Natural Fibre Solutions

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EcoTechnilin

Growing businesses through expertise and flexible solutions

Introduction

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EcoTechnilin

- World leaders in natural fibre composites since 1995.
- Production facilities in UK and France.
- Pioneers in production of natural fibre non-wovens
- Supplying composites to most of the world's Tier 1 auto suppliers

EcoTechnilin overview

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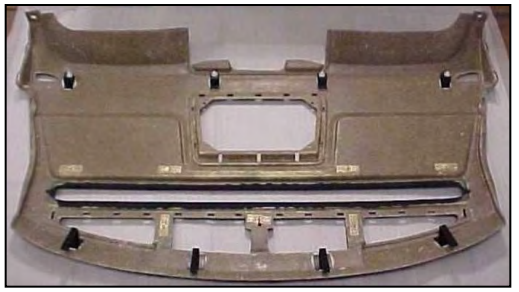
Established producer of non-woven, natural fibre mats (with PP binders)

Producing for the auto industry since 1995 – 7,000 tonnes capacity

wheel arch liners

door trims/inserts

trunk floors

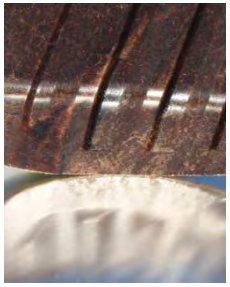


parcel shelves

Proposing a range of bio sourced composites (flax/bioresin) since 2009

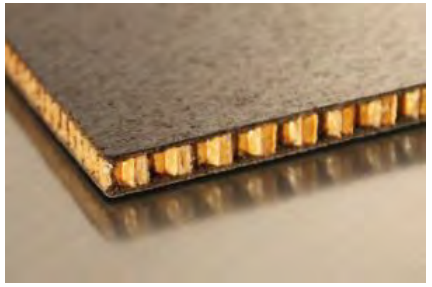
door trims

ceiling tiles



furniture

structural



aircraft panels

Presentation overview

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Topics for presentation

- What are the real drivers?
- Current use of composites using natural fibre non-wovens
- FibriCard: a 100% bio-sourced in production since 2012
- FibriRock: taking bio-sourced aircraft composites to new heights!

Market drivers

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Automotive

CO_2 emission targets are driving down vehicle weights.

End of Vehicle Life legislation is specifying recyclable materials.

Use of materials with low embodied energy is being encouraged.

Construction

EU Directive for zero carbon rating in all new buildings by 2016 ?

Aircraft

Weight saving… whatever the material cost or embodied energy?

1kg reduction in weight saves $185 of fuel per year

Automotive drivers for composite materials

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Technically desirable

Weight reduction, mechanical properties, ELV, embodied energy.

Real life - financial

Cost reduction for materials, parts and assemblies

Cost reduction for tooling (design and manufacture)

Reduced cycle times + no. of operations - ideally one-shot process

Weight reduction, maintaining mechanical & acoustic performance

Reduction of petro-sourced materials (=> less price volatility)

Replacement of undesirable ingredients (phenolics, PU, etc)

Process overview

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Cultivation → Fibre Preparation → Consolidation into mats

Flax grown by farmers

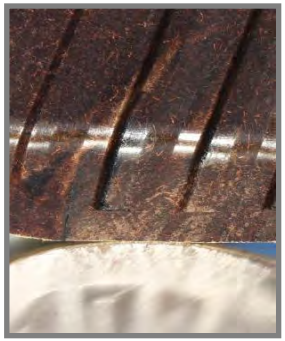
Fibres extracted by coops

Non-wovens made by ET

We advise on the whole process but this is our core activity

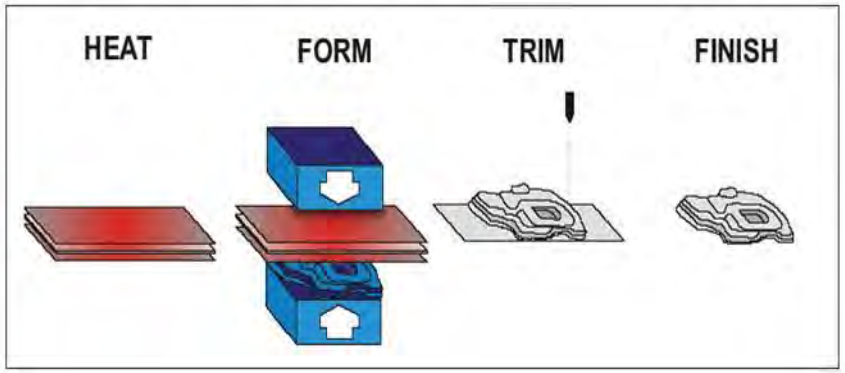
End user applications ← Part forming by Tier1

Automotive



Furniture

Aircraft



Non-woven Production

Scutched flax production

2012 figures

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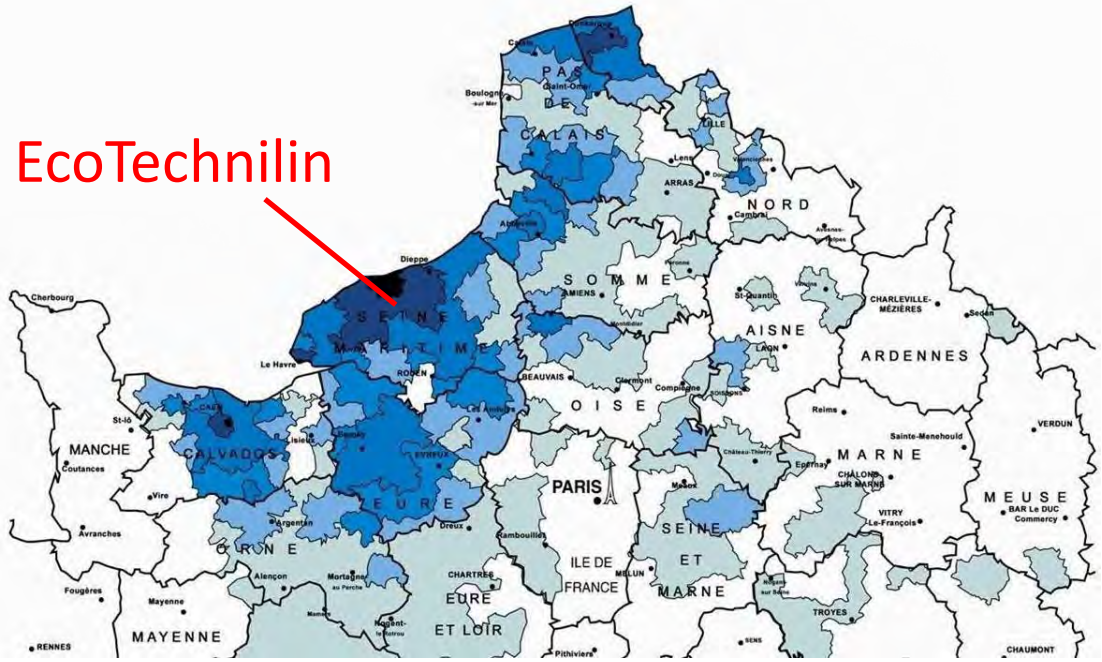
Country	Hectares	Tonnes
France	64,400	96,000
Belarus	60,200	13,000
Russia	48,000	10,000
Belgium	11,450	17,000
Egypt	10,100	10,000
China	6,100	3,000
Ukraine, Poland	4,000	1,500
Netherlands	1,500	2,800

France, Benelux:
75% of global volume

Lin = flax in French.
All “linen” comes from flax fibres



Why natural fibres?

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- Lightweight & strong – flax has better modulus than glass
- Better properties at failure + no sharp edges
- Sustainable and recyclable – our flax is “waste”
- Low embodied energy
- Fibres are hollow so have good resin retention
- Easy to manhandle (the fibres don’t prick or sting)
- Minimal environmental impact
- No change in properties at low temperatures (eg -40^{o}C)

Fibre properties

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Properties	Fibre – only				
	Glass	Flax	Hemp	Jute	Kenaf
Density g/cm^3	2.55	1.54	1.48	1.44	1.19
Tensile strength 10E6 N/m2	3200	1000 - 1600	550 - 900	400 - 800	240 - 600
E-modulus (GPa)	73	60 - 80	70	20 - 30	14 - 38
Elongation at failure (%)	4.6	2.4 – 4.1	1.6	1.8	1.7
Embodied energy (MJ/kg)	21	5.5	5	4.5	9

Bio-composite Development

FibriMat

100% flax

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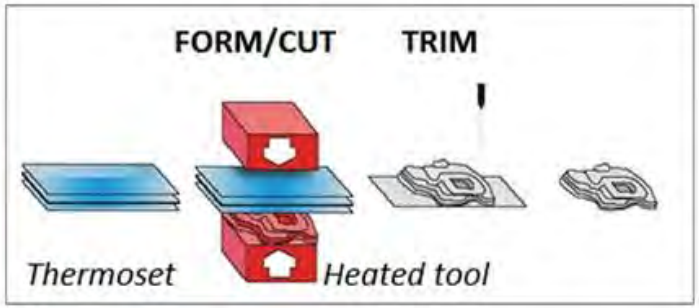
Flax mats

- Weights from 300 to 2400 g/m^2
- Very low environmental impact

We supply FibriMat direct to large building companies for use as an underlay below wooden floors



We have supplied FibriMat to some companies for use with polyurethane for parcel shelves (eg Audi and Jaguar)

We convert most FibriMat into pre-preg which we call FibriPreg

Eco impact of flax non-wovens

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Study conducted for flooring underlay application

Type of Impact	Unit	Cork sheet	Extruded polystyrene	100% flax non-woven	cf cork sheet	cf polystyrene
Embodied energy	MJ	25.43	100.07	7.70	-70%	-92%
Biotic impoverishment	kg Sb eq	1.03E-02	4.35E-02	7.23E-04	-93%	-98%
Acidification	kg SO2 eq	5.35E-03	1.67E-02	6.27E-04	-88%	-96%
Eutrophisation	kg PO4--- eq	2.71E-03	3.43E-03	1.96E-04	-93%	-94%
Climate warming	kg CO2 eq	1.15	10.52	0.10	-91%	-99%
Ozone layer degradation	kg CFC-11 eq	9.24E-08	1.64E-04	1.71E-08	-81%	-99.99%
Human Toxicity	kg 1,4-DB eq	1.00	0.90	0.12	-88%	-86%
Aquatic toxicology: fresh water	kg 1,4-DB eq	0.43	0.50	0.03	-92%	-93%
Aquatic toxicology: salt water	kg 1,4-DB eq	903.63	963.23	72.06	-92%	-93%
Terrestrial toxicology	kg 1,4-DB eq	6.17E-03	5.19E-03	1.17E-03	-81%	-77%
Photochemical Oxydation	kg C2H4	4.46E-04	1.28E-03	2.40E-05	-95%	-98%

FibriPreg
With **Sugar-based Bioresin**

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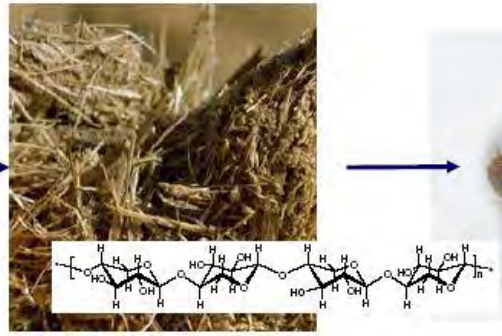
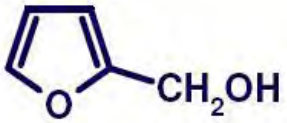
Sugarcane

Sugar

Foundry

Biomass-based resins





Bagasse
also
Corncobs
Oat, rice hulls
Nut husks, shells
Olive residue

Construction

High pressure laminates

FibrPreg
Eco impact of Bioresin

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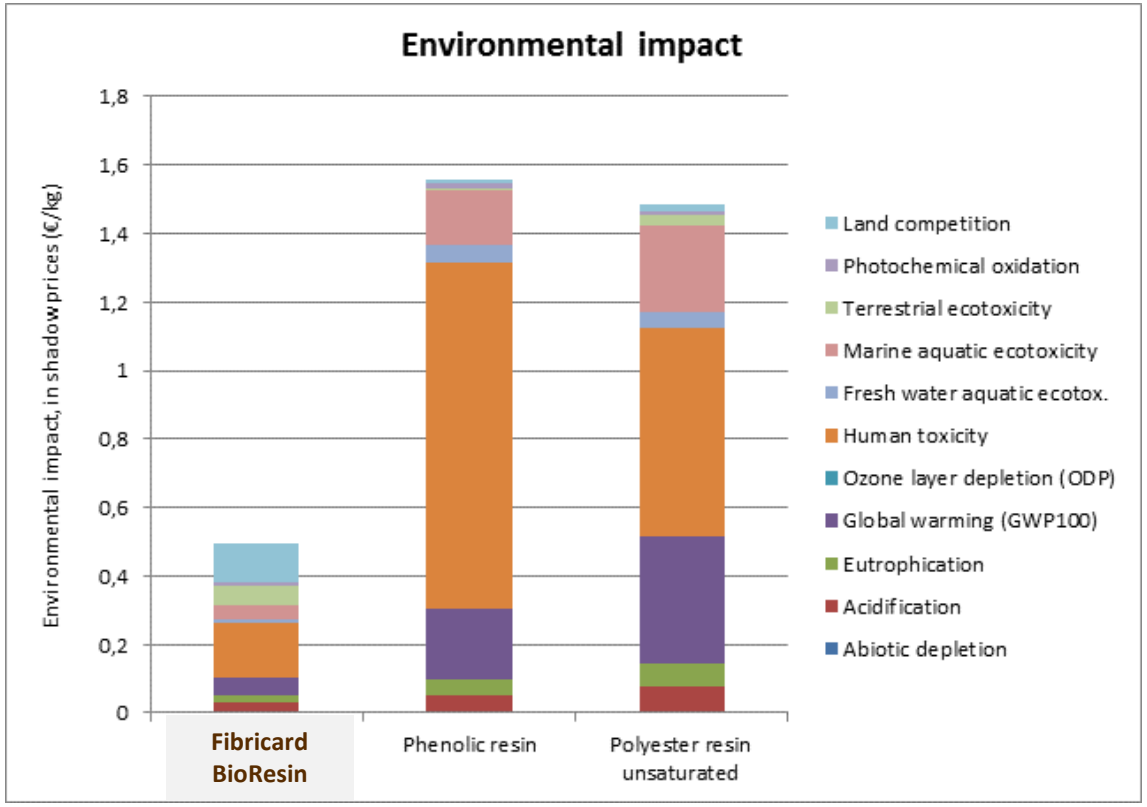
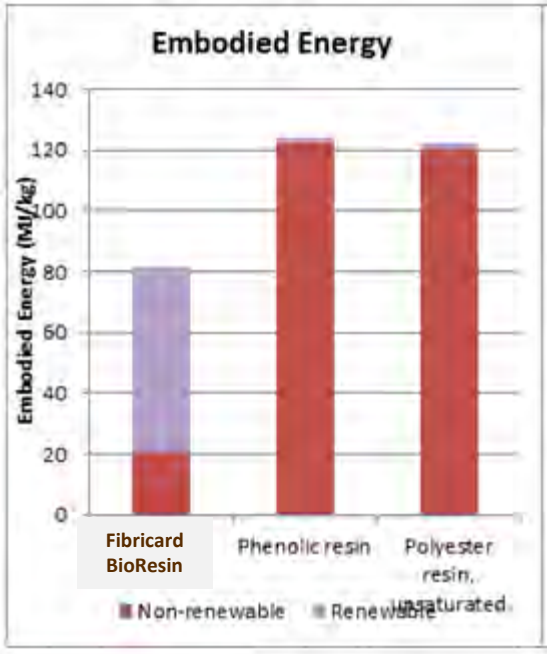
LCA analysis





Calculated using the CML2 shadow price method
Comparison to a phenolic and a polyester resin

FibriBoard for furniture
flax/bioresin

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FibriBoard: 100% flax mat with sugar-based Bioresin

- Green, Sustainable
- Rigid, Light, Formable
- Flame-resistant

Applications:
Seats, partitions

Main advantage:

- Cycle times of 60s achievable

First projects starting in 2015

FibriBoard FR ceiling tile

flax/bioresin FR

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Developed with Armstrong & Knauf

- Lightweight, sustainable
- Works in existing process
- Ready to be launched
- All impregnation outsourced

Results on 600 x 600 panel:

- Class 1 fire/smoke performance

  (Steiner test: 18/42)
- 83% acoustic absorption
- Shape stability.

FibriCard load floor

flax/bioresin/paper core

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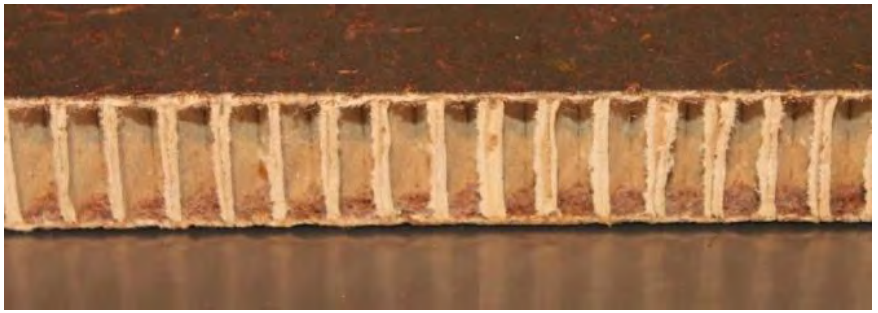
FibriCard: FibriBoard /paper honeycomb / FibriBoard

- Lightweight, rigid
- Low energy
- 100% bio-sourced



Applications

- In Jaguar F-type load floor
- Homologated on Qashqai
- Planned for Peugeot 508
- Train tables, partitions

Developed on projects for JLR, Nissan, PSA, Gordon Murray Design

Growing despite resistance from established board suppliers

JLR L152

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Cabinsystems F-Type convertible – renewable source load floor

JAGUAR | LAND ROVER

The F-Type load floor uses EcoTechnilin supplied flax + bio-resin binder to form the outer cores and replaces the use of Polyurethanes.)

0.8Kg weight save = 8.56Kg CO_2 saved

FibriRock galley cart

flax/bioresin/basalt/Nomex

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FibriRock: FibriPreg Aero / Nomex / FibriPreg Aero

Developed for airline galley cart

Basalt similar to S2 glass with better high temperature performance (>550°C)

Many applications in aeronautical and railway

- Excellent fire performance
- Good mechanical performance
- 150 second process time

FibriRock data

flax/bioresin/basalt/Nomex

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6mm panel for lightweight galley cart (21G rated to carry 50kg)

Test	Units	Result	Criteria
Bending modulus (auto test?)	*N/mm²*	*9200*	21G Certified *inc. 9g pull test*
Long beam compression test	N	550	
Short beam shear test	N	1025	
Peel strength	N/76mm	107	
Burn length	inches	2.3	< 6
Drip exiting time	seconds	0	< 3
Heat release rate	kWmin/m2	**15**	**< 65**
Max heat release rate	KW/m2	**18**	**< 65**
Smoke emission	DS max	**10**	**< 200**
Toxic gas emission		**v.low**	

150 second process time

FibriRock benefits

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- 87% biosourced: flax/bioresin/basalt
  13% Nomex-type core (meta-aramid paper saturated in phenolic)

- Natural fibre + (bio)resin for structural adhesive system
  -> natural fibres absorb vey well resin

- Organic fibres hold resin in position during high temp curing
  -> vastly reduced cycled times: 150 seconds (10x faster than comp.)

- Lightweight organic material releases low energy during burning
  -> excellent heat release figures: allows cheaper films/finishes
  -> very low smoke levels, no dripping, no toxins

- Clever process integrates flax and mineral fibres
  -> easier processing + greatly improved mechanical properties

Summary

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❖ Don’t underestimate Mother Nature!
Natural fibres are strong, tough, light and hollow

❖ Furan-based bioresins can be used very effectively
From waste-sugar -> not competing for field space with food

Flax + bioresin -> **FibriPreg**

These bio-composites give excellent performance… even at -40°C
Are already replacing existing “less green” composites

Flax + bioresin + basalt -> **FibriRock**

Integrate basalt (natural) fibres to increase rigidity

Resulting composite has excellent fire performance
… with cycle times from the auto industry!

Natural Fibre Solutions

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Growing businesses through expertise and flexible solutions