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Intrinsically Reprocessable, Repairable and Recyclable (3R) thermoset composites for more Competitive and Sustainable Industries

CUBIC
NOVEL BIOBASED MATERIALS TO IMPROVE CIRCULARITY

TRAINING SESSION

Lecture 4:
Revalorization routes of 3R-CAN composites materials

Circular Bio-based Europe Joint Undertaking

Bio-based Industries Consortium

Funded by the European Union

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The materials of the future today

New generation of advanced 3R Composites

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3R Composites

A new generation of **Reprocessable, Repairable and Recyclable high-performance fibre-reinforced thermoset composites.**

They can be manufactured following traditional methods but the resulting material can be reprocessed, repaired and recycled.

Composites:

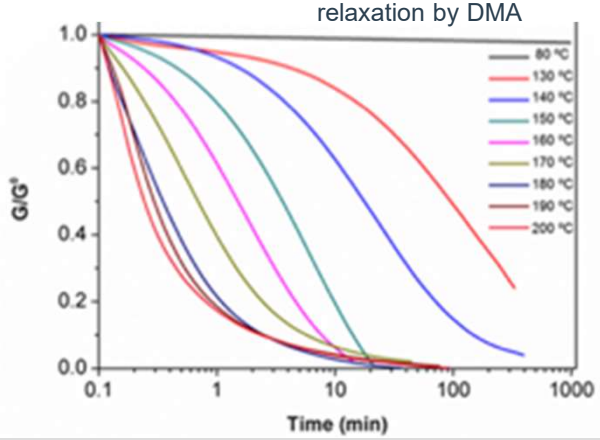
> **3R resin**

Reprocessing,

Repairing,

Recycling

Characterization of the stress relaxation by DMA



Conventional epoxy resin

200 ºC → 100 bar

3R epoxy resin

200 ºC → 100 bar

- At temperatures above Tg, **the dynamic epoxy network** is able to completely relax stress and flow.
- The obtained relaxation times ranged **from 3 hours at 130 ºC to 20 seconds at 200 ºC.**

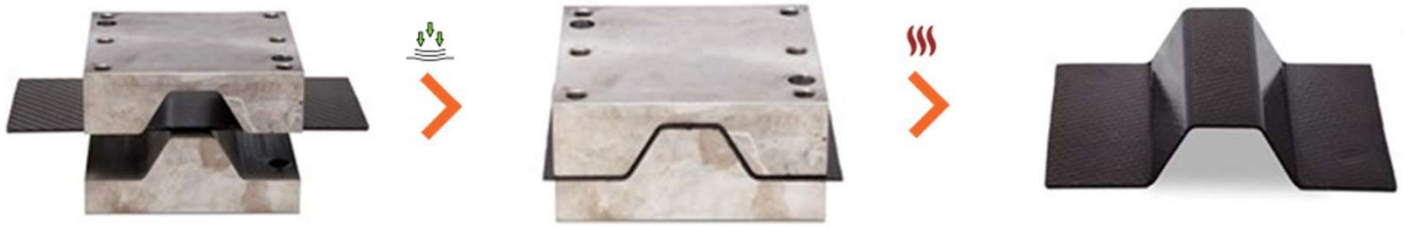
> 3R Composites:

Reprocessing,

Repairing,

Recycling

3R composite laminates can be heated 80ºC above the Tg and re-shaped in a few minutes applying pressure, which allows the thermoforming of cured 3R laminates to obtain 3D geometries, in a similar way to thermoplastic composites.



35%

reducing the manufacturing costs.

This technology enables the development of high production rate manufacturing processes for thermoset composites **reducing the manufacturing costs of thermoset CC parts by over 35% vs autoclave manufacturing.**

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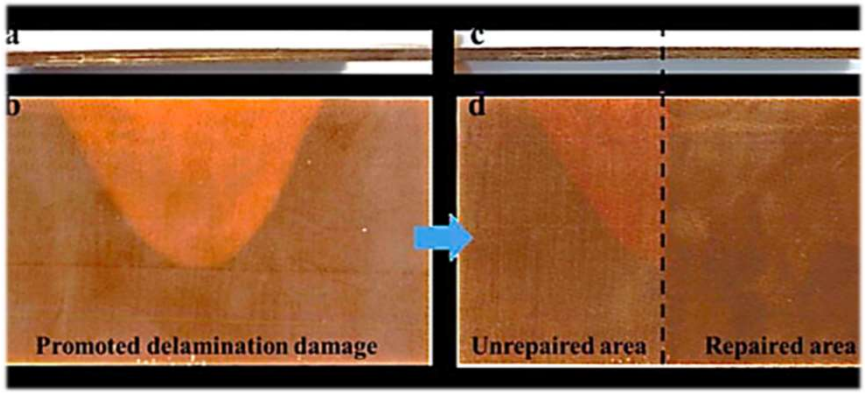
> 3R Composites:

Reprocessing,

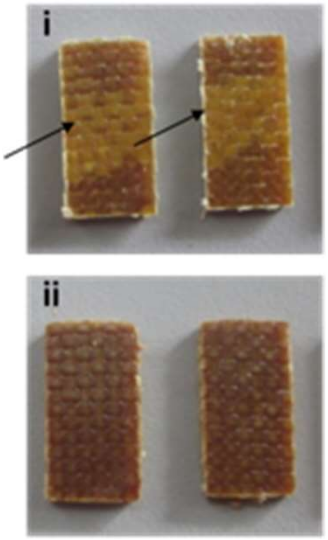
Repairing,

Recycling



Repair of damages based on resin/fibre delaminations and resin micro-cracks by applying heat and pressure to the damaged part.

ILSS: 37,2 ± 2,81 MPa



ILSS: 38,0 ± 2,4 MPa

50%

reducing the current costs of MRO.

This technology enables **to reduce the current costs of MRO associated to the reparation or replacement of thermoset CC parts by 50%** (nowadays damaged parts are often rejected due to the high costs and repair times of the traditional patch techniques).

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> 3R Composites:

Reprocessing,

Repairing,

Recycling

Mechanical recycling: the cured 3R composite can be ground into flakes or pellets which can then be reprocessed by heating 80ºC above the Tg and pressing, obtaining a new short fibre reinforced 3R composite.

This technology enables the valorisation of the scraps generated during the manufacturing of thermoset CC **offering 3 different environmental and industrial advantages**:

REDUCTION OF LANDFILL WASTE.

REDUCTION OF THE COSTS OF WASTE MANAGEMENT OF SCRAPS.

MANUFACTURING OF COST **COMPETITIVE AND SUSTAINABLE** NEW THERMOSET CC PARTS BASED ON VALORISED SCRAPS.

> 3R Composites:

Reprocessing,

Repairing,

Recycling

Chemical recycling: the 3R matrix exhibit the same good chemical resistance to conventional solvents and acid or basic media, but it can be completely disrupted by the addition of a specific chemical agent without affecting the reinforcement.

This technology enables the recycling and reuse of the carbon fibre reinforcement **offering environmental and industrial advantages**:

REDUCTION OF LANDFILL WASTE.

MANUFACTURING OF COST **COMPETITIVE AND SUSTAINABLE** NEW THERMOSET CC PARTS BASED ON VALORISED SCRAPS.

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a greater future today