Biocomposite plastics vs. traditional plastics

Just how much are petroleum-based plastics costing us?

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According to the United Nations Environmental Programme (UNEP), petroleum-based plastic production costs the world economy $75 billion each year in natural capital. Plastic incineration and marine pollution are accounted for in that figure, but it is also estimated that fully 30 percent of that number is the result of "greenhouse gas emissions from raw material extraction and processing."

Petroleum is a big problem in plastic.

A major study published recently by researchers at the Carnegie Institution for Science at Stanford University simulated the probable effects of humans burning the rest of the planet's fossil fuels. It found that, were that to happen, we could be looking at sea level rises of between 160 and 200 feet. That would be bad news for major cities built along coastlines, which just so happens to be almost all of them.

Levels of carbon dioxide in the atmosphere have already passed the ominous milestone of 400 parts per million. As industries like transportation and manufacturing are exploring ways to make huge cuts in energy consumption, single and limited use items—many still made from entirely petroleum-based plastic feedstock—represent one of the most obvious and promising sectors for helping to cut fossil fuel use.

According to the U.S. Energy Information Administration, the United States used about 191 million barrels of hydrocarbon gas liquids (HDLs), or 2.7 percent of total U.S. consumption, on the production of plastics in 2010, the most recent year that statistics are available. The technologies and expertise exist to bring that number down. If the alternative is continuing oil exploration in sensitive ecosystems such as the Arctic Circle or Virunga region of the Congo Basin, two areas currently under threat, then surely it makes sense to be exploring every possible option for reducing demand for these nonrenewable materials.

Decades ago, the argument for exploring alternative materials in order to reduce the burning of fossil fuels may have been a purely environmental one. But today consumers are showing demonstrable preferences for consumer goods with lower environmental impacts. This is why innovative companies like Lego are distancing themselves from oil partnerships, and exploring ways to reduce the amount of petroleum feedstock that goes into their beloved toys. It's the reason for government programs such as the U.S.

Department of Agriculture's Biopreferred program, which certifies verifiably biobased products so that consumers can make informed, lower impact purchasing decisions.

Consumers recognize the dangers of ignoring planetary warning signs and want to make smarter choices at checkout. This has spurred on the search for viable alternatives to the use of petroleum-based plastics in consumer goods.

A biocomposite compromise

Biocomposite plastics represent an attractive alternative, both in their physical properties and their chemical makeup, to primarily petroleum-based plastic feedstock. Biocomposites are made from a matrix of plastic and renewable fillers. By replacing some of the petroleum-based content with organic fillers—up to 70 percent in some applications—biocomposites drastically reduce the amount of non-renewable feedstock that makes up these materials. Organic fillers can include reclaimed wood fibers, starch or other natural fibers, such as jute, hemp or flax. Biocomposites can be compounded with a variety of plastics including polyethylene and polypropylene.

Some biopolymers, such as PLAs and PHAs, have shown early promise as more sustainable alternatives. But, being based on natural chemical processes, their properties tend to be more or less fixed. Some have trouble standing up to even moderately high temperatures. Some become brittle at even moderately low temperatures. Some are simply too expensive to be manufactured as plastics on a large scale. For a solution to petroleum-based plastics to gain widespread use, a substitute will need to deliver a reduced carbon footprint without sacrificing performance, cost or quality. And the solution will need to be relatively easy to implement.

Biocomposite plastics meet all of those criteria. They are highly customizable in both physical appearance and performance characteristics. Wood-plastic composites, for instance, are capable of achieving a number of different

natural looks and feels based on the size and species of the chosen wood filler. Starch-based and other composite materials are also capable of mimicking traditional plastics very well; meaning manufacturers already happy with the look and feel of their products shouldn't shy away from investigating biocomposites. After all, with more than 70 percent of consumers now saying they value sustainability from the products they buy, these materials add value for even the best products.

Recycled plastic may be used to further reduce the environmental footprint of the material. Bio-fillers can be added to biodegradable polymers to lower cost without sacrificing renewable content or biodegradability. These composite materials can also be produced in a highly concentrated masterbatch, which can then be brought to the appropriate ratio by the customer.

Moreover, because biocomposites behave very similarly to traditional plastics, no expensive equipment overhauls or disruptive modification to manufacturing processes are necessary. These materials are viable alternatives for use in traditional manufacturing methods such as injection molding, extrusion or blow molding. They are even suited to lower processing temperatures, and faster processing times, resulting in reduced production costs.

As with processing any plastic, though, it's important to consider the processing conditions required for biocomposites. General considerations when processing a biocomposite include pre-drying, melt temperature and shrink behavior.

Biocomposites readily absorb moisture from the environment, which is why drying in a desiccant dryer prior to processing is often recommended for these materials. Processing temperature for biocomposites should not exceed 400° Fahrenheit. Above that threshold, the cellulosic parts of the fillers and

fibers risk burning, whereby the material can begin to discolor and degrade. In injection molding, increasing the size of runners and gates and decreasing injection speed can also help to alleviate the shear heat that can build up during the injection process. The natural fiber and fillers in a biocomposite also reduce the melt flow and shrink rate of the material. For example, polyethylene reinforced with wood fiber shrinks at a lower rate than pure polyethylene — and the higher the ratio of wood, the lower the melt flow and shrink rate of the composite.

Paint your product green

Just as early installations of wind turbines and rooftop solar panels haven't eliminated the need for fossil fuels completely, biocomposites won't be the silver bullet that eliminates the planet's need for fossil fuels. But they are a more sustainable alternative to petroleum-based plastics, and they are ready to be substituted into plastics manufacturing operations right now.

Some biocomposites materials are already certified as biobased by the USDA's Biopreferred program. This means that products made with these materials may qualify under the program and receive preferential treatment in federal government purchasing contracts.

Manufacturers can feel pride at the prospect of making a product with a reduced carbon footprint, while at the same time capitalizing on consumer preferences. And because biocomposite plastics are cost-competitive, they won't need to pit their customer's ideals against their wallets.

Biocomposite plastics are a step in the right direction for reducing carbon emissions and for moving towards independence from materials that rely on the extraction and processing of fossil fuels. If you would like to begin talking about how to make your material selection more environmentally responsible, reach out to Green Dot to request a product consultation today.

Request a product development consultation

Let's have a conversation about your product, timeline and goals.

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