ALPHARECYCLAGE COMPOSITES

CUSTOMISIZE

Workshop 08/10/2019| Recycling of carbon fibres by steam water thermolysis

Serge Da Silva – R&D Director
s.dasilva@alpharecyclage.com

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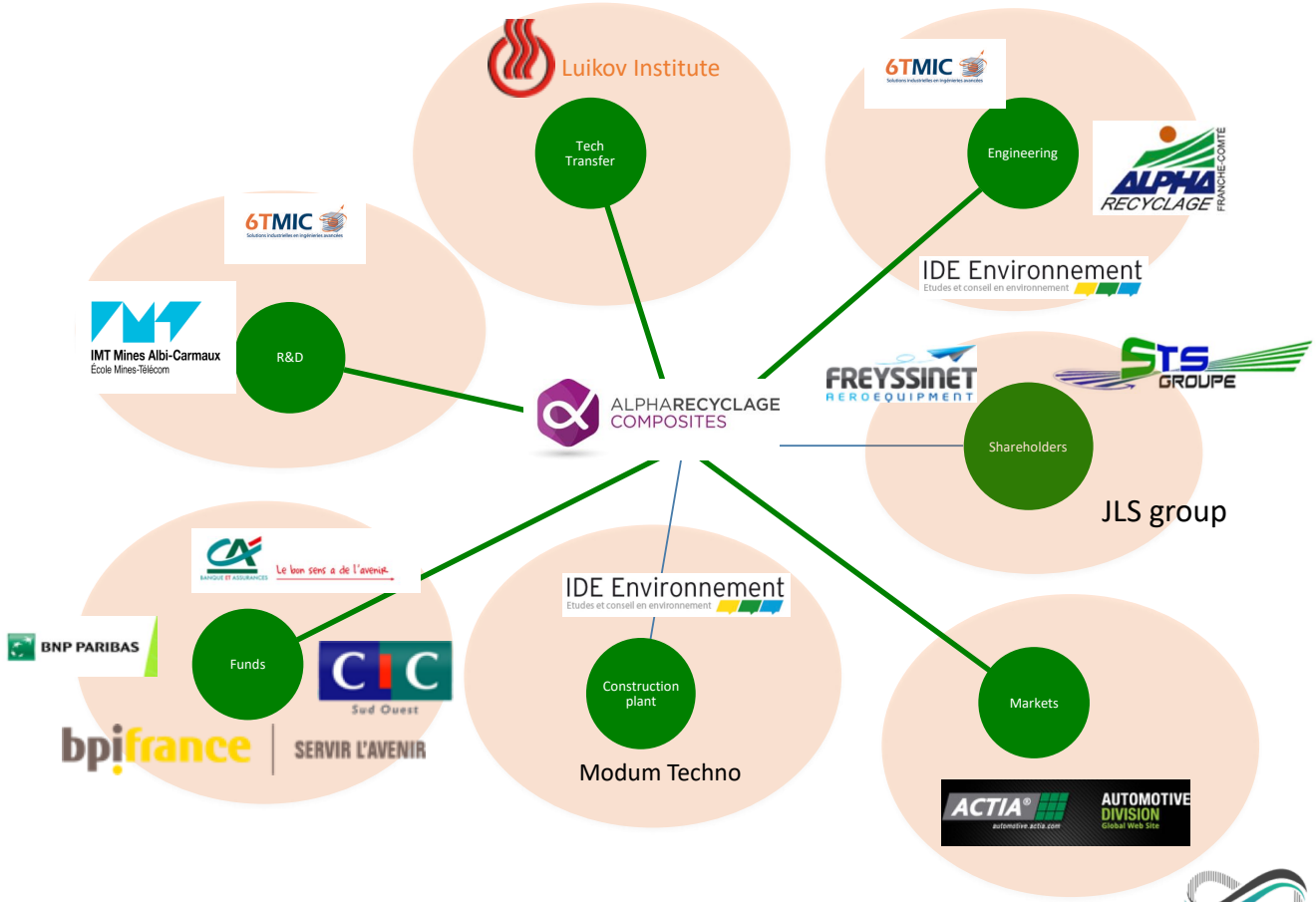
1. Company presentation

A SME in an industrial environment



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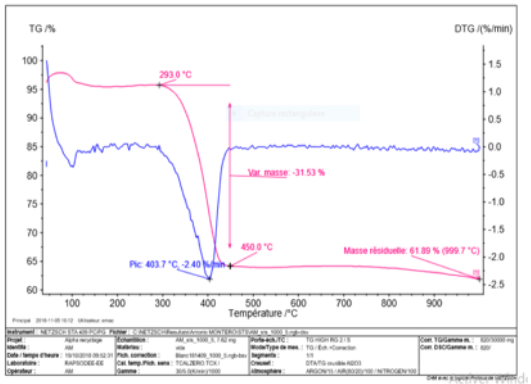
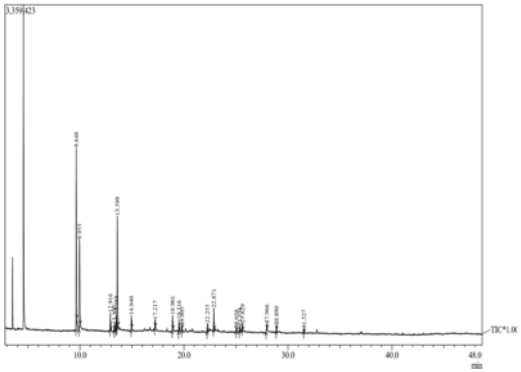
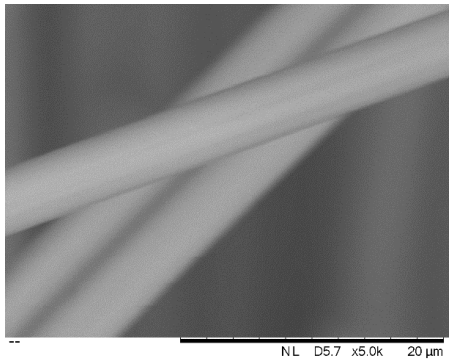
A joint lab with R&D centres

IMT Mines Albi-Carmaux
École Mines-Télécom

RAPSODEE cnrs







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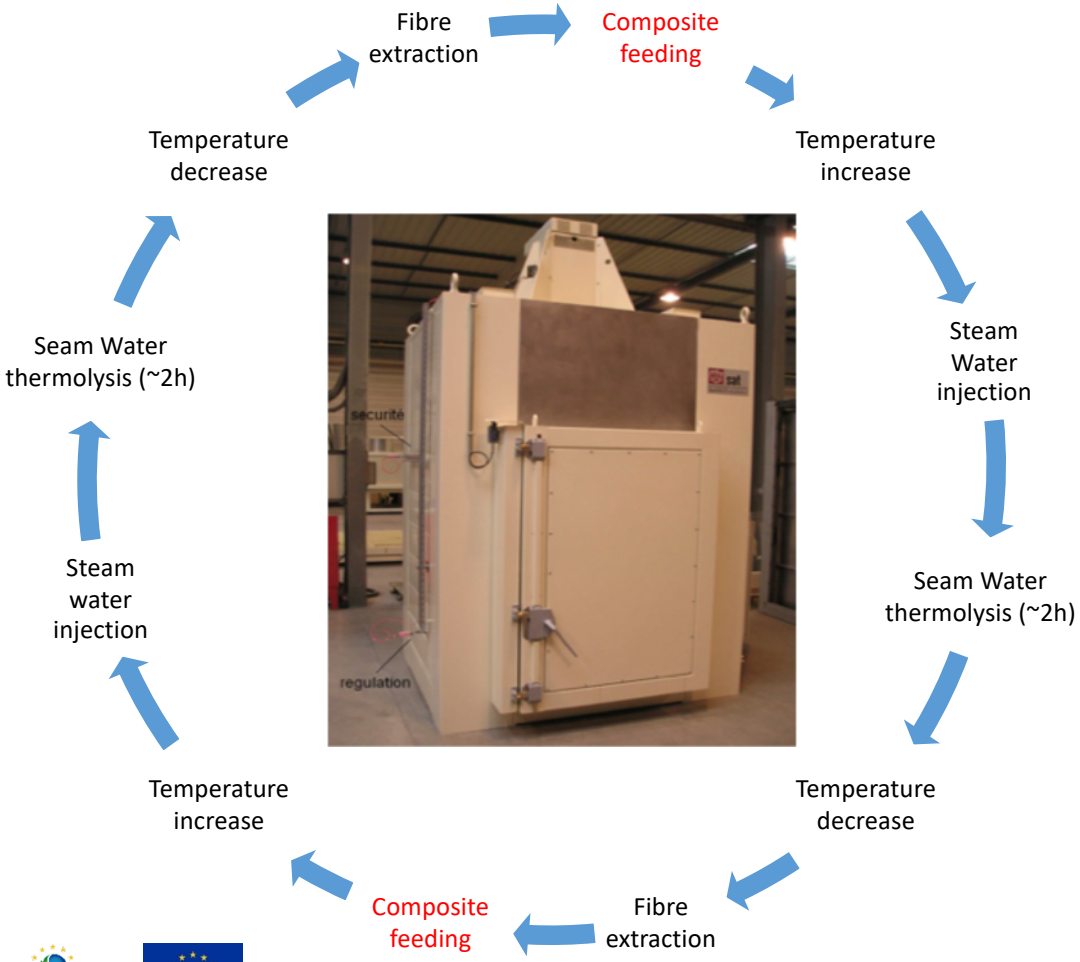
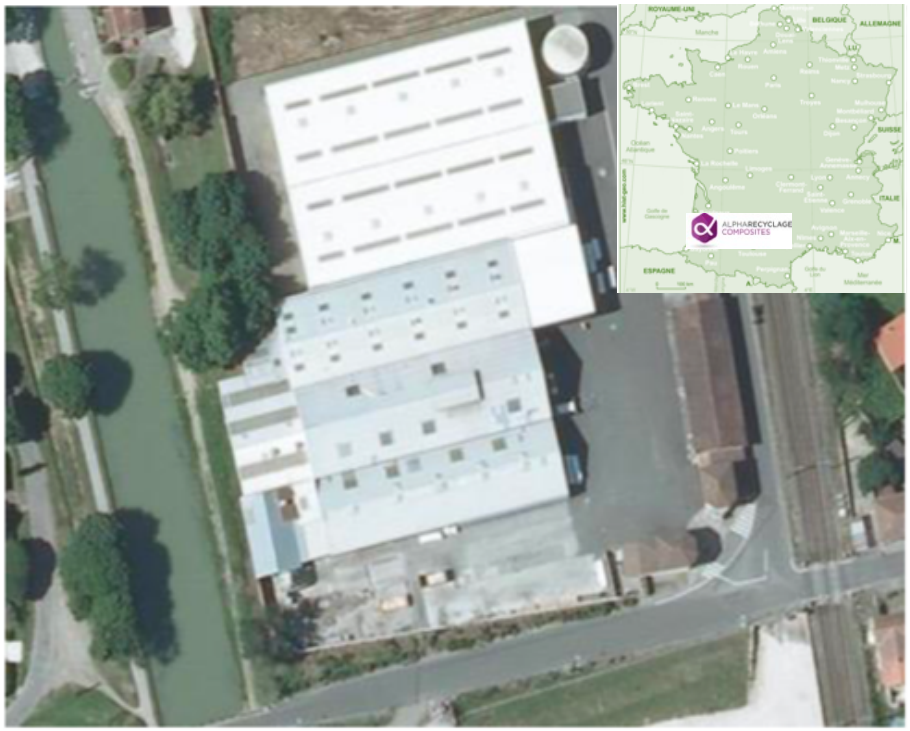
A 2 tons per day reactor available….





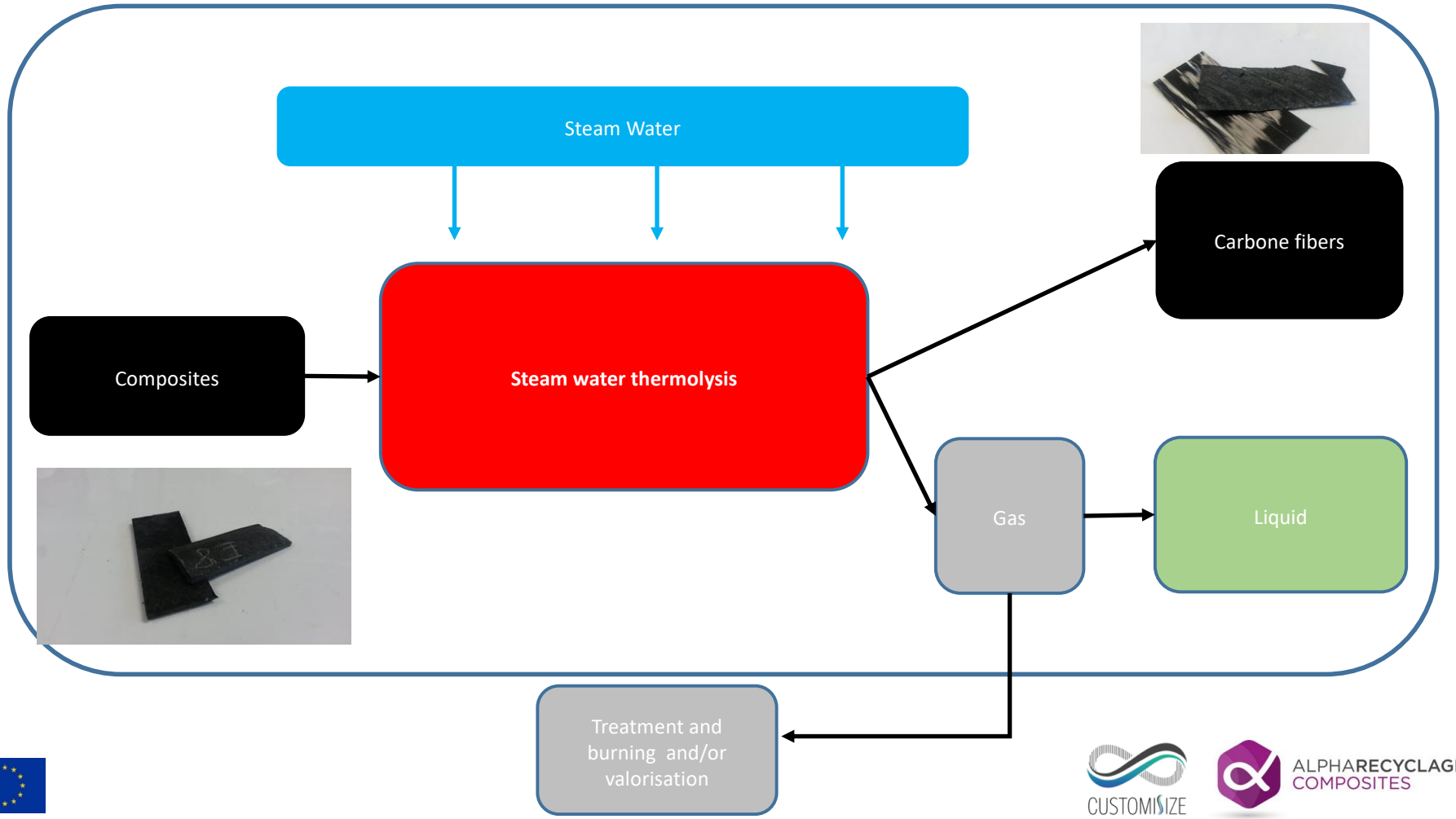
Implantation site of Steam Water Thermolysis unit for Composite in Castelsarrasin (France)

… now and in operation at the end of 2019

Confidential pictures

2. Technology presentation

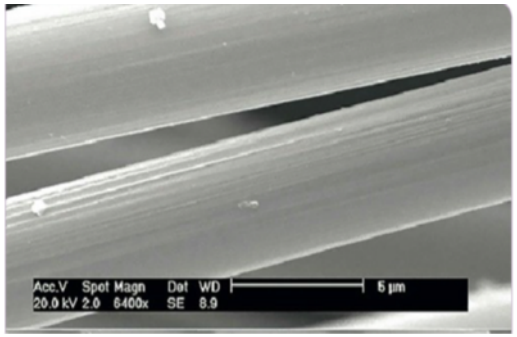
The steam water thermolysis principle



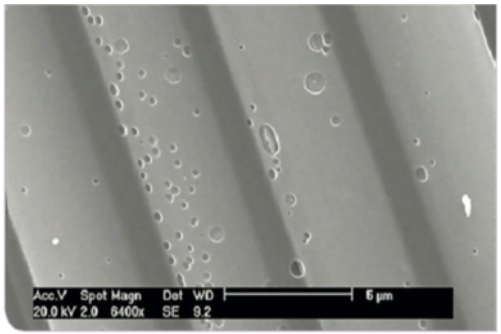
Steam water thermolysis advantages

PA6 reinforced by carbon fibres*

Same parameters



Steam water thermolysis



Pyrolysis

Activation energy of PA6* degradation (kJ/mole)

	Steam water thermolysis	Pyrolysis
Kissinger	175 ± 5,0	232 ±11,0
IKP	178 ± 1,5	186 ± 4,0

**** A.O. Nunes – PhD thesis – November 2015***

Steam water thrmolysis vs. pyrolysis

- Safer process
- Higher thermal transfer
- Catalysis by water

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3. Some technical cases

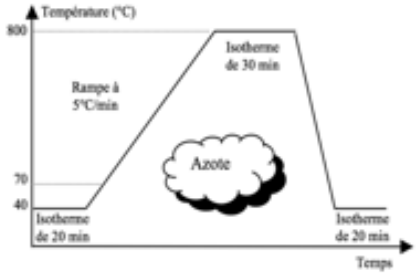
Waste qualification - Methodology

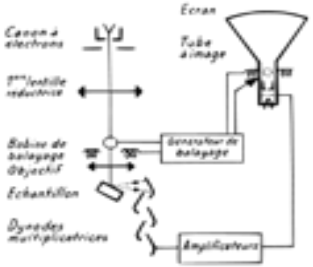
TGA-DSC

Optimal parameters in Lab-scale conditions

- Fibre surface state =**MEB**
- Resin degradation ration = **Chemical attack & mass balance**
- Gas and liquid characterisation = **GC & GC-MS**

Thermal characterisation → Steam Water Thermolysis → Product characterisation





Lab scale **characterisation**

Industrialisation

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Example of wastes

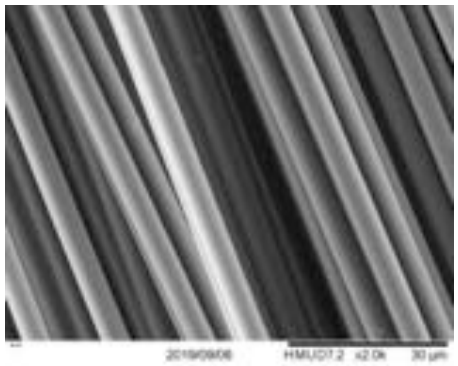
Example of material

Up to 92,3 % (w/w) of resin elimination

- **From an aeronautic**
- M21 prepreg
- 2 mm thick

Steam Water Thermolysis :
400 – 600 °C

Fibres



Gases

In progress

Liquids

In progress

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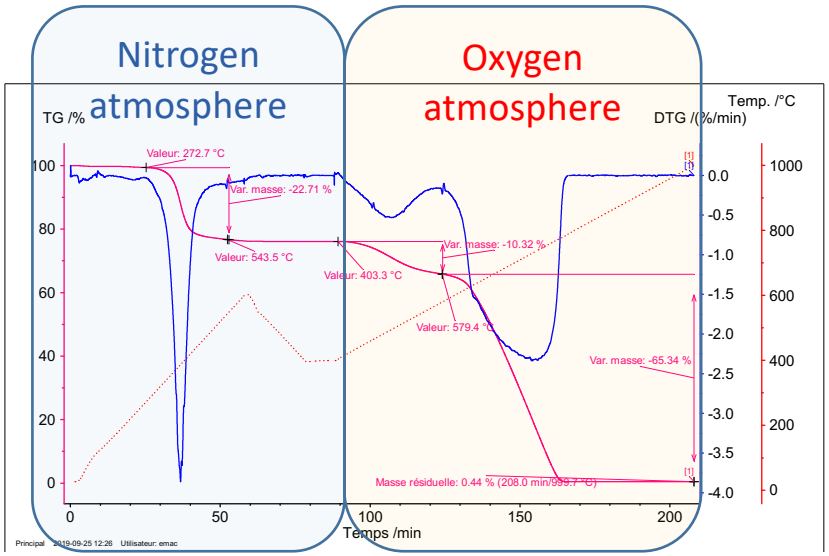
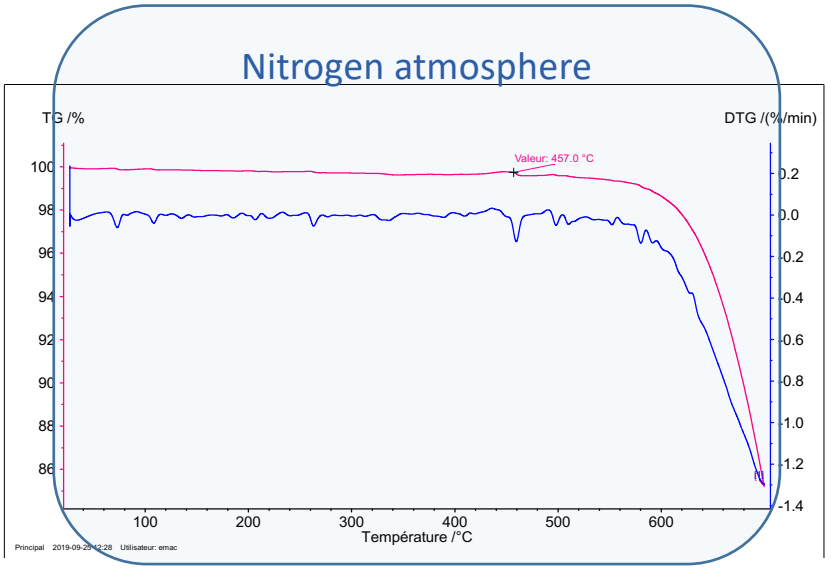
Example of material

- **From an aeronautic company**
- M21 prepreg
- 2 mm thick

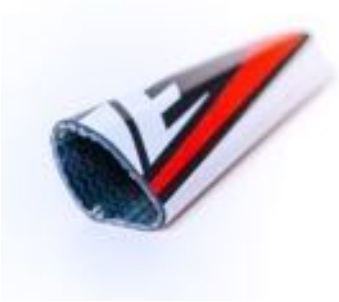


TGA of prepreg <u>before</u> the Steam Water Thermolysis



TGA of fibres <u>after</u> the Steam Water Thermolysis

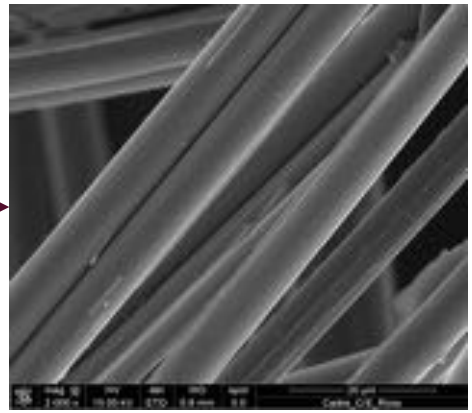
Example of material

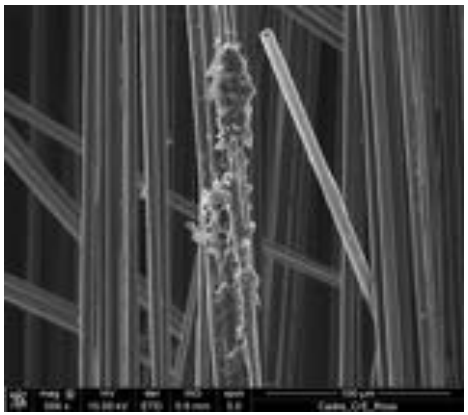


- **Rossignol (Look)**
- Epoxy resin
- 3 mm Thick

96,8 % (w/w) of resin elimination

Fibres





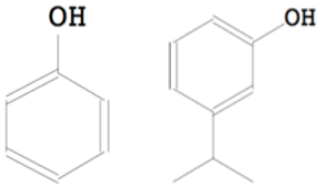
MEB pictures x 2000 et x 500

Steam Water Thermolysis :
400 – 600 °C

Gases

CO_2, CO, H_2, C1-C4

Liquids



Phenolic molecules (85%vol)

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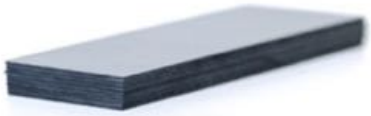
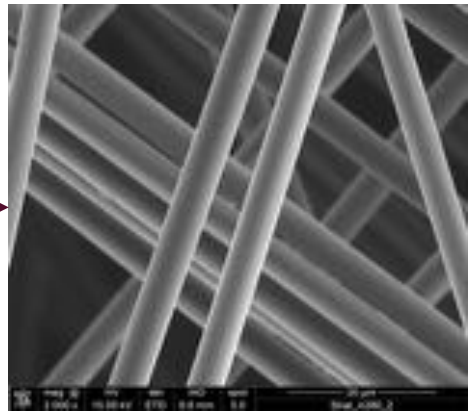
Example of material

99,7 % (w/w) of resin elimination



- **Omega Systèmes**
- Epoxy resin
- 8 mm thick

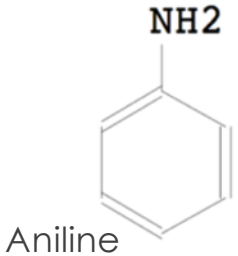
Fibres



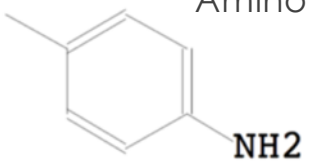
Steam Water Thermolysis :
400 – 600 °C

Gases

CO_2, CO, H_2, C1-C4



Aniline



Aminotoluene

Liquids

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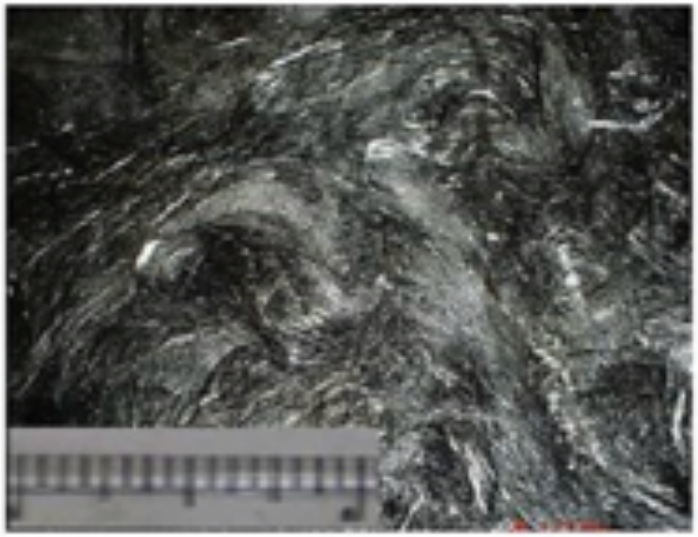
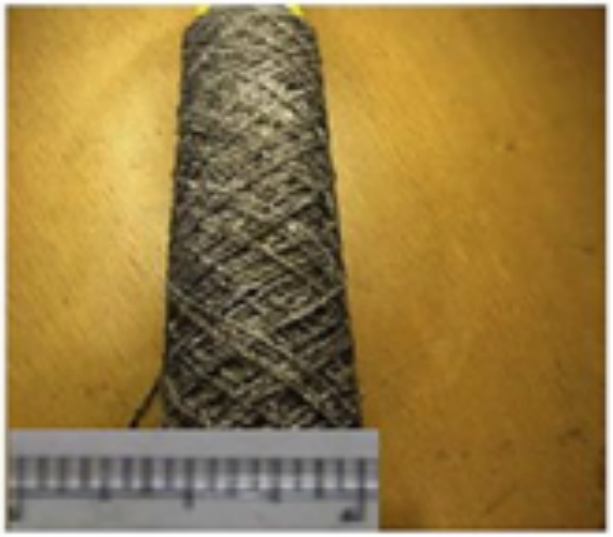
4. Some applications





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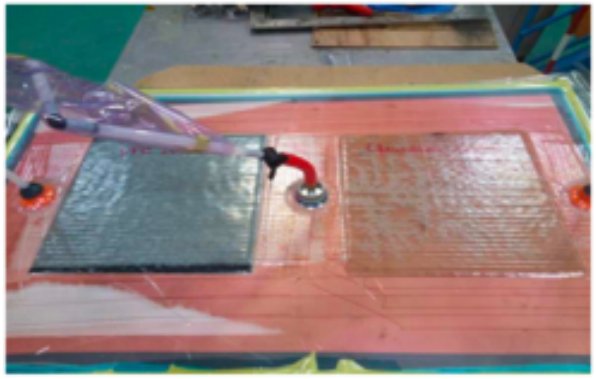
Mechanical properties of non-woven and stitched non-woven rCF composites compared to glass fibre 4 axes



Epoxy resin

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Results

To be continued ….

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Thanks for your attention

Merci pour votre attention

Gracias por su atención