Biocomposites for interior facades and partitions to improve air quality in new buildings and restorations

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Composite materials are revolutionizing architecture, since they allow the replacement of traditional materials and provide more options allowing higher design freedom to designers. Durability is one of the key factors in the development of composite materials in the construction sector. The use of biocomposites will allow us to improve the indoor air quality of houses and therefore personal health. It will also increase the thermal and acoustic insulation of houses and control the breathability of construction systems.

Composites are revolutionizing architecture

The plastics market, in general, and the composites market, in particular, is on the rise, with good growth prospects in the immediate future, and more importantly, in the long term. The possibilities that composites offer in the field of weight reduction, design, ease of assembly and low maintenance, have resulted in their introduction in all spheres of modern life.

Currently, composite materials are revolutionizing architecture. Their application has allowed the replacement of traditional materials and the provision of more options allowing higher design freedom to designers. Among the advantages that plastic materials and composites offer in different applications of the construction sector, we highlight their weight reduction, design, ease of assembly, low maintenance, as well as their better behavior against corrosion. Up to now, composite materials have been used in secondary structures or as supporting structures as domes, but recently, some architects and engineers have developed complex solutions to satisfy creativity in the design of singular buildings and constructions. These applications are possible thanks to the use of plastics and composite materials and their advantages, such as their light weight and ability to obtain complex designs.

Composites of glass fiber-reinforced polymers can be used in different types of infrastructures, such as pedestrian walkways, bridges, reinforcements for bridges and construction of façades. Different processes can be used to produce composite materials adapted to different raw materials, the required product geometry, the properties, the processing time and the cost. The pultrusion process is a continuous manufacturing process of profiles of composite materials, where continuous fibers are used a main reinforcement. Different resin systems can be used with the aim of obtaining the desired final properties. The design flexibility and the possibility of combining different materials are the main advantages of pultrusion. The properties at the structural level of this kind of materials are almost unlimited. In the pultrusion process, fibers are impregnated with a thermostetting resin and introduced in a heated mold, where the curing process takes place. Different combinations of laminates are possible by using reinforcements as roving, mats and fabrics. The final profiles are cut to the required length at the end of the pultrusion line. Figure 1 presents the pultrusion equipment available at AIMPLAS’ facilities.

Case studies in composites

The congress center of Badajoz (Spain) is an example of a building where composite materials were used. It has a surface area of 15,000 m² and consists of a circular façade built with GFRP (Glass-Fibre Reinforced Plastics) profiles, providing visibility and transparency to the main cylindrical building. The circular façade has a diameter of 75 m and is 14 m high. It contains more than 12 km of profiles made of composite materials (Figs 2, 3).

Another example of the use of composite materials in the construction sector is the restoration of a building on the seafront in the Marina Real Juan Carlos I, in Valencia, where the business
school Edem, Lanzadera, is located. The aim was to renovate the building’s image, control solar radiations and their energy efficiency. Another aspect considered was to optimize its durability in an aggressive environment such as the seafront. For this project, approximately 7000 m² of coating panels and more than 15,000 m of slats and sunshades made of composite materials have been used (Fig. 4).

This project recently won the JEC Innovation Chicago Awards 2017 in the building category. This is one of the most important prizes in composite sector, recognizing the effort of the partners involved in the project (Owens Corning, (France), Gazechim Composites Iberica, S.A. (Spain), Polymec SI (Spain), ERRE Arquitectura (Spain), Miraplas, S.L. (Spain), RTM Bey Consultant (Spain)).

The construction industry as a whole needs an update in terms of legislations and sustainability in order to adapt itself to the new demands of the occupants. This can be applicable in sectors, new buildings and restoration, also taking into consideration the need for energy-efficient buildings.

**Biocomposites to improve indoor air quality**

As abovementioned, composite materials offer solutions that can boost the needed update in the construction sector: light weight or mass, durability, corrosion resistance, design flexibility, efficiency in construction, properties as insulation, good specific properties, possibility of obtaining panels for restoration, among others. If we go a step further, we observe that biocomposites can offer us the same solutions as composites, but with lower environmental impacts, reduction of CO₂ due to the use of natural fibers and bio-resins, use of materials from renewable sources, healthier construction, as well as higher quality living conditions.

Biocomposites are those materials formed by natural fibers or bio-resins. The most used natural fibers are jute, hemp and kenaf. Among the bio-resins we stress polyurethane resins, epoxy or vinylster, 100% bio-resins such as furanic resins and bio-thermo-plastics. Usually, the bio content of a resin is between 10% and 100%.

Indoor air quality and the emissions of construction materials are a major challenge for scientists, the industry, and consumers,
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