternative to these petro-sourced materials. The properties of the sheets are similar to those of dibond and surpass those of PVC. This makes them ideally suited to POP advertising.

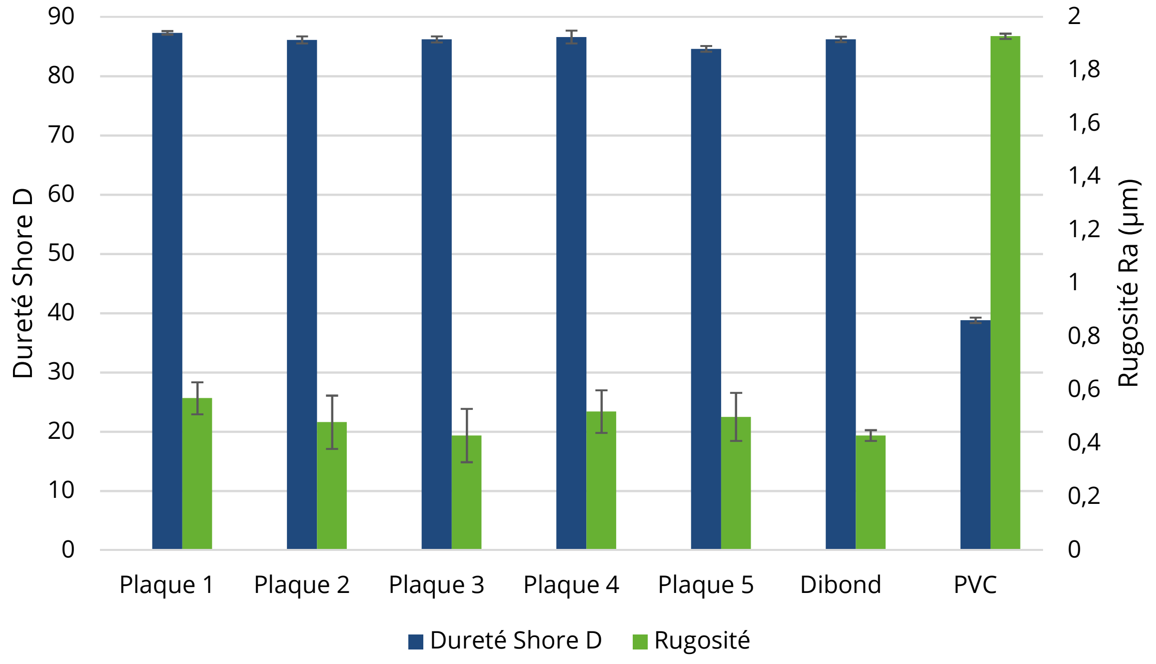

Figure 6 : hardness and roughness properties for different sheets and competing materials

3 Conclusion and perspective

Despite the installation of a cooler, the surface finish obtained did not fully meet our expectations. We plan to modify the material and the process to obtain the desired surface finish. These new changes will enable us to manufacture a POS prototype at a later date.

Tests to characterise the scratch resistance of biocomposite materials are still under way. The results should be available by the end of October.