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FEATURE

Composites made from recycled thermoplastics and natural fibers: a new philosophy for the future

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Transmare is a compounder with an interesting philosophy. In an eclectic mix they try to expand the gamut of possible materials by combining the best that modern and classical technology have to offer. This results in innovative resin and fiber mixes that help to create a more sustainable future for composite materials.

A bamboo forest: a resource that only needs some sunshine and rain.

Transmare (www.transmare.nl) in Roermond, the Netherlands, processes granulates to add value to them. The granulates leaving the factory are used worldwide by thermoformers, extruders and injection molders to make products.

'I am a chemical engineer, a process engineer originally,' says Robin Beishuizen, the manager sales responsible for all commercial activities of the Roermond plant. He has been working for Transmare for 16 years. 'I got into plastics and have a fascination for materials,' he says. 'At Transmare we try to add as much value as possible in one compounding step. For example: ultraviolet resistance, antioxidants, coupling agents, and pigments.' The material leaving the Transmare factory already has all the properties needed to create the end product.

One of the processes Transmare performs is elastomer modification, i.e. mixing in rubber compounds to increase the impact resistance of the material. 'That is for products used in cold climates or in high impact conditions,' Beishuizen says. 'All sorts of packaging for example, shock resistant crates and boxes, and the bumpers and side panels of cars, bicycles, motorcycles and other vehicles. The percentage of plastics in those vehicles is increasing all the time.'

Transmare does not employ plasticizers. 'In another factory we used to compound PVC,' Beishuizen explains. 'There we did have to use plasticizers. But that is over. We only use high quality rubbers now, preferably recycled, depending on the application and availability. And sometimes we add certain oils with a plasticizing function. But we do not use any typical chemical plasticizers in Roermond.'

It is interesting that the move away from plasticizers was not caused by environmental concerns, but by technical considerations. 'We just do not process any recipes at the moment that would require plasticizers,' Beishuizen says. 'So it was not a conscious decision. But now that we know that there are environmental concerns about plasticizers, we do try to steer clear of them. They may be indispensable for some applications, but in the products we make at Roermond we just do not need them.'

Other processes Transmare performs include adding fillers and reinforcements: 'We can add up to 40 percent glass fiber reinforcement or mineral fillers,' Beishuizen says. 'And we also use natural fiber reinforcements: mainly short, free flowing bamboo fibers which we extrude on-site. Longer fibers, like hemp or flax are possible as well.'

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Bamboo stems before they are processed and turned into fibers for reinforcing plastics.

A bamboo stem after splitting and drying and before grinding, classifying and sifting.

Bamboo

'We have been involved with natural fibers for about fifteen years, and with bamboo for about ten,' Beishuizen says. 'I can honestly say that apart from human hair we have tried just about every natural fiber you can find. It brings you into contact with people far outside the oil industry. And it is fascinating that you can employ a material that grows back every year, needing only a bit of sunshine and rain. And it is ineradicable and regarded as a weed by gardeners. There are so many people on the earth today that you have to use materials like bamboo that are available in large quantities. And bamboo is an enormous carbon sink: you can keep that carbon trapped in a product for 20 or 30 years. Then you can recycle it, keeping it trapped for another 20 years. And in the end you can still recycle it for something simple like a brush handle.'

Transmare are not about endless theorizing, as Beishuizen explains: 'We have extruders, side-feeders and gravimetric feeders. So we just run all materials and assess what comes out. You cannot simply say that a material is good or bad. Lots of natural fibers will give composite fantastic properties: some give it a beautiful color, others can be easily dosed, and the next one is resistant to scorching at high processing temperatures. We have tried them all. And eventually we ended up with bamboo because of its overall performance in all properties we consider important. Its availability is huge, it is not expensive, it grows like mad on all continents – different kinds of course, but their properties are more or less the same – no pesticides are used, no trees have to be cut down for it, and every stem you cut off grows back more quickly than before you cut it. The processing is trouble-free for us, but also for transporters, injection molders and thermoformers. And bamboo is generally regarded in a positive light. Its future outlook is very good.'

Bamboo has no real history in Europe yet. It was just an exotic weed to use in the garden. Flax, hemp, sisal, and burlap: those are all fibers known in Europe. 'In the days of the Dutch East India Company for example only natural fibers were used,' Beishuizen says. 'Then the plastics industry came in and wiped them all off the market in just a few years. They were replaced by nylons, PET, PE, PP, etcetera. In South America and Asia on the other hand they have a lot of experience with bamboo. There are fibers with even better properties, but they are generally expensive or not available in sufficient quantities. The cost of bamboo is around six hundred Euros per ton for a well prepared fiber.'

So the material is priced between glass fiber (which is around 1000 Euros per ton) and talcum (250–500 Euros per ton, depending on the type and whiteness).

The bamboo fibers are prepared by Transmare as close as possible to the source. That means the bamboo is split, dried, ground up, classified, sifted in a number of steps, and packaged in different sizes. It looks like sawdust in different fractions. The finest fraction is a powder, the coarsest are needle shaped fibers, almost like matchsticks. Then the material is shipped to Roermond for compounding.

Like cookies

Bamboo fibers work well with polymer matrixes like PP, PE, PS, as well as bioplastics like PLA and starch. But in polymers that require processing temperatures far above 200°, certain sugars in the bamboo will start caramelizing, causing some degradation in the fibers: they will become darker and start smelling like a burnt cake. So it is best not to use them with nylon, polycarbonate and ABS. 'That smell will eventually go away,' Beishuizen says. 'But it will linger too long for mass production. Injection molders cannot afford to air out a part for a few weeks before it is shipped. If you process bamboo at a temperature below 200°, the smell is no problem. It will still smell a bit like a cookie factory, but that is not unpleasant and it disappears in a few days. If you package it immediately after injection molding, you do seal in that smell. But after three days out in the open, the cookie-smell is gone.'

It is a natural smell, but consumers have gotten used to sterile environments, so it is not clear if they would for example accept the interior of their new car having a faint cookie-smell. Customers do however still love that typical natural smell if a car has leather seats. So maybe it is up to a few marketing managers and industrial designers to come up with a context in which a slight cookie-smell is appreciated by the consumer.