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DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Bioplastic - Better Living Through Green Chemistry ?

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The New York Times recently had an editorial on Samsung's "Corn Phone", which is being heavily promoted as environmentally friendly as the casing is made from bioplastic. Somewhat to my surprise, they point out that it is neither - firstly because the bioplastic is made from corn (and is thus contributing to the problems that corn based ethanol is causing) and secondly because phones have become nearly throw away items that are rarely recycled.

> The electronics industry has been a major polluter, from the manufacturing end to the landfill. The dizzying pace at which consumer electronics become obsolete (What, you're still using that old phone?) compounds the problem. And increasingly rich countries are offloading the disposing, and often the incinerating, of phones and computers to poorer countries.
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> Unfortunately Samsung's new cellphone relies on a flawed equation: corn equals green. It is really time to throw out this formula for good. Bioplastic derived from corn requires special handling in recycling, and the difficulty of those processes makes them energy inefficient. Bioplastic also creates another market for corn, a much smaller market than the ethanol market, but growing nonetheless. New industrial demands for corn are driving up world food prices and are increasing the pressure to convert more nonagricultural land to corn production.
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> The truly green solution for electronics makers is to close the loop between manufacturing and recycling: reusing the plastics we so quickly and happily toss away to make new cellphones.

While Samsung's phone doesn't seem to have passed the "greenwash" test, peak oil poses a problem for plastic production for which bioplastic could be one potential solution, so in this post I'll have a look at what is happening in the industry and how our desire for plastics could perhaps be satisfied in a post oil world.

Plastic and peak oil

Chemicals and plastics are an integral part of peak oil concerns, as oil is the primary raw material used in their production, leading to the conclusion that as we pass the peak the shrinking availability and rising price of oil will cause a reduction in supply of these products.

There are 3 basic approaches to dealing with this scenario in a positive way:

1. Substitution: Use other materials - cardboard or paper packaging for example, or going back to using metal eating utensils instead of disposable plastic ones. Many other items currently made with plastic can also be made with wood, glass or metal (or even popcorn).

2. Recycling: Some plastics can be recycled - or converted back to oil for that matter, though the net energy benefit of this is debatable. Plastic recycling is already widely practiced though we have a long way to go before all recyclable plastics reach the correct destination. Recycling plastic not only reduces the amount of feedstock required to make the material, it also reduces the energy required in manufacturing by around 70%.

3. Bioplastics: Use carbohydrates to create plastics instead of hydrocarbons, an endeavour which was historically known as "chemurgy".

By and large, substitution would often seem to be a good thing in terms of reducing the amount of waste that ends up in our landfills (and the number of nurdles floating around in the oceans), though there are drawbacks like the extra effort and cost required to make objects out of materials that can't simply be injection moulded the way plastics can.

As a result, while substitution and recycling will often be the best way of dealing with the decline in availability of oil as a feedstock for plastic manufacture, we will likely still want to make new quantities of plastic each year - which leads us to bioplastics.

Bioplastic in Context

At this point bioplastics still comprise just a tiny fraction of the overall market, though one growing at an impressive rate of over 20% per year. The European Bioplastics Association says 1.5 million tonnes of bioplastics will be manufactured annually by 2011.

In comparison, according to the NZ plastic industry, 150 million tonnes each year of petroleum based plastics are produced (estimates for total production vary wildly unfortunately - BusinessWeek recently quoted a number of 500 million tons, while Biopact quotes a number of 200 million tonnes).

Plastic production is estimated to consume around 5% of global oil production each year (again, estimates vary quite a lot, and depend on if just feedstock is counted or if the energy to produce the plastic is also included) which represents the largest use outside the transport and energy sectors.

Developments in Bioplastic

Bioplastic developments have been appearing in the news with great regularity in recent years - The Economist recently noted that the number of patents granted for industrial biotechnology now exceeds 20,000 per year - with the rising price of oil increasing interest in them.

While bioplastic is often considered "green", this isn't necessarily true. Even if we ignore the problems associated turning food into packaging (in the case of corn based bioplastics), there are still many forms of bioplastic which aren't biodegradable. There is also the energy required to power farm machinery used in growing biomass feedstock, to produce fertilisers and pesticides, to transport biomass to processing plants, to process the biomass and ultimately to produce the bioplastic - most of which currently comes from non-renewable sources (though this could eventually be remedied, in time).

The best approach for dealing with the limits on bioplastic production (besides the substitution and recycling options) is similar to the approaches Amory Lovins talks about for dealing with the biofuels problem - redesign products so they need less bioplastic, and produce the bioplastic by harvesting from polyculture, perennial crops like switchgrass grown on non-agricultural land.

Designer Phillippe Starck, a recent high profile convert to green thinking (dubbing all his previous work "unnecessary") recently explained his choice of environmentally unfriendly polycarbonate as the material for a new chair design, which should give you an idea of some of the trade-offs

currently facing designers considering alternatives to plastics:

> Wired: Recently, you have begun to look at the environmental impact of your designs. How does a plastic chair fit in?
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> Starck: The stupidity of the ecological movement is that people kill trees for wood. It's ridiculous. The best ecological strategy is to make products of a very high creative quality, so you can keep them for three generations. I prefer to make a very good chair in the best polycarbonate than make any shit in wood that will be in the trash one year later.
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> Wired: Why not use recycled plastic?
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> Starck: It's a little joke of a material. You can do almost nothing with it. And I also refuse bioplastic, which comes from something that people can eat. Scientists agree that we have a real food problem, a famine approaching. It's a crime against humanity to take something you can eat and make a chair — or use it as gas for your SUV.

There are also some concerns about greenhouse gas emissions, though these seem questionable.

Some examples of bioplastic producers and uses include:

* US company Metabolix, manufacturer of a biodegradable bioplastic called Mirel, has announced that they have genetically engineered a way to generate "significant amounts" of bioplastic by growing it in directly in the fast growing perennial plant switchgrass. Metabolix is also looking to use a technology developed in Queensland to produce plastic from sugarcane (without affecting sucrose production) at a cost of $1 to $2 per kilogram.

* Mazda is looking to use cellulose based bioplastic in cars from 2013.

* Australian firm Plantic produces a biodegradable bioplastic from corn starch which is used in packaging, using a technology developed by the CSIRO.

* US firm NatureWorks (a subsidiary of agribusiness giant Cargill) has opened a factory in Nebraska, producing 140,000 tonnes of a biodegradable plastic known as PLA, using corn starch. Wal*mart is a major customer, using the material for food containers.

* Dow (the world's largest producer of conventional plastics), is building a factory in Brazil that will produce polyethylene using ethanol made from sugarcane. It is due to open in 2011 and will produce 350,000 tonnes of the material a year. The Times quotes a Dow spokesman as saying

that using sugarcane to make polyethylene (rather than the usual naptha-based crude oil or natural gas) is economic with oil prices even when they are at $45 per barrel.

* Brazilian company Braskem is also aiming to produce 200,000 tonnes of polyethylene a year from ethanol.

* NEC has developed a recyclable bioplastic which remembers its shape

* Researchers at New York's Polytechnic University have genetically engineered a bioplastic that can be converted into biodiesel after it has been used, resulting in funding from DARPA and interest from the US military.

* A process developed at the University of Waikato in New Zealand will allow animal waste like blood meal and feathers to be turned into a biodegradable plastic.

* Researchers at Iowa State University and Cornell are looking at using nanoclay particles and nanotechnology techniques to make bioplastics that biodegrade faster and have improved mechanical properties (such as strength).

* Novomer is trying to commercialise a process developed at Cornell for producing bioplastic from carbon dioxide and orange peels (a rare useful example of carbon sequestration).

* Canada's National Research Council is researching the use of bacteria that produce bioplastic from maple syrup and sap, harnessing the large surplus of syrup.

* Fabric manufacturer Interface is looking to make plastic from potatoes in Maine.

* Japanese firm NTA is looking to produce bioplastic from Kenaf grown in Queensland.

* The rising price of polyurethane is causing some surfboard manufacturers to turn to plant based biofoam.

Summary

The 5% of oil consumption that is related to plastic production seems to be a form of low hanging fruit that we could dispense with fairly easily, with a combination of mandating the use of recyclable plastics and/or bioplastics and making sure that materials are recycled wherever possible, while also looking to be more efficient in our usage of the stuff in the first place.

Bioplastics aren't a silver bullet in this respect but they are a useful tool for helping to eliminate one form of oil usage, so I think they should be encouraged and promoted - particularly biodegradable versions manufactured from non-food crops or waste.

Cross-posted from Our Clean Energy Future.