



The Society Promoting Environmental Conservation

Biodegradation: An Easy Solution?

Today the environmental problems posed by disposable plastics are well known; images of wild and marine life entangled in bags have been circulated online, in newspapers and elsewhere. We also know that plastic fills up our landfills and doesn't fully biodegrade, and traditional petroleum-based plastics pose serious ecological risks and waste management problems. Recycling of plastics, while now more common, is still low¹ and does not constitute a closed-loop cycle². As a solution we've been told to use biodegradables and similarly, businesses, restaurants and cafés have switched to allegedly biodegradable packaging, food ware and utensils. The question is, is transitioning to these materials truly a step forward? What does biodegradable really mean, and are the realities of the end-of-life treatment of biodegradable products in line with what we have come to expect for a compostable product?

What is biodegradation?

Biodegradation is the process of decomposition through microbial attack - but just because something *can* be lunch for a host of hungry bacteria, doesn't mean it will be. Just as you aren't going to get a chance to eat a delicious cake left on the moon, if a technically biodegradable material is left in an environment that is totally inhospitable to the microbes that like to eat it, it will simply sit there for a very, very long time. The insides of landfills might as well be the dark side of the moon if you're a microbe; they can be so dry, so dark and so airtight, that they aren't inviting at all for the bacterial processes which were planned for, and essentially mummify³ things buried in them, leaving even something as seemingly transient as newspaper legible for *decades*. So any product labeled, certified, or otherwise advertised as being biodegradable isn't living up to its promises if we just throw it in the trash. In other words, biodegradation is an opportunity - not a guarantee.

The Benefits

Many of the new biodegradable materials being marketed today have one great advantage over petroleum plastics - they aren't made of petroleum! Instead, these new plastics are being derived from a variety of organic materials, which means that any carbon they ultimately release into the atmosphere upon incineration or aerobic decomposition was taken *out* of the atmosphere by plants fairly recently, making the whole cycle carbon neutral (at least in terms of materials - manufacturing is discussed below). This zero-sum game for carbon is in stark contrast to the tons of greenhouse gases

¹ "Energy and Economic Value of Nonrecycled Plastics (NRP) and Municipal Solid Wastes (MSW) that are Currently Landfilled in the Fifty States", N.J. Themelis et. al., Columbia University Earth Engineering Center, <http://jrnetsolserver.shorensteincen.netdna-cdn.com/wp-content/uploads/2011/11/Report-from-Columbia-Universitys-Earth-Engineering-Center.pdf>

² Curious or unsure about the idea of a 'closed loop economy'? Check out the charming introductory video at http://www.youtube.com/watch?feature=player_embedded&v=zCRKvDyyHml

³ "The Archaeology of Contemporary Landfills", W.L. Rathje, *American Antiquity*, 57(3), 1992, pp. 437-447.

being pumped into our atmosphere every year by the consumption and disposal of petroleum plastics, and that makes biologically derived plastics another handy tool for slamming the brakes on global warming and avoiding the many immediate environmental hazards unique to traditional plastics like nurdle spills⁴ and long-term wildlife exposure⁵. When composted carefully under the conditions they were designed to decay under, bioplastics can in principle be effectively diverted from landfill, thus mitigating landfill volume and reducing the lifetime of plastic pollution long-term - but the tremendous boons of helping to shake off our addiction to oil and stem the flow of garbage to our landfills doesn't come without a price.

The Drawbacks

Biodegradable plastics may be a slam dunk when it comes to material composition, but that's neither the beginning nor the end of a disposable product's life story. We already touched on one of the key problems with biodegradable plastics - that biodegradation doesn't *just happen* in any old place, but has to be nurtured with the right conditions. Major international standards of biodegradability such as ASTM D6400⁶ and D6868⁷ as administered by the Biodegradable Products Institute only guarantee that certified products will biodegrade properly in large-scale, professionally managed industrial facilities - not in a back-yard composter, and absolutely not in a landfill. In fact, a published study⁸ illustrated that bioplastics are in simulation the *worst* contributor to landfill greenhouse gas production as they decay anaerobically (meaning without any oxygen), in landfills that don't use the most cutting edge methane capture and mitigation technologies. So in reality, if we are throwing bioplastics in with the trash, we may be making a bigger problem than we're solving. Compound this with the fact that bioplastic production may rely on crop inputs that conflict with food production (driving up the cost of produce around the world) or incorporate transgenic crops or use petroleum as fuel, pesticides or fertilizers and all the potential problems that come packaged with them, and the ecological pricetag of bioplastics becomes higher than we may have bargained for.

When we are shopping it is not uncommon to see some products labeled 'biodegradable', and others labeled 'compostable' - it is easy to think these words are synonymous, but unfortunately, it is not that simple. As noted above, biodegradability only asserts that a host of microbes can attack and consume a material via metabolic processes - the question is, what do those microbes turn our garbage into? Just because a process occurs under the auspices of a biological reaction does not mean its results are benign; some of the most brutal toxins in the world are biological in origin, and microbes are perfectly capable of ingesting and re-releasing inorganic compounds into the ecosystems they inhabit. In order for a material to be genuinely compostable - that is, for it to decompose in the environmentally benign way we are hoping for when we seek to buy compostable or biodegradable products - the material end result must be that of *humus*⁹ - nutrient rich soil composed of strictly organic material that remains stable indefinitely or until consumed by new plant growth - and this is not necessarily true of every material that may be attacked microbially. The linguistic snarl

⁴ <http://www.takepart.com/article/2012/08/09/thats-not-snow-its-plastic-spill>

⁵ WARNING: unpleasant photographs

<http://www.chrisjordan.com/gallery/midway/#CF000313%2018x24>

⁶ http://greenplastics.com/wiki/ASTM_D6400

⁷ <http://www.bpiworld.org/Default.aspx?pageId=190424>

⁸ 'Is Biodegradability a Desirable Attribute for Discarded Solid Waste?', *Environmental Science & Technology*, Vol. 45, Issue 13, page 5470-5476

⁹ http://en.wikipedia.org/wiki/Bioplastic#The_.22Compostable.22_Controversy , also <http://en.wikipedia.org/wiki/Humus>

between the terms 'compostable' and 'biodegradable' becomes especially misleading when companies assert the compostability of their product under the authority of the now-abandoned compostability standard ASTM D 6002, which failed to forbid the presence of inorganic compounds¹⁰ in the end product of the biodegradation process. It seems especially egregious and dishonest for companies to continue to represent their products under an abandoned standard of compostability that does not reflect the level of environmental stewardship that concerned parties would expect of materials carrying such labels, and as such, it is crucial that buyers beware of just what the green-seeming labels on their products mean! Biodegradability doesn't guarantee a benign composting process resulting in biologically rich and friendly humus - and even former industry standards of compostability adhered to by some companies out of convenience do not guarantee we're getting what we're paying for. New and stricter standards of compostability are needed, and until then - buyer beware.

Conclusion

All told, the use of biodegradable and biologically derived plastics has a lot of promise, but it isn't a free pass to buy whatever we want and chuck it out afterwards. Nevertheless, information and certification that products can biodegrade is a necessary first step in creating a system that stewards plastics from responsible creation and consumption, through disposal that respects our planet and meets the expectations that we have all been led to have for compostable and biodegradable materials. Looking forward, the same study that pointed the finger at bioplastics as being the worst offender in average American landfills for greenhouse gas production also noted that when a landfill is properly managed, switching to biodegradable plastics does in fact lower the greenhouse gas footprint of landfills, and avoids the extremely long-term persistence of traditional plastics. And biodegradable products made from the waste materials of food production skirt many of the issues associated with using food as bioplastics.

For now, it is crucial that we remember that the promises of biodegradability are only a potential for our waste - a potential that still has to be lived up to. In the meantime, remembering not to use unneeded products will help reduce unnecessary consumption, whether biodegradable or not.

¹⁰ [http://en.wikipedia.org/wiki/Biodegradable_plastic#The .22Compostable.22 Controversy](http://en.wikipedia.org/wiki/Biodegradable_plastic#The_.22Compostable.22_Controversy) ; also internally, <http://www.compostable.info/compostable.htm>