FEATURE

Wood and natural fiber composites current trend in consumer goods and automotive parts

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Is the ''sleeping giant'' of injection molding with wood and natural fibers still asleep, as there are still many obstacles to be overcome? Most pessimistic actors believe that there are too many barriers for the injection molding of bio-based composites at present. Still, there are many signs in the market that the use of natural fibers – and especially pulp and wood fiber use – has increased in injection molding and not only in Europe, and that it will further increase due to a lot of new market players, larger production capacity, better quality and lower market prices.

WPC- and NFC-consumer goods entering bigger markets

More and more companies specifically use wood and natural fiber plastic granulates in consumer goods like watchcases, toys, combs or trays – the unique look and feel give the impression of a high-value product and are well received by customers. For many years research institutes and industrial labs have been developing Wood-Plastic Composites (WPC) and Natural Fiber Composites (NFC) and use the materials in small series of consumer goods. So far relevant volumes are only placed at the decking market. But it seems that the time has come to implement these materials in large-scale production. The end products have a more refined look as pure plastic products; they stand out, look more natural, have a nice feel and need less plastic due to the wood and natural fibers – which benefits the environmental footprint. The mechanical properties are also nothing to sneeze at. But the most important part: the products appeal to consumers.

In November 2015, Tchibo (DE) carried a WPC bedside table clock, two weeks later a series of toys from plantoys (TH) with wood particles from old rubber trees as filler. The surfaces of the toys have a pleasant rubber-like feel, quite different from traditional plastics. Bamboo fibers are also more and more frequently found in consumer goods, such as in trays from Yong (CH) at organic restaurants. The drugstore chain dm (DE) has been selling

NFC tray with bamboo fiber made by Yong. Image courtesy: nova-Institut GmbH. Image available at [1].

WPC bedside table clock by Tchibo. Image courtesy: nova-Institut GmbH. Image available at [1].

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WPC comb available at dm drug stores. Image courtesy: nova-Institut GmbH. Image available at [1].

Plantoys stacking game rocket made with rubber tree particles as filler, available at Tchibo amongst others. Image courtesy: nova-Institut GmbH. Image available at [1].

a comb made of 30% wood and 70% bio-based PE for about three years and recently added a second model. Special functionality of the material used is antistatic. The comb from ebelin (DE) belongs to nature-brand from ''dm'' that covers hygienic, cosmetic and detergent products with bio-based raw materials.

Market data

About 400,000 tons of Wood-Plastic Composites (WPC) and Natural Fiber Composites (NFC) are produced in Europe every year. The most important markets are decking, light-weight components for automobile interiors and consumer goods, for example toys. Sixty commercial WPC and NFC granulate producers and traders with web addresses and the plastics and fibers they use are listed in the latest edition of nova-Institute's market study ''Wood-Plastic Composites (WPC) and Natural Fiber Composites (NFC): European and Global Markets 2012 and Future Trends in Automotive and Construction'' (http://bio-based.eu/markets).

The most commonly used plastics in wood and natural fiber composites are PP, PE and PVC, but also bio-based polymers such as Bio-PE and PLA are used. Wood fibers are used in many variations; main contenders in natural fibers are bamboo, flax and hemp. Many producers, global players and small and medium sized companies alike are in business for the past few years. Only this newly developed professional infrastructure allows the consumer goods manufacturers to use the new materials without technical risk. The higher-quality look more than compensates for slightly higher granulate prizes.

From all fiber reinforced composites produced in Europe 15% (= 400,000 t) of total are reinforced with natural fibers like wood or bast fibers like hemp and kenaf.

Only a small share of 15,000 tons of these so called bio-based composites was injection-molded, with an average fiber share of 42% in 2012. According to survey from nova-institute in this kind of composites 92% of the polymers of choice were polypropylene (PP); the share of bio-based polymer matrix used was 6% and 2% was using polyethylene (PE) matrix. In injection molding, wood fibers have a share of 80%; the other fiber sources applied were pulp, bamboo, hemp and other natural fibers, along with grass and cellulosic waste materials. Why is the total amount of injection-molded WPC and NFC products still so small compared to extruded WPC or compression molded NFC products?

Experts see many specific reasons in the market structure. The prices for bio-based granulates are often higher than for conventional granulates, and greater knowledge still has to be gained about the material, i.e. neither plastic nor wood, but a composite with new properties. Technical sales of bio-based granulates pose a challenge and can easily frustrate trade staff, which are used to an easier job – i.e. selling standard plastic granulates by price alone.

The capacity to control the process by means of new process parameters like the necessity for additional drying of the compounds or reduced process temperatures must first be acquired. The use of natural fibers also makes a better tooling surface more of a necessity than for standard polymers. If WPC or NFC granulates is not dried adequately before processing, moisture from the wood content in matrix is released at high processing temperatures and helps to set free organic acids from the hemicelluloses, which then can corrode metal parts. As a result, tooling surfaces turn brown or black and the surfaces of the injection-molded parts looks inadequate.

Intensive cleaning and the use of surface additives are short-term measures, but intensive pre-drying is required for long-term success. The processing personnel have to learn about all the changes to standard polymer processes, like lower temperatures. Often positive results are not achieved simply by testing WPC in plastic standard processing, and frustrating experiences can leave users with the conclusion that WPC does not perform. Process control is one of the greatest market obstacles to the use of bio-based composites in injection molding.

So far, also mainly small producers and traders were offering WPC and NFC granulates with a limited technical support and often missing data for simulations. But also this is changing since PolyOne, one of the world leaders of compounding, is offering their new developed materials reinforced with special industrial produced wood fibers: PolyOne opens the industrial use of natural fibers reinforced solutions in many demanding end applications and markets, including automotive. reSound™ NF of PolyOne has a high level of consistency in shape and performance, with global availability. These two features have been among others most important hurdles in use of natural fibers in automobile application reSound™ NF of PolyOne has a minimum bio-based content of 30% in weight, and consists of a family of lightweight engineered wood fiber reinforced thermoplastics, together with a new coupling technology and a specific compounding process. reSound NF has to-date

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