THE CIRCULAR ECONOMY IN COMPOSITES AND THE ARTIFICIAL TURF INDUSTRY

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The initial development and implementation of plastic materials was a major step forward in improving the quality of life in societies. In fact, the use of composites (plastics reinforced with glass or carbon fibre) produced a high point in the wind power sector within the field of renewable energies. The blades of wind turbines could now be made with these lightweight materials, which also have very good mechanical properties. Another interesting advance was the use of artificial turf in football stadiums and recreational areas, which meant the facility could be used longer and consumed less water. This material is made of a polyurethane (PUR) or latex secondary backing, a polypropylene (PP) primary backing and polyethylene (PE) yarns, as shown in Figure 1.

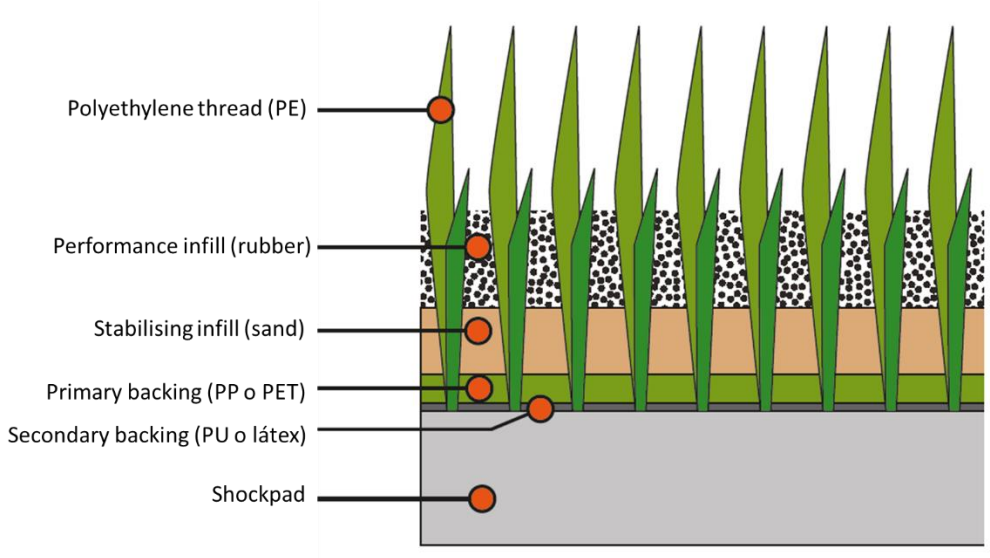

Figure 1. Composition of a typical artificial turf piece

As a result of this progress in plastic materials, society is now facing one of the greatest challenges of our time: finding an end-of-life solution for the enormous amount of plastic waste being generated and reducing the consumption of fossil resources, maintaining the long-term sustainability of the supply chain and mitigating the negative impact of these materials on the environment.

Plastic waste from wind turbine blades and artificial turf football pitches is very difficult to recycle because it is made of different materials from different sources that melt at different temperatures and have different viscosities. Most of this waste is therefore landfilled and only a small part is shredded for reuse as fillers (see Figure 2). Both types of waste represent a major problem that must be solved as soon as possible. In fact, an estimated 42,000 wind turbines are expected to be decommissioned in Europe next year and almost half of them are located in Spain, which means that 1.5 million tonnes of composite waste will be generated. Artificial turf football pitches have a lifespan of five to ten years and around 2,570 pitches (only those certified by FIFA) have been installed in Europe since 2006. A football pitch contains approximately 160 tonnes of artificial turf, which means that more than 400,000 tonnes of artificial turf is now being removed or will require removal in coming years.

Figure 2. Removal of wind turbines (left) and artificial turf (right), where sand and rubber are automatically separated.

AIMPLAS, the Plastics Technology Centre, is fostering the development of R&D projects in the field of mechanical and chemical recycling. Advances are now being made in chemical recycling technologies such as solvolysis (application of temperature, solvents and catalysts), pyrolysis (heating to temperatures over 400°C in the absence of oxygen) and biological degradation (using enzymes and microorganisms to mineralize polymers). In all cases, the goal is to depolymerize plastics to obtain their source monomers and fibres. In response to these two problems, two research projects led by AIMPLAS are being carried out: the EROS Project and the RECITURF Project.

The EROS Project (Circular Economy in Composites: from the Wind and Aeronautical Sector to the Ceramics Industry and Transport), funded by the Ministry of Science and Innovation - AEI - State Research Agency (file no. RTC2019-007206-5), aims to implement a real circular economy system that starts with mechanical and chemical recycling of wind turbine blades and waste from the aeronautical industry and closes the circle by recovering materials (glass fibre, carbon fibre and glycols) so they can be used in other sectors, such as the ceramics industry (backings, frits, glazes and inks) and the transport industry. This will involve optimizing the solvolysis and pyrolysis processes for glass and carbon fibre composites. The following companies are participating in this project: Fritta, Keraben Grupo, Reciclalia, Sofitec Aero and the Ceramics Technology Centre (ITC), as well as AIMPLAS.

The RECITURF Project (Recycling of Artificial Turf by Means of Biological Processes) is funded by the Valencian Innovation Agency within the programme of strategic cooperation projects of the Valencian Innovation System's strengthening and development grants to improve the production model. This project (INNEST/2020/29), in which ACTECO and REALTURF also participate, aims to promote the circular economy in the artificial turf industry through innovative waste treatment. The goal is to increase the recycling rate and obtain higher-quality materials to ensure that recovery is also economically sustainable. New recycling processes are therefore being developed, including biological degradation and solvolysis of the secondary polyurethane backing so that the different thermoplastic materials that make up the turf can then be separated by means of mechanical recycling. This ensures recovery of the PP, PE and PUR contained in the product.

Both projects cover the entire value chain of the industries involved to guarantee that industrial implementation is possible. The results of the two projects are demo samples (for the ceramics, aeronautical and artificial turf industries) made with the recycled materials obtained.