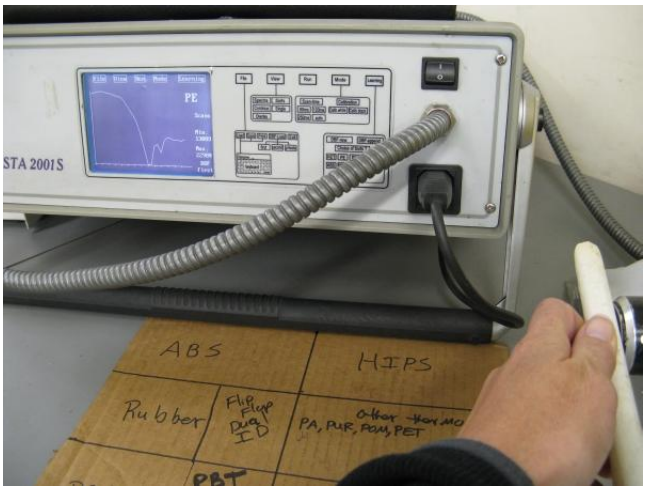
PLASTIC WASTE STREAM

By Melanie Smith

Plastics are durable and degrade very slowly; the molecular bonds that make plastic so durable make it equally resistant to natural processes of degradation. Since the 1950s, one billion tons of plastic has been discarded and may persist for hundreds or even thousands of years.

Unfortunately, recycling plastics has proven difficult. One of the biggest problem with plastic recycling is that it is difficult to automate the sorting of plastic waste, and so it is labor intensive. Typically, waste plant workers sort the plastic by looking at the resin identification code; though common containers like soda bottles can be sorted from memory. Plastic is also sorted with float/sink water tests and wind tests. There are machines that sort with laser technology and can differentiate between most of the known plastics. Other recyclable materials, such as metals, are easier to process mechanically. However, new mechanical sorting processes are being utilized to increase plastic recycling capacity and efficiency.

While bottles are made from a single type of plastic, making them relatively easy to sort out, a consumer product like a cellular phone may have many small parts consisting of over a dozen different types and colors of plastics. In a case like this, the resources it would take to separate the plastics far exceed their value and the item is discarded. However, developments are taking place in the field of Active Disassembly, which may result in more consumer product components being re-used or recycled. Recycling certain types of plastics can be unprofitable, as well. For example, polystyrene is rarely recycled because it is usually not cost effective. These unrecycled wastes are typically disposed of in landfills, incinerated or used to produce electricity at waste-to-energy plants.



Testing plastic with laser equipment to determine type at the MBA Polymer plant in Richmond, CA. The small white pipe is held to the laser sensor and the screen reads the type, in this case it is PE.

The only recyclable plastics in curbside or household recycling are number 1, PET, and 2, HDPE. The majority of this is exported to China where it is reprocessed. Plastic film is gathered at markets and is remanufactured into decking. In fact it is the only recycled plastic that stays in

the US for reprocessing and reuse in its new form. The majority of other recycled plastics are shipped to Asia or Canada and then often returned to the US in its new product form.

The biggest threat to the conventional plastics industry is most likely to be environmental concerns, including the release of toxic pollutants, greenhouse gas, litter, biodegradable and non-biodegradable landfill impact as a result of the production and disposal of petroleum and petroleum-based plastics. Of particular concern has been the recent accumulation of enormous quantities of plastic trash in ocean gyres

Recycling Solutions

Plastic polymers require greater processing to be recycled than metal or glass... Heating alone is not enough to dissolve such a large molecule; because of this, plastics must often be of nearly identical composition in order to mix efficiently otherwise when different types of plastics are melted together they tend to separate, like oil and water, or bead up preventing them from being reformed. Even plastic of the same type, such as HPDE 2 if it has been molded as in an open neck container verses blown for a closed neck container, requires different flow agents and will not combine. To offset this problem virgin polymers are added to the recycled stock to create new pellets or beads. There are companies such as MBA Polymers of Richmond CA with plants in China and Austria that recycle sorted, shredded plastic into new resin beads with an additive of a small percentage of new resin to strengthen and bind the recycled material. They are recycling high-impact poly-styrene, polypropylene, ABS from commercial sources.

Another potential option is the conversion of plastics into petroleum by thermal depolymerization or pyrolysis process. Such a process would be able to accept almost any polymer or mix of polymers, including rubber tires. Like natural petroleum, the chemicals produced can be made into fuels as well as polymers.

DEFINITION OF PYROLYSIS

Pyrolysis is the chemical decomposition of condensed organic substances by heating. The word is coined from the Greek-derived elements pyro "fire" and lysys "decomposition". Pyrolysis is usually the first chemical reaction that occurs in the burning of many solid organic fuels, like wood, cloth, and paper, and also of some kinds of plastic. Anhydrous pyrolysis can also be used to produce liquid fuel similar to diesel from plastic waste.

The pyrolysis process for plastic takes the long chain polymer molecules and breaks or cracks them into shorter chains through heat and pressure. Essentially the process is mimicking the

natural process of the earth to break down carbon into oil which takes million of years in nature. The pyrolysis process does this with intense heat in a closed system in a short amount of time.

Conditions for producing pyrolysis oil are more likely to include virtually no oxygen. The pyrolysis of plastics produces a liquid product, pyrolysis oil or oil that can be readily stored and transported. Pyrolysis oil can be used directly as fuel or further refined into diesel or jet fuel.

The Envion Oil Generator.

Converts waste plastic into oil producing 3 to 5 barrels of refined light or medium oil per ton of plastic waste

PYROLYSIS TYPES Defined

Thermal Depolymerization is a process using hydrous pyrolysis for the reduction of complex organic materials (usually waste products of various sorts, often known as biomass and plastic) into light crude oil. It mimics the natural geological processes thought to be involved in the production of fossil fuels. Under pressure and heat, long chain polymers of hydrogen, oxygen, and carbon decompose into short-chain petroleum hydrocarbons with a maximum length of around 18 carbons. TDP can mean conversion of biomass to oils using superheated water, although it more usually is applied to fuel production via pyrolysis.[2][3]

Thermal Conversion Process: A company called Renewable Environmental Solutions (RES) was formed as a joint venture between ConAgra Foods and Changing World Technologies

to operate the plant at Carthage, Missouri and the name of the process was changed from Thermal Depolymerization to Thermal Conversion Process.

Hydrothermal Liquifaction: Direct hydrothermal liquefaction involves converting biomass to an oily liquid by contacting the biomass with water at elevated temperatures (300-350°C) with sufficient pressure to maintain the water primarily in the liquid phase (12-20 MPa) for residence times up to 30 minutes.

Hydrous pyrolysis: Refers to the thermal decomposition which takes place when organic compounds are heated to high temperatures in the presence of water.

Anhydrous Pyrolysis: Simple heating without water, anhydrous pyrolysis has long been considered to take place naturally in the earth's crust. It is the process in which organic material contained in rock is broken down to release the oil and fossil fuels. Some pyrolysis methods which create hydrocarbons through depolymerization use dry materials (or anhydrous pyrolysis) which requires expending a lot of energy to remove water.

Pyrolysis Plant Manufactures

Ozmotech, Melbourne-based environmental technology manufacturer, developed its ThermoFuel system using a pyrolysis chamber, a patented catalytic converter and a series of specially built condensers to produce energy-rich diesel fuel from unsorted waste plastics. Plastics that are unsuitable for other recycling purposes because of an undesirable or contaminated mix of polymers are no problem. Ozmotech has spent two years developing the original pyrolysis technology into a fully operational system capable of producing over 19,000 litres of diesel fuel per day for less than 30 cents per liter. Several systems are already in operation in Japan but the fuels produced are used exclusively for power generation through diesel generators.

The Envion Oil Generator accepts PET, HDPE, PVC, LDPE, PP, PS, and several other plastic materials, such as GPPS, EPS, HIPS, and PA. Envion originally developed their platform as a joint effort between South Korea and the US to assist China with the growing problem of trash. The first plant they built was to be mounted on a barge for use on a major river in China. It would travel up and down the river to process waste, mostly plastic, and create oil that could be further refined into fuel. They now have a plant operating in Derborne Maryland and plants in China.

Biodegradable (Compostable) plastics

Research has been done on biodegradable plastics that break down with exposure to sunlight (e.g., ultra-violet radiation), water or dampness, bacteria, enzymes, wind abrasion and some instances rodent pest or insect attack are also included as forms of biodegradation or environmental degradation.

Extensive testing is being done on polymers made from polysaccharides, such as corn glucose and agroproteins currently known as PLA and PHA. These are possibly the answer to creating a fully marine degradable plastic. Other biodegradable plastics will only fully degrade if the plastic is exposed at the surface, with microbial exposure in composting systems and will not degrade in landfills... Starch powder has been mixed with plastic as a filler to allow it to degrade more easily, but it still does not lead to complete breakdown of the plastic within the matrix, the starch breaks sown leaving the polymer molecules intact.

Some researchers have actually genetically engineered bacteria that synthesize a completely biodegradable plastic, but this material, such as Biopol, is expensive at present. The German chemical company BASF makes Ecoflex, fully biodegradable polyester for food packaging applications.

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