Nano-enabled pultrusion for lightweight construction

At a glance: Development of highly resistant reinforcement nanomodified bars by pultrusion for reinforced concrete structures and nano-enabled coatings to protect the concrete structure against corrosion in aggressive environments.

Keywords:

Construction, Pultrusion, Nanoadditives Nanosafety , durability, Fireprotection

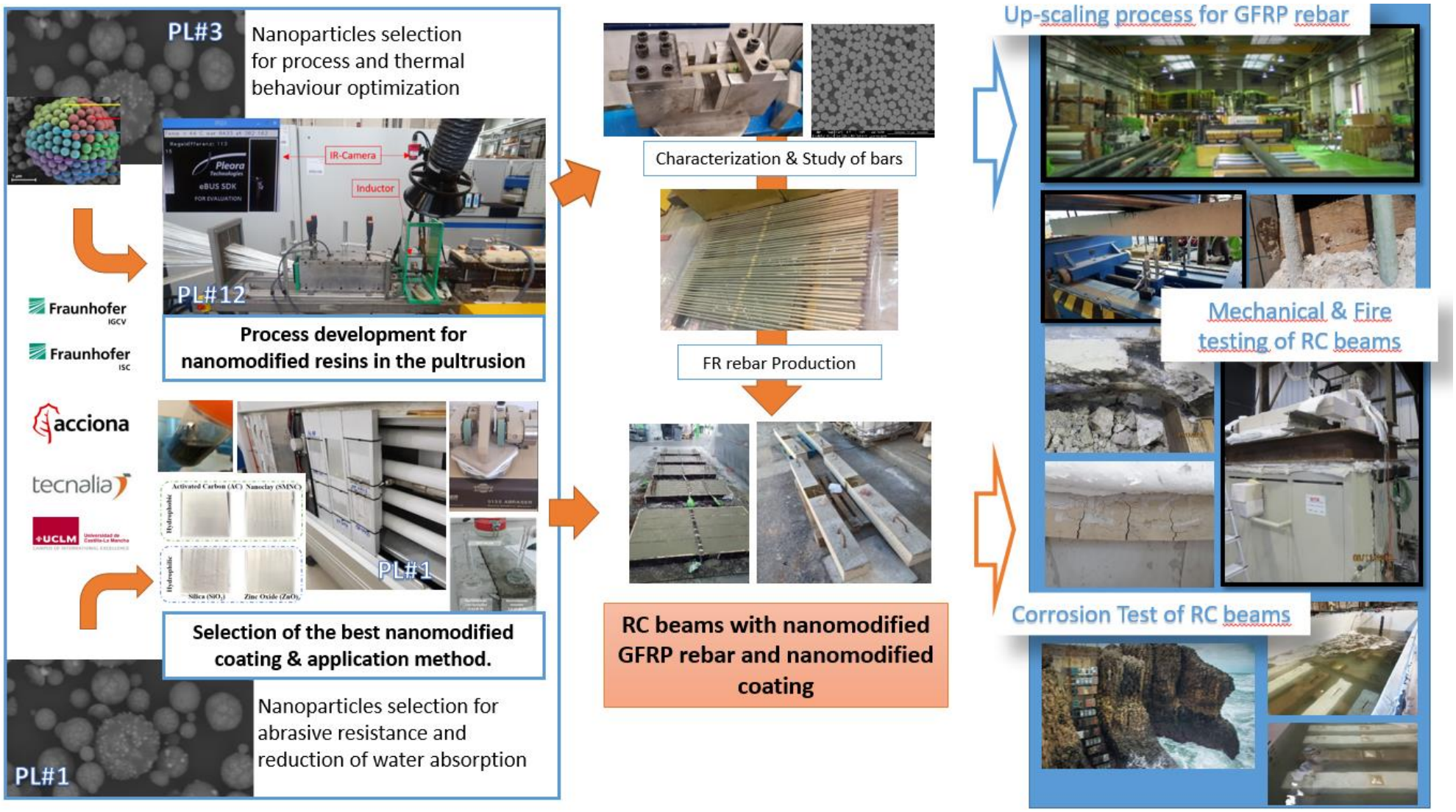
Context

ACCIONA participates in OASIS as an End-user of the Civil engineering sector providing its expertise and capabilities to develop novel multifunctional FRP rebars and stirrups for a more sustainable construction sector. Indeed, through the use of novel nano-additives enhances fire retardant performance and durability of composite widening their use in highly corrosive and aggressive environments (marine, low temperature with snow+deicing salts, Industrial…). In addition, more sustainable production is achieved optimising the processing parameters and energy consumption.

The Challenge:

The partnership between ACCIONA and OASIS service providers consists of the implementation of composite rebars with an enhanced mechanical performance in tradicional RC elements. Thanks to the addition of nanoparticles enhanced performance at elevated temperatures is achieved keeping the specification required concerning the curing degree of the bars, fiber fraction, tensile strength, and elastic modulus... In parallel, the use of corrosion-resistant Nano-enabled coating will improve the long-term properties of the RC elements when it is exposed to aggressive environments.

The Results: The use of two different nanoparticles was successfully implemented in the Pultrusion process. An direct influence from the particles on the viscosity and the curing behaviour of the resin is observed but can be controlled in the process, without effecting the rebar quality. With the magnetic particles a increased production speed of over 100 % was achieved using a induction coil for preheating the resin. Regarding the corrosion resistant coating, one immersion of the concrete samples for 10 minutes into a Epoxy resin, with the dispersion of 1 wt.% of different nano-particules was selected as the best methodology. After the accelerated weathering test, all coatings presented a lower weight gain in comparison to the neat epoxy resin, especially ZnO-epoxy resin. The best adherence and abrasion resistance properties were developed with AC-epoxy resin and SiO2-epoxy resin coatings. Final concrete beams reinforced with GFRP bars have achieved good results regarding the mechanical properties and fire behaviour. Durability testing in a real marine environment is being carried out and the result will drop a interesting information for the developed coating.



Conclusion:

Promising results have been obtained thanks to the OASIS project and the collaboration between end-users and pilot plants. The development and incorporation of nanomaterials specifically designed to improve the properties give the opportunity to develop specific solutions to real problems. The enhance of the performance of composite materials against fire and the improvement of the manufacturing process parameters, will help the composite materials to be more competitive against reinforcement steel bars used nowadays overcoming one of the disadvantages of composites and reducing costs thanks to a more sustainable processing. Nano-modified coatings protect concrete against aggressive environments by improving the durability of the final structure by reducing water absorption and improving abrasion, which would enhance maintenance and repairs compared to traditional concrete structures.

OASIS Techniques:

- **PL#1**: aerogel panels
- **PL#3**: Magnetic and flame-retardant nanoparticles
- **PL#12**: Pultruded nanoreinforced parts
- **Characterisation**:
  - microstructure
  - Corrosion resistance
  - Fire performance
- **Nanosafety assessment**
- **Business support services**

OASIS SC1

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 814581.