

Wind Turbine Blade Manufacture 2019
9-11 December, Germany



Volume opportunities for re-manufacturing GFRP-waste; test results & applications

by Markku Vilkki, CEO, Conenor Ltd



29.11.2019

Sivu 1 | 39/2019 | Tekniikka&Talous

Liikkuva sääsuoja turvaa puurakentamisen

Robotti hioo vielä melko kehnosti

Korkeakoulutettujen tarve kasvaa hurjaa vauhtia

39

Tekniikka & Talous

29.11.2019

83000 LUKIJAA ■ HINTA 4,30 EURA ■ WWW.TEKNIIKKATALOUS.FI



ONGELMA-JÄTETTÄ

Tuulivoimaloiden lapojen uusiokäyttö aiheuttaa päänvaivaa. Ratkaisu saattaa löytyä pienestä suomalaisverstaasta.

Tilaajille

40 miljoonaa tonnia ongelmajätettä ylhäältä: Maa ilma hukkuu tuulivoiman lapoihin - Ratkaisu voi löytyä pienestä suomalaisverstaasta.

12:00

Lusimat

Näin "Kinnanselkäden" toimitukset kallistuvat ensi vuonna 19100.

TIILAAJILLE

40 miljoonaa tonnia ongelmajätettä ylhäältä: Maa ilma hukkuu tuulivoiman lapoihin - Ratkaisu voi löytyä pienestä suomalaisverstaasta



12:00



Risto Siilasmaa lähtee Nokian hallituksesta - Sari Baldaufista seuraaja puheenjohtajana

12:25 HETIMITÄMINEN



Näin Nokian Siilasmaa hehkutti terveysteknologiaa: "260 miljardin markkina" - nyt harkinnassa luopuminen

15.2.2018 TERVENS.



He ovat vahvimmissa Suomen seuraavaksi pääministeriksi - "olen vasemmistolainen sosialidemokraatti"

12:18 POLIITIKKA

Pääministeri Rinne jätti eronpyyntönsä - Presidentti hyväksyi eron



12:00 POLIITIKKA



Head line news at Tekniikka&Talous 3.12.2019 Internet version



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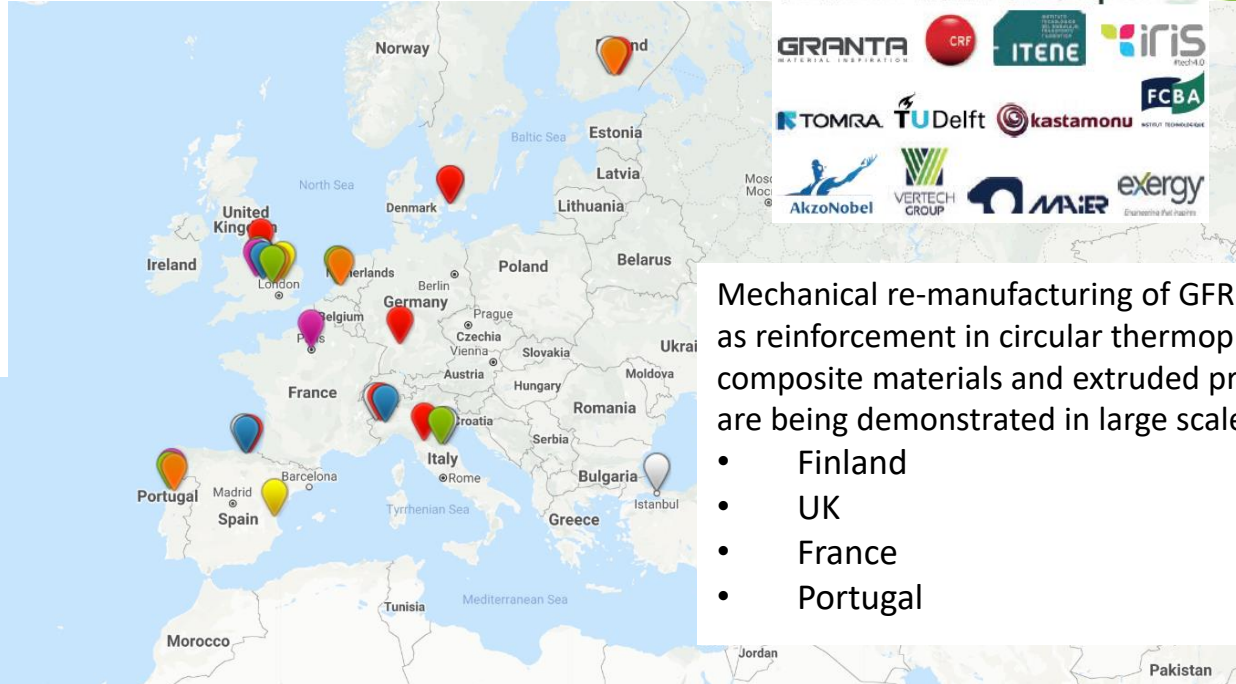
- H2020 ECOBULK-project www.ecobulk.eu
- Recycling of wind turbine blades is A MUST
- Recycling options for GFRP-waste
- Thermoplastic composites reinforced with GFRP-waste;
 - materials & formulations
 - processing
 - test results
- Applications
- what next...

H2020-project ECOBULK

www.ecobulk.eu



- 2017 – 2021
- 28 beneficiaries
- 12,2 M€
- Automotive
- Furniture
- Construction



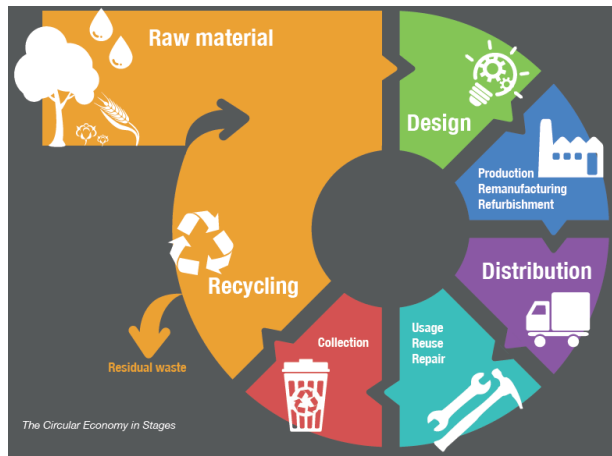
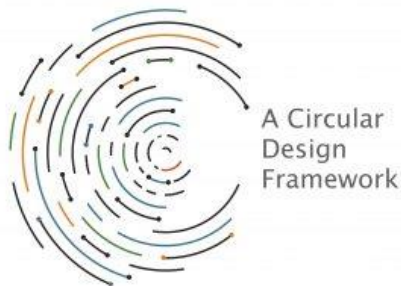
Mechanical re-manufacturing of GFRP-waste as reinforcement in circular thermoplastic composite materials and extruded products are being demonstrated in large scale in ;

- Finland
- UK
- France
- Portugal

H2020-project ECOBULK

- Ecobulk is not a wind turbine blade recycling project...*BUT*

Recycling GFRP-waste – and especially when taken from EoL blades – has become the driver and most innovative part of Ecobulk developing and demonstrating circularity and material efficiency in constructions



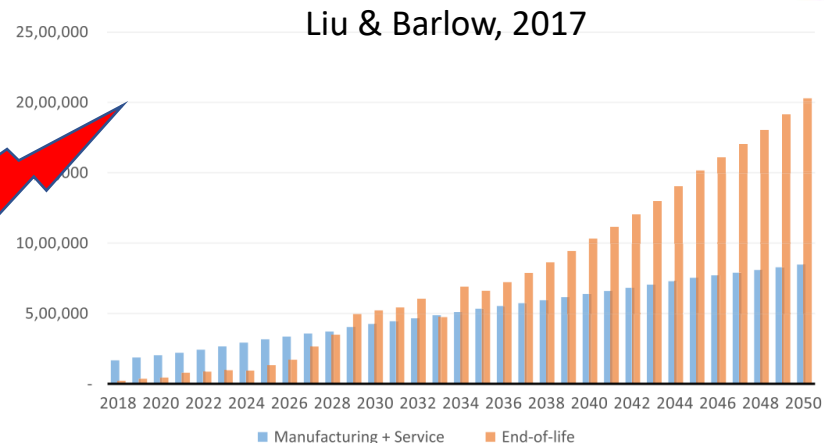
Conflict of strategies

Plastics vs. Renewable Energy

Discrepancy in wind...unless blades become recycled



Zu geringe Recyclingkapazitäten für Rückbau von Windenergieanlagen
UBA-Studie betrachtet Umweltaspekte des Recyclings alter Windenergieanlagen
<https://www.umweltbundesamt.de/presse/pressemitteilungen/zu-geringe-recyclingkapazitaeten-fuer-rueckbau-von>



year 2050 total global waste volume ~43 Mton/a

Manufacturing blades

The annual wind power capacity installed in Europe in 2016 attained 12.5 GW, bringing the use of FRP composites in blades to 150.000 - 186.000 tonnes, a threefold increase when compared to the 2000 figures. (WindEurope 2017)

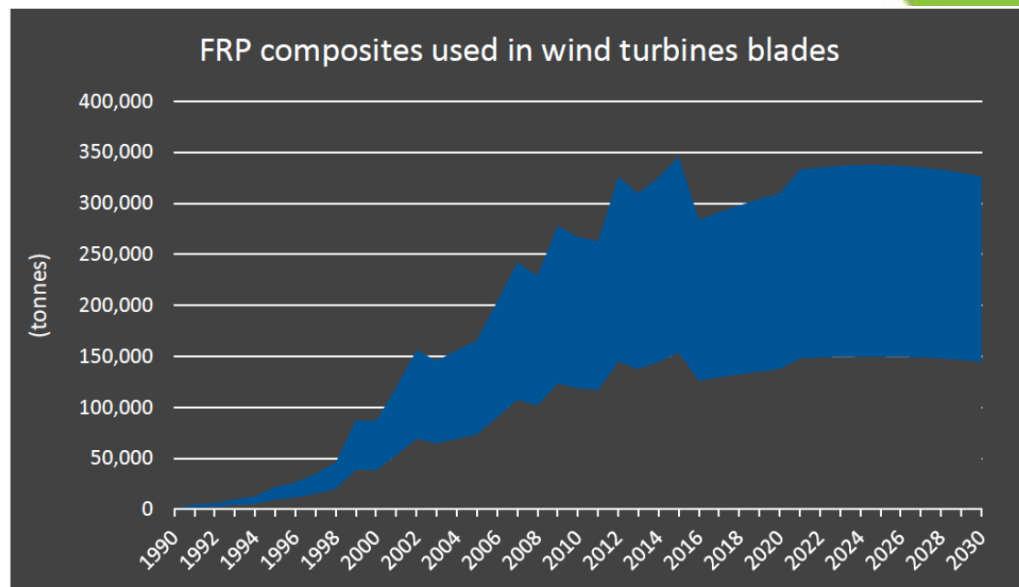


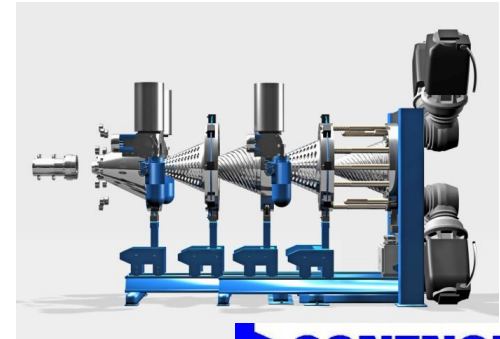
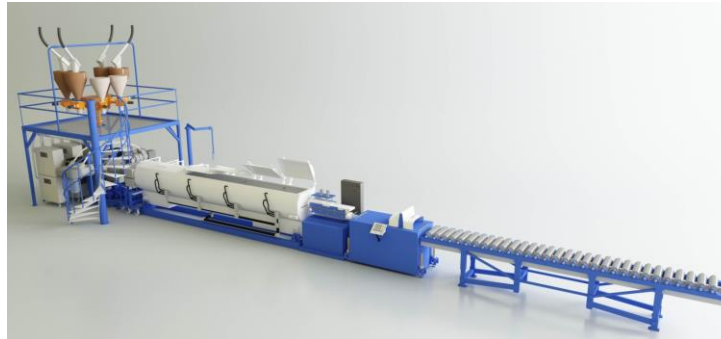
Figure 2. Annual use of FRP composites in wind turbine blades (WindEurope 2015)

Conenor Ltd

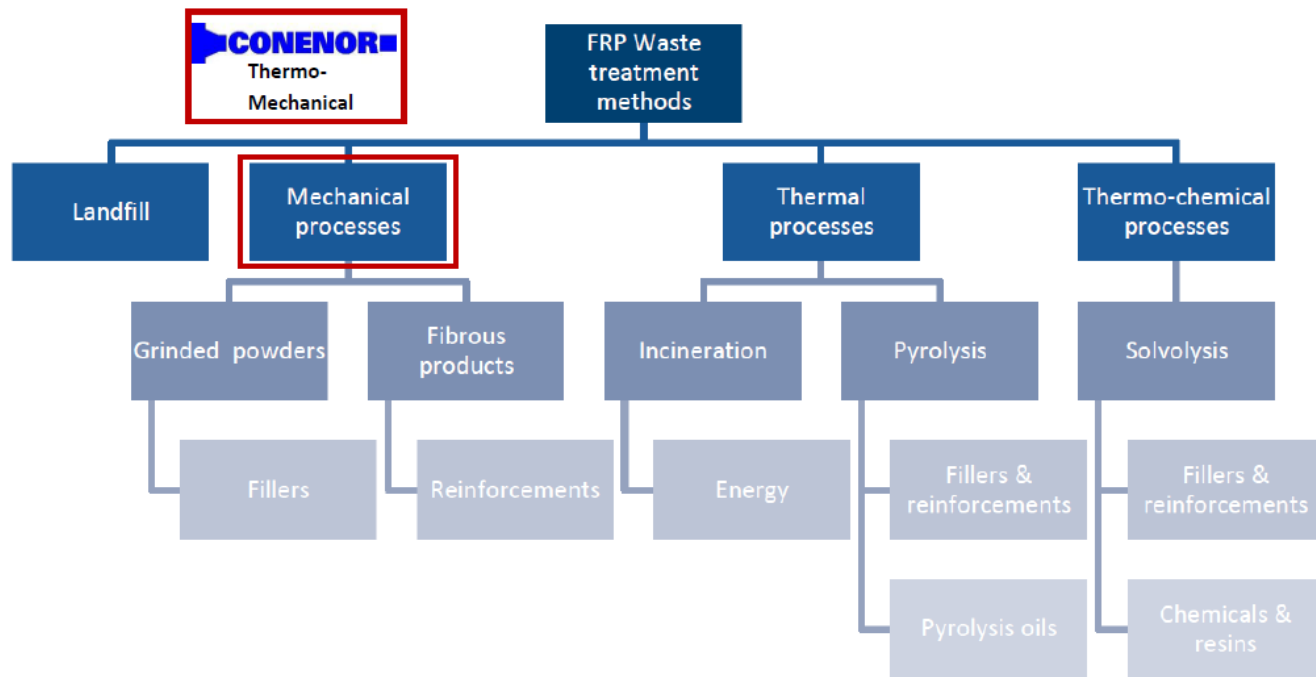
- SME since 1995 developing innovative extrusion solutions
- Providing outsourced R&D services in composites to industrial clients
- Participation recently in 4 EU-funded major R&D-projects
- Not a manufacturer but technology developer & provider
- Inventor of unique conical extruder CONEX[®]
- Inventor of thermo-mechanical process to utilize GFRP-waste as reinforcement in thermoplastic composites (*patents pending*)



IRCOW OSIRYS
HISER ECOBULK



FRP-waste treatment methods



FRP composite waste treatment methods (adapted from Sacchi 2014¹² Composites UK 2016¹³; Skrifvars 2015¹⁴)

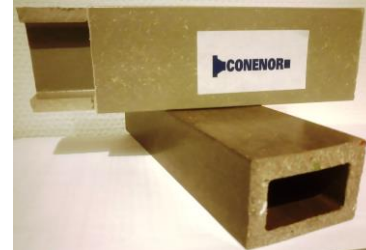
Blade waste downsized



Processing into thermoplastics

Processing in 3 main steps

- 1) Downsizing blades by cutting and shredding including metal separation (by third parties)
 - 2) Production of material formulations by hot mixing ;
 - agglomerates for extrusion
 - granules for injection moulding and other
 - 3) Extrusion or injection moulding or other
- ✓ Both recycled and virgin thermoplastics (PE,PP) can be used
 - ✓ Total recycled and waste material content can be >90%-w.
 - ✓ Circular material - can be recycled again several times
 - ✓ If GFRP-price zero → cost of new raw material ~ 500 EUR/tonne

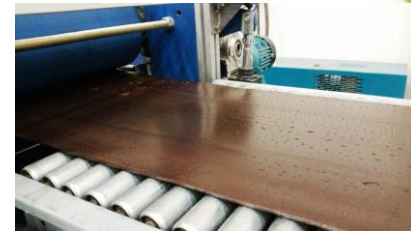


Products with GFRP-waste

- I) Outdoor Furniture
- II) Building & Construction

Conenor composite components available ;

N.o	Name	Dimensions	Layers		Notes
			single	multi	
1	Solid Plank R	120x30mm	x	x	round corners
2	Solid Plank S	120x30mm	x	x	sharp corners
3	Solid Plank F-F	140x30mm	x	x	female-female edges
4	Hollow Board	120x28mm	x	x	
5	Hollow Board F-F	140x28mm	x	x	female-female edges
6	Solid Panel 5	390x5mm	x		straighth edges
7	Solid Panel 10	390x10mm	x		straighth edges
8	Solid Panel 10B	390x10mm	x		bevelled shi lap edges
9	Hollow Pillar 5	125x125mm	x	x	5mm wall
10	Hollow Pillar 10	125x125mm	x	x	10mm wall
11	Hollow Pillar 15	125x125mm	x	x	15mm wall
+	Feature "Fire Retardancy"		x	x	EN Class B



Product Prototypes

Extruded Composites containing FRP-waste

Outdoor Furniture & Construction



Product test samples sent to CNR-Italy



Components:

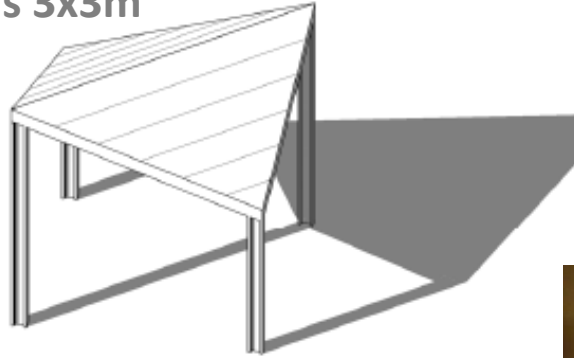
- ✓ solid multilayer planks 120x30mm with Re-Ma core containing FRP-waste (from WTB-EoL and Exel Composites' manufacturing), weight 3,9kg/m
- ✓ panels 390x10mm from Re-Ma (FRP-waste from WTB-EoL and Exel Composites' manufacturing), weight 4,5kg/m
- ✓ panels 390x10mm (FRP-waste from WTB-EoL and Exel Composites' manufacturing)
- ✓ hollow pillars 125x125mm with 10mm wall both in recycled HDPE→PEXr and PP and 15mm in PP

Demos KymiRing - Finland

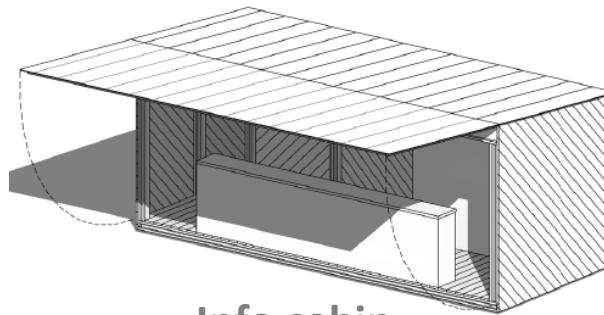
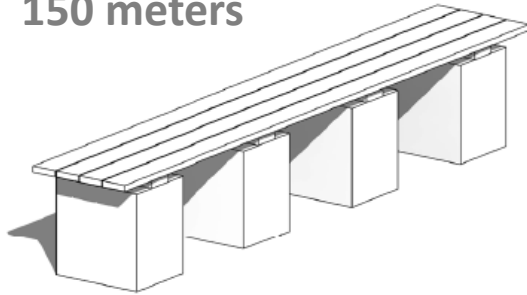


ECOBULK

Visitor shelters 3x3m
20 units



Visitor benches 3x0,5m
150 meters



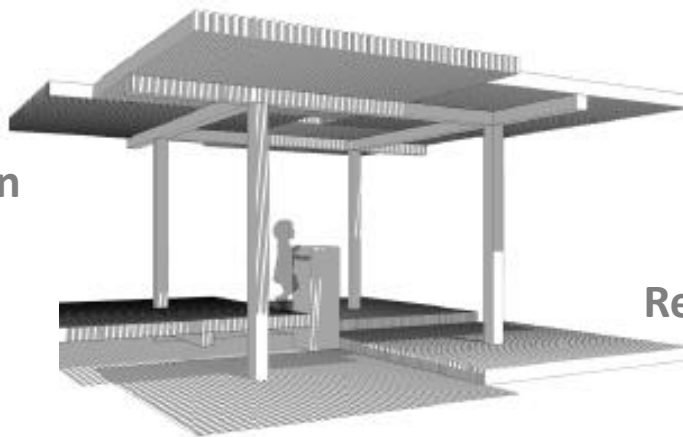
Cabin, axonometry

Info cabin

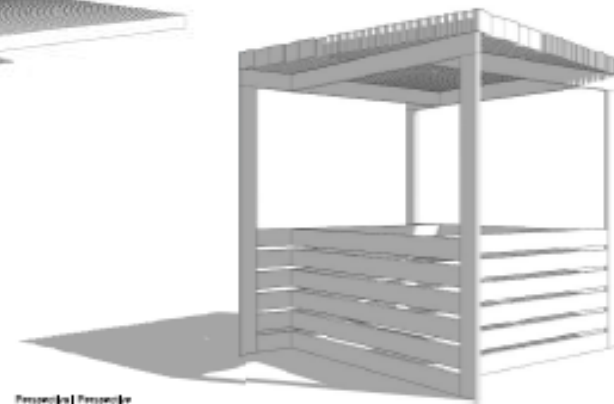


Demos Lipor - Portugal

Drinking fountain



Recycling bin shelter



Rest area with shadow
around a tree

Demos UK (3 Universities)



- Warwick
- Cranfield
- Coventry

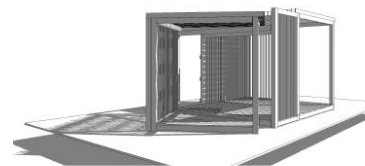



8 B-B'
1:25



11 Architecture 3D

12 Architecture 3D-2

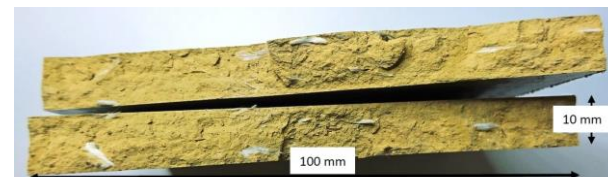


	
Designed By: Daniela Cadena	Date: 12/08/2019
Project: ECOBULK	Observatore:
Use: OUTDOOR SHELTER	Location: WARWICK UNIVERSITY

Materials in panel tests

COMPOSITE PANEL SAMPLE MATERIAL FORMULATIONS (%-w.)

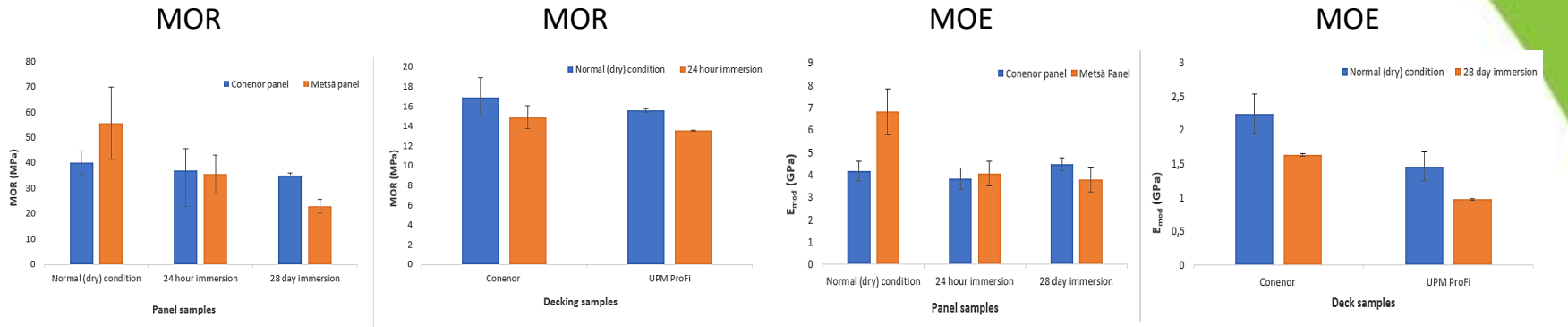
<u>MATERIAL</u>	<u>SERIE 1</u> <u>PE</u>		<u>SERIE 2</u> <u>½-rema</u>	<u>rPP</u>	<u>rPP+</u>
EoL –WTB	30		30 + 2,5 rGF	35	40
POLYMER	30 virg. biobased		30 rec.	50 rec. (incl. talc)	36 rec.+ 10 virg.
COUPLING AGENT	2,5		3	3	2,5
COMPATIBILIZER	2		<u>no</u>	<u>no</u>	<u>no</u>
WOOD WASTE	31		30	5	4,4
PROCESSING AID + PIGMENTS	4,5		4,5	4 + 3	4 + 3,1



Comparing products

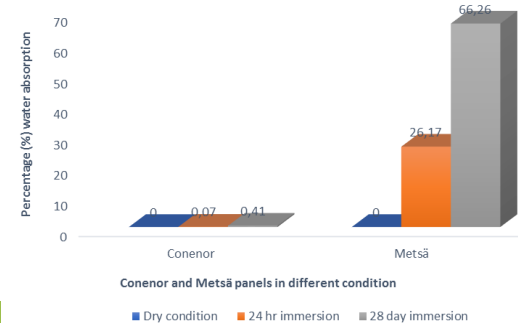
Master thesis y Mr. Ramji Pandey at University of Eastern Finland (UEF)

Panels; **Serie 1 samples**



Main outcome:

- ✓ Ecobulk hollow boards (140x28mm) with FRP-waste **are** stronger and stiffer vs. quality commercial WPC decking boards in dry as well as wet conditions
- ✓ Ecobulk composite panels 390x10mm with FRP-waste **become** stronger and stiffer vs. quality commercial plywood panels when getting into contact with water (EN-test method)

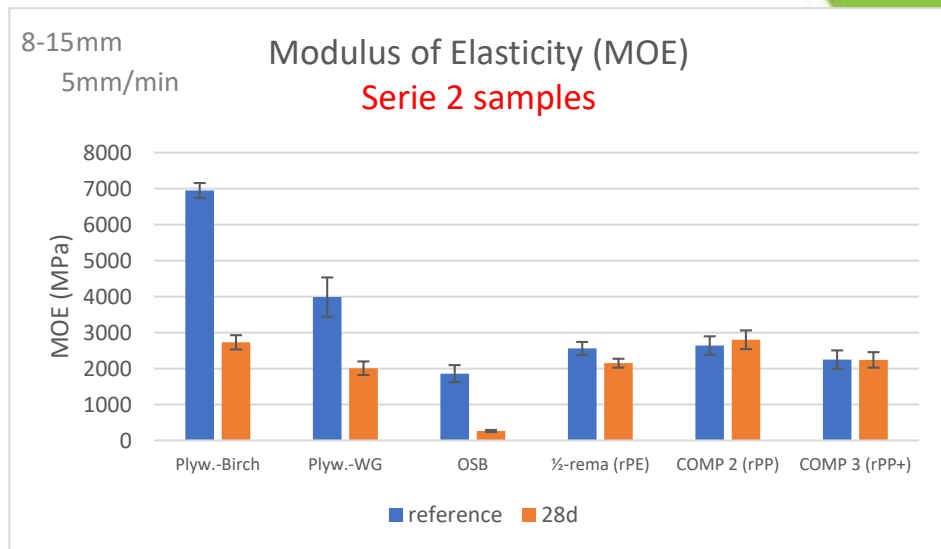
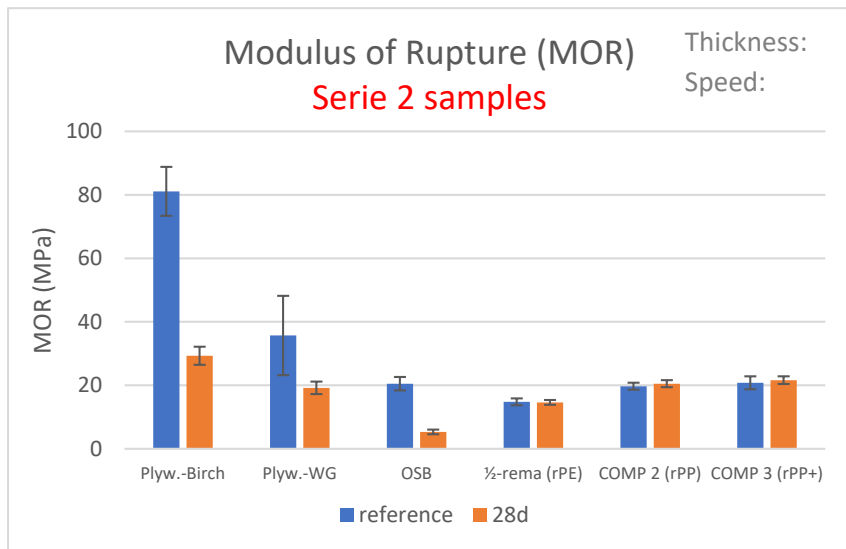


Panel flexural testing ISO 178

By test lab Muovipoli Oy, Finland

Span: 128mm

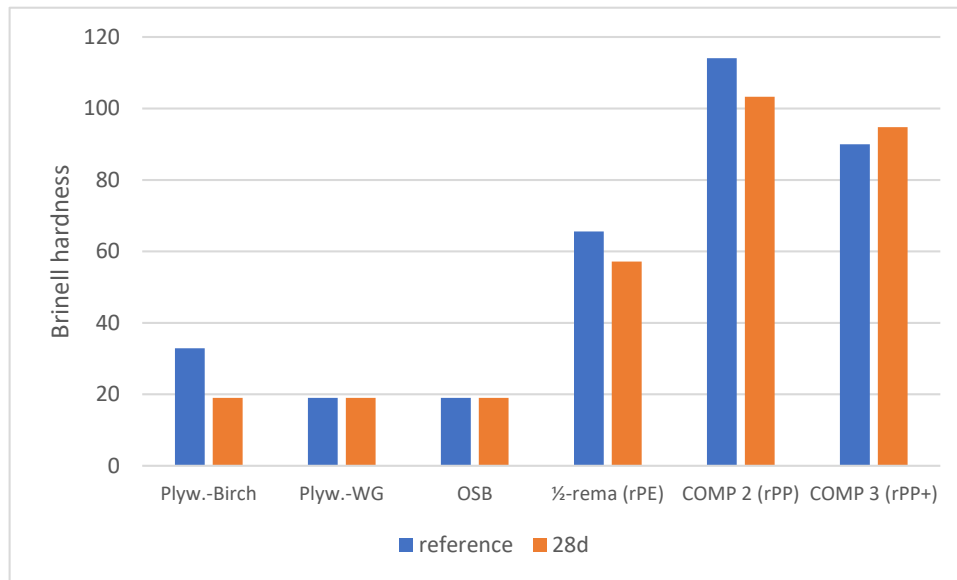
Width: 100mm



Brinell hardness

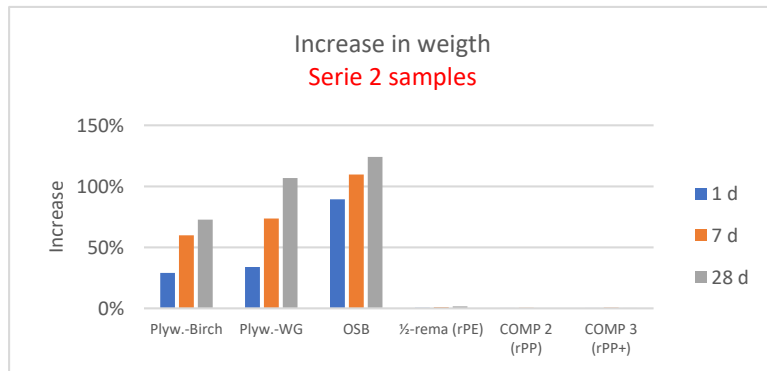
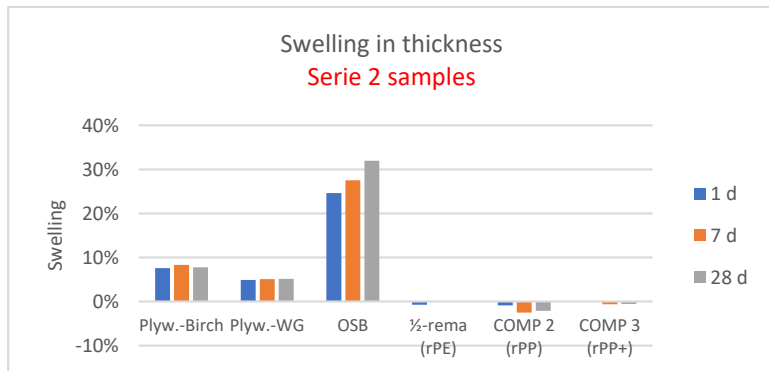
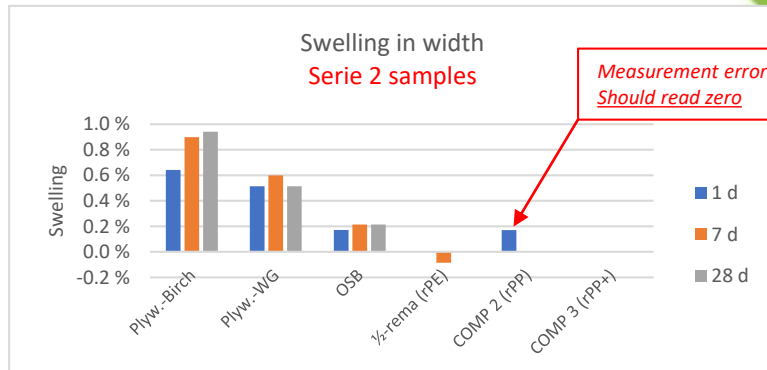
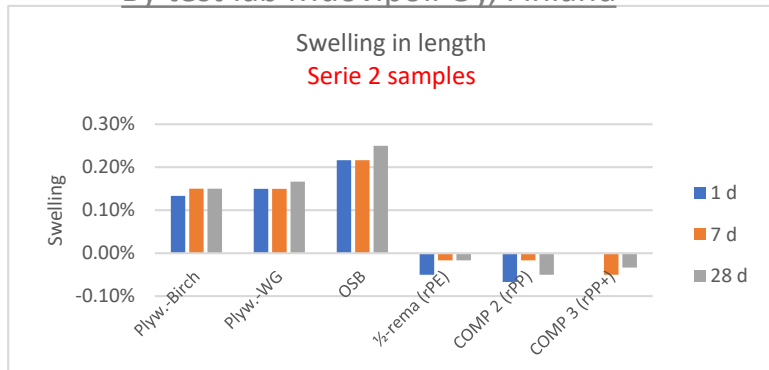
By test lab Muovipoli Oy, Finland

Serie 2 samples



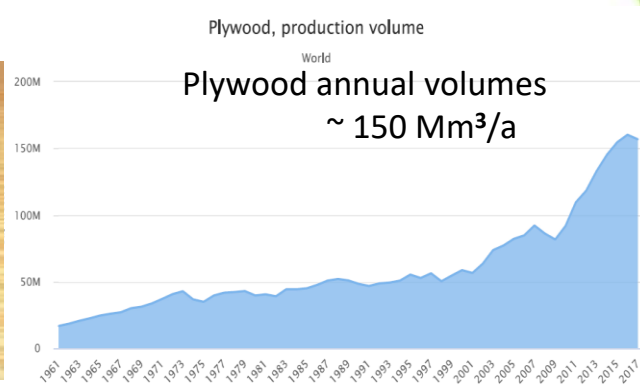
Swelling and water absorption

By test lab Muovipoli Oy, Finland



Panels in moist conditions

- Wooden panels absorb moisture which causes loss of mechanical properties, swelling and change of dimensions, promote growth of microbes and together with release of formaldehyde result poor air quality in buildings – and are not fire retardant.
 - Recycled composite panels do not absorb moisture and retain original properties, do not promote growth of microbes and are formaldehyde free and fire retardant !
- **Composite panels outperform wooden panels, both plywood and OSB, in moist conditions and offer a very lucrative product application worldwide where to utilize GFRP-waste**



Source: FAOSTAT

Composite railway crossties

called also "sleepers"; see presentation http://www.conenor.com/s/Conenor_Composite-Railway-Crossties-j4ej.pptx

Ideal volume application for GFRP-waste in recycled composites

- The most common composite sleeper material, Type-1 sleepers, made of consumer plastics without reinforcements offer a range of benefits including ease of drill and cut, good durability, consumption of waste materials, reasonable price, and tough.
 - However, it suffers from low strength and stiffness, limited design flexibility, temperature and creep sensitivity, and low resistance to fire.
- **Type-1 sleepers can be made much stronger and stiffer by extrusion method while adding GFRP-waste as reinforcement in consumer plastics**

Indian Railways to use 'green' composite sleepers

"Aiming to become more eco-friendly, Indian Railways has decided replace wooden sleepers with composite sleepers that are not only lighter but also stronger."

see news from 2018 ;

<https://www.zeebiz.com/india/news-indian-railways-to-use-green-composite-sleepers-67086>



What next ...if anything

- Conenor has developed and proven a new proprietary thermo-mechanical process technique to utilize GFRP-waste as reinforcement in thermoplastic composites
- Ecobulk-project will demonstrate and assess in large scale applications how to construct e.g. shelters, benches and cabins from extruded composites from the new circular raw materials and present business models for the market
- So *what...* world will not change unless **You take the lead and make it happen !**
- The **KEY is investments** in ;
 - Downsizing facilities locally nearby the wind farms
 - Facilities in producing new circular raw materials utilizing GFRP-waste
 - Facilities in producing new circular products utilizing GFRP-waste (extrusion, inj.m., etc.)
- Supporting activities required in marketing and sales promotion, R&D new products and applications with construction companies to establish succesful value chains
- Product standardization and approvals

Thank You !

Any questions?

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www.conenor.com

