EU/CHINA RESEARCH ON ECO-COMPOSITES FOR AVIATION INTERIOR AND SECONDARY STRUCTURES

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SICMSE2019

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Background

Potential reduction of environmental impacts of aviation by:

Aircraft configuration

Propulsion / alternative fuels

Aerodynamics

Trajectory / flight path

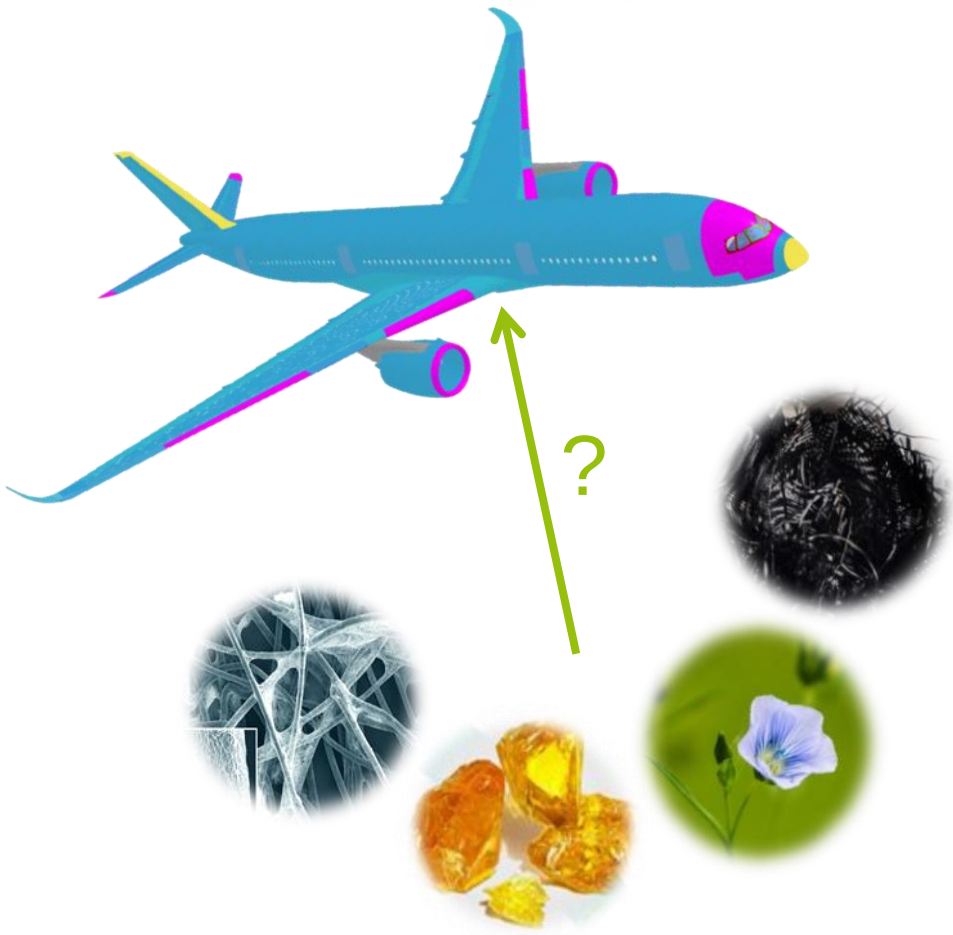
…

Lightweight design

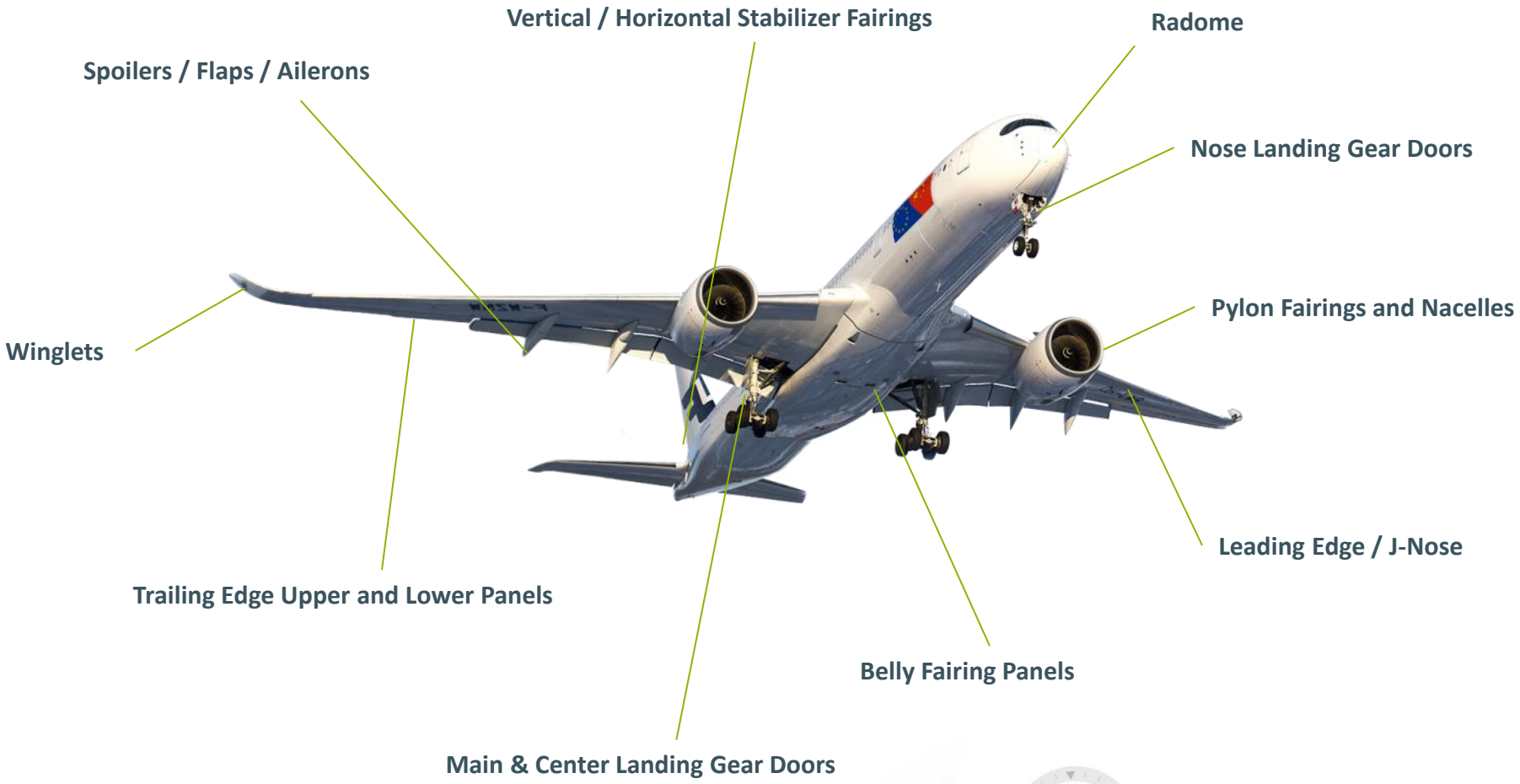
- Fibre Reinforced Composites
- CFRP, GFRP, GLARE, …

→ Synthetic / man-made materials

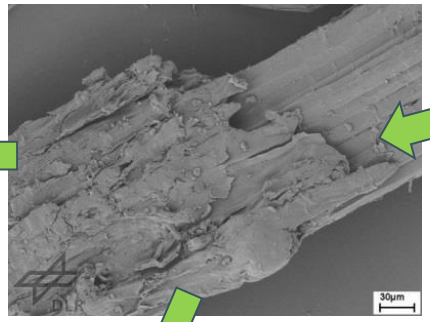
- **Natural Fibres?**
- **Bio-based resins?**
- **Recycled fibres?**
- **Multifunction?**

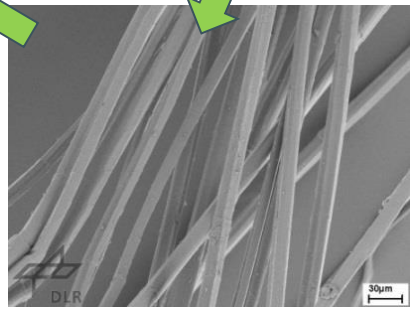


ECO-COMPASS Application

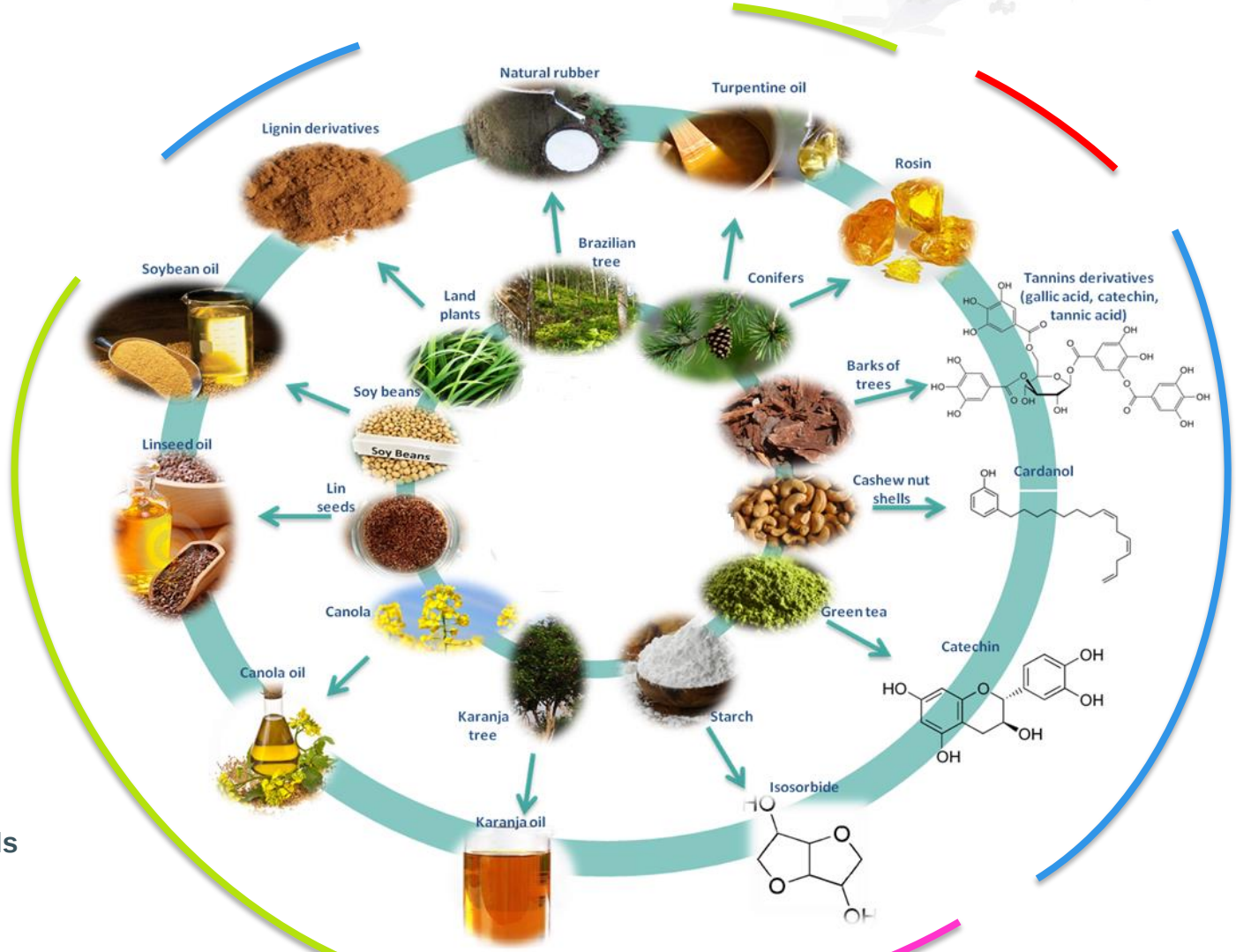


“bio-based”





bio-bases resins



- Epoxidized natural oils
- Rosin
- Saccharides
- Natural polyphenols

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Ecological and Multifunctional Composites for Application in Aircraft Interior and Secondary Structures

- Cooperation of Chinese and European partners
- 2016 – 2019

- Identification of applications for eco- and multifunctional composites
- Development, characterization and simulation of eco-materials to give a broad overview of the possibilities in aviation with leverage to other transport sectors like automotive and railway.
- Application / Demonstrators
- Life Cycle Assessment (LCA)

ECO-COMPASS

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EUROPEAN PARTNERS

FROM 6 COUNTRIES

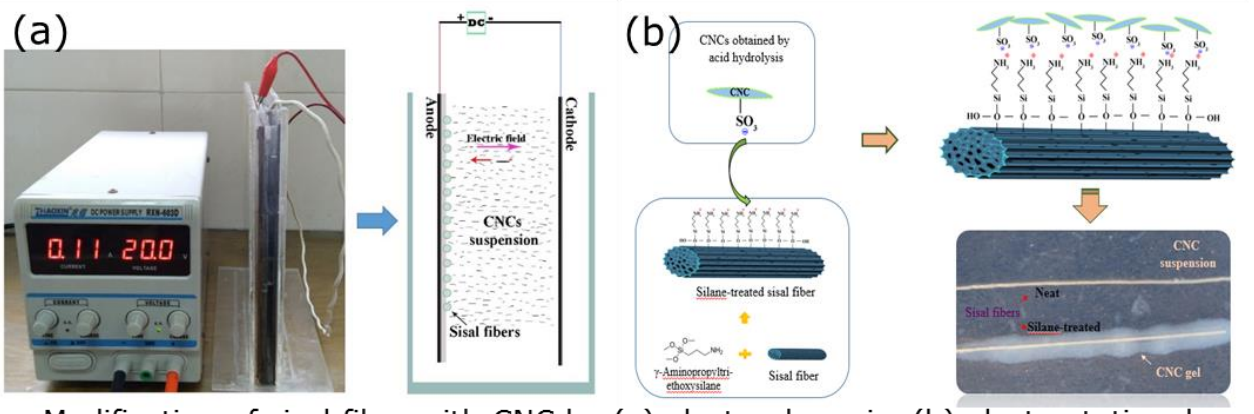
11

CHINESE PARTNERS

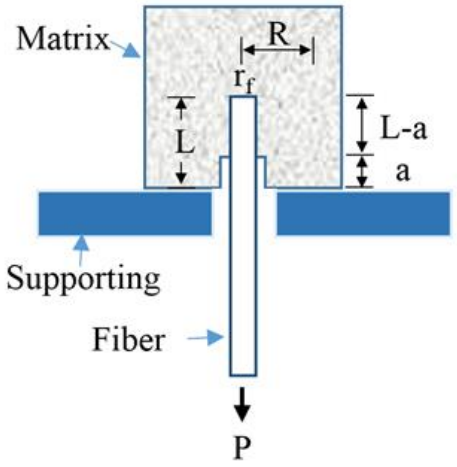
www.ECO-COMPASS.eu

ECO-COMPASS Results

- Improvement of fibre properties

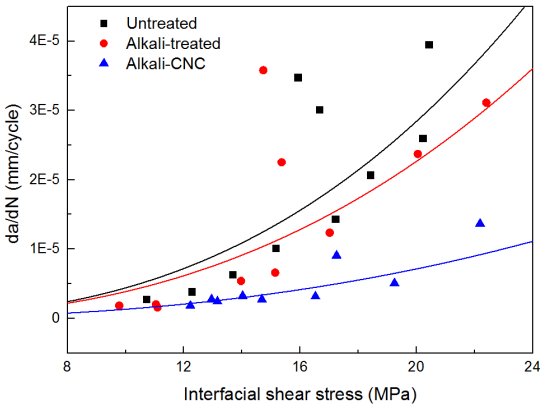


Modification of sisal fiber with CNC by (a) electrophoresis, (b) electrostatic adsorption

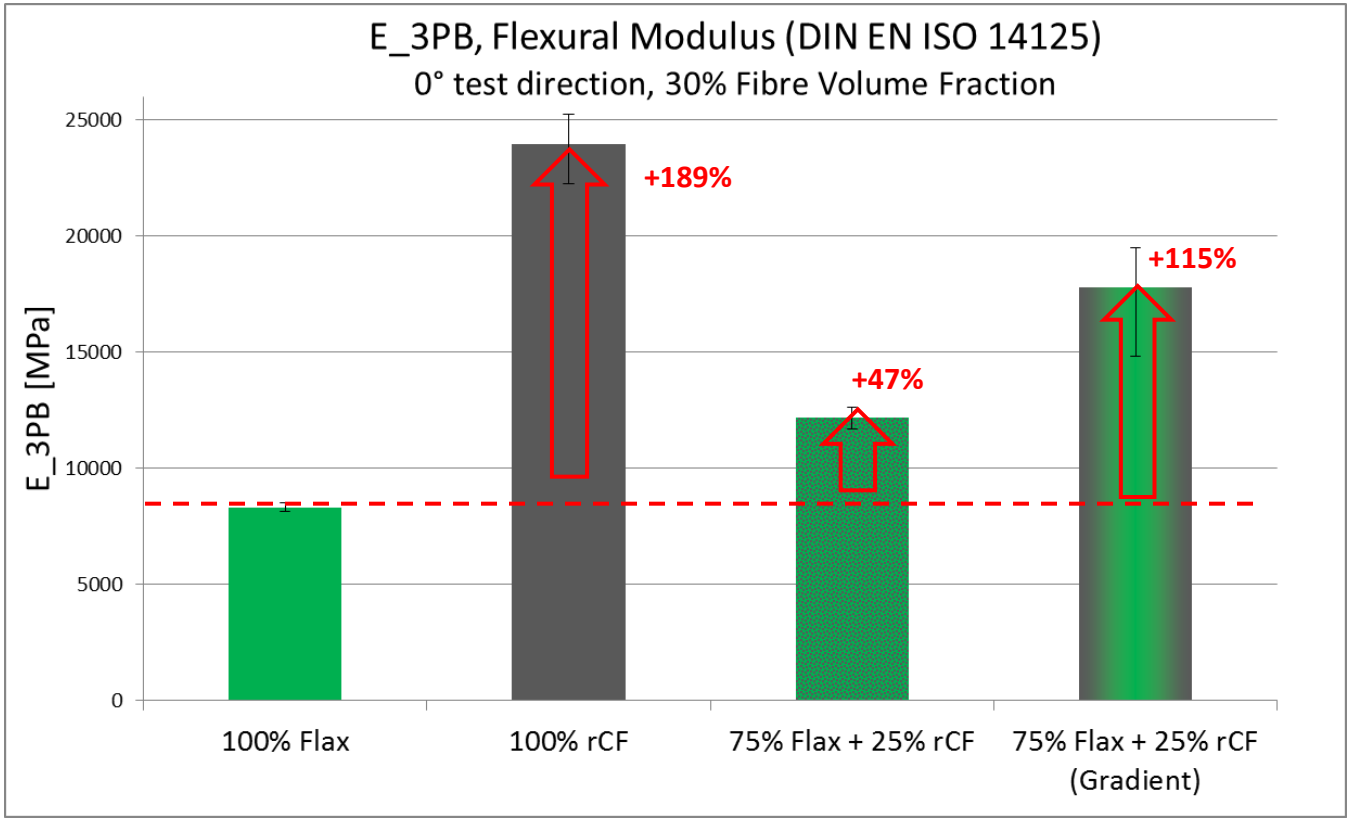


dynamic interface fatigue pull-out test

Treatment	Diameter (µm)	Tensile strength (MPa)	Young's Modulus (GPa)
Untreated	173.3 (31)	529.9 (102)	13.6 (2.9)
CNC-treated	175.3 (32)	511.5(97)	14.4 (3.3)
Alkali-treated	142.6 (18)	692.8 (92)	18.8 (3.0)
Alkali-CNC-EPD	156.4 (23)	614.9 (73)	22.0 (3.1)
Alkali-CNC-ESA	150.2 (20)	716.6 (110)	21.0 (2.6)



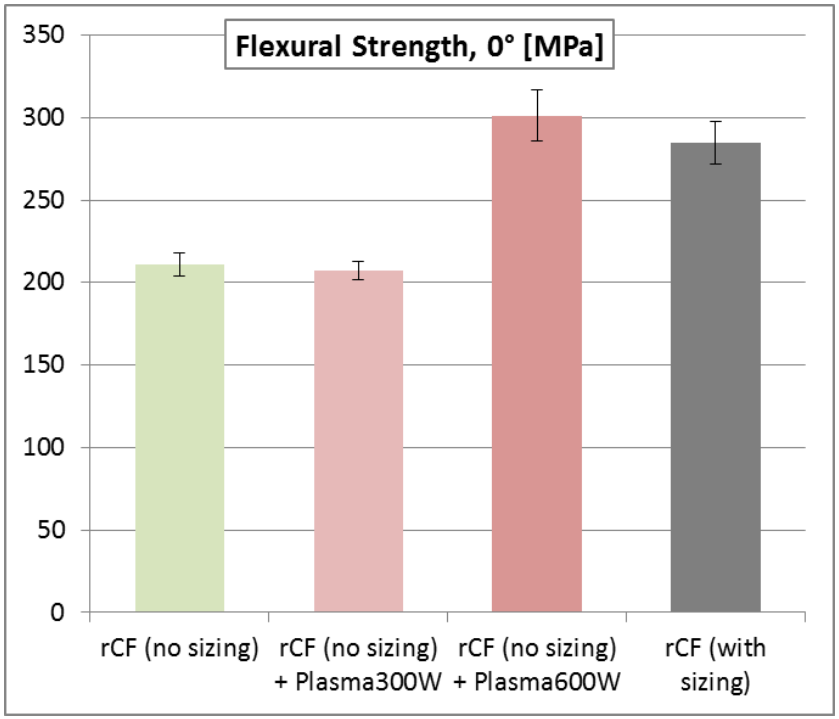
Reinforcements

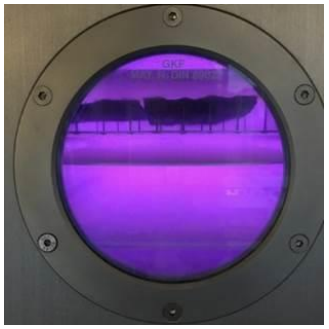


Aerospace 2018, 5(4), 107; https://doi.org/10.3390/aerospace5040107
Aerospace 2018, 5(4), 120; https://doi.org/10.3390/aerospace5040120

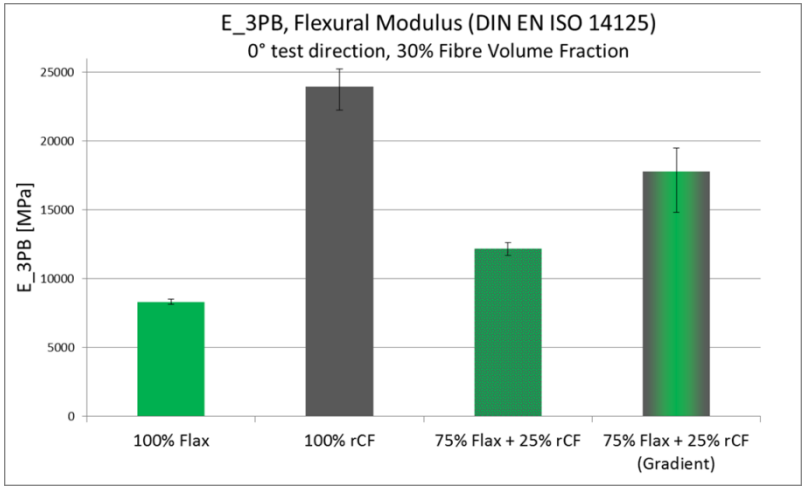
ECO-COMPASS Results

Plasma treatment (rCF, flax)





Low pressure plasma



Techtextil 2019 forum, TTF 9 - sustainable fibre innovations & applications: “Plasma treatment of bio-based and recycled fibres for eco-composites”, R Garcia, LEITAT

ECO-COMPASS Results

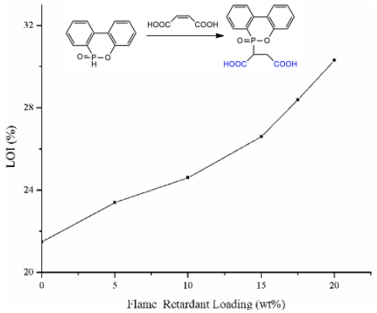
Rosin-based curing agent epoxy resin

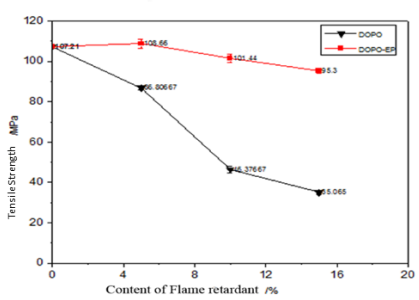
Property and test condition		Unit	Reference[1]	Test result	Standard
Tensile strength warp	RT/dry	MPa	≥500	707	ASTM D 3039
Tensile modulus warp	RT/dry	GPa	65±8	62.3	
Tensile strength weft	RT/dry	MPa	≥500	557	
Tensile modulus weft	RT/dry	GPa	65±8	60.9	
Compression strength warp	RT/dry	MPa	≥300	509	ASTM D6641
Compression modulus Warp	RT/dry	GPa	58±8	61.2	
Compression strength Weft	RT/dry	MPa	≥280	362	
Compression modulus weft	RT/dry	GPa	57±8	57.7	
Bending strength warp	RT/dry	MPa	≥650	883	ASTM D 790
Bending modulus warp	RT/dry	GPa	58±8	56.8	
Short bean shear strength	RT/dry	MPa	≥50	55.7	ASTM D2344
In plane shear strength	RT/dry	MPa	≥45	72.6	ASTM D3518
In plane shear modulus	RT/dry	GPa	3.5±1	3.84	

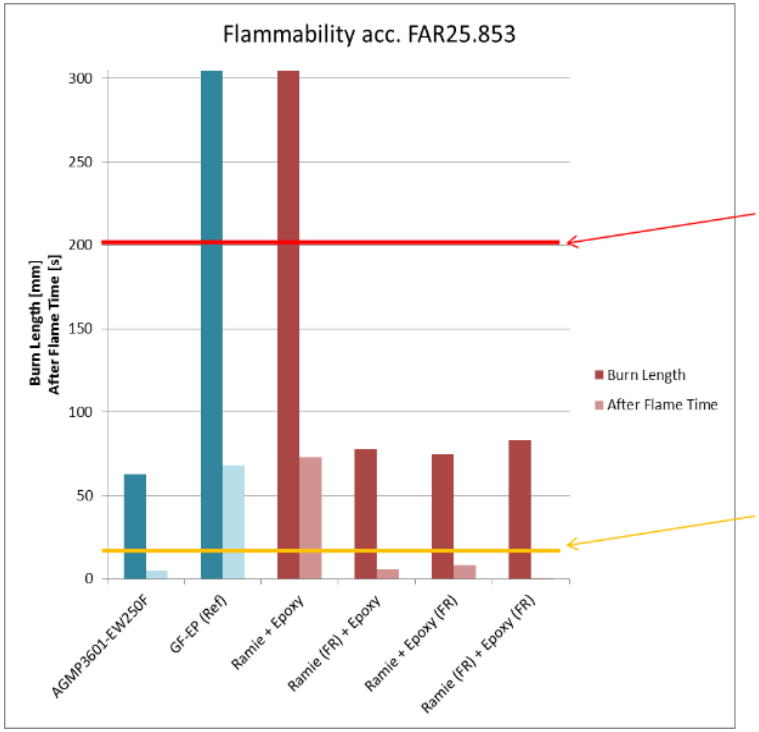
[1] A commercial product

Aerospace 2018, 5(2), 65; https://doi.org/10.3390/aerospace5020065
Aerospace 2018, 5(4), 110; https://doi.org/10.3390/aerospace5040110

ECO-COMPASS Results



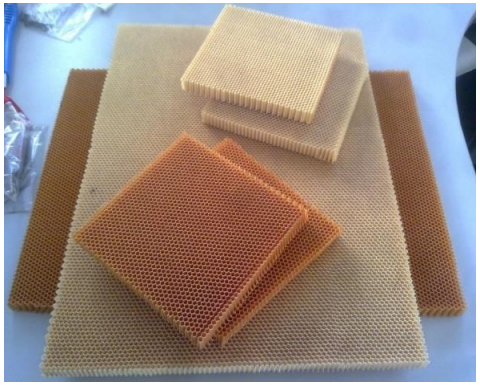


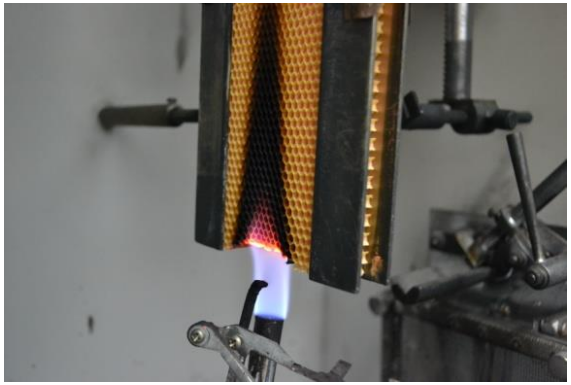


ECO-COMPASS Results

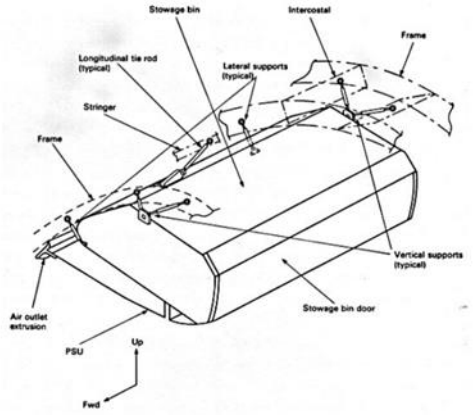
AGMH-1 “Green Honeycomb” is made of plant fiber hybrid paper containing 20% plant fibers.

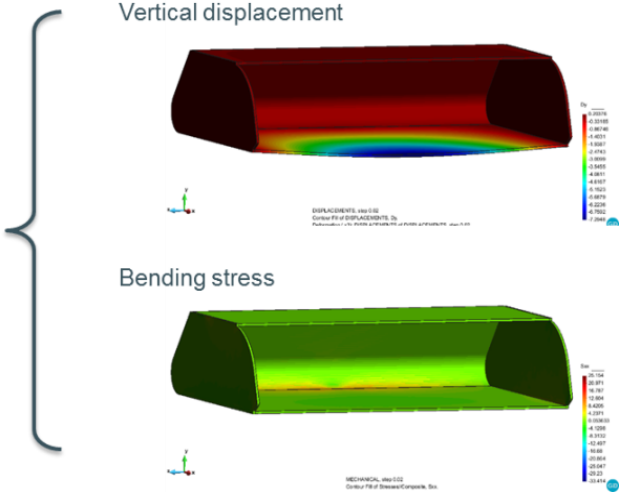
Items	Compression strength, MPa	Longitudinal shear strength, MPa	Transversal shear strength, MPa	Longitudinal shear modulus, MPa	Transversal shear modulus, MPa
Nomex, I	1.24	1.0	0.55	32.5	19.5
Nomex, II	1.64	1.07	0.58	36	19
GREEN Honeycomb	1.78	1.16	0.75	43.2	29.3





ECO-COMPASS
Results

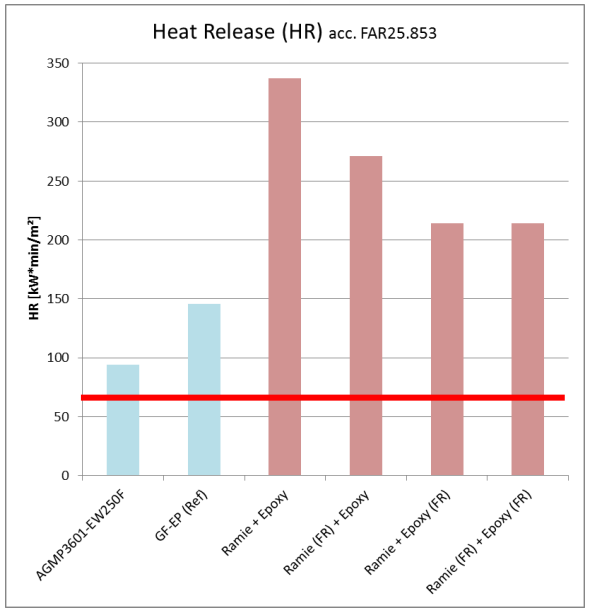


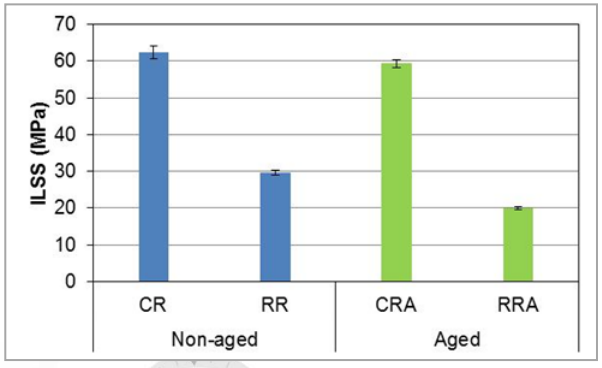


Composite Structures 131 (2015): 707-719. DOI: 10.1016/j.compstruct.2015.06.006
Composite Structures 206 (2018): 215-233. DOI: 10.1016/j.compstruct.2018.08.022

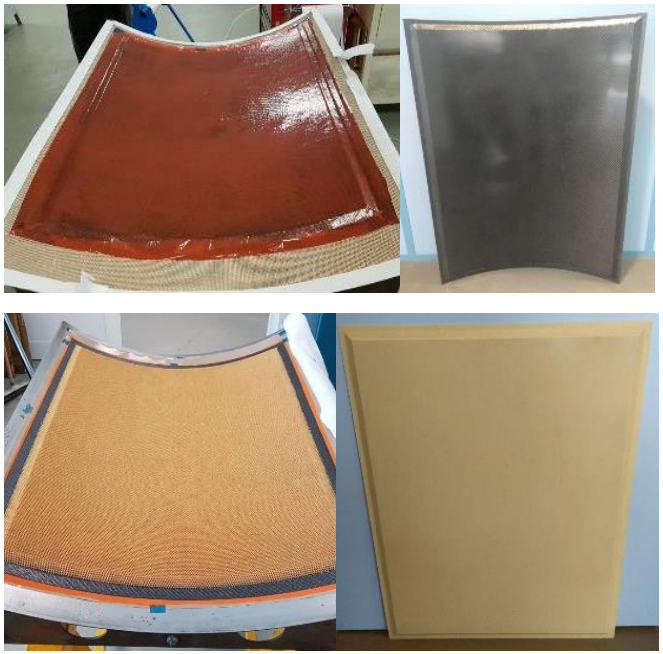
ECO-COMPASS
Potential Gaps and Challenges

- Fire performance, especially the Heat Release of NFRP and (bio-based) epoxy resins.
- Long term behaviour
- Upscaling of fibre modification technologies
- Assessment of potential environmental impacts of treatments and processes to improve properties of eco-composites





ECO-COMPASS Demonstrators



Airbus

AVIC