Materials Classifications

Composite and hybrid materials

Smart materials

Nano-materials

- Materials
  - Metals
  - Ceramics
  - Polymers
    - Bio-polymers or Natural polymers
    - Thermoplastics
    - Thermosetting plastics
    - Rubbers and Elastomers

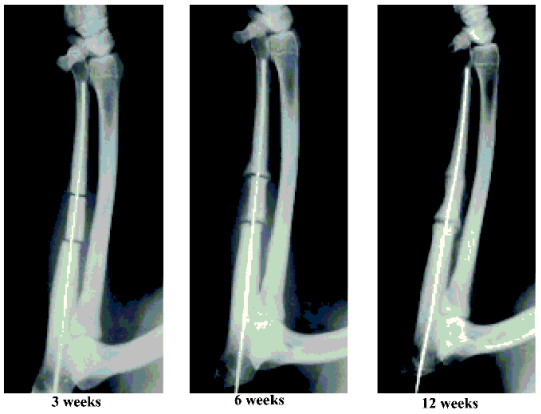
Ref

Ref. www.siammasterwood.com

Ref. http://www.nanowerk.com/spotlight/id2878_1.jpg

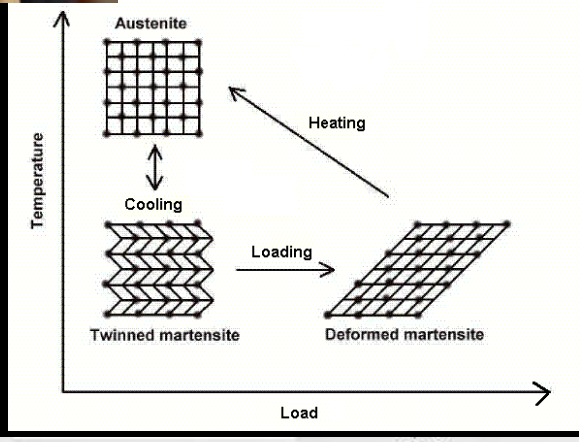
http://www.prepol.com/images/nanofluor.jpg


ENVIRONMENT FRIENDLY DVD
Corn


3 weeks
6 weeks
12 weeks


16 weeks
36 weeks


SUMMER 07
ECO TRIP
Windows Live Spaces
spacesecotrip.spaces.live.com
Biodegradable Corn Plastic


Austenite
Heating
Cooling
Temperature
Loading
Twinned martensite
Deformed martensite
Load


OFF
ON

POLYMERS

- Polymers consist of large molecules joining together repeatedly in the form of long and flexible chains.
- Advantages of polymer materials over others (metals and ceramics)
- Polymers have a wide range of the properties.
- Manufacturing processes are relatively easy and fast.
- Little energy (temperature and pressure) is required.
- No decoration or painting is necessary.
- Costs are low (prices and transportation).
- Recycling is likely possible.

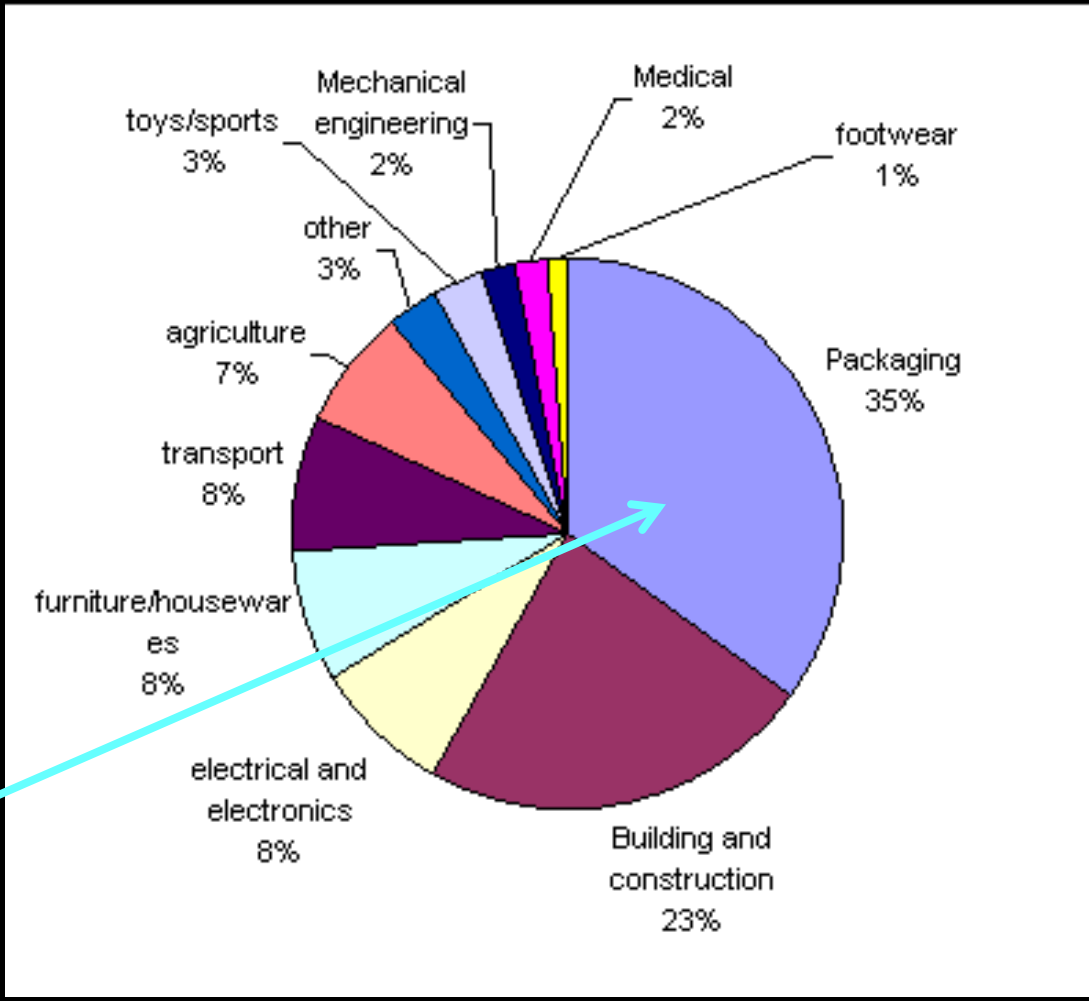
Plastic goods consumption in UK, 2001 year

World annual of plastic products

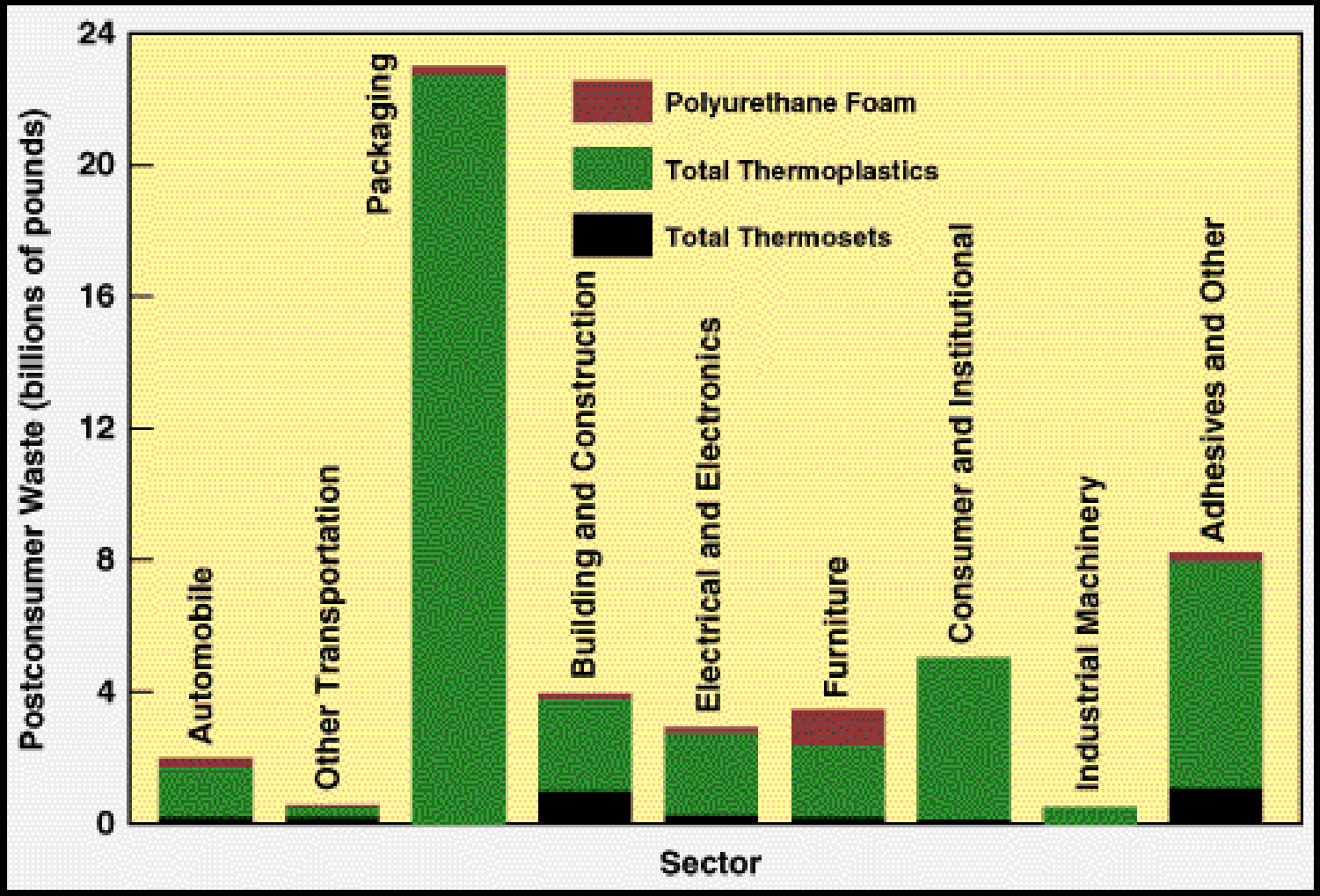
5,000 million tonnes in 1950s to 100,000 million tonnes in 2001s

Increasing 20 times

In 2001 year, UK had total consumption of plastic products **~ 4,700 million tonnes.** Packaging were largest sector of using (35%).

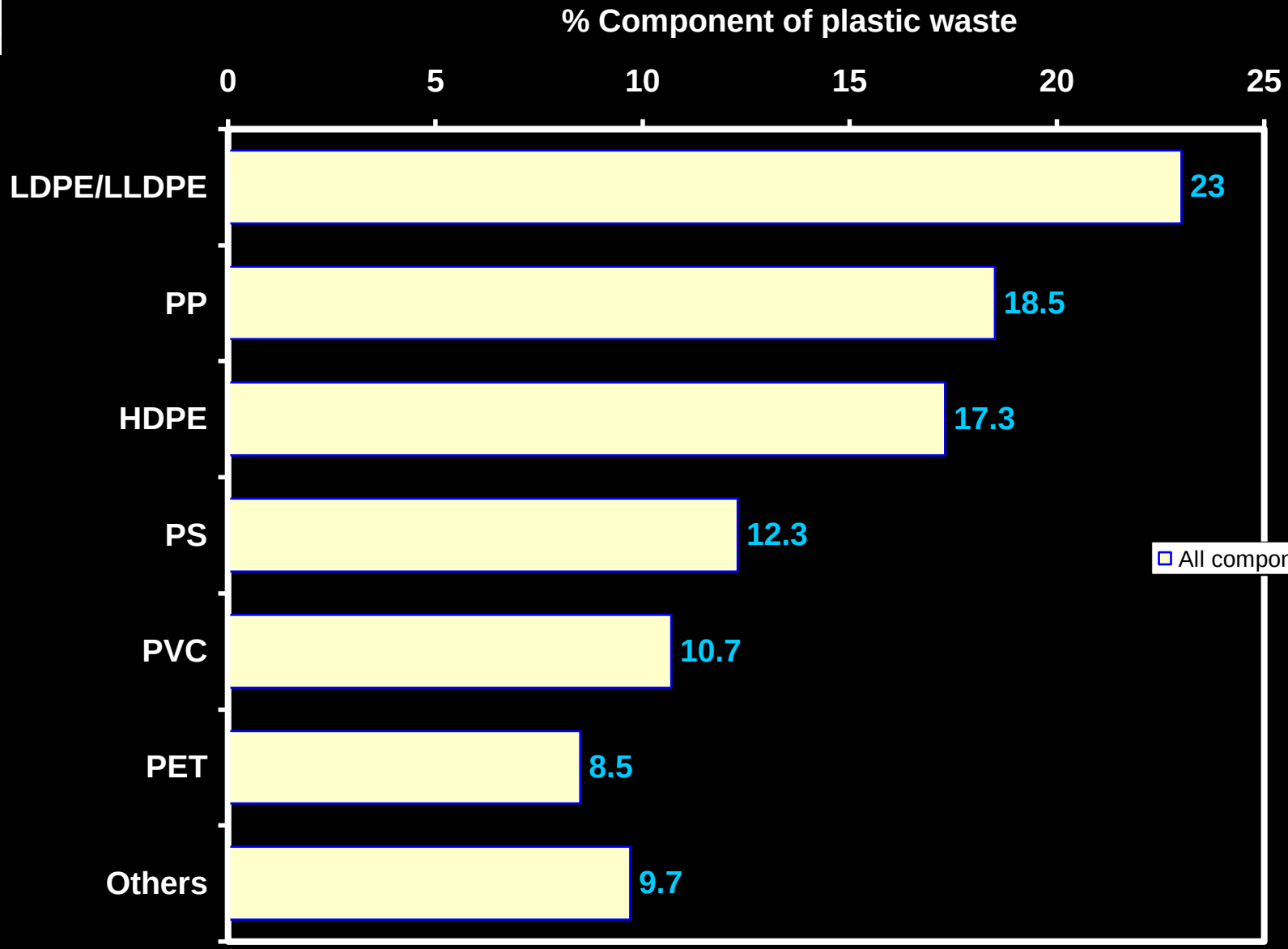


Ref http://www.wasteonline.org.uk/resources/InformationSheets/Plastics.htm#_Types_of_plastic



A projection of post-consumer plastic waste is shown for different sectors in the year 2000

Ref. http://www.lotfi.net/recycle/



Ref. R. Siddique et. al. (2007) Waste management

(Association of plastics Manufactures in Europe, 2004)

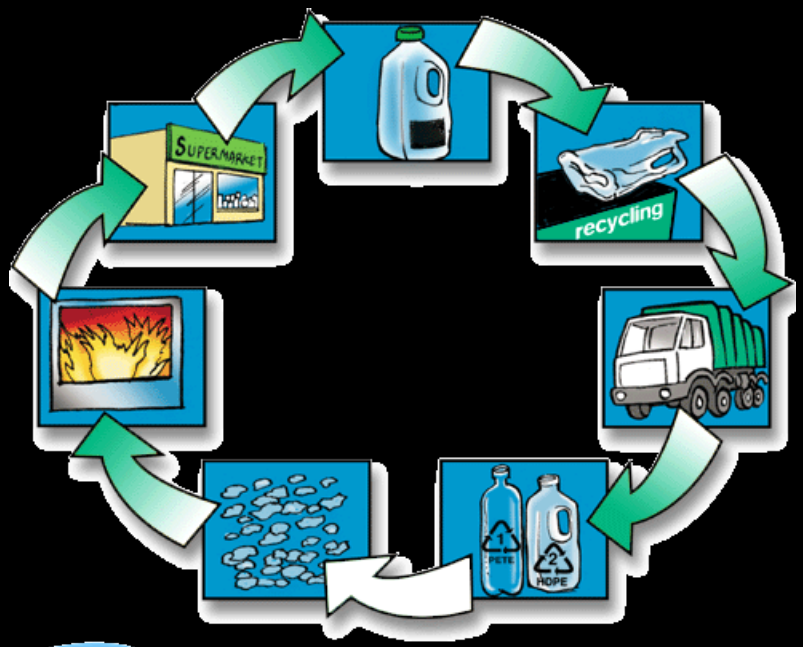
Plastic waste management

Ref. www.makingthemodernworld.org.uk

1. Incineration (Burn)

Ref. http://www.boonecountyky.org

2. Landfills



Ref. http://www.devon.gov.uk

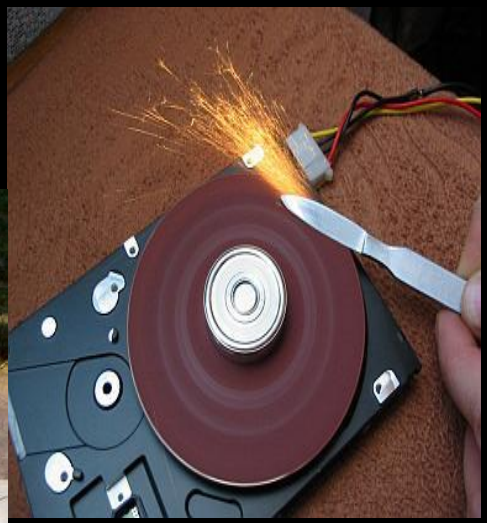
3. Re-use

4. Re-form

5. Recycling

CD Re-use

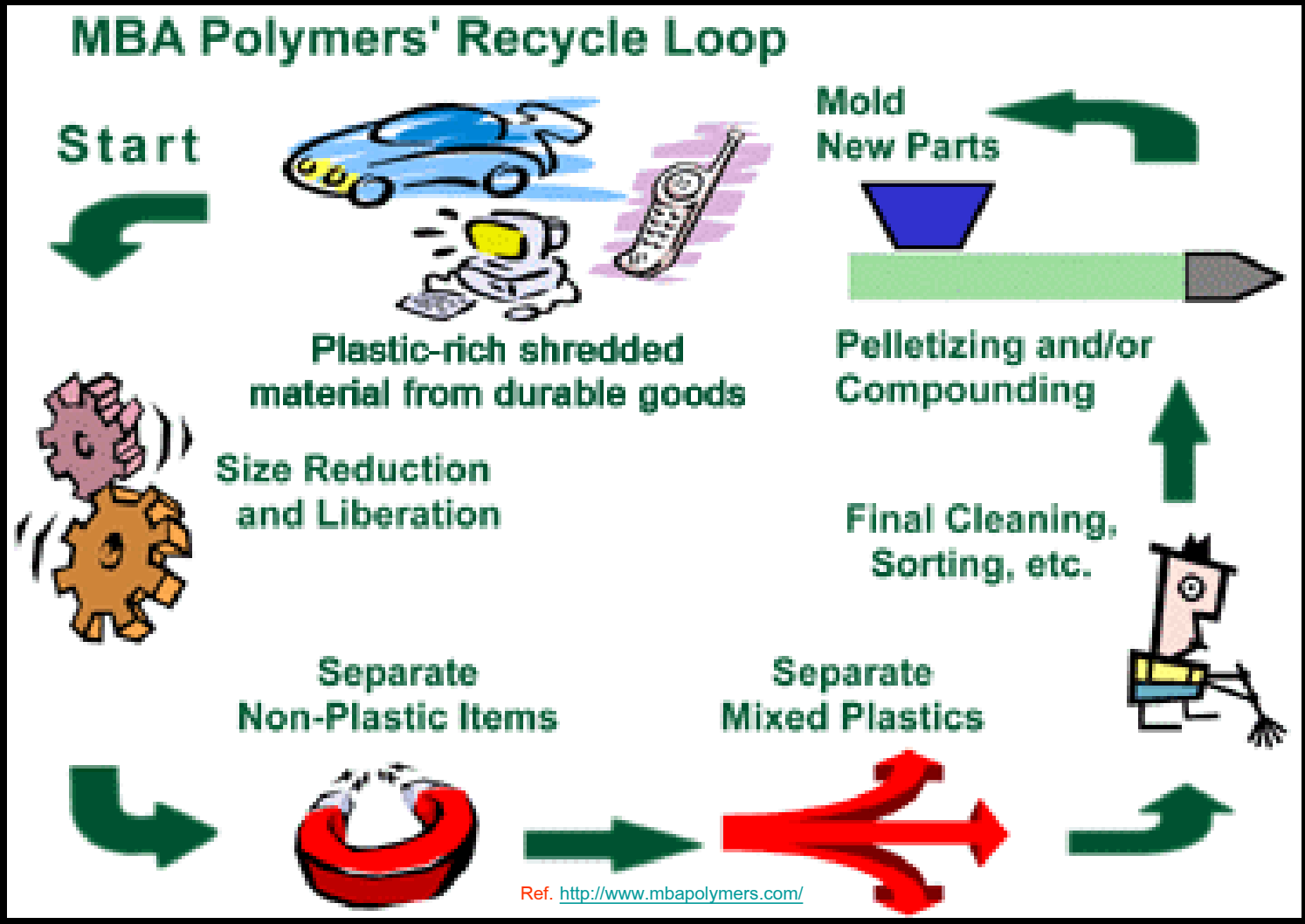
PC Re-use

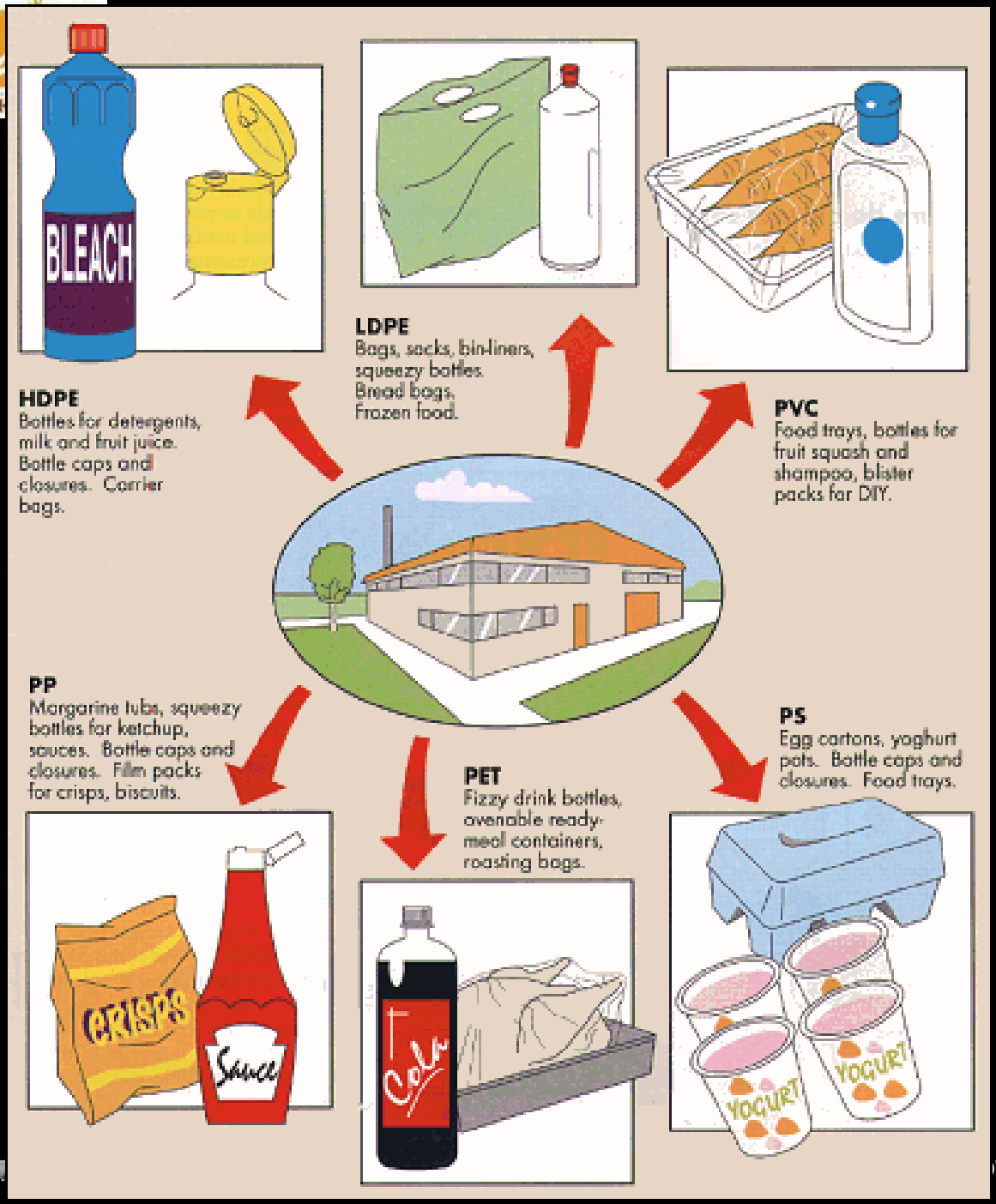


Status of polymer waste in the USA

Title	1990s	2000s	2010
• Reuse/recycling	10%	45%	60%
• Incineration	30%	50%	35%
• Dumping	60%	5%	5%
• Total	100%	100%	100%

Recycling


MBA Polymers' Recycle Loop
Start
Plastic-rich shredded material from durable goods
Size Reduction and Liberation
Separate Non-Plastic Items
Separate Mixed Plastics
Final Cleaning, Sorting, etc.
Pelletizing and/or Compounding
Mold New Parts
Ref. http://www.mbapolymers.com/



1 PET

2 HD-PE

3 PVC

4 LD-PE

5 PP

6 PS

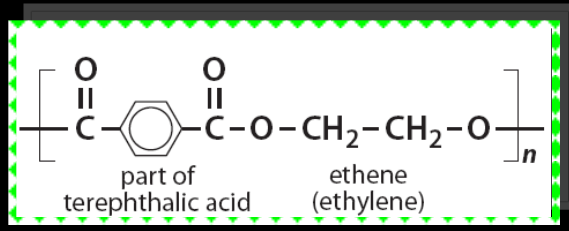
7 Others

Ref.

http://www.incpen.org/pages/userdata/incp/Plastics.gif

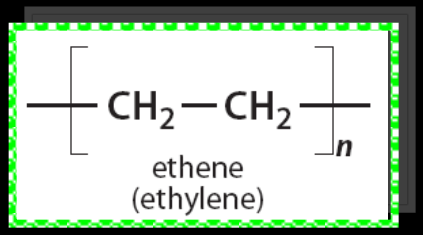
Types, codes and structures of some polymers

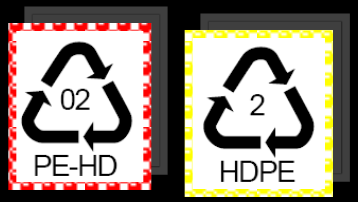
Polyethylene terephthalate, PET



Clear, hard, tough

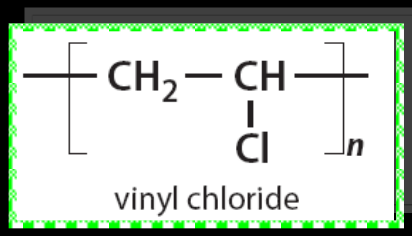
High-Density Polyethylene, HDPE

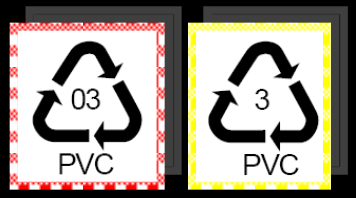




Hard to semi-flexible, opaque to translucent

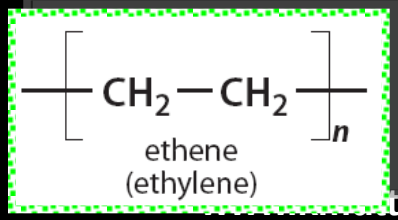
Poly (vinyl chloride), PVC

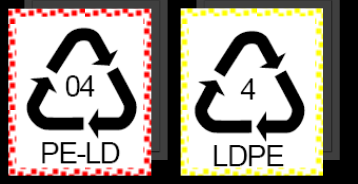




Hard ,rigid (flexible when plasticized)

Low-Density Polyethylene, LDPE

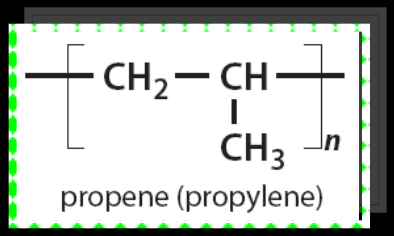


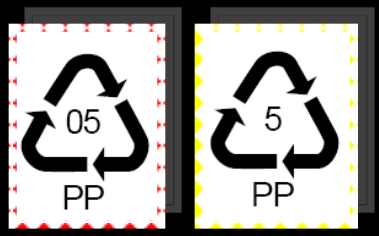


Soft, flexible, translucent

Types Codes of and Characteristics polymer recycle

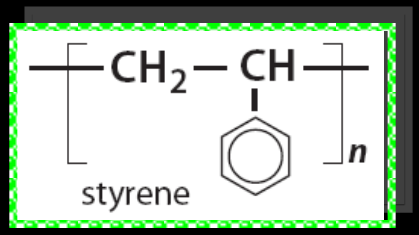
Polypropylene, PP





Hard but flexible, translucent

Polystyrene, PS



Rigid, semi-tough, clear to opaque

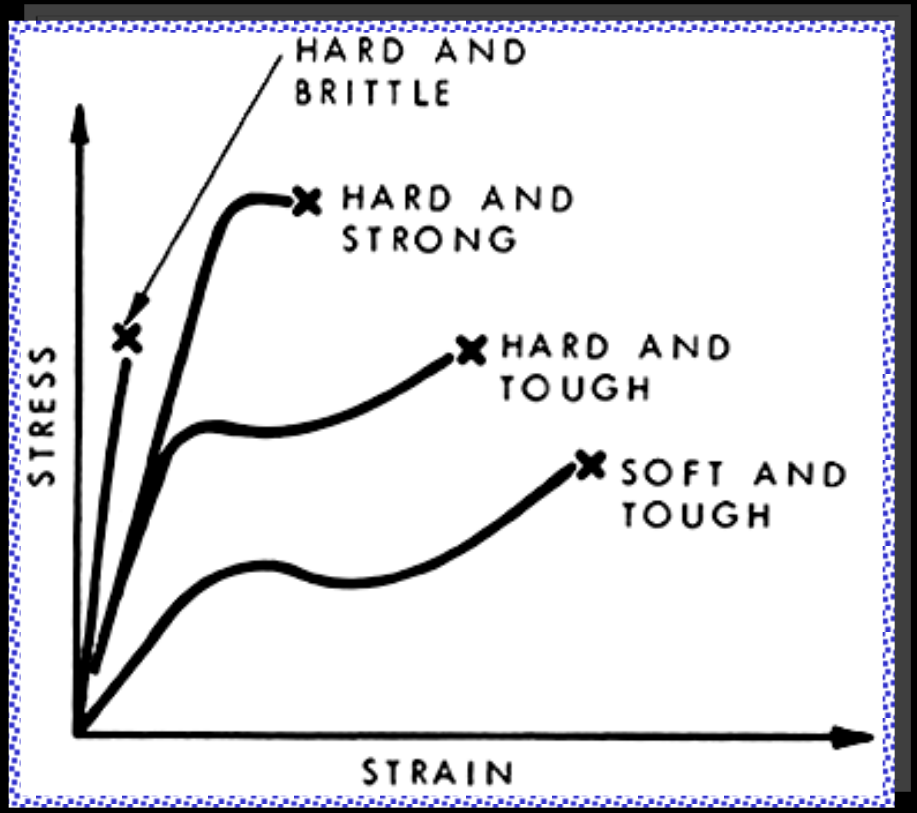
Others

Layered, mixed plastics or resins

Widely

Physical appearances

- Rigidity
- Bouncing
- Clearness
- Sound
- Feeling



Definition

Polymer Processing

- Involves heating and cooling processing.
- Converts raw polymer materials to a polymer article by:
  - Heat (internal and external)
  - Pressure
  - Flow

Polymer Processing

Involves three distinct thermo-mechanical stages, these being:

- Plastication stage
- Flowing stage
- Solidification stage

Flow properties of polymers

- Measured when polymers are molten.
- Generally measured in terms of viscosity.
- Dependent on the flow properties

Effects of processing parameters on the flow properties of polymer melts

- Temperature
- Pressure
- Flow rate or shear rate
- Molar mass of polymers
- Additives

Processing methods of polymers include:

1. **Extrusion**

- Single-screw extrusion
- Twin-screw extrusion
- Extrusion blow moulding
- Blown-film extrusion
- Sheet and film manufactures
- Pipe and tube manufactures
- Co-extrusion
- Coating, multilayer and lamination
- Wire coated manufacture

Processing methods of polymers include:

2. **Injection Moulding**
   - Conventional injection moulding
   - Injection blow moulding
   - Sandwich injection and co-injection
   - Gas-assisted injection moulding
3. **Compression moulding**
4. **Transfer moulding**
5. **Thermoforming**
6. **Calendering**
7. **Rotational moulding**

Processing methods of polymers include:

8. Reactive Injection Moulding (RIM) and derivatives (RRIM and SRIM)
9. Composite processes
   - Hand Lay-up and Spray up
   - Resin injection
   - Hot and cold press-moulding
   - Sheet Moulding Compound (SMC)
   - Dough Moulding Compound (DMC)
   - Filament winding (FW)
   - Pultrusion
10. Melt spinning
11. Foam manufacturing processes