The 30% Solution – Why Recycling Works but Doesn't Work

Recycling is Simply a Solid Waste Management Solution

By Laura Mauney

Municipal recycling of petrochemical plastics in the United States has been a hard-won fight for eco-conscious citizens. Even as the biopolymer market expands, plastics recycling must clearly continue for as long as petrochemicals are part of the waste stream.

The battle in the U.S. to raise awareness about the impact of littering started back in the 1950s with the "Keep America Beautiful" (http://www.kab.org/site/PageServer?pagename=index) campaign. In the early 1970s, dramatic television commercials like the one shown here sounded early warnings about the impact of non-degradable trash on the environment.

By the 1980s, as trash built up in landfills, on city streets, on highways and in waterways, limited efforts to recycle had begun.

Households, schools, and businesses were rallied to sort single-use containers made of aluminum, plastic, glass and newspaper from regular garbage. Communities organized private recycling efforts, often as fundraisers. Recycling companies launched satellite stations in parking lots at shopping plazas, enabling individuals to carry in recyclables to redeem for cash on the spot.

Ironically, the 1980s was also the decade when mass production ballooned for disposable plastic products. Soon, plastic bottles, grocery and trash bags, disposable diapers, shrink wrap, jewel cases, milk carton caps, yogurt cups, single-use dishware became commonplace in our culture. Landfills (which also consume valuable land) quickly began to fill beyond capacity with plastics that had not been diverted to recycling.

Plastics recycling was complicated, too. Unlike glass, aluminum and paper, different types of plastics (soft to hard to foamed) are made of different chemical compounds. The chemical range prevents multivarious plastic items from being reformed in a single melting pot.

In 1988, the SPI (Society of the Plastics Industry) created the plastic resin code system (http://www.plasticsindustry.org/AboutPlastics/content.cfm?ItemNumber=823&navItemNumber=1125). Each number represents a different plastic compound. The resin codes, which we now commonly see embedded on plastic objects, are used by recycling facilities to sort plastic types from each other.

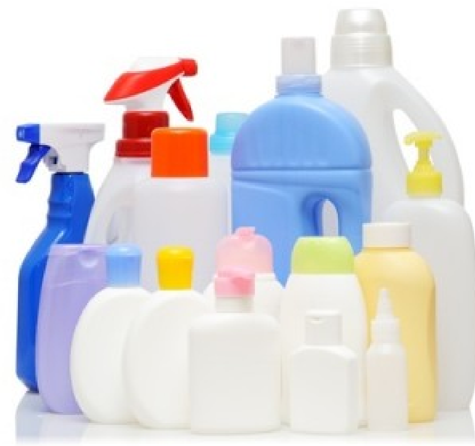
Petro-Plastic Resins and Codes

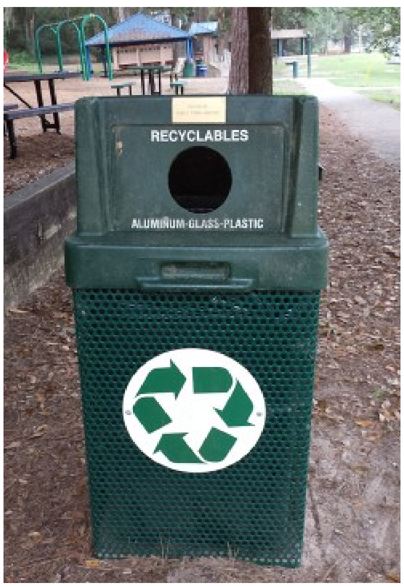
(Roll mouse over to see typical virgin and recycled uses and known chemical risks)

1. Poly(ethylene terephthalate) – PETE or PET
2. High-density Polyethylene – HDPE or PE-HD
3. Poly(vinyl chloride) – V or PVC
4. Low-density Polyethylene – LDPE or PE-LD
5. Polypropylene – PP
6. Polystyrene (foamed plastic) – PS – EPS

7. Other resins – OTHER

*Sources: *PlasticsIndustry.org (http://www.plasticsindustry.org/AboutPlastics/content.cfm?ItemNumber=823&navItemNumber=1125)*, *Wikipedia.org (https://en.wikipedia.org/wiki/Plastic_recycling)*, *NationofChange.org (http://www.nationofchange.org/numbers-plastic-bottles-what-do-plastic-recycling-symbols-mean-1360168347)*, *BreastCancerFund.org (http://www.breastcancerfund.org/clear-science/environmental-breast-cancer-links/plastics)*





U.S. municipal recycling systems had kicked in full-bore by the 1990s. Blue bins emblazoned with white recycling symbols were delivered to households across the nation. Recycling receptacles began to show up in public parks and the alleys behind restaurants.

On a different front, scientists began to research and develop more eco-compatible materials.

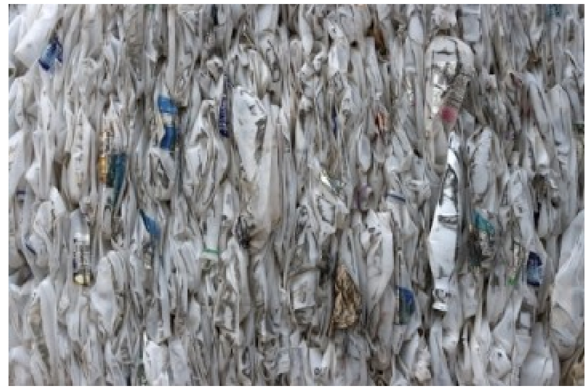
In 1998, *Nodax*^{TM} PHA – a bioplastic that decomposes organically, like discarded food and yard waste – was invented by Dr. Isao Noda and patented by Procter & Gamble. The company developed it for use in disposable diapers to help mitigate landfill buildup.

By the mid-2000s, localized environmentalism had evolved into a new movement to "reduce, reuse, repurpose, and recycle" non-degradable, single-use products. The movement was led by the very young millennials who'd been reared on single-use plastic products.

Today, over sixty years after the launch of "Keep America Beautiful," municipal and state governments across the U.S. are passing legal bans against plastic single-use carryout bags, microbeads in cosmetic products, and foamed plastic dishware.

Meanwhile, recycling and repurposing non-compostable trash has become both a household routine and big business for municipalities and private firms. According to Statista.com, the business of recycling in the U.S. (http://www.statista.com/topics/1275/recycling-in-the-united-states) has grown into a multi-billion dollar industry since the 1970s, with projected growth to over 100 billion in revenues by the year 2020.

From large urban areas like Los Angeles, (http://lacitysan.org/solid_resources/recycling) with a 76% landfill diversion rate



(http://lacitysan.org/solid_resources/pdfs/2013/ZERO_WASTE_PROGRESS_REPORT_2013_GRAPH_AND_CHART.pdf), to mid-sized towns like Tallahassee, FL, with a 67% diversion rate (http://www.marpan.com/about-marpan/history), recycling has become – almost – an American success story.

So Why is there still so much Plastic Trash Lying Around?

According to the U.S. EPA, in 2013, the average municipal solid waste diversion rate for the U.S. (http://www.epa.gov/solidwaste/nonhaz/municipal) was 34.3%. Out of a total of 254 million tons of generated MSW, about 87 million tons were diverted. Plastic (all kinds) comprised 12.8% or about 32 million tons of the total MSW. Of that, only 31.3% of PET bottles and jars, and 28.2% of HDPE bottles were successfully recycled.

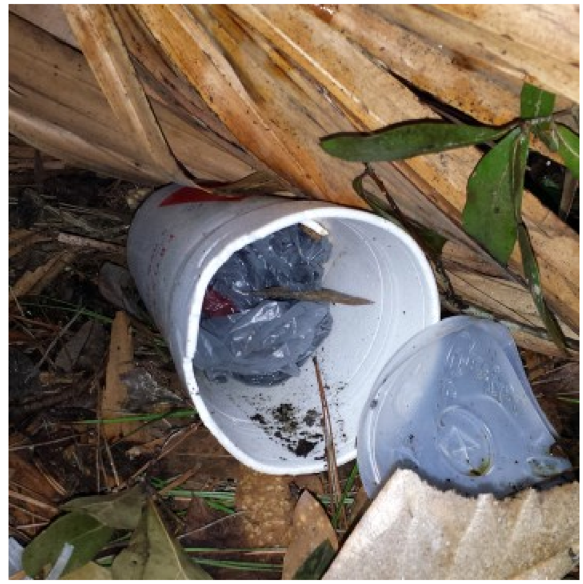
Reality Check:

Successful petro-plastics recycling is entirely dependent on human behavior. No matter how efficient municipal waste management becomes, people will continue to discard plastic in the wrong bin, or simply drop it after use. Additionally, similar to the situation in the U.S. decades ago, waste management systems in emerging nations today lag far behind the impacts of population growth and the globalization of the plastics market.

Moreover, the problems with plastic remain whether the stuff is recycled or not. Plastic will not break down into base elements for hundreds of years. It attracts and binds with toxins at the molecular level. It cannot be openly burned because incineration releases toxic gasses and smothering carbon pollution into the atmosphere.

Additionally, a lot of plastic trash is not recyclable at all. In some cases, the chemical constitution of a resin cannot survive reconstruction. In others, the plastic was initially used in a way that cannot be managed by a recycling facility.

Meat wrapping, Styrofoam crumbles, peel off lids, labels, adhesive, tape, and bottle seals – unlike paper or bioplastic – simply wind up lying by the wayside, floating in water, floating in the air, or stuck in a landfill, seemingly forever.



Says Dr. Noda, who now serves as MHG's Chief Science Officer, "The world has to realize that we produce every year about 30,000,000 metric tons of petroleum-based non-degradable plastics. About 8% of them are believed to end up in the ocean and obviously they are not recycled."

"Incineration and recycling takes only a very tiny portion of this enormous and continuous influx of plastics to the world," continues Noda. "And what will happen to the rest? They will stay with us, our grandchildren and well beyond! Should we be scared? Yes, we should.

"Unless we have a replacement material to the conventional plastics with predetermined lifetime instead of the semi-permanent persistence, we will keep accumulating more and more of the waste to no end. Bioplastics with known end-of-life points may be one of the very few currently available hopes for dealing with such challenge."

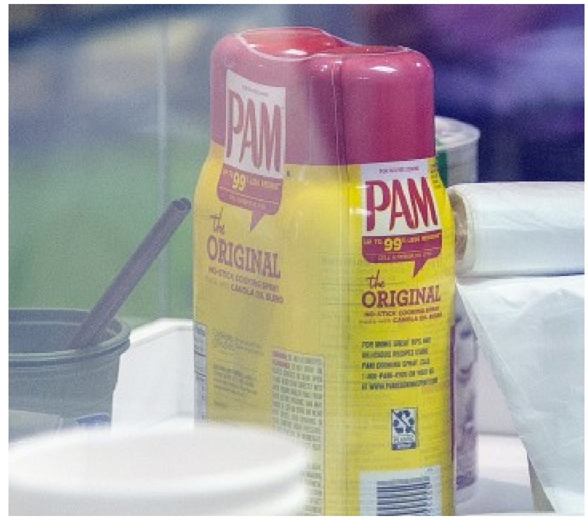
Bioplastics are both a Resource Management Solution and a Solid Waste Management Solution

Although, again, there is no question that recycling efforts should continue to grow, the bottom line is that the only 100% solution to plastic pollution is to replace as many petrochemical plastics as possible with biodegradable plastics.

Today, at MHG, the same *Nodax*^{TM} PHA introduced at the end of the last century to facilitate the breakdown of disposable diapers in landfills is being further developed for a much broader range of plastic applications.

PHA can be structurally modified to create a variety of bioplastic resins that equal or improve on the properties of many petrochemical resins. Variations of PHA do not require a numbering system for correct disposal or reuse. Because it is entirely biobased, PHA will simply be eaten as fatty food by microbes when discarded in landfills, compost, soil or water.

Applications for PHA include bottles, carryout shopping bags, dishware and clamshells, agricultural mulch, food packaging, fishing lures, hard plastic toys and soft plastic baby bottle nipples, and a full range of personal products.



The biodegradability of PHA will have a positive impact on both managed and mismanaged waste. PHA will help lower landfill volume, improve landfill natural gas (LNG) production, eliminate plastic litter, and mitigate the adverse environmental impact of petro-plastic production and disposal.

Even as bioplastics output continues to grow, efforts to recycle, and the industries that support those efforts, can continue to grow, as well. MHG, in fact, produces products made of PHA that assist the recycling industry.

Explains Dr. Noda, “When cardboard products and packages, which are glued with conventional polyolefin-based hot melt adhesive, is recycled, it creates the so-called stickies, which interfere with repulsing. In contrast, aliphatic polyester used in our novel hot melt adhesive will be chemically digested to a benign material during the de-inking and repulsing processes of cardboard for recycling.”

Additionally, bottles and other commonly recycled products made of PHA bioplastics are unlikely to interfere with the recycling stream.

“Fortunately, our PHA does not look like PET at all,” says Noda. “Instead it looks like polyolefin, such as polyethylene or polypropylene. So it can be easily differentiated from PET. It is even easier to sort out PHA from polyethylene or polypropylene since PHA sinks in water while polyolefin plastic floats. Infrared-based sorting also is straightforward.”

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