Manufacturing with wood-plastic composites

What product designers and plastics manufacturers need to know about working with wood-plastic composites

green dot®

The material selection process usually begins with a new idea for a product, or an idea for improving on an existing product. The owner of that idea then sits down with a product designer to talk about turning it into a reality. They may discuss necessary physical characteristics, the materials that could in theory meet those needs, and the benefits and drawbacks of each potential material. Once these design decisions are made, the product can be sent to the manufacturer.

Though many of the formulaic details concerning the makeup of wood-plastic composites are made long before the material reaches the manufacturer, the particulars will be of some interest to toolmakers, molders, extruders and other manufacturers, as they may have a subtle effect on the overall flow of the process. Even with wood-plastic composites, which preserve so much of traditional plastic production, manufacturers will want to have a handle on details like the percentage of biomaterials used in the composite, particle size and processing temperatures.

This knowledge will help to alleviate any concerns that wood-plastic composites are an all-together foreign raw material and dispel any myths about their inherent “manufacturability.”

Particle size and wood species: The designer's choice

Particle size and wood species are two features of wood-plastic composites that designers are able to choose prior to production. These characteristics are typically selected during the design phase and will have a significant bearing on the look and feel of the finished product.

Larger-sized wood particles will be visible in the finished product, giving it a more wood-like appearance. Products manufactured from smaller-sized particles, on the other hand, will appear more like they were formed from a traditional plastic. If the appearance of being crafted from wood is important to the overall product, designers will be better served by a larger particle size.

The species of wood selected as the organic filler for the composite plastic will have an effect on the color of the final product. Items manufactured using a pine filler will come out lighter than those manufactured from a maple filler, for example. Discussing color considerations with your supplier is always a good idea.

Hardwood blends are another option for designers. But these can be difficult to color match, with a natural variability resulting from the uniqueness of each blend. If consistency is a primary concern, consider staying away from hardwood blends.

It may be helpful for product designers to engage manufacturers to discuss particle size and wood species, why each was chosen and any advice from the supplier on achieving the agreed-upon final characteristics. This will ensure that things flow smoothly from conception through execution.

Formula and tooling considerations for wood-plastic composites

The ratio of wood to plastic in the chosen formula of a wood-plastic composite will have some effect on its behavior as it goes through the production process. The percentage of wood present in the composite will have an effect on the melt flow index (MFI), for example. As a rule, the more wood that is added to the composite, the lower the MFI.

The percentage of wood will also have a bearing on the strength and stiffness of the product. Generally speaking, the more wood that's added, the stiffer the product becomes. Wood can make up as much as 70 percent of the total wood-plastic composite, but the resulting stiffness comes at the expense of the ductility of the final product, to the point where it may even risk becoming brittle.

Higher concentrations of wood also shorten machine cycle times by adding an element of dimensional stability to the wood-plastic composite as it cools in the mold. This structural reinforcement allows the plastic to be removed at a higher temperature than a conventional plastic. At temperatures where conventional plastics are still too soft to be removed from their molds, composites made with wood can successfully be ejected.

If the product will be manufactured using existing tools, the gate size and general shape of the molding should factor into the discussion of optimal wood particle size. A smaller particle will likely better serve tooling with small gates and narrow extensions. If other factors have already led designers to settle on a larger wood particle size, then it may be beneficial to redesign the existing tooling accordingly. But, given the existing options for different particle sizes, this outcome should be completely avoidable.

In general, the tooling considerations when working with wood-plastic composites are more or less the same as when working with conventional plastics. Even when changes are necessary, they can often be made as modifications to existing tooling, rather than from-scratch reboots. This compatibility makes beginning to work with wood-plastic composites a relatively easy transition.

Processing considerations for wood-plastic composites

Pellet size is an important aspect in plastic production no matter which feedstock is used. It's no less true when using wood-plastic composite pellets. Despite this reality, some wood-plastic composite suppliers seem to ignore the importance of small, rounded pellets during the production phase. They're simply unwilling to invest in the machinery necessary to achieve uniformity or to go through the time-consuming drying procedures required by more precise pellet cutting methods.

When pellets are too large they have a tendency to melt unevenly, create additional friction and settle into a structurally inferior final product. The ideal pellet should be about the size of a small BB and rounded to achieve an ideal surface to volume ratio. These dimensions facilitate drying and help to ensure a smooth flow throughout the production process. Manufacturers working with wood-plastic composites should expect the same shape and uniformity they associate with traditional plastics. The presence of organic filler is no excuse for chaotically sized pellets.

Low moisture content, again an important consideration in any plastic production, is essential to creating high quality plastics with organic fillers. A properly designed manufacturing process can bear most of the burden of reducing the presence of moisture. In an operation designed to first-and-

foremost produce wood-plastic composite materials, much of the machinery in the facility should be dedicated to drying. Organic fillers need to be dried properly before being added to the plastic, or the two will not bond correctly. The composites need to be dried again before being packaged to avoid the onset of molding and eventual degradation of the product. Ideally, customers themselves will not have to dry composite plastics once they've arrived at their facility. Low moisture content is something manufacturers should simply demand from their suppliers.

Processing temperatures are one of the few portions of the manufacturing phase where wood-plastic composites differ significantly from conventional plastics. Wood-plastic composites generally process in temperatures around 50 degrees lower than the same, unfilled material. Most wood additives will begin to burn at around 400 degrees Fahrenheit.

Melting wood-plastic composites at too high of a temperature risks shearing— pushing a material that's too hot, through too small of a gate, where the increased friction burns the wood and causes discoloration and a degraded plastic. This problem can be avoided by running wood-plastic composites at a lower temperature, ensuring the gate size is adequate and removing any unnecessary turns or right angles along the processing pathway.

Relatively low processing temperatures means that manufacturers seldom need to achieve higher temperatures than a traditional polypropylene. This eliminates the difficult task of taking heat out of the manufacturing process. There's no need for the addition of mechanical cooling equipment, molds specifically designed to reduce heat or other extraordinary measures. This means further reduced cycle times for manufacturers, on top of already faster cycle times due to the presence of organic fillers.

When it comes to processing techniques, wood-plastic composites once again behave similar to any other plastic. During foaming, extrusion and injection

molding, wood-plastic composites are compatible with existing machinery. For injection molding, the above considerations should be taken into account regarding gate size and positioning, but the overall process remains the same. With standard extruding equipment, uniformly sized wood-plastic composite pellets will have no problem performing up to expectations.

Wood-plastic composites are also compatible with foaming agents. The addition of these foaming agents can create a balsa-like material. This is a useful property when the finished product needs to be especially lightweight or buoyant.

The long and short of working with wood-plastic composites

The specifics of wood-plastic composite formulations should be discussed and considered throughout product design and manufacturing. Designers must keep in mind that material decisions concerning wood particle size and species will have implications for manufacturers. Manufacturers will no doubt have some questions about the chosen material. Will it work with my existing machinery? Will I need to redesign my tooling? What sort of cycle time should I expect with wood-plastic composites?

Knowing the answers to these questions will help manufacturers become more comfortable working with wood-plastic composites. As it turns out, wood-composite plastics are remarkably similar to conventional plastic, with the added benefit of environmental sustainability.

Green Dot has gone to great lengths to make sure this is the case. It's why we've invested in the cutting and drying equipment to produce uniform plastic pellets manufacturers can trust to create quality products. Because making the switch to Green Dot's wood-plastic composite pellets shouldn't feel like starting from square one, but instead, the start on the path to sustainability and beyond.

For more information about wood plastic composites and other bioplastics, visit Green Dot's website.

greendotbioplastics.com

527 Commercial Street
Suite 310
Emporia, Kansas
66801 USA

Email: info@greendotbioplastics.com
Phone: 620-273-8919