Colorado Recycles

Recycling Tips

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What Do All Those Plastic Resin Codes Mean?

Introduction

We receive many inquiries about recycling plastic. People become frustrated when they are told that not all plastic is readily recyclable. Some of the more ubiquitous plastic products are widely recycled, and there are many drop-off and curbside recycling opportunities for the communities. Other types of plastic are not as easily recycled because they are not in as wide-spread use and there are few markets for the recycled resins.

Frequently, exasperated inquirers will ask about the plastic resin codes that are stamped on the product. “Don’t these numbers mean that it can be recycled?” they ask. No, that is not the purpose of the codes. “But,” they reply, “the number is inside those chasing arrows and that means recycling.” Well, yes, they are but the codes were never intended for consumers to use to judge what is recyclable and that is why most recycling organizations and businesses provide examples or lists of what plastic products are and are not acceptable for their systems.

A good example of this is a container that has both a lid and a body. Although both the lid and the container may be manufactured from the same plastic resin, the two were created through different manufacturing processes. The processes give them different melting points. At the same temperature, one may melt to the consistency of tapioca or pudding, while the other is more liquid or viscous. For that reason, the recycler knows that the two are not compatible, and may ask you to recycle only the body and to throw the lid away in the trash.

The Presence of Plastics

Plastic is a particularly wonderful material. It is light, it is easy to store and transport, it can be formed into an infinite number of shapes and sizes, and it can successfully hold just about anything from liquids to solids to gases. The very nature of the wonderful properties of plastic makes it sometimes more challenging to recycle than glass, aluminum or newsprint. Some plastic ends up being disposed of through the trash collection system, and deposited into landfills or burned in incinerators. To a certain extent, plastic is a victim of its success. The technologies for plastic production, product development and new uses advance many times faster than the technology of recycling.

The Resin Codes

The resin codes that are imprinted in the plastic, that small number inside the “chasing arrows”, were developed by the Society of the Plastics Industry (SPI) in the late 1980’s. These codes were designed for use by the plastics industry in an attempt to more easily identify and sort the plastics for recycling. As the SPI has noted on many occasions, the numbers were intended to facilitate handling, they were never intended to guarantee or warrant that the particular item or type of plastic would be recycled.

There are seven codes, but there are literally tens of thousands of different types of plastics. Various dyes and additives can be added to the basic resin to produce an end product in the color, shape, design, and texture desired by the user. Because the additional ingredients are not uniform across multiple products, the melting temperatures and reprocessing techniques also vary. To be recycled and reprocessed for new uses, the plastics must be separated by these component ingredients so that they do not contaminate each other and become unusable.

To be sure, there are recycling technologies and techniques for most forms of plastic. However, there is not a universal or even wide-spread recycling infrastructure beyond the most commonly used plastics. For any kind of recycling to work, the collectors and handlers must be able to cost effectively collect, sort and market the product. That means that the buyers of that product must be able to use it in the remanufacturing process. If the material is contaminated or of inferior quality, there will be no market for it.

However, simply because the collectors and handlers have successfully generated market sized quantities of plastics does not mean that there is a viable market for the new “raw” material. The material generated from the recycling system must compete with other sources of resin. It is often the case that the manufacturer can secure virgin resins at a cheaper price and from a more reliable source. Recycling has become a very popular and, in many cases, a very effective way of reducing certain types of waste going to landfills. However, recycling does not always yield measurable economic or environmental benefits. Recycling requires energy and generates waste by-products that must be managed, just like any other manufacturing process. Sometimes it simply is better economics and environmental wisdom to not recycle.

Recently, some collection entities have begun to experiment with “all-bottles” or “all-plastics” collection programs. These new innovations in collection and sorting hold great promise, and we will have a separate discussion paper on these innovative concepts.

It is also the case that plastic degrades each time it is reheated in the remanufacturing process. There are limits to how many times a plastic resin can be used for the same purposes. It is more accurate to say that plastics are “down cycled” rather than that they are “recycled”. Unlike aluminum or glass, plastic is not readily recycled into the same use. For example, an aluminum can or a glass bottle is often recycled into the same basic product and returned to the consumer in a short period of time. A plastic bottle, such as those used for soft drinks or water, is likely to be recycled into fiber for clothing (e.g. fleece), backpacks, carpet or other valuable and useful products.

Plastic Resins: One through Seven

The following discussions will provide you with the basic information on each of the resin codes. The American Plastics Council has prepared an extraordinarily good and useful comparative table that demonstrates the differences in uses of the various plastics resins. We encourage you to review the work that the APC has done by following this link to their chart: www.plasticsresource.com and follow the menu prompts to the resin chart.

In addition, Colorado Recycles and its members encourage consumers to seek out and purchase products that contain recycled plastics. Again, the American Plastics Council maintains a very comprehensive directory of products made with recycled plastics, and that directory is available to the public on line at the preceding link. Just follow the menu prompts to Recycled Products and Markets Database.

Polyethylene Terephthalate (PET, PETE)

Polyethylene is most likely the polymer that you see most often in your daily life. It is the most popular and most used plastic in the world. Polyesters can be either a fiber or a plastic. Those who remember (fondly or not) the fashions of the 1970’s will remember polyester in the form of fiber for clothing associated with the disco era. Fortunately, polyester survived that rather humbling era and has gone on to much better uses. You now see polyester in the shatterproof bottles used for shampoo and beverages, grocery bags, children’s toys and even personal safety articles. In 2002, PET accounted for 53% of plastic bottle resin sales, making it the most widely used resin in plastic bottles.

PET was patented in 1941 after it had been discovered by British chemists John R. Whinfield and James T. Dickson. Whinfield and Dickson, along with some other inventors, created the first polyester fiber in 1941, and called it “Terylene.” The second polyester fiber to be created was the Dupont Corporation’s “Dacron.” Dupont was to purchase the United States rights to Terylene in 1945, and began research into future development and uses. It was the research by Dupont that led to the development of trademark protected products such as Mylar, which was developed from research on Dacron in the early 1950’s.

What’s The Proper Acronym: PETE or PET?

Actually, both acronyms are correct. They tend to be associated with the industries that use them. The chemical industry tends to use the acronym PET because it is a symbol shorthand for the plastic polyethylene terephathalate. PET is also the acronym used by national and international standards setting organizations such as the American Society for Testing and Materials International.

The acronym PETE is used mostly by those who manufacture plastic bottles and containers from polyethylene terephathlate, and is used for assisting in the sorting of such containers for recycling. However, some containers which are manufactured outside the United States may use the acronym PET rather than PETE which is used by United States manufacturers.

Nonetheless, PETE and PET are both correct, and both refer to the same basic type of resin. PET is a popular packaging material for food and non-food products because it is inexpensive, lightweight, can be resealed, and is shatter-resistant. It is also recyclable. PET is clear and has good moisture and gas barrier properties. The flakes and pellets of cleaned postconsumer recycled PET are in heavy demand for use in spinning carpet yarns and for producing fiberfill and geotextiles.

PET is the fastest growing plastic used in household applications. PET has a wide variety of packaging applications as soft drink bottles, water bottles, sports drink bottles, beer bottles, mouthwash bottles, peanut butter containers, salad dressing containers, juice bottles, vegetable oil bottles, ketchup bottles, pickle jars, jam and jelly jars, and other similar container uses. Its properties make it particularly useful for films that cover food products that can be used in ovens and microwave ovens.

PET is in high demand as a recycled product for the manufacture of yet other extremely valuable commodities. Among the products that are manufactured with recycled PET, are fiber, tote bags, clothing, film and sheet, food and beverage containers, carpet, strapping, fleece wear, luggage and bottles.

High Density Polyethylene (HDPE)

High-density polyethylene (HDPE) resin is produced from the chemical compound ethylene.

In 2002 HDPE accounted for 43% of plastic bottle resin sales, making it the second most widely used resin in plastic bottles. HDPE and PETE together accounted for 96% of plastic bottle resin usage. Bottles made from HDPE come in both pigmented and unpigmented (translucent) resins. HDPE also has good stiffness and barrier properties. Thus, it is ideal for packaging products, such as milk, that have a short shelf-life. HDPE's good chemical resistance allows it to be used in containers holding household or industrial chemicals.

Bottles are blow-molded while containers are injection-molded. Milk bottles are the most common HDPE package. Most milk and water bottles use a natural-colored HDPE resin, while detergents, shampoos, motor oils and other products usually have added colorants. Injection-molded HPDE containers also are used for products such as margarine and yogurt. HDPE lends itself to many, and varied, packaging applications such as milk containers, juice bottles, water bottles, bleach bottles, detergent bottles, shampoo bottles, trash bags, grocery and retail carrying bags, motor oil bottles, butter and margarine tubs, household cleaner bottles, yogurt containers, flower pots, garden edging, and cereal box liners.

HDPE has a high recyclability potential. The packaging industry, which uses post-consumer recycled HDPE for bottles, is the largest HDPE recycling market. Drainage pipe, film, pallets and plastic lumber are other uses as are liquid laundry detergent bottles, oil bottles, pens, benches, doghouses, recycling containers, floor tile, picnic tables, fencing, lumber, and mailbox posts.

HDPE also is exported, usually in bales with other plastics, to Pacific Rim processors. Markets for clear (translucent) HDPE milk bottles are the highest priced markets for HDPE bottles.

Vinyl (Polyvinyl Chloride or PVC)

The V in the first (and original) symbol actually stands for vinyl, however, the plastic resin is usually referred to as polyvinyl chloride (PVC) and the symbol has evolved to the resin designation of PVC.

In 1999 PVC accounted for 2% of plastic bottle resin sales. Polyvinyl chloride is the plastic known at the hardware and garden stores as PVC. This is the PVC from which pipes are made, and PVC pipe is everywhere. The plumbing in your house may be PVC pipe, unless it's an older house that was constructed before local and national building codes recognized the use of PVC for such applications. It is not unlikely that if you need to replace the drain pipe under your sink that the replacement material will be PVC pipe. PVC pipe is what scuba diving instructors use to manufacture and assemble training platforms for scuba diving students. PVC has great versatility beyond pipe. It is the "vinyl" siding used on houses. Inside the house, PVC is used to make linoleum for the floor. In the seventies, PVC was often used to make vinyl car tops.

Among the extraordinarily useful properties of PVC is that is resists both fire and water. Because of its water resistance it is used to make raincoats, scuba diving platforms, many marine applications for decks and boats, shower curtains, and (of course) water pipes.

The wide variety of vinyl products can be broadly divided into "rigid" and "flexible" applications. Bottles and packaging sheet are major rigid products, as are construction applications for such products as pipes and fittings, siding, carpet backing and windows. Flexible vinyl is used in wire and cable insulation, film and sheet, floor coverings, synthetic leather products, coatings, blood bags, medical tubing and many other applications.

PVC is also recyclable into a variety of products such as loose-leaf binders, decking, paneling, mud flaps, roadway gutters, flooring, cables, speed bumps, mats, flooring, cassette trays, electrical boxes, cables, traffic cones, garden hose, mobile home skirting, and drainage eves and downspouts.

A good resource for learning more about the nearly infinite uses of vinyl and the most current information about vinyl recycling, please visit the website of the Vinyl Institute at www.vinylinfo.org.

Low Density Polyethylene (LDPE)

In 1999 LDPE accounted for just 1% of plastic bottle resin sales. Because of its toughness, flexibility, and transparency, LDPE is commonly used in applications where heat sealing is necessary. It is also widely used in wire and cable insulation and jacketing. LDPE is similar to HDPE in composition. It is less rigid and generally less chemically resistant than HDPE, but is more translucent. LDPE is used primarily for "squeeze" applications.

Since LDPE is a very effective moisture barrier, it is particularly useful as film for bags used for food, such as bread, and for trash and leaf bags. Its properties lend it to very successful applications in packaging containers in the way of squeezable bottles (for products such as honey and mustard), bread bags, frozen food bags, tote bags, clothing, furniture, dry cleaning bags, and carpet.

Similarly, LDPE can be readily recycled for use in other films and sheets, floor tile, garbage can liners, shipping envelopes, furniture, compost bins, paneling, trash cans, lumber, and landscaping ties.

Polypropylene (PP)

Polypropylene is one of the most versatile of the resins, and, similarly with PET, it can serve both as a fiber and also a plastic. It has the lowest density of the resins that are customarily used for packaging, and it is both strong and resistant to chemicals. It has a very high melting point, which makes it more useful in applications for dishwasher safe food containers than polyethylene which will warp in high dishwasher temperatures. Its resistance to high temperature makes it useful for applications that require a container that is to be filled with a hot liquid, such as hot pancake syrup, grease or oil.

An additionally valuable use of polypropylene because of its high resistance to heat is in medical and surgical applications where the end product is subject to the high heat required for sterilization.

When polypropylene is used in its fiber form, it is often used for the manufacture of indoor-outdoor carpeting. It is frequently used as the "carpet" around swimming pools and miniature golf courses. Since it does not absorb water, it is more useful in these applications than carpet, or coverings, made of nylon.

Polypropylene is often recycled and used for such products as signal lights, battery cables, brooms, brushes, auto battery cases, ice scrapers, landscape borders, bicycle racks, rakes, bins, pallets, and trays.

Polystyrene (PS)

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PS

Polystyrene is about as ubiquitous a product as can be imagined. Only polyethylene is probably more recognizable by the consumer. Polystyrene is so common in our daily lives, that it almost goes unnoticed. It is hard to imagine what products are, and are not, manufactured with polystyrene.

The computer monitor that you are reading this discussion paper on is probably made of polystyrene. Because polystyrene is not particularly expensive and it is very, very durable, it is used in a multitude of products from toys to the molded interior component parts of our automobiles.

But, perhaps polystyrene is most familiar to us when it is used as foam packaging and insulation. It is important, however, to make a clarification of terms. People have become accustomed to referring to all foam polystyrene packaging as "Styrofoam." The word "Styrofoam®" is actually a proprietary and trademarked name of a particular brand of foamed insulation introduced by Dow Chemical Company in the mid-1950's. "Styrofoam®" is a registered trademark name, and we take special effort to avoid misusing it.

Most of what we in society loosely refer to as Styrofoam is really a product known as Expanded Polystyrene (EPS) foam packaging. Expanded Polystyrene (EPS) foam packaging is the familiar white material that cushions, insulates and protects all types of products during distribution. This includes custom shaped material used to package electronic equipment and appliances, loose fill packaging often called "peanuts", blocks of foam which protect furniture and appliances and shipping containers used to help preserve perishable foods and medicines.

The Expanded Polystyrene packaging (loose fill) is 99.6% air, so it is both light and it is reusable. Plastic peanuts, for example, are at their intended use and there is no reason that they cannot be used over and over. In fact, more than 30% of all Expanded Polystyrene is reused, and there are more than 1,500 collection programs and sites around the country. Collection centers report that 50% of their loose fill needs are met with reusable loose fill donated by consumers. For more information about Expanded Polystyrene uses, visit the website of the Polystyrene Packaging Council at www.polystyrene.org.

The Plastics Loose Fill Council maintains information on where to recycle EPS packaging peanuts on its website at www.loosefillpackaging.com . In addition, Colorado Recycles maintains comparable information in our database for the Recycling Guide. Just use the convenient Recycling Guide menu button, and select packaging materials on the pull down menu. For information concerning where to recycle EPS protective package (used for the safe transportation of computers and other sensitive electronic devices), please refer to either our Recycling Guide or to the website for the Alliance of Foam Packaging Recyclers at www.epspackaging.org .

Polystyrene can also be made into rigid as well as foamed products. It has a relatively low melting point, but is particularly useful in applications such as dinner ware (plate, cups, cutlery, etc.), meat trays, egg cartons, yogurt cups, disposable drink cups, carry-out containers, compact disc jackets, and some medicine bottles. It is commonly used with dry products including vitamins, petroleum jellies and spices. Polystyrene does not provide good barrier properties and exhibits poor impact resistance.

It has a multitude of uses when recycled, and is often used in the manufacture of thermal insulation, light switch plates, egg cartons, desk trays, vents, rulers, license plate holders, foam packing, and carry-out containers.

One of the most common uses of polystyrene is in the manufacture of single-use food service packaging. Single-use food service packaging is technically "recyclable" but it presents some unique problems. After the product has been used, it has been contaminated by food waste and by human contact. The light weight and low density of these products often makes the transportation costs higher than can be easily recovered. Care must be exercised if the product is destined to be recycled into other food protection or preservation uses since the recycled package cannot be allowed to contaminate or compromise the food that it is intended to serve. The Federal Food and Drug Administration requires that the food packaging manufacturer be certain that under the intended conditions of use the packaging material will not contaminate or adulterate the food that it contains.

Other

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OTHER

Other plastics are often made of multiple resins or layers of different types of plastics. These may include microwavable packages, snack bags and industrial plastics. In 1999 there was minimal usage of resins in the 'other' category in plastic bottles. The category of "Other" includes any resin not specifically numbered 1, 2, 3, 4, 5, or 6, or combinations of one or more of these resins.

Conclusion

Plastics have become an increasingly important part of our day-to-day lives. Each year brings us new uses for plastics. Sometimes these are new entries into the consumer markets. Sometimes they are technological advances that allow plastics to be used in place of metal, wood or other materials. Most often, the new plastic use provides distinct advantages over the materials that are being replaced.

It is true that a lot of plastic winds up in the municipal waste stream, but the recyclability of plastics improves with each year. Of particular importance is the astonishing array of consumer products that are manufactured with recycled plastics. As we have noted, some plastic resins are more readily recyclable than others, and each generation of technological innovation brings new opportunities.