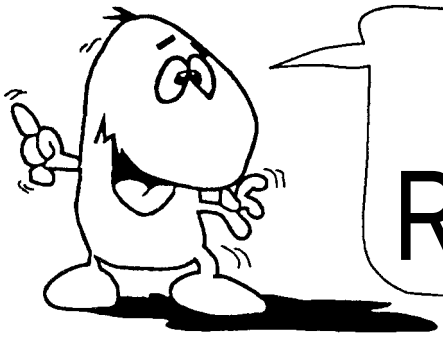

PLASTIC RECYCLING

HISTORICAL BACKGROUND

Plastic is a word meaning 'able to be formed or moulded' (malleable). Glass and clay are both natural plastic materials which have been used for thousands of years. Today the word plastic often describes synthetic organic **polymers**.

The first plastic was celluloid, invented by Alexander Parkes in 1870 and used as a substitute for ivory.

Celluloid is made from plant cellulose which is found in wood, cotton and flax fibres. It is the most abundant natural organic compound and comprises more than 95% of the natural fibres of cotton and flax and 50% of wood fibres. Cellophane and the first synthetic silk fabric, Rayon, also come from plant cellulose.

One of the few remaining uses of celluloid is the table tennis ball.

In 1907 **bakelite**, the first totally synthetic plastic was produced by Hendrick Bakeland from the chemical union of phenol and formaldehyde.

The advantages of Bakelite were:

- ***its electrical insulating properties***
- ***great strength***
- ***resistance to known solvents and most chemicals***
- ***its usefulness as a varnish, enamel or protective coating.***

MODERN PLASTIC

The Manufacturing Process

Modern plastics or polymers originate from many sources and come in more than 60 synthetic versions. Plastics are materials based on giant molecules called polymers that are produced by the conversion of natural products such as

- cellulose (see above)
- caseins, from skim milk
- organic acid, from coal tar
- potatoes, corn, peanuts and soybeans,

or by synthesis from primary chemicals

- natural gas
- coal
- oil

The main raw by-product materials are natural gas and oil. One of the largest sources of plastic is from a by-product of the petrochemical industry. Only 4% of oil is used in the manufacture of plastics while around 86% of oil production is used for transport, heating and energy in single use applications.

Information sheet 4

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Release of noxious gases must be stringently controlled.

When and if oil reserves run low, plastic waste could be a potential fuel source.

HOW *YOU* CAN HELP

Plastic recycling technology will catch up, but until large scale recycling is a reality you can help by:

- ***sorting and washing your plastic waste for recycling***
- ***locate your nearest plastic drop off depot if you do not have a kerbside collection in your area***
- ***buying groceries in bulk avoiding single use plastic containers***
- ***using less plastic wrap***
- ***taking your own bags to the supermarket, or reusing plastic bags***

DON'T LITTER!

- ***disposing of plastic thoughtfully when outdoors or on the water***
- ***encouraging manufacturers to produce more reusable plastic packaging***
- ***encouraging manufacturers to print directly on to plastic rather than applying paper labels***
- ***buying minimally packaged products***

RE-USE!

- ***finding uses around your home or at the local school, kindy or play centre for plastic packaging such as ice cream containers***

PLASTIC CAN BE A RESOURCE NOT A WASTE

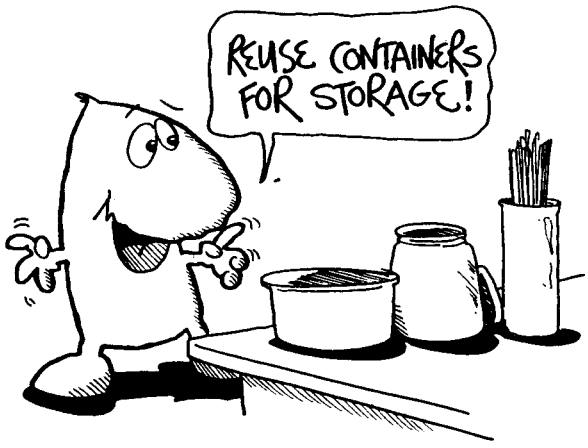
DO *YOUR* PART TO -

CONSERVE RESOURCES

PRESERVE OUR ENVIRONMENT

REMEMBER

BUY WISELY
RECYCLE



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There are two main types of plastic.

a) **<u>Thermoplastic</u>:**
Softens when heated and hardens again when cooled. 80% of plastics are of this type, eg plastic bags.

b) **<u>Thermosetting</u>:**
Hardened by curing and cannot be remoulded, eg melamine table top.

1. When crude oil is refined into various fractions by heating, it produces a number of different products, one of which is naphtha.

From naphtha comes petrol, ethylene gas and other chemicals.

2. Instead of being flared off, the ethylene gas is converted into polyethylene and from this come the following basic plastics:

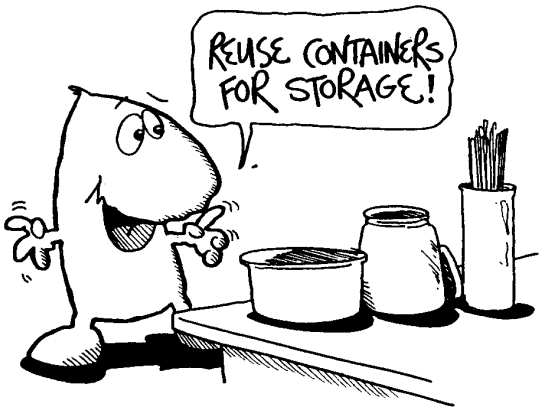
PVC	Polyvinyl chloride
LDPE	Low density polyethylene
HDPE	High density polyethylene
PP	Poly propylene
PS	Polystyrene

Some PVCs are also made from chlorine released from making soda ash for industry, for example in glass manufacture.

43% Ethylene + 57% Chlorine = PVC

3. There are two chemical processes used for forming plastics (polymers)

a) Addition polymerisation
b) Condensation polymerisation



Addition Polymerisation:

Joins a large number of individual molecules (monomers) to form long chains of polymers

eg: *ethylene monomers*
join to form
polyethylene

Condensation Polymerisation:

Combines large numbers of 2 different kinds of monomers to form a long chain while at the same time eliminating a small molecule, usually water.

eg: *adipic acid molecules* + *hexmethylene diamine molecules*

join to form a long chain molecule called
nylon
at the same time eliminating
H_2O (water)

Basic plastics or polymers can be modified with additives to form different types of plastics to suit a wide variety of functions. Additives are used to increase heat resistance and impact resistance. Stabilisers, flame retardants and colourants are other additives.

Basic plastics are usually granules or powder which are melted down to be formed into a wide range of products.

Products made from plastic are formed by one of four processes, dependant on the type of polymer being used and the type of product being made.

Extrusion:

Process for making fibres from thermally softened "thermo plastic". The material is extruded through the small holes of a spinneret.

Used in the production of finished or semi-finished goods, these need further processing before becoming useful items. However some extrusions come as finished goods, eg plastic pipe.

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Injection Moulding:

Process for high quality mouldings, requiring great accuracy and usually without any further finishing. A mould is closed as the cavity is injected with the molten plastic then cooled while in the mould.

Calendaring: Process of making sheets or materials, eg satchels, cases, etc. Plastic is slowly heated and rolled into continuous sheets, then it can be printed and embossed.

Foaming: Plastic foams can be made by injection moulding, extruding and calendering the plastic so as to create rigid plastic bubbles, which give the material a light density.

Plastics are available now in almost any variety of colour and shape making it a very versatile product.

ADVANTAGES OF PLASTIC

Modern varieties of plastic are used in many aspects of our daily lives. It provides cheap, easily maintained colourful toys, lightweight, clean, food storage containers in the home and has revolutionised medical science, playing a role in medical instruments and supplies. Many of these products have a five to ten year life span.

Plastic is used in the building trade, electrical industry and agriculture. It is used for making car parts, furniture and clothing. Plastic is:

- economic
- light
- versatile
- durable
- resistant to moisture, chemicals and decay.

Packaging:

- ***Plastic makes lightweight durable clean containers that protect products before sale.***
- ***Plastic makes products look attractive.***
- ***Plastic hygienically seals and preserves food.***

The Plastics Environmental and Advisory Council (PEAC) contends that plastic is:

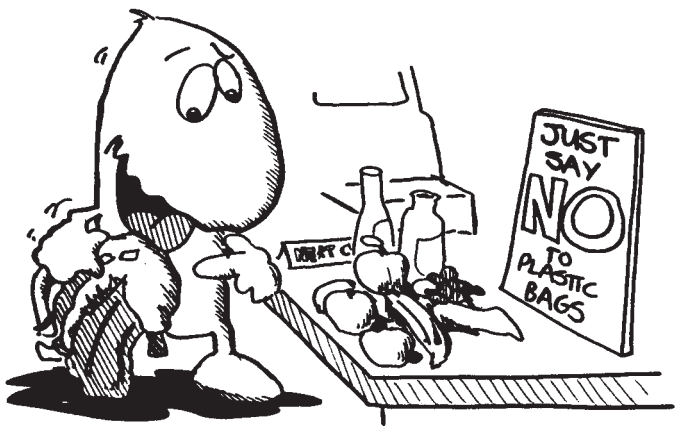
- ***environmentally acceptable, using only 4% of our petroleum***
- ***contributing only seven percent (by weight) of municipal waste***
- ***sanitary and stable in a landfill, and is not contaminating and is non degrading***

THE CODING SYSTEM

In 1989, the Plastics Institute of New Zealand initiated a voluntary coding system. This is part of an international system to assist in identifying containers for recycling. The large export component of plastic packaging requires use of the code, even if the type of container is not recycled in New Zealand.

Is The Coding System Effective?

The coding system does an excellent job of identifying the different types of plastic to both the general public and plastic recyclers. However, the coding system is misleading. The general public perceive the recycling arrows to show that the product is being recycled in New Zealand when this is not necessarily the case.



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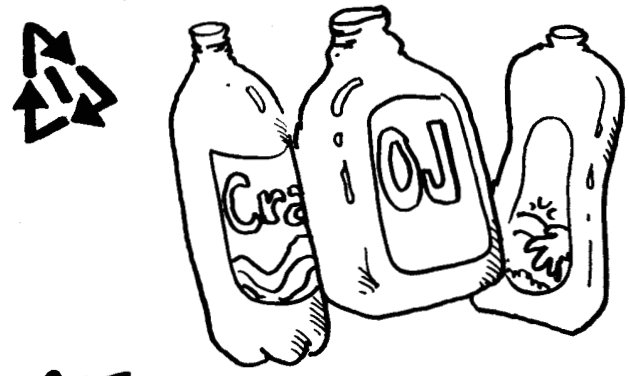
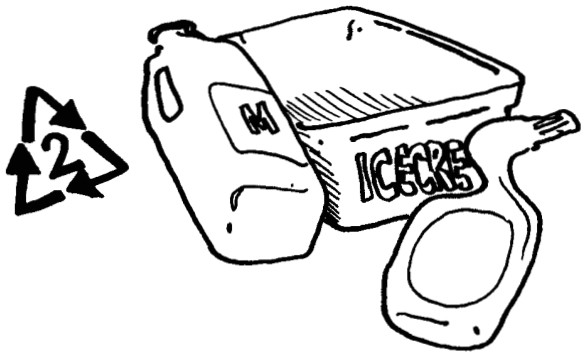
PLASTICS CODING SYSTEM



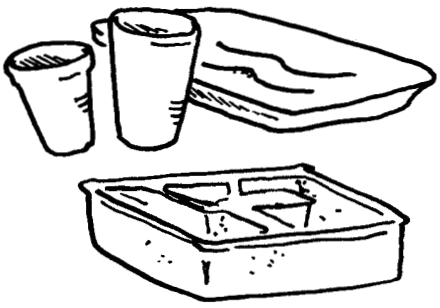
PET polyethylene terephthalate



HDPE high density polyethylene

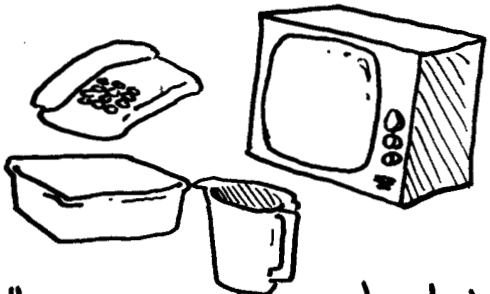
PVC polyvinyl chloride

LDPE low density polyethylene



PS polystyrene

PP polypropylene



all other resins and layered material

MoB

PLASTIC RECYCLING IN NEW ZEALAND

There are a few factories in New Zealand which process plastics coded 1 and 2 and manufacture products from the recycled material. There are also a number of small factories recycling plastics with the remaining numbers (3-7) but only in limited quantities and usually not from the domestic waste stream. Also both number 1 and 2 coded plastics are being exported for recycling in Australia and China.

To be recycled, each type of plastic must be kept separate. This is achieved by the coding system.

There are two approaches to plastic recycling:

1. **Recycling post consumer waste**
2. **Recycling pre consumer waste**

Post Consumer Waste:

What is post consumer waste?

This is waste plastic that has been used by the consumer.

To be recycled, plastics need to be retrieved from the waste stream, sorted and baled and then reprocessed into other products. At present in the Auckland region, the full recycling processes for household recycled plastics have not been put in place for all types of plastic, but most collection systems accept plastics coded 1 (PET) or 2 (HDPE).

What Are The Difficulties Of Recycling Post Consumer Waste Plastic?

At present the problem of recycling household plastic waste is environment versus economics. Currently, manufacturers find using new materials to make plastic packaging and disposing of waste as landfill, more economic.

1. The process of collecting, sorting, washing and reprocessing is sometimes more than the cost of the virgin product.

2. Contamination of waste plastic by food or other substances means expensive and time consuming sorting and cleaning, and removal of lids by recyclers.

3. Although plastic food containers are recyclable, for health reasons they cannot be recycled into new food containers so other uses must be found for the recycled plastic. However, new technology is happening all the time. The newly developed Coca-Cola initiative to produce PET (fizzy drink) bottles using up to 25% post consumer PET presents an example of a plastic food container being able to be recycled and re-manufactured for its original use.

The price for plastic depends on world oil prices and thus affects the markets for recycled plastics. When oil prices are high, virgin plastic reflects these prices and recycled plastic becomes more attractive.

Pre Consumer Waste:

What is pre consumer waste?

This is plastic that is recycled from factory offcuts or waste as part of the manufacturing process, or unused products that are rejected because of imperfections or overproduction.

This process is much easier to implement because the plastic is clean and does not need to be sorted or washed.

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Virtually 100% of industrial scrap is recycled in New Zealand. Clean scrap and waste plastic are shredded, reformed into granules, then fed into a moulding machine to make a new product.

Large quantities of polyethylene film (used to wrap goods in supermarkets) are collected and recycled, mostly into black sheeting for the building industry and cable cover for the electrical industry. Some of this is post consumer and some is pre consumer waste.

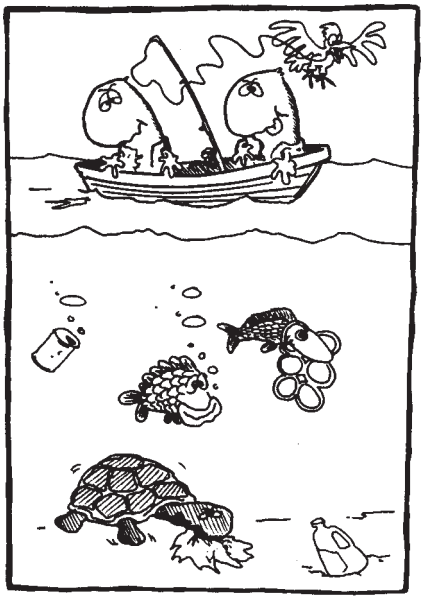
Coloured scrap can be used to make dark coloured products such as black plant pots and agricultural piping.

ENVIRONMENTAL CONSIDERATIONS:

Plastic is a very durable commodity and takes a long time to break down in landfills. This durability can cause environmental concern. For example it is estimated that 6 pack plastic rings could take up to 450 years to decompose.

In our oceans, plastic litter is a hazard to marine life.

Burning the waste is not an easy solution, as plastic releases gaseous pollutants if combustion conditions are not controlled.



PLASTIC FACTS

- Plastic containers are lighter and use less plastic than they did as recently as 1975.
- NZ recycles 28,000 (approx) tonnes of plastics per annum including plastic factory wastes. This amounts to 20% of the total plastics in the solid waste stream.
- Most manufacturers of plastic products regrind or recycle up to 100% of their own plastic waste.

WHY RECYCLE?

One of the main points of recycling is not landfill diversion, but the ability to make products using materials that have already been refined, reducing the need to continually use up both renewable resources (like trees) and non renewable resources (like oil).

To achieve the same standard of living using fewer resources, an increasing percentage of the products sold should contain recycled content.

Recycling plastic:

- conserves non renewable raw materials
- reduces landfill requirements
- conserves overseas funds
- increases employment opportunities
- provides new opportunities and new products.

ENERGY from PLASTIC

Recycling the energy content of plastic may be more economical than recycling the plastic itself. Many countries burn household waste in huge incinerators to generate steam, hot water and electricity.

Plastic, with three times the energy of brown coal, helps burn other parts of the waste mix.

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NOTES

For further information
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Auckland

ARC Wasteline (09) 366-2070
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