

A new spin on old tyres

aste products and materials have become one of the world's major headaches.

We have too much rubbish, particularly plastic in the oceans and too much general rubbish and waste materials going into landfill. All this comes at tremendous cost both financially and to the environment. It is for these reasons that we now go to ever greater lengths to recycle as much of this waste as possible.

Nevertheless, it costs money to recycle and if the resultant product or material is of a lower quality or intrinsic value than the original, there is still a substantial financial loss even though the waste is being reused as, for example, in the case of recycled paper which is worth much less than the original virgin product. This is in fact a good example of what is called down-cycling. If on the other hand, the waste product or material can be transformed into a new product or material of equivalent value to the original, it can be said to have been upcycled, a much better outcome. Unfortunately, this can be extremely difficult to achieve with many products and materials.

Take, for example, truck and car tyres. Over a billion scrap tyres are currently generated globally every year and, in 2015, the US alone generated 300 million and had a stockpile of 67 million collected in previous years. Traditionally, most scrap tyres have either been burnt or simply consigned to landfill. The fact that they are bulky, have a 75% void space in the centre and generate methane makes this latter solution unsustainable in the long term. In addition, the sheer material waste and cost is enormous. The only way to solve the problem is for the scrap rubber to begin a new product life cycle.

This is not a new concept and old tyres have long been recycled into rubber chips for all weather surfaces, turned into crumb rubber to enhance asphalt paving or as aggregate in cement manufacture. These, however, are all examples of down-cycling as the resultant product is of inferior value to the original. Finding ways to upcycle rubber waste has proved to be more difficult up until now.

After more than five years of development, the Austin Rubber Company, headquartered in Austin,

Texas, claims to have succeeded where others have failed. It has developed a new technology to effectively devulcanise scrap rubber in an affordable, environmentally sustainable process whilst, at the same time, maintaining the quality of the rubber so that it can be used as a virgin rubber compound substitute. In other words, a clear instance of upcycling.

FAN PROCESS

Austin Rubber manufactures its revolutionary APX upcycled rubber using the Fan Process, named after Dr. Lianf-tseng Fan, one of its inventors and a co-founder of the company. The process is a patented method for devulcanising scrap rubber that converts recycled tyres and other vulcanised scrap rubber items into a less expensive, sustainable substitute for virgin rubber compounds. The process is based on a chemical reaction between vulcanised rubber compounds and GSX, a family of proprietary reagents. When mixed with rubber compounds, GSX cleaves the sulphur-sulphur and carbon-sulphur bonds that form the molecular cross-links in vulcanised rubber.

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Moulded APX rubber casual shoe sole.

CREDIT: AUSTIN RUBBER

The process is a chemical devulcanisation method that is said to be both highly effective and sustainable in itself. Using a closed-loop manufacturing operation, it employs chemicals that are low in toxicity, does not create waste by-products and has a low emissions footprint. It is also cost effective, which allows APX upcycled rubber to be sold at a discount compared to virgin compounds. The company says that the result is a ground-breaking process that helps solve a global environmental problem, is sustainable, and benefits all stakeholders economically without relying on government subsidies.

APX AND APO

APX devulcanised rubber compound is an agglomerated black powder that disperses easily in a rubber compound master batch. Containing approximately 70% natural and synthetic rubbers, and 30% tyre-grade carbon black, it comprises 90% of the final upcycled product. Physical and dynamic properties of rubber compounds containing APX generally remain within +/- 10% of a baseline comparison, depending on the load level involved.

Independent tests have shown that it is a high quality raw material capable of being mixed into new rubber compounds at load levels ranging from 25% to 50% or more. Indeed, the company says that with the addition of APX, many rubber compounds actually demonstrate significantly improved physical properties together with better processing and handling at reduced cost compared to raw virgin equivalent materials typically used in the given compound formulation.

APO plasticiser is an economically priced 'reprocessed' oil extracted from used tyres during the devulcanisation process and can be used as a plasticiser substitute in new rubber compounds. It contains process oil, accelerators, curatives and antioxidants, and accounts for the remaining 10% of the final upcycled product. As it contains these traces of rubber accelerators extracted from crumb rubber, using it can also reduce the amount of new cure components in rubber formulations.

The company has also developed a full range of APX-based compounds that are again said to be both sustainable and cost-effective. Its in-house compounding lab has a large library of compound formulations that can be used 'off the shelf' or, alternatively, it can work with customers to incorporate and optimise APX into existing compounds. The library contains formulations with varying physical and dynamic properties that are tailored to a number of industries including footwear.

CASUAL SHOE OUTSOLE PERFORMANCE DATA

The performance table shown below, is based on a compound available to all

customers that was initially developed to demonstrate that APX could be used to achieve whatever physical properties were required for a variety of outsole applications while also meeting different price points. However, the company can and does work with multiple footwear companies and their outsole suppliers in order to meet target physical properties for various footwear applications e.g., lifestyle, oil and water slip-resistant, etc.

Austin Rubber is already selling APX to a number of footwear companies. Among these is BATA India at its Batanagar factory for use in its Power brand Jogger outsoles. The company spent 12 months in collaborative testing before making the commitment in order to satisfy itself fully of the financial, environmental and performance benefits it could gain. In this instance, 25% APX content is being used and Sanjay Kanth, Vice President of Manufacturing, is reported as having said that the company is more than satisfied that it has been able to make a positive contribution towards a cleaner environment without compromising the product specification, performance or cost.

APX appears to be both a good product as well as a solution to a major recycling problem. The company is currently producing 25 of a 50 tons per day installed capacity at its Greenville plant in Pennsylvania, of which it hopes that, in the medium term, footwear will account for half of the output. One suspects that taking the good performance figures into account, it could well need to expand sooner rather than later. One problem it will never have, however, is a shortage of its raw material: used tyres 🔄

Physical Properties	APX Footwear outsole
Durometer Shore A	62
Tensile Strength (psi)	1770
Elongation (%)	400
Modulus @ 300 (PSI)	1510
Die C Tear Strength (lbf/in)	179
Specific Gravity	1.11
Abrasion Loss (mm ³)	137
APX Recycled Content (%)	38