COALINE

Development of an innovative manufacturing process for the in-line coating of pultruded composites

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A GREAT ADVANCE IN COMPOSITES INNOVATION

Coaline European Project launched in September 2013 with funding from the European Union Seventh Framework Programme (FP7/2007-2013), under Grant Agreement no. 609149, has finally achived the result of a pultruded composite profile coated in-line and cured with Microwave heating.

Trying to face the challenges of traditional pultrusion process, like high costs and hazardours emissions, the Coaline project has developed an in-line, clean one-stage process, free of VOCs and small particle emissions, able to produce properly coated pultruded composite profiles using new sensing technology, advanced mould design and microwave- aided curing.

Coaline pultrusion process obtains an improved composite coating adhesion with reduced labour and process costs (Figure 1).

Figure 1: PULTRUSION MACHINE

Also, Coaline profile will be joined to other materials by means of a primer-type coating also incorporated in-line, with on-demand bonding properties. The new range of primers and adhesives allows bonding and debonding on deman for composites pultruded profiles with other traditional materials.

The Coaline project aims reducing the cost of coated pultruded profiles by up to 35%, simplifying the process and increasing its output in volumen and quality.

The innovative process developed will considerably reduce the number of steps and the emission levels involved in the production of a high-quality coated part by integrating the forming, coating and finishing processes in one single step (Figure 2).

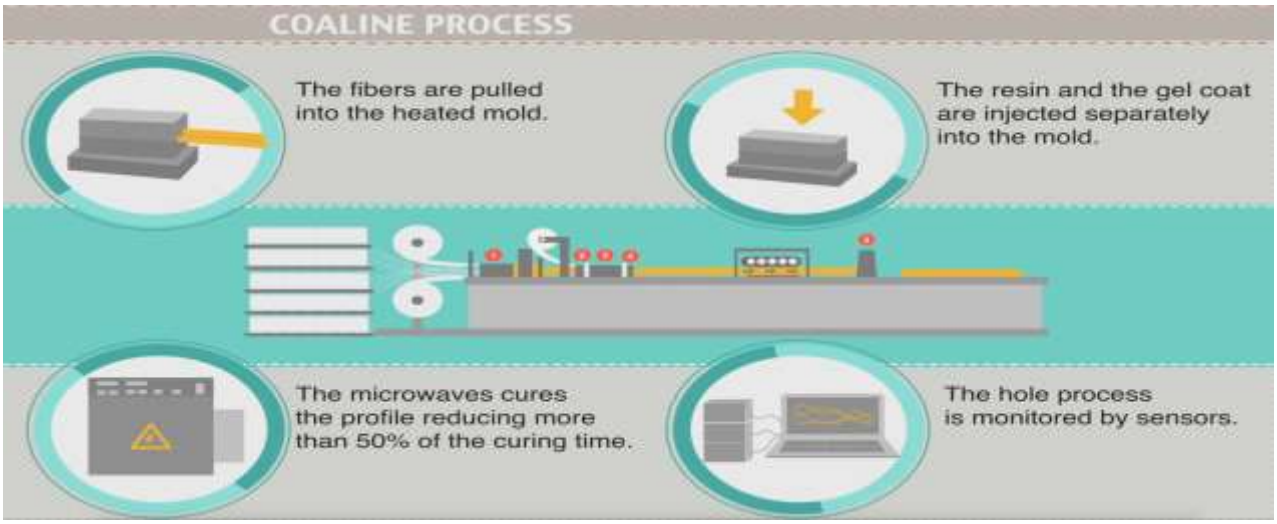

Figure 2: PULTRUSION PROCESS

Pultruded composite profiles provide manufacturers and designers with the benefits of high strength-to-weight ratios, corrosion resistance, heat resistance, dielectric properties, dimensional stability and weather resistance.

For this reason, it will produce a formidable thermoset composite material suitable for the substitution of traditional structural parts in construction as well as in vehicles, thus reducing their weight, energy consumption and emissions.

Furthermore, the faster production of high-performance coated profiles will allow the high output and continuous production demanded by these two industries, reducing costs and increasing benefits (Figure 3).

Figure 3: PULTRUDED BAR

Coaline´s project main target sectors are construction and transportation. Competing with traditional materials used in these two sectors, such as wood, aluminum, PVC (polyvinyl chloride), concrete and steel, pultruded profiles have the following atributes:

- **Durable quality and stability in their dimensions.**
- **80% lighter than steel and 30% lighter than aluminum. Perfect alternative when it comes to reduce weight.**
- **Resistance and stiffness: correctly choosing the type and orientation of the reinforcements, can resist more than a piece of steel.**
- **Excellent finishes.**
- **High resistance to corrosion and chemicals. They are not electrically**

conductive and have a low thermal 250 times lower than aluminum and 60 times conductivity than Steel.

- Electrical and thermal insulation.
- Maintenance-free.
- Easy to install.
- Flame retardant property.
- Increase security in places where high voltage is used.
- Upper slip surface, lightweight.
- Reduce costs and maintenance.
- Stable in different environments.
- UV protection, with or without anti-skid.

- Consistent quality and dimensional stability: easy to repair, low tolerances.
- Transparency and magnetic RF: suitable for medium applications, antennas, etc.
- High drag and fatigue.

The use of microwaves to initiate the curing process of resins is well known. Liquid resins that cure at high temperatures need an increase in temperature to start the polymerization reaction and nally become a solid material. Several methods can be used to increase the temperature, such as conventional heating, ultraviolet radiation, electron beam or microwave radiation. Microwave (MW) curing has two main advantages: heating is volumetric and homogeneous, and curing time is reduced to seconds, so that VOC emissions are also reduced (Figure 4: Microwave Equipment).

Figure 4: MICROWAVE EQUIPMENT

The recent trials shows that microwave curing of polyester and vinylester resins achieves best results when microwave absorbents, called susceptors, are used (epoxy does not need susceptors). Examples of susceptors are metallic charges, organic dipolar additives and inorganic additives transparent to microwaves.

In this project, microwave radiation is used to cure the resin in order to reduce the polymerization time and the die length.

The main microwave absorption mechanism in a polymer is the reorientation of dipoles in the imposed electric field. This reorientation

makes the polymer's molecules vibrate, thus heating the material. As in a conventional microwave oven, the materials with the greatest dipole mobility will exhibit the most efficient coupling.

These susceptors reduce the polymerization time during microwave curing of resins and gelcoats by 46-71%. In addition, the application of susceptors to improve MW absorption and reduce polymerization time does not in fluence the mechanical properties of the resins.

The Project is still on going and it will finish in 2017, hopefully with the desired results as the actual trials are being succesful, reaching the spected goals.

Next workshop will be in Composites Europe Exhibition (Düsseldorf), November 2016, and the stand for visitors will be in hall 08b, D65.

The project consortium partners are: Aimplas, Fraunhofer, Riga

Tehniska Unniversitate, Rescoll, Muegge, Composites Aragón, Synthesites, Polymec, Ecoinnova, Resoltech, Acciona and Àlke.

For further information, please visit the COALINE website:

www.coaline.eu

or contact Aimplas: www:aimplas.es