LIFE REFIBRE

High value asphalt pavements with glass fibre from sustainable recycling of wind powered generator blades

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LIFE16 ENV/ES/000192

What is GFRP?

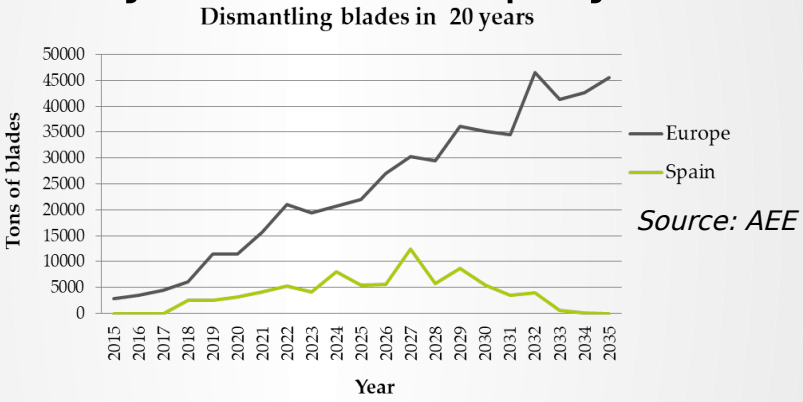
- **GFRP = Glass fibre reinforced plastic** is a composite material, formed by a resin matrix reinforced with glass fibres.
- It is very used in several fields due to its lightweight, resistance and great rigidity. For example, in aeronautics (airplane wings), in construction (as an enclosure or facades in buildings), in the nautical industry (boat's hull), automotive sector (parts and car body), health (manufacture of prosthesis), sports (canoes, rackets), etc.
- LIFE REFIBRE project proposes working with a waste that contains high amounts of GFRP and which is very pro **wind turbines out**

64% GFRP
35% wood
1% other

How comes up?

- Currently, in Spain, there are 20,306 wind turbines installed in 1,123 wind farms, amount that increases every year.
- The amount of blades produced by the decommissioning of wind farms with 20 years of antiquity, will be increasing with time.

There will be a growing of blades waste need to be properly managed



Source: AEE

Year 2035
500,000 t blades
324,000 t GFRP

- Currently, these blades go to landfill are an inert compound occupy a high volume generating problems of space.
- The glass fibres are not biodegradable from 100 to 4.000 years to decompose.
- LIFE REFIBRE is proposed to solve the environmental problem that supposes the accumulation of a high amount

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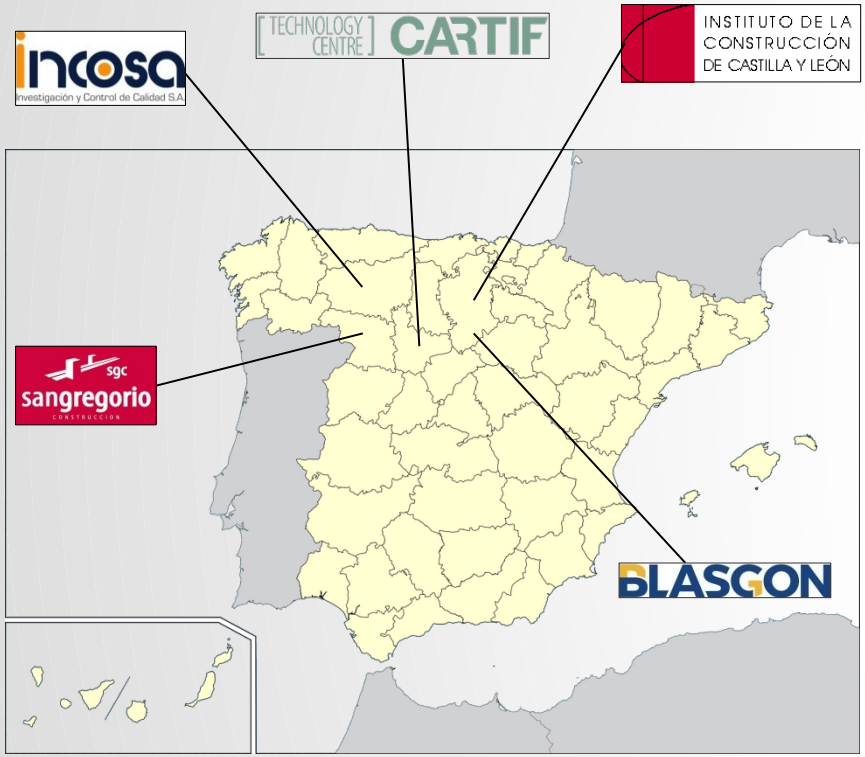


DATES

Start: 01/10/2017

End: 30/09/2020

Duration: 36 months

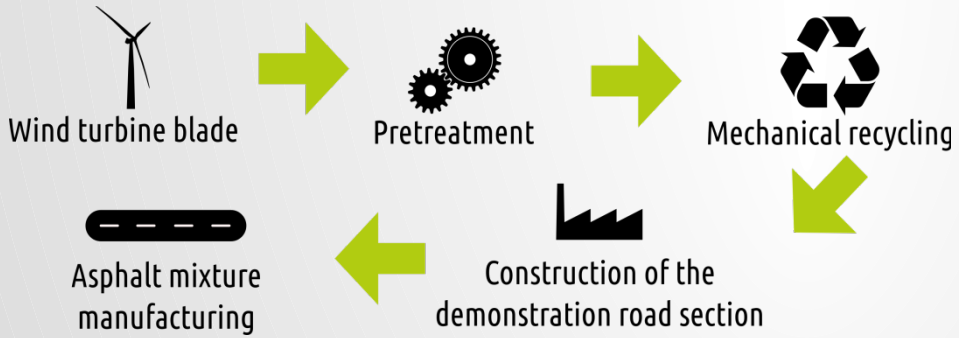
NUMBERS

Budget: 1,789,539 €

European Contribution: 60%

OBJECTIVES

- ✓ Collection and pre-treatment of blades waste.
- ✓ Design and construction of an **innovative prototype plant** for the **mechanical recycling** of blades waste.
- ✓ **Recovery the glass fibres** of these blades.
- ✓ **Introduction of glass fibres in asphalt mixtures** for the **construction of 1.500 meters of road section pavement** with different percentages of glass fibres study its behaviour for a year.
- ✓ **Improvement the mechanical properties** of the road.



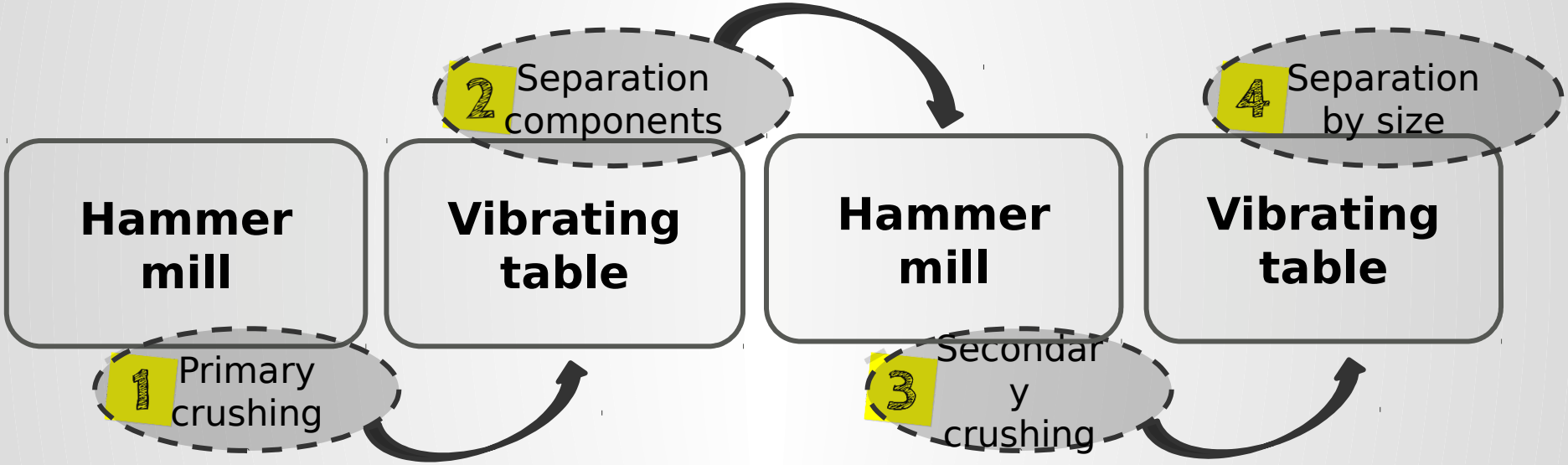
Close the life cycle of wind turbine blades waste, giving them an added value by using the recovered glass

Collection and pretreatment

- **12 wind turbine blades** out of use have been collected from Spanish wind farms **52 tons waste**.
- **Pre-treatment** of these blades Consist of a cutting of the blades in the wind farm to reduce the volume facilitate the transport.

Mechanical Recycling

The mechanical recycling process has been design in four stages:



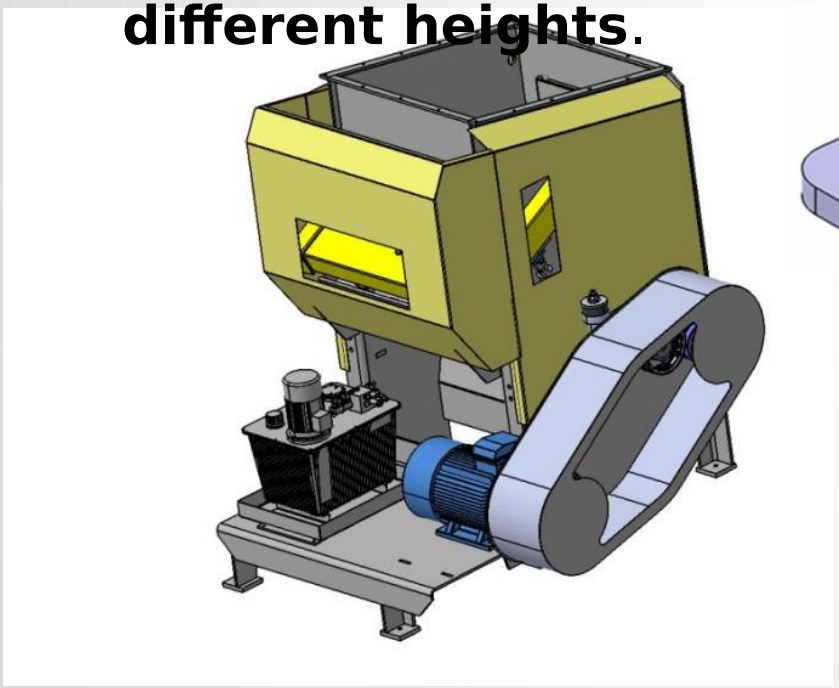
Mechanical Recycling

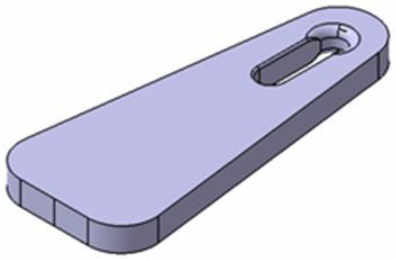
Pre-treatment

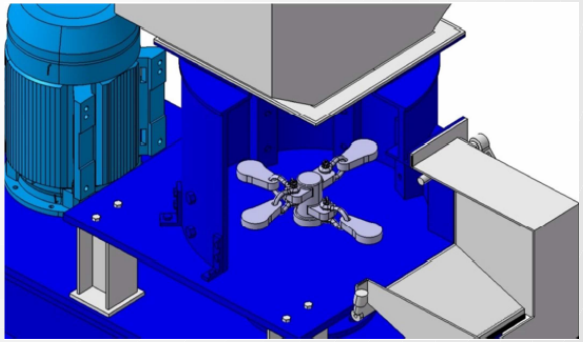
Mechanical Recycling

Primary crushing

- **Hammer mill prototype break the structure of the blades**, created between the glass fibre, the resin, the wood and others minor materials.
- The design of the hammers, its number and disposition, are very important for the correctly operation of the crushing process **four hammers located in the same axis at different heights**.







Mechanical Recycling

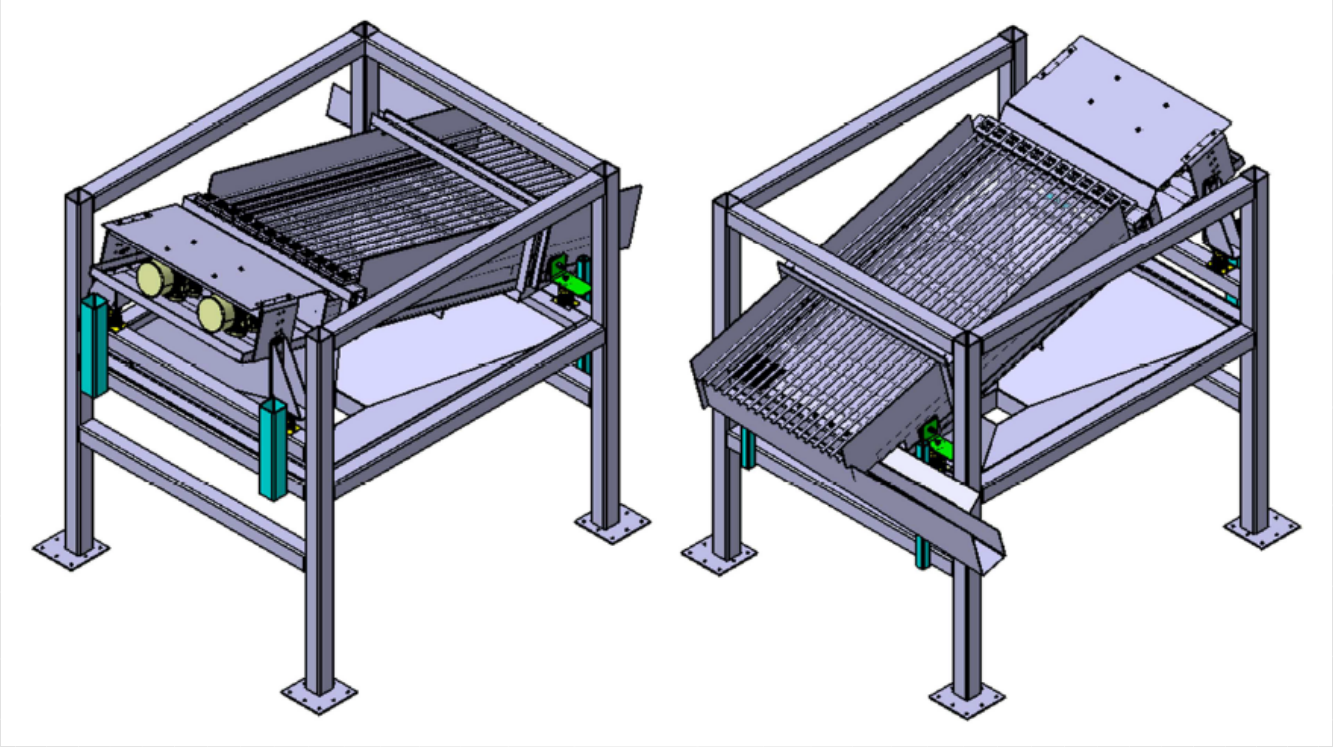
Mechanical Recycling

Mechanical Recycling

2 Separation components

Due to the difficulty of separating the different materials of the blades try various separation options: electrostatic separation, separation by water and **mechanical screen**.

- **Vibrating table** separation of the fibre glass and resin pieces from the rest of the components (basically wood).



Mechanical Recycling

2

Mechanical Recycling

Secondary crushing

Once the glass fibres are separated from the rest of the components the size of these fibres are larger than desired secondary crushing achieving the reduction of the size.

- **Hammer mill prototype reduced the size of the glass fibres** obtained previously in the vibrating table.
- The hammer mill has been optimized to this new crushing variating the residence time which in this crushing will be higher than the primary as well as the striking force.

Mechanical Recycling

3

Mechanical Recycling

4 Separation by size

The last stage consists of the separation of the glass fibres by size.

- **Vibrating table** → size classification → modifications: bars are removed and sieves are incorporated.

Mechanical Recycling

OBBTAINING RESULTS

- ✓ Collected **12 wind turbine blades** out of use **52 tons of waste treated**.
- ✓ **Design and construction** of an innovative **mechanical recycling** plant of blades waste to obtain glass fibre.
- ✓ Capacity of **100 kg/h**.
- ✓ **Recovery of 15 tons of glass fibres** with a size less than 2 cm, avoiding this amount is sent to landfill Yield of **70%**.
- ✓ Study of different asphalt mixtures with the recovered glass fibres at lab scale **0,00%, 0,50%, 0,75%, 1,00%, 1,25%** Resistance to plastic deformation with Marshall device, determination of density and hollows, and water sensitivity.

EXPECTED RESULTS

- ✓ The optimal dosage of the asphalt mixture studied will be applied in **five demonstrator asphalt pavement segments of 300 metres each one, with a total of 1,500 m**, in Zamora, in Spain.
- ✓ **For a year, a complete monitoring of this pavement** will allow to know the real behaviour, the evolution and the improvement of the mechanical properties due to the introduction of the recovered glass fibres in the asphalt pavement.
- ✓ These recycled fibres are expected to **improve the next mechanical properties of the pavement:**
  - o increasing the *road shelf life*,
  - o increasing the *resistance*,
  - o increasing the *resilience*,
  - o increasing the *fatigue resistance*,
  - o increasing the *rigidity,*
  - o increasing the *resistance to extreme temperatures*

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