Solid Waste Special Service District #1

REFUSE, Then REDUCE

REUSE or REPURPOSE

Then

RECYCLE

Where does Plastic fit in the R Hierarchy?

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Plastic is Plastic – Right?

The first human-made plastic was invented by Alexander Parkes in 1855; he called this plastic Parkesine (later called celluloid). It was unveiled at the 1862 Great International Exhibition in London.

The development of plastics has come from the use of natural plastic materials (e.g., chewing gum, shellac) to the use of chemically modified natural materials (e.g., rubber, nitrocellulose, collagen, galalite) and finally to completely synthetic molecules (e.g., bakelite, epoxy, polyvinyl chloride, polyethylene).

To assist recycling of disposable items, the Plastic Bottle Institute of the Society of the Plastics Industry devised the now-familiar scheme to mark plastic bottles by plastic type for 1 through 7 which are known as the resin identification code.

- 1 PET *(PETE)*, polyethylene terephthalate - Carbonated drink bottles, water bottles, some microwavable packaging.
- 2 HDPE, high-density polyethylene - Detergent bottles and milk jugs.
- 3 PVC, polyvinyl chloride - Plumbing pipes and guttering, shower curtains, window frames, flooring.
- 4 LDPE, low-density polyethylene - Outdoor furniture, siding, floor tiles, shower curtains, clamshell packaging.
- 5 PP, polypropylene - Bottle caps, drinking straws, yogurt containers, appliances, car fenders (bumpers), plastic pressure pipe systems, some is “compostable”
- 6 PS, polystyrene - Packaging foam/"peanuts", food containers, plastic tableware, disposable cups, plates, cutlery, CD and cassette boxes. Not compostable
- 7 Other types of plastics

7 – "Other" Plastics - Common

- Polyester (PES) – Fibers, textiles
- Polyethylene (PE) - Wide range of inexpensive uses including supermarket bags, plastic bottles.
- Polyvinylidene (PVDC) (Saran) - Food packaging.
- High impact polystyrene (HIPS) - Refrigerator liners, food packaging, vending cups.
- Polyamides (PA) (Nylons) - Fibers, toothbrush bristles, fishing line, under-the-hood car engine moldings.
- Acrylonitrile butadiene styrene (ABS) - Electronic equipment cases (e.g., computer monitors, printers, keyboards), drainage pipe.
- Polycarbonate (PC) - Compact discs, eyeglasses, riot shields, security windows, traffic lights, lenses.
- Polycarbonate/Acrylonitrile Butadiene Styrene (PC/ABS) - A blend of PC and ABS that creates a stronger plastic. Used in car interior and exterior, and mobile phone bodies.
- Polyurethanes (PU) - Cushioning foams, thermal insulation, surface coatings, printing rollers (Currently 6th or 7th most commonly used plastic material, for instance the most commonly used plastic found in cars).

7 – "Other" Plastics (Special Use)

- Melamine formaldehyde (MF) - One of the aminoplasts, and used as a multi-colorable alternative to phenolics, for instance in moldings (e.g., break-resistance alternatives to ceramic cups, plates and bowls for children) and the decorated top surface layer of the paper laminates (e.g., Formica).
- Plastarch material - Biodegradable and heat resistant, thermoplastic composed of modified corn starch.
- Phenolics (PF) or (phenol formaldehydes) - High modulus, relatively heat resistant, and excellent fire resistant polymer. Used for insulating parts in electrical fixtures, paper laminated products (e.g., Formica), thermally insulation foams. It is a thermosetting plastic, with the familiar trade name Bakelite, that can be molded by heat and pressure when mixed with a filler-like wood flour or can be cast in its unfilled liquid form or cast as foam (e.g., Oasis). Problems include the probability of moldings naturally being dark colors (red, green, brown), and as thermoset it is difficult to recycle.
- Urea-formaldehyde (UF) - One of the aminoplasts and used as a multi-colorable alternative to phenolics. Used as a wood adhesive (for plywood, chipboard, hardboard) and electrical switch housings.
- Polyetherimide (PEI) (Ultem) - A high temperature, chemically stable polymer that does not crystallize.
- Polyetheretherketone (PEEK) - Strong, chemical- and heat-resistant thermoplastic, biocompatibility allows for use in medical implant applications, aerospace moldings. One of the most expensive commercial polymers.
- Polylactic acid (PLA) - A biodegradable, thermoplastic found converted into a variety of aliphatic polyesters derived from lactic acid which in turn can be made by fermentation of various agricultural products such as corn starch, once made from dairy products.
- Polymethyl methacrylate (PMMA) - Contact lenses, glazing (best known in this form by its various trade names around the world; e.g., Perspex, Oroglas, Plexiglas), aglets, fluorescent light diffusers, rear light covers for vehicles. It forms the basis of artistic and commercial acrylic paints when suspended in water with the use of other agents.
- Polytetrafluoroethylene (PTFE) - Heat-resistant, low-friction coatings, used in things like non-stick surfaces for frying pans, plumber's tape and water slides. It is more commonly known as Teflon.

REFUSE – Waste Hierarchy Step One

- Just Say NO to purchase of plastic items

Reduce – Waste Hierarchy Step Two

- Consumer decision on what to buy – homeowner, business owner, institutional, others
- Plastics are lighter so reduces weight
  - Road damage which leads to repairs
  - Fuel consumption
  - Work safety and health (handling heavy versus lighter weight)
  - Carbon footprint impacts
- Durable (takes a long time to degrade)
  - May last longer in use (plastic versus metal)
  - In some instances, stronger (Space Shuttles)
  - Food handling and storage

Reuse –Waste Hierarchy Step Three

- Consumer decision on how to reuse
  - Plastic shopping bags used in garbage cans to collect trash OR use Reuseable plastic impregnated shopping bags
- Medical – probably not practical
  - Concern: sterilization, stopping spread of communicable disease, bloodborne pathogens
- Industrial
  - Manufacturing (recapture product/waste material)
- Citizens
  - Second hand clothing stores
  - Used Cars (downside is other environmental issues using older, less efficient cars)
- Sometimes reuse and recycle are an alliance –
  - Reuse soda pop bottles to make carpet could also be recycling
  - Melting down milk jugs and oil jugs, pouring into a 4 x 8 mold for plastic panels
- Great Potential for local entrepreneurship and creativity for local value added

Recycle – Waste Hierarchy Step Four
Difficult and Depends on Type

- It is difficult to automate the sorting of plastic wastes - labor intensive.
  - Workers sort the plastic by looking at the resin identification code, although common containers like soda bottles can be sorted from memory.
  - Caps for PETE bottles are made from PP plastic which is not recyclable
  - New processes of mechanical sorting are being developed to increase capacity and efficiency of plastic recycling - costly
- Containers can be made from a single type and color of plastic OR they are not a single type – e.g. cellular phones have many small parts consisting of over a dozen different types and colors of plastics.
  - Resources to separate the plastics far exceed their value.
  - Developments in the field of active disassembly - may result in more consumer product components being re-used or recycled.
- Recycling certain types of plastics can be unprofitable, as well.
  - Polystyrene is rarely recycled because it is usually not cost effective.
  - Unrecycled wastes are typically disposed of in landfills, incinerated or used to produce energy at waste-to-energy plants.

Cost and Environmental Impact Considerations

- Don’t buy plastic
  - Compare costs for alternatives – financial, environmental, health, social, etc
- Reuse plastic containers
  - Practical Limitations
- Recycle - Marketing of collected plastics
  - Processing/shipping
    - Plastic has “memory” so hard to remain squished
    - Granulated – requires energy and equipment and people
    - Transportation costs to move plastics to market
- How pay for recycling costs
  - Manufacturer (pass along costs to consumer)
  - Consumer (fees at collection or when purchase commodity)
  - Government (increased taxes to pay for services)
  - Market driven/global economic impacts (price of virgin versus “used” feedstock, change of chemical composition, technology changes)
- True Cost accounting
  - Financial/Economics
  - Labor/Economics
  - Environmental (collection, processing, storage, transportation, disposal, incineration, etc)
  - Other factors (cultural, societal, geography, political)

Raw Data Divert PET (per ton)

Receiving	$ 67.00
Processing (Baling)	$ 242.00
Storage	$ 23.00
Shipping	$ 116.00
TOTAL	$ 448.00
Revenue Paid to District from Sale	$ 10.00

- Carbon Footprint – Savings
- 1.02 Tonnes MTCO2

- 21 Tons Diverted in 2017
- Net Cost to Recycle $9,198
- Metric tonnes MTCO2 21.42

Raw Data Divert HDPE-Natural (per ton)

Receiving	$ 141.00
Processing (Baling)	$ 289.00
Storage	$ 21.00
Shipping	$ 116.00
TOTAL	$ 557.00
Revenue Paid to District from Sale	$ 100.00
Carbon Footprint – Savings	0.34 Tonnes MTCO2
8 Tons Diverted in 2017	Net Cost to Recycle $ 3,656
	Metric tonnes MTCO2 2.72

Raw Data Divert HDPE-Other (per ton)

Receiving	$ 101.00
Processing (Baling)	$ 192.00
Storage	$ 18.00
Shipping	$ 116.00
TOTAL	$ 427.00
Revenue Paid to District from Sale	$ 10.00
Carbon Footprint – Savings	0.25 Tonnes MTCO2
6 Tons Diverted in 2017	Net Cost to Recycle $ 2,502
	Metric tonnes MTCO2 1.5

Raw Data Divert # 3-7 (per ton)

Receiving	$ 67.00
Processing (Baling)	$ 182.00
Storage	$ 17.00
Shipping	$ 116.00
TOTAL	$ 382.00
Revenue Paid to District if sold	- $ **50.00**
Carbon Footprint – Savings	0.07 Tonnes MTCO2
14 Tons Diverted in 2017	Net Cost to Recycle $ 6,048
	Metric tonnes MTCO2 .98

Raw Data for Plastics

- PET Annual Cost (Loss) $9,198
- HDPE-Natural Annual Cost (Loss) $3,656
- HDPE-Other Annual Cost (Loss) $2,502
- Plastic 3-7 Annual Cost (Loss) $6,048
- TOTAL Annual Cost (Loss) $21,404

- Annual MTCO2 savings: 26.62 tonnes MTCO2 roughly equivalent to 5.6 cars emissions

Plastic – China Ban Impacts

More than meets the eye

- **Plastics 3-7 – banned due to high contamination other export market limited**
- **Plastics 3-7 – no good domestic market**
- **Plastics 1 & 2 – contamination criteria < 0.5%**
- **Plastics 1 & 2 – opportunity to develop domestic mills**
- **Projection: May no longer accept Plastics 3-7 due to high costs and lack of adequate market**
- **Financial: Generators pay to recycle**

Open for Discussion