Engineered recycled rubber products: poised for growth

The use of recycled tyre rubber crumb in engineered products has been gaining popularity in recent years, and is set to grow further. Initially limited to use in composite materials and in flooring and sports fields, the push for lower CO_2 supply chains and a desire to reduce production of new plastics, has highlighted the value of this material in building a wider variety of durable, low cost products and components to service the renewable industry and its wider supply chain. PES spoke to specialised rubber engineering house TCT to better understand what the industry is developing.

Tyre rubber crumb is a by-product of the tyre recycling process. Scrap tyres are cleaned, metal and fabric removed and the remaining vulcanised rubber material shredded into small pieces. These are then processed into various sizes, from powders through various sizes of granules which can be used in a very wide variety of applications. In the EU-27 in 2020, 1.5 million tonnes of tyres were processed for material outputs.

Environmental benefits

Aside from the most obvious benefits of reducing pollution from sending millions of tyres to landfill or incineration plants, recycling tyres into a sustainable material has a number of key benefits for the environment.

Lowering our eco footprint

According to the European Tyre Recycling Manufacturers Association (ETRMA) there is around 70% energy savings associated with the manufacture of 1kg of recycled tyre rubber, compared to 1 kg of virgin rubber. This in turn has an impact on the CO_2 footprint of the material. The CO_2 footprint of recycled rubber is impacted by a number of factors including logistics, efficiency of the manufacturing process and the country's power grid, but on average in Europe and the US, tyre rubber has a lower CO_2 equivalent than both natural rubber and most synthetic virgin rubber alternatives.

Reducing plastic waste

Manufacturing volume, long life products from recycled rubber crumb reduces the need for new synthetic rubbers, or new forms of plastic, whilst also preventing microplastics from entering the wider environment. Recycled rubber products themselves can eventually be broken down and added to permanent structures in the form of concrete and road surfaces.

Push for innovation

The global tyre industry is a multi-billion dollar market, worth $US 314,07 billion in 2022[1], with a huge amount of money spent on engineering a high quality, durable, safe material. Additives in tyre rubber make the material resistant to wear and sunlight, with

1 Source EMR

Energy required to manufacture 1 kg natural rubber = 14 MJ

Energy required to manufacture 1 kg virgin synthetic SBR rubber= 32 MJ

Energy required to manufacture 1 kg recycled tyre rubber = 6-13 MJ

1 kg of natural rubber = 3-5 kg of CO_2e

1 kg of virgin synthetic SBR rubber = 9.9 kg CO_2e

1 kg recycled tyre rubber = 0.9 – 1.5kg pf CO_2e

World Resource Institute (WRI) and ETRMA

* CO_2 equivalent, also known as carbon dioxide equivalent, is a measure used to compare the warming potential of different greenhouse gases (GHGs) based on their global warming potential (GWP) relative to carbon dioxide (CO_2)

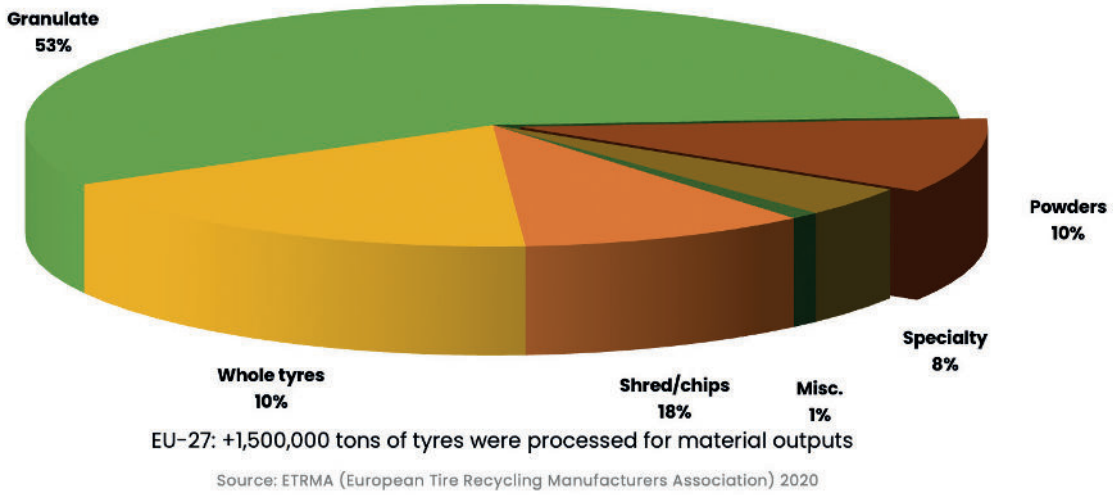

Diagram 1: Recycled Tyre Rubber: Material Outputs

a reported flash point of 310°C. In addition, rubber as a material is a good insulator, is able to absorb vibrations and sound and can withstand a full range of ambient temperatures from -40°C to +90°C without undergoing permanent property change. These virtues are passed on in the recycled tyre materials.

In the past, the recycled tyre products industry has tended to focus on the mats and sports flooring sectors, but over the past five years there has been a growing recognition of the key properties of the material and a significant push for innovation around both the processes to make recycled rubber products and the types of products being made by the sector. According to ETRMA in 2020, recycled granulate/crumb was used 37% in mats and sports surfaces, 17% added to road surfaces, 18% in construction materials such as concrete and 27% into a growing variety of manufactured products.

What does this mean for the renewable sector and its supply chains?

To date, the renewable sector has largely used recycled rubber in a variety of barriers, mounting feet, roof blocks and matting products.

TCT in particular has focused a lot of research and development on roof blocks and mounting feet, helping solar PV companies both in Europe and the US to design, prototype and manufacture a range of products. In 2022, the company developed a 'push fit' design concept, where it is able to replace rubber mats that are sometimes pre-stuck on to the base of metal mounting structures to protect the roof membranes, with a push-fit rubber foot that matches the rail width and can be pushed on to the mounting rails before or during installation.

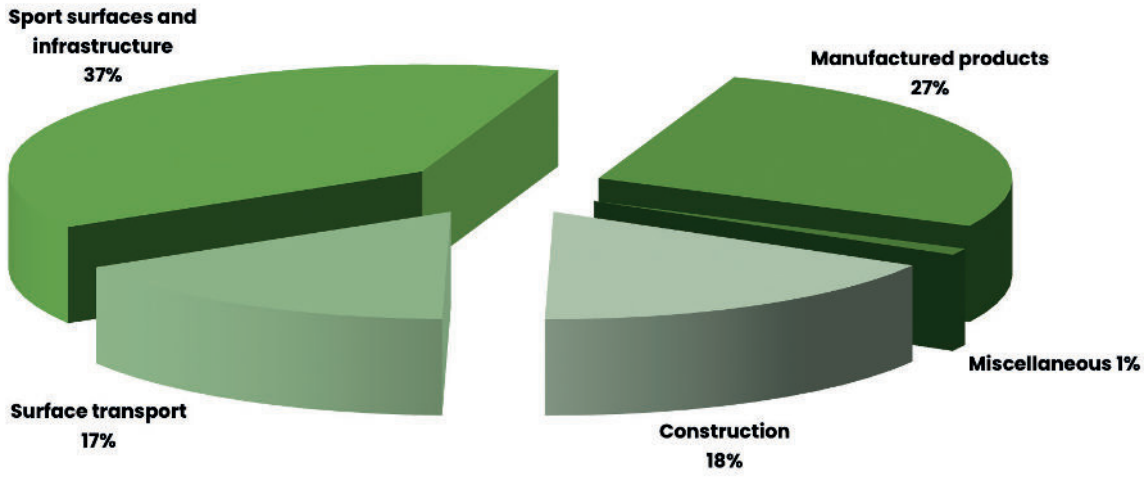

Diagram 2: Uses of recycled tyre material: EU 27 2020

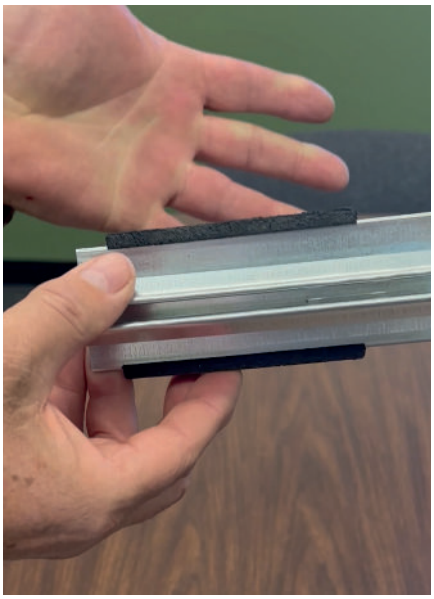

Diagram 3: Push-fit mounting feet

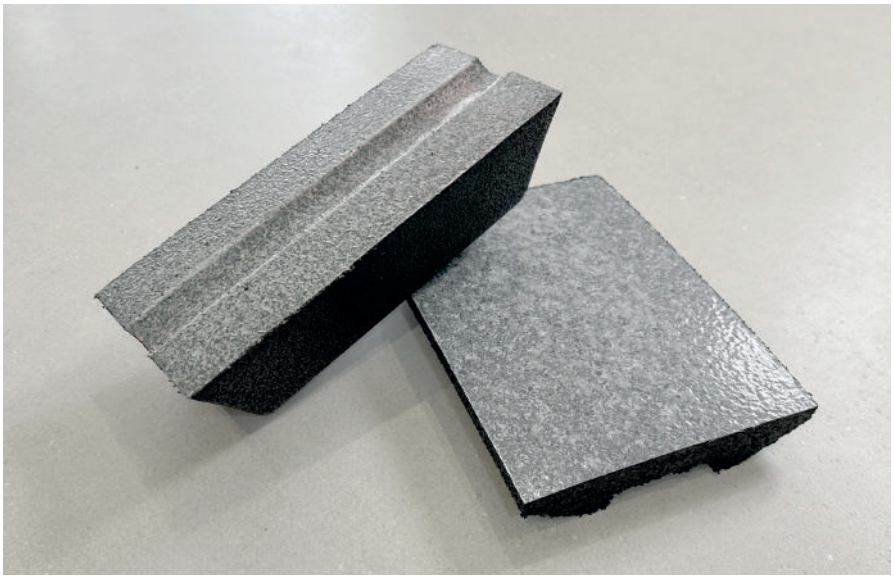

Diagram 4: TCT barrier material

TCT-Europe patented barrier material

There has always been a concern in the Solar PV sector around using recycled rubber as a material on PVC roofs, because of possible plasticiser migration. TCT has conducted extensive research into low cost barrier solutions that address this concern, so that its products can be used on all roof surfaces.

The company made a highly significant breakthrough at the end of 2022, with a new low cost barrier that is more effective than the aluminium tape offerings currently on the market. These aluminium tapes are often applied post production and can come loose from the products over long periods outside. The new TCT barrier is applied in production in the mould so is permanently bonded to the rubber.

The TCT barrier has been tested to industry standards, at high pressure and in a full range of ambient temperatures and humidity. The material is also 100% recyclable.

Over the past few years, some mounting companies have looked to move away from recycled rubber, to using virgin synthetic plastics and rubbers such as EPDM on mounting feet, to address the plasticiser problem. Some of these alternative plastics have a lower UV resistance, lower durability and crack or fade outdoors. TCT believes this barrier could be a game changer for the recycled rubber industry looking to address roof top products moving forward.

TCT believes there is also a potential for the material in other parts of solar PV systems, including in the inverter and emerging battery technologies, as well as in the wind sector, where the material has the potential to be used in the form of vibration dampening pads and for use in the tower bases. Rubber is a flexible and durable material that is a good insulator and absorbs both sound and vibrations.

In terms of logistics and storage, rubber can be used in various components of packaging, storage, and transport of solar PV systems. Rubber materials can be used to create cushioning and shock-absorbing components, such as corner protectors, edge protectors, and inserts, to protect the system from damage during transport and storage. These components will be reusable and reduce waste in the wider supply chain.

www.tire-conversion.com

About TCT

With engineers in the UK and the US and manufacturing facilities in the US and Poland, TCT is focused on the design, engineering, rapid prototyping and volume manufacturing, using compression moulding or extrusion, of products made from recycled rubber crumb.

The company combines its extensive understanding of the material properties of rubber crumb with the latest engineering and design, to create equivalent or improved alternatives to current virgin synthetic rubber or plastic options.

Problem resolution is at the core of the company's focus. TCT-Europe is interested in working with UK, European and US companies looking for design and engineering expertise for new or adapted products and with a need for volume manufacturing of final units.