

Bio-based TPE and PP compounds fulfill the demands of the market

FKuR introduces new bio-based styrenic thermoplastic elastomers and polypropylene compounds

The product characteristics of the newly developed bio-based TPE and PP compounds correspond largely or entirely to those of their petrochemical counterparts, hence, they can substitute them in existing markets and open up new perspectives. With Terraprene, FKuR has brought new TPE-S grades based on a high content of bio-sourced raw materials to market maturity. In addition, the recently released Terralene PP compounds made by FKuR are partially bio-based and currently include an injection molding and an extrusion grade.

The variety of biodegradable and bio-based plastics offered in the market has increased significantly in recent years. They are now established in many market segments, are perceived well by consumers and the demand is rising. Some European countries favor solutions with bioplastics so highly that they even require using them by law. Large brand-owners have developed strategies for sustainable products and place sustainability increasingly in their focus.

Basically, biodegradable plastics do not necessarily need to be made from renewable resources. In contrast, bio-based plastics, whose carbon chains are generated from renewable sources, usually are non-bio-degradable. Mostly, the bio-based plastics offer the same or similar material properties as their counterparts based on fossil materials. In addition, bio-based plastics often exhibit properties that biodegradable plastics can only offer conditionally, for example, a high barrier to moisture.

Pure bio-based plastics, e. g. Green PE (sugar cane-based polyethylene from Braskem), have established themselves in certain market segments and are replacing petrochemical plastics there. On the other hand, some biodegradable products are currently on their way to commodity products, e. g. in the form of waste bags, where price pushes quality and unique features into the background. This development stands in contrast to the high development effort these products require.

The versatile commodity plastic polypropylene (PP) as well as the large group of thermoplastic elastomers (TPE) belong to the group of plastics, where bio-based types are limited or previously not even represented.

Fully or partially bio-based TPE

The TPE family comprises different compounds, all with their own unique strengths

and advantages. Thus, TPE-S grades offer a favorable energy balance; they allow low weight components and injection molding or extrusion processing with short cycle times. In both cases, they are suitable for the two-component technology, e. g. for processing with PP or polyamide (PA).

Terraprene is a new bio-based TPE-S product line from FKuR with a renewable content of between 40 % and 90 %. Producers using Terraprene can tailor the hardness for the specific application depending on the proportion, between 20 Shore A and 40 Shore D (**fig. 1**). The performance characteristics and resistance properties of Terraprene compounds are similar to those of conventional petrochemical-based TPEs. The goal of current ongoing developments is to increase the renewable raw material portion in the lower Shore A hardness.

All Terraprene types can be colored individually. The density can also be adjusted according to customers' specifications. For the manufacture of products with unique and noticeable design features (**fig. 2**), fillings with wood fibers or other natural fibers are possible. Woody surfaces with a soft touch can be realized this way, thus the visualization of soft and natural surfaces is provided.

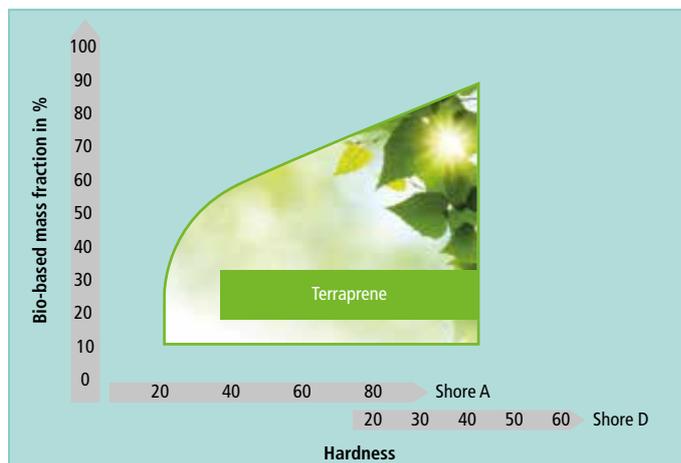
Partially bio-based PP compounds

PP, one of the most widely used plastics worldwide, is almost universally applicable, equally suitable for injection molding, thermoforming and extrusion and unproblematic for recycling. While PP homo-polymers are

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Fig. 1: Influence of the proportion of renewable raw material on the hardness of Terraprene



more stiff and transparent, PP copolymers have good low temperature properties due to their ethylene content, and PP random copolymers combine high strength with high transparency.

Bio-based PP grades have an opportunity in the market, if they also bring along these properties. FKUR continues to develop such modified PP compounds for injection molding and extrusion, with performance and processing characteristics similar to those of the established fossil based PP grades, so that converters can continue to use their existing tools. One of the first products available on the market is the partially bio-based Terralene PP 2509. With an MFI of 50 g / 10 min (measured at 230/2.16) it is also suit-

able for producing complex or thin-walled parts with long flow paths. In addition, this grade offers a good impact value, comparable to the value of conventional PP.

The partially bio-based PP compound Terralene PP V 260 for extrusion applications is still in development (V = experimental type). It combines a low MFR of 7 g / 10 min (measured at 230/2.16) with the PP performance characteristics. In **figures 3 and 4**, the properties of the new Terralene PP compounds are compared with those of conventional PP grades.

As these comparisons show, the modification in both types has little influence on the hardness. Regarding the stiffness, Terralene

PP 2509 reached slightly lower values than the pure PP materials, at the same time however, this grade is characterized by its high impact strength. Furthermore, a comparison of the flow properties emphasizes its good suitability for injection molding. As to the development type Terralene PP V 260, the MFI is currently still a bit too high for a pure extrusion grade. While the typical PP rigidity has already been achieved, the current subject of development is to bring the MFI down.

Increased bio-based content as a target

Since the basic development of the bio-based Terraprene TPE-S is already well advanced at FKUR, in this group of materials addressing customer-specific requirements is in the limelight. The Terralene PP grades with bio-based contents of 30 % to 35 % already offer many opportunities to replace conventional PP grades, without compromising the classical PP characteristics. Here, the current priority is the preservation of the PP typical properties, while further increasing the proportion of bio-based raw materials. In order to produce integrated bio-based plastic products, an overall focus is the combined processing of partially bio-based TPE and PP compounds in co-extrusion or 2K injection molding process.

Fig. 2: Terraprene TPE-S grades filled with wood offer a specific look and special surface structure



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Fig. 3: Comparison of tensile stiffness and Vicat A values of Terralene PP Compounds and typical conventional PP grades

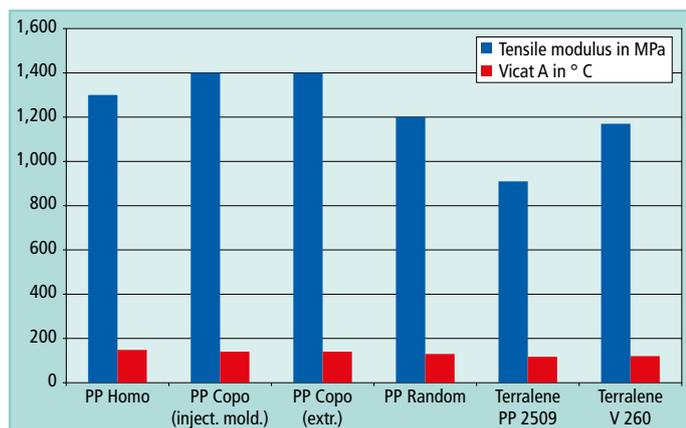


Fig. 4: Comparison of tensile strength, MFI values and Charpy notched impact strength of Terralene PP compounds and typical conventional PP grades

