Plastic recycling

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Plastic recycling is the process of recovering scrap or waste plastic and reprocessing the material into useful products. Since plastic is non-biodegradable, recycling it is a part of global efforts to reduce plastic in the waste stream, especially the approximately eight million metric tonnes of waste plastic that enter the Earth's ocean every year.[1][2] This helps to reduce the high rates of plastic pollution.

Plastic recycling includes taking any type of plastic sorting it into different polymers and then chipping it and then melting it down into pellets after this stage it can then be used to make items of any kind such as plastic chairs and tables. Soft Plastics are also recycled such as polyethylene film and bags. This closed-loop operation has taken place since the 1970s and has made the production of some plastic products amongst the most efficient operations today.

Compared with lucrative recycling of metal, and similar to the low value of glass, plastic polymers recycling is often more challenging because of low density and low value. There are also numerous technical hurdles to overcome when recycling plastic.

A macro molecule interacts with its environment along its entire length, so total energy involved in mixing it is largely due to the product side stoichiometry (see enthalpy). Heating alone is not enough to dissolve such a large molecule, so plastics must often be of nearly identical composition to mix efficiently.

When different types of plastics are melted together, they tend to phase-separate, like oil and water, and set in these layers. The phase boundaries cause structural weakness in the resulting material, meaning that polymer blends are useful in only limited applications.

Another barrier to recycling is the widespread use of dyes, fillers, and other additives in plastics. The polymer is generally too viscous to economically remove fillers, and would be damaged by many of the processes that could cheaply remove the added dyes. Additives are less widely used in beverage containers and plastic bags, allowing them to be recycled more often. Yet another barrier to removing large quantities of plastic from the waste stream and landfills is the fact that many common but small plastic items lack the universal triangle recycling symbol and accompanying number. An example is the billions of plastic utensils commonly distributed at fast food restaurants or sold for use at picnics.

The percentage of plastic that can be fully recycled, rather than downcycled or go to waste can be increased when manufacturers of packaged goods minimize mixing of packaging materials and eliminate contaminants. The Association of Plastics Recyclers have issued a Design Guide for Recyclability.[3]

The use of biodegradable plastics is increasing.[4]

Contents

Processes

Before recycling, most plastics are sorted according to their resin type. In the past, plastic reclaimers used the resin identification code (RIC), a method of categorization of polymer types, which was developed by the Society of the Plastics Industry in 1988. polyethylene terephthalate, commonly referred to as PET, for instance, has a resin code of 1. Most plastic reclaimers do not rely on the RIC now; they use automatic sort systems to identify the resin. Ranging from manual sorting and picking of plastic materials; to mechanized automation processes that involve shredding, sieving, separation by rates of density i.e. air, liquid, or magnetic, and complex spectrophotometric distribution technologies e.g. UV/VIS, NIR, Laser, etc.[5] Some plastic products are also separated by color before they are recycled. The plastic recyclables are then shredded. These shredded fragments then undergo processes to eliminate impurities like paper labels. This material is melted and often extruded into the form of pellets which are then used to manufacture other products.

Thermal depolymerization

Another process involves the conversion of assorted polymers into petroleum by a much less precise thermal depolymerization process. Such a process would be able to accept almost any polymer or mix of polymers, including thermoset materials such as vulcanized rubber tire separation of wastes and the biopolymers in feathers and other agricultural waste. Like natural petroleum, the chemicals produced can be made into fuels as well as polymers. A pilot plant of this type exists in Carthage, Missouri, United States, using turkey waste as input material. Gasification is a similar process, but is not technically recycling, since polymers are not likely to become the result.

Waste Plastic Pyrolysis to fuel oil

Plastic Pyrolysis can convert petroleum based waste streams such as plastics into quality fuels, carbons. [6] [7] [8] [9] [10]

Given below is the list of suitable plastic raw materials for pyrolysis:

- Mixed plastic (HDPE, LDPE, PE, PP, Nylon, Teflon, PS, ABS, FRP etc.)
- Mixed waste plastic from waste paper mill
- Multi Layered Plastic

Heat compression

Yet another process that is gaining ground with startup companies (especially in Australia, United States and Japan) is heat compression.[11] The heat compression process takes all unsorted, cleaned plastic in all forms, from soft plastic bags to hard industrial waste, and mixes the load in tumblers (large rotating drums resembling giant clothes dryers). The most obvious benefit to this method is the fact that all plastic is recyclable, not just matching forms. However, criticism rises from the energy costs of rotating the drums, and heating the post-melt pipes.

Distributed recycling

For some waste plastics, recent technical devices called recyclebots[12] enable a form of distributed recycling. Preliminary life-cycle analysis(LCA) indicates that such distributed recycling of HDPE to make filament of 3-D printers in rural regions is energetically favorable to either using virgin resin or conventional recycling processes because of reductions in transportation energy[13][14]

Other processes

A process has also been developed in which many kinds of plastic can be used as a carbon source in the recycling of scrap steel.[15] There is also a possibility of mixed recycling of different plastics, which does not require their separation. It is called Compatibilization and requires use of special chemical bridging agents compatibilizers. It can help to keep the quality of recycled material and to skip often expensive and inefficient preliminary scanning of waste plastics streams and their separation/purification.[16]

Applications

PET

Post-consumer polyethylene terephthalate (PET or PETE) containers are sorted into different colour fractions, and baled for onward sale. PET recyclers further sort the baled bottles and they are washed and flaked (or flaked and then washed). Non-PET fractions such as caps and labels are removed during this process. The clean flake is dried. Further treatment can take place e.g. melt filtering and pelletising or various treatments to produce food-contact-approved recycled PET (RPET).

RPET has been widely used to produce polyester fibres.[17] This sorted post-consumer PET waste is crushed, chopped into flakes, pressed into bales, and offered for sale.[18]

One use for this recycled PET that has recently started to become popular is to create fabrics to be used in the clothing industry.[19] The fabrics are created by spinning the PET flakes into thread and yarn.[18] This is done just as easily as creating polyester from brand new PET.[20] The recycled PET thread or yarn can be used either alone or together with other fibers to create a very wide variety of fabrics. Traditionally these fabrics are used to create strong, durable, rough, products, such as jackets, coat, shoes, bags, hats, and accessories since they are usually too rough for direct skin contact and can cause irritation.[21] However, these types of fabrics have

become more popular as a result of the public's growing awareness of environmental issues. Numerous fabric and clothing manufacturers have capitalized on this trend.

Other major outlets for RPET are new containers (food-contact or non-food-contact) produced either by (injection stretch blow) moulding into bottles and jars or by thermoforming APET sheet to produce clam shells, blister packs and collation trays. These applications used 46% of all RPET produced in Europe in 2010. Other applications, such as strapping tape, injection-moulded engineering components and even building materials account for 13% of the 2010 RPET production.

In the United States the recycling rate for PET packaging was 31.2% in 2013, according to a report from The National Association for PET Container Resources (NAPCOR) and The Association of Postconsumer Plastic Recyclers (APR). A total of 1,798 million pounds was collected and 475 million pounds of recycled PET used out of a total of 5,764 million pounds of PET bottles.[22]

HDPE

Plastic # 2, high-density polyethylene (HDPE) is a commonly recycled plastic. It is typically downcycled into plastic lumber, tables, roadside curbs, benches, truck cargo liners, trash receptacles, stationery (e.g. rulers) and other durable plastic products and is usually in demand.

PS

Most polystyrene products are currently not recycled due to the lack of incentive to invest in the compactors and logistical systems required. As a result, manufacturers cannot obtain sufficient scrap. Expanded polystyrene (EPS) scrap can easily be added to products such as EPS insulation sheets and other EPS materials for construction applications. When it is not used to make more EPS, foam scrap can be turned into clothes hangers, park benches, flower pots, toys, rulers, stapler bodies, seedling containers, picture frames, and architectural molding from recycled PS.[23]

The resin identification code symbol for polystyrene

Recycled EPS is also used in many metal casting operations. Rastra is made from EPS that is combined with cement to be used as an insulating amendment in the making of concrete foundations and walls. Since 1993, American manufacturers have produced insulating concrete forms made with approximately 80% recycled EPS.

Other plastics

The white plastic polystyrene foam peanuts used as packing material are often accepted by shipping stores for reuse.[24]

Successful trials in Israel have shown that plastic films recovered from mixed municipal waste streams can be recycled into useful household products such as buckets.[25]

Similarly, agricultural plastics such as mulch film, drip tape and silage bags are being diverted from the waste stream and successfully recycled[26] into much larger products for industrial applications such as plastic composite railroad ties.[27] Historically, these agricultural plastics have primarily been either landfilled or burned on-site in the fields of individual farms.[28]

CNN reports that Dr. S. Madhu of the Kerala Highway Research Institute, India, has formulated a road surface

that includes recycled plastic: aggregate, bitumen (asphalt) with plastic that has been shredded and melted at a temperature below 220 degrees C (428 °F) to avoid pollution. This road surface is claimed to be very durable and monsoon rain resistant. The plastic is sorted by hand, which is economical in India. The test road used 60 kg of plastic for an approximately 500m-long, 8m-wide, two-lane road. The process chops thin-film road-waste into a light fluff of tiny flakes that hot-mix plants can uniformly introduce into viscous bitumen with a customized dosing machine. Tests at both Bangalore and the Indian Road Research Centre indicate that roads built using this 'KK process' will have longer useful lives and better resistance to cold, heat, cracking, and rutting, by a factor of three.[29]

Recycling rates

The quantity of post-consumer plastics recycled has increased every year since at least 1990, but rates lag far behind those of other items, such as newspaper (about 80%) and corrugated fiberboard (about 70%).[30] Overall, U.S. post-consumer plastic waste for 2008 was estimated at 33.6 million tons; 2.2 million tons (6.5%) were recycled and 2.6 million tons (7.7%) were burned for energy; 28.9 million tons, or 85.5%, were discarded in landfills.[31]

Economic and energy potential

In 2008, the price of PET dropped from $370/ton in the US to $20 in November.[32] PET prices had returned to their long-term averages by May 2009.[33]

Recycling one ton of plastic can save 5,774 kWh of energy, 98,000,000 btus of energy, 1,000-2,000 gallons of gasoline, 685 gallons of oil, 30 cubic yards of landfill space, 48,000 gallons of water.

Consumer education

United Kingdom

In the UK, the amount of post-consumer plastic being recycled is relatively low,[34] due in part to a lack of recycling facilities.

The Plastics 2020 Challenge was founded in 2009 by the plastics industry with the aim of engaging the British public in a nationwide debate about the use, reuse and disposal of plastics, and hosts a series of online debates on its website framed around the waste hierarchy.

There is a facility in Worksop capable of recycling 60–80 thousand metric tonnes a year.[35]

In Northern Ireland, the rate of recycling is relatively low at only 37.4%. However, emerging technologies are helping to increase the recycling rates of items previously landfilled e.g. mixed hard plastics.[36]

Plastic identification code

Five groups of plastic polymers,[37] each with specific properties, are used worldwide for packaging applications (see table below). Each group of plastic polymer can be identified by its Plastic Identification code (PIC), usually a number or a letter abbreviation. For instance, Low-Density Polyethylene can be identified by

the number "4" or the letters "LDPE". The PIC appears inside a three-chasing-arrow recycling symbol. The symbol is used to indicate whether the plastic can be recycled into new products.

The PIC was introduced by the Society of the Plastics Industry, Inc., to provide a uniform system for the identification of various polymer types and to help recycling companies separate various plastics for reprocessing. Manufacturers of plastic products are required to use PIC labels in some countries/regions and can voluntarily mark their products with the PIC where there are no requirements.[38] Consumers can identify the plastic types based on the codes usually found at the base or at the side of the plastic products, including food/chemical packaging and containers. The PIC is usually not present on packaging films, since it is not practical to collect and recycle most of this type of waste.

Plastic Identification Code	Type of plastic polymer	Properties	Common Packaging Applications	Melting- (°C) and Glass Transition Temperatures	Young's Modulus (GPa)
	Polyethylene terephthalate (PET, PETE)	Clarity, strength, toughness, barrier to gas and moisture.	Soft drink, water and salad dressing bottles; peanut butter and jam jars; small consumer electronics.	Tm = 250;[39] Tg = 76[39]	2-2.7[40]
	High-density polyethylene (HDPE)	Stiffness, strength, toughness, resistance to moisture, permeability to gas.	Water pipes, hula hoop rings, five gallon buckets, milk, juice and water bottles; grocery bags, some shampoo/toiletry bottles.	Tm = 130;[41] Tg = -125[42]	0.8[40]
	Polyvinyl chloride (PVC)	Versatility, ease of blending, strength, toughness.	Blister packaging for non-food items; cling films for non-food use. May be used for food packaging with the addition of the plasticisers needed to make natively rigid PVC flexible . Non-packaging uses are electrical cable insulation; rigid piping; vinyl records.	Tm = 240;[43] Tg = 85[43]	2.4-4.1[44]
	Low-density polyethylene (LDPE)	Ease of processing, strength, toughness, flexibility, ease of sealing, barrier to moisture.	Frozen food bags; squeezable bottles, e.g. honey, mustard; cling films; flexible container lids.	Tm = 120;[45] Tg = -125[46]	0.17-0.28[44]
	Polypropylene (PP)	Strength, toughness, resistance to heat, chemicals, grease and oil, versatile, barrier to moisture.	Reusable microwaveable ware; kitchenware; yogurt containers; margarine tubs; microwaveable disposable take-away containers; disposable cups; soft drink bottle caps; plates.	Tm = 173;[47] Tg = -10[47]	1.5-2[40]

	Polystyrene (PS)	Versatility, clarity, easily formed	Egg cartons; packing peanuts; disposable cups, plates, trays and cutlery; disposable take-away containers.	Tm = 240 (only isotactic);[42] Tg = 100 (atactic and isotactic)[42]	3-3.5[40]
	Other (often polycarbonate or ABS)	Dependent on polymers or combination of polymers	Beverage bottles; baby milk bottles. Non-packaging uses for polycarbonate: compact discs; "unbreakable" glazing; electronic apparatus housings; lenses including sunglasses, prescription glasses, automotive headlamps, riot shields, instrument panels.[48]	Polycarbonate: Tg = 145;[49] Tm = 225[50]	Polycarbonate: 2.6;[40] ABS plastics: 2.3[40]

United States

Low national plastic recycling rates have been due to the complexity of sorting and processing, unfavorable economics, and consumer confusion about which plastics can actually be recycled.[51] Part of the confusion has been due to the use of the resin identification code which is not on all plastic parts but just a subset[52] that includes the recycling symbol as part of its design. The resin identification code is stamped or printed on the bottom of containers and surrounded by a triangle of arrows. (See the table in Plastic.) The intent of these symbols was to make it easier to identify the type of plastics used to make a particular container and to indicate that the plastic is potentially recyclable. The question that remains is which types of plastics can be recycled by your local recycling center. In many communities, not all types of plastics are accepted for sidewalk recycling collection programs due to the high processing costs and complexity of the equipment required to recycle certain materials. There is also sometimes a seemingly low demand for the recycled product depending on a recycling center's proximity to entities seeking recycled materials. Another major barrier is that the cost to recycle certain materials and the corresponding market price for those materials sometimes does not present any opportunity for profit. The best example of this is polystyrene (commonly called styrofoam), although some communities, like Brookline, MA, are moving toward banning the distribution of polystyrene containers by local food and coffee businesses.[53][54]

See also

- Baler
- Bisphenol A article on "BPA", esp. relevant to types 3 & 7 plastics.
- Economics of plastics processing
- Glass recycling
- Microplastics
- Phase-out of lightweight plastic bags
- Phytoremediation; soil polluted with plastic can be cleaned by fungi[55]
- Plastics 2020 Challenge

- Reuse of bottles

References

1. Hardesty, Britta Denise and Chris Wilcox (13 February 2015). "Eight million tonnes of plastic are going into the ocean each year". *The Conversation*. Retrieved 21 February 2015.
2. Jambeck, Jenna, Science 13 February 2015: Vol. 347 no. 6223; et al. (2015). "Plastic waste inputs from land into the ocean". *Science*. **347** (6223): 768–771. doi:10.1126/science.1260352. PMID 25678662. Retrieved 21 February 2015.
3. http://www.plasticsrecycling.org/images/pdf/market_development/APR_Design_Guide_Exec_Summary2014.pdf
4. Hatti-Kaul, Rajni. "Industrial biotechnology for the production of bio-based chemicals – a cradle-to-grave perspective". *Trends in Biotechnology*. Lund University. Retrieved 26 August 2012.
5. Plastics Europe: Association of Plastics Manufacturers. "*Waste Pre-Treatment and Sorting*." http://www.plasticseurope.org/plastics-sustainability-14017/zero-plastics-to-landfill/waste-pre-treatment-and-sorting.aspx. Retrieved 2015.7.8
6. "Plastic Pyrolysis Plant". RESEM Group China. Retrieved 2016-10-23.
7. "Engineer's plastic-to-fuel device passes patent office tests". The Times of India. Retrieved 2016-10-23.
8. "Plastic 2 Oil". Retrieved 2016-10-23.
9. "Successfully Converting End-of-Life Plastics to Liquid Fuel project (P2F) by United Nations Environment Programme" (PDF). Retrieved 2016-10-23.
10. "Power and Fuel from Plastic Wastes". Retrieved 2016-10-23.
11. [1] (http://recyclenation.com/green-glossary/heat-compression)
12. Baechler, Christian; DeVuono, Matthew; Pearce, Joshua M. (2013). "Distributed Recycling of Waste Polymer into RepRap Feedstock". *Rapid Prototyping Journal*. **19** (2): 118–125. doi:10.1108/13552541311302978.
13. M. Kreiger, G. C. Anzalone, M. L. Mulder, A. Glover and J. M Pearce (2013). Distributed Recycling of Post-Consumer Plastic Waste in Rural Areas. MRS Online Proceedings Library, 1492, mrsf12-1492-g04-06 (https://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=8851128) doi:10.1557/opl.2013.258 (https://dx.doi.org/10.1557%2Fopl.2013.258)
14. Kreiger, M.A.; Mulder, M.L.; Glover, A.G.; Pearce, J. M. (2014). "Life Cycle Analysis of Distributed Recycling of Post-consumer High Density Polyethylene for 3-D Printing Filament". *Journal of Cleaner Production*. **70**: 90–96. doi:10.1016/j.jclepro.2014.02.009.
15. Steel (http://www.cnn.com/2005/TECH/08/10/plastic.steel.reut/index.html) CNN. Retrieved 9.11.06.
16. Ignatyev, I.A.; Thielemans, W.; Beke, B. Vander (2014). "Recycling of Polymers: A Review". *ChemSusChem*. **7** (6): 1579–1593. doi:10.1002/cssc.201300898. PMID 24811748.
17. "EcoSpun (Eco-fi) Clothing - Eartheasy.com Solutions for Sustainable Living". Eartheasy.com. Retrieved 2010-08-21.
18. Idea TV GmbH. "Recycled plastic - the fashion fabric of the future". Innovations-report.com. Retrieved 2010-08-21.
19. PT, November 13, 2009 (2009-11-13). "Trashy Chic: Recycled clothing from Playback - Brand X". Thisisbrandx.com. Retrieved 2010-08-21.
20. "Reware's REWOVEN Technology Info: The Eco Narrative - Recycled PET". Rewarestore.com. Retrieved 2010-08-21.
21. "Billabong ECO Supreme Suede Boardshorts: Sustainable is Good Eco Products". Sustainableisgood.com. 2008-04-09. Retrieved 2010-08-21.
22. "Recycling for PET packaging reaches 31 percent in 2013". *PlasticsToday*. Retrieved 12 March 2016.
23. Polystyrene recycling. (http://pspc.intoweb.co.za/index.php?page=recycle1) Polystyrene packaging council. Retrieved on 2009-03-06.
24. "Let Peanuts Live! Mail Boxes Etc. Recycles as Part of National Effort; Recycle Loose-fill, Foam 'Peanuts' At Participating Mail Boxes Etc. Locations". AllBusiness.com. Retrieved 2010-08-21.
25. Plastic trial procedure (http://www.oaktech-environmental.com/plastictrials.htm) Oaktech Environmental website. Retrieved 9.11.06.
26. Agricultural plastics recycling process (http://www.rkoindustries.com/id26.html) Agricultural plastics recycling website. Retrieved 07.11.08.
27. Plastic Composite Railroad Tie Facts (http://www.rti-railroad-tie.com/id5.html) Plastic Composite Railroad Ties website. Retrieved 01.21.08.

28. Recycling Used Agricultural Plastics (http://environmentalrisk.cornell.edu/AgPlastics/References/Garthe&Kowal-a.pdf) James W. Garthe, Paula D. Kowal, PennState University, Agricultural and Biological Engineering
29. Patel, Almitra H. (October 2003), *Plastics Recycling and The Need For Bio-Polymers*, **9** (4), EnviroNews Archives, International Society of Environmental Botanists
30. The Self-Sufficiency Handbook: A Complete Guide to Greener Living by Alan Bridgewater pg. 62--Skyhorse Publishing Inc., 2007 ISBN 1-60239-163-7, ISBN 978-1-60239-163-5
31. " "Energy and Economic Value of Non-recycled Plastics and Municipal Solid Wastes" at Journalist's Resource.org".
32. Page, Candace, Waste district raises recycling fees, *Burlington Free Press*, November 12, 2008
33. Financial Times, May 15, 2009 (article by Max Hogg)
34. Plastics (http://www.wasteonline.org.uk/resources/InformationSheets/Plastics.htm#_Hows) wasteonline.org.uk. Retrieved 10.18.07.
35. Administrator. "MBA Polymers - MBA Polymers UK Ltd". Retrieved 12 March 2016.
36. "Plastic Recycling - Envirogreen Recycling - Cardboard Recycling – Plastic recycling". Retrieved 12 March 2016.
37. "Safe Use Of Plastic Food Packaging And Containers".
38. "19". *Holt Chemistry (Florida edition)*. Holt, Rinehart, and Winston. 2006. p. 702. ISBN 0-03-039114-8. "More than hlf the states in the United States have enacted laws that require plastic products to be labeled with numerical codes that identify the type of plastic used in them."
39. [2] (http://www.polymerprocessing.com/polymers/PET.html) PolymerProcessing.com
40. [3] (http://www.engineeringtoolbox.com/young-modulus-d_417.html) The Engineering Toolbox
41. [4] (http://www.dynalabcorp.com/technical_info_hd_polyethylene.asp) Dyna Lab Corp
42. [5] (http://www.sigmaaldrich.com/etc/medialib/docs/Aldrich/General_Information /thermal_transitions_of_homopolymers.Par.0001.File.tmp/thermal_transitions_of_homopolymers.pdf) Sigma Aldrich
43. [6] (http://www.polymerprocessing.com/polymers/PVC.html) PolymerProcessing.com
44. Modern Plastics Encyclopedia 1999, p B158 to B216. (Tensile Modulus)
45. [7] (http://www.dynalabcorp.com/technical_info_ld_polyethylene.asp) Dyna Lab Corp
46. [8] (http://www.lasalle.edu/academ/chem/ms/polymersRus/Resources/GlassTrans.htm) Wofford University
47. [9] (http://www.polymerprocessing.com/polymers/PP.html) PolymerProcessing.com
48. "What is Polycarbonate (PC)?".
49. "polycarbonate information and properties". Polymerprocessing.com. 2001-04-15. Retrieved 2012-10-27.
50. [10] (http://www.polymerprocessing.com/polymers/PC.html) PolymerProcessing.com
51. Watson, Tom (June 2, 2007). "Where can we put all those plastics?". *Seattle Times*. Retrieved 2007-06-02.
52. SPI Resin Identification Code - Guide to Correct Use, http://www.plasticsindustry.org/AboutPlastics /content.cfm?ItemNumber=823
53. Where can we put all those plastics? By Tom Watson June 2, 2007 Seattle Times http://seattletimes.nwsource.com /html/homegarden/2003730398_ecoconsumer02.html
54. Brookline Town Meeting bans Styrofoam coffee, takeout containers by Brock Parker Nov 13, 2012 Boston.com http://www.boston.com/yourtown/news/brookline/2012/11/brookline_town_meeting_bans_st.html
55. "TU/e signs agreement with paper industry for research into revolutionary solvent". Retrieved 12 March 2016.

External links

- West, Larry. "Recyclable Plastic: Why are So Few Food Containers Made of Recyclable Plastic?". About.com. Retrieved 2009-05-04.
- Plastic Packaging Resin Codes (http://www.americanchemistry.com/s_plastics/bin.asp?CID=1102&DID=4645&DOC=FILE.PDF) data from the American Chemistry Council
- Plastic recycling grades (http://www.plasgranltd.co.uk/cms/wp-content/uploads/2015/07/Plasgran-Guide-to-Plastic-Recycling-Grades.jpg)
- ISF's Plastics Recovery Manual
- American Chemistry Council Statement on Plastic Recycling (http://www.greenbuildingsolutions.org

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/s_greenbuilding/sec.asp?CID=2134&DID=8972)

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