Sustainable Plastics

Introduction

Most of the energy used by industry to create plastics comes from fossil fuels, i.e. coal, oil and natural gas.

Most of the hydrocarbons used to create plastics also come from fossil fuels.

There are a number of problems with this, i.e.

- fossil fuels are a finite resource. Plastics production using hydrocarbons from fossil fuels cannot be sustained because fossil fuels are running short and will run out in the future. If manufacturers are to continue using polymers to make products, a sustainable source of energy and hydrocarbons must be found
- our use of fossil fuels damages the environmental by:
  - oil leaks during drilling operations
  - oil leaks during transportation of oil through pipelines
  - oil leaks and spillages in tankers (ships) caused by accidents at sea
  - mining operations
  - burning fossil fuels, this creates carbon dioxide, a greenhouse gas that is a major cause of global warming
  - causing major problems of storage and disposal of waste plastic products because polymers created from fossil fuel based hydrocarbons tend to be non-biodegradable.

Sustainable plastics

Sustainable plastics are made using materials and energy that:

- will never run out, or
- are renewable.

Two strategies designed to sustain our use of plastics are:

- the six Rs of sustainability, i.e. reduce, reuse, recycle, repair, rethink, refuse
- identifying new sources of hydrocarbons that can be used to manufacture polymers.

The 6 Rs of sustainability i.e. Reduce, Reuse, Recycle, Repair, Rethink, Refuse

1. Reduce. This is achieved by:
   a. reducing the amount of plastics used to make products
   b. reducing the amount of fossil fuels used to make plastics by: reducing the amount of fossil fuels used as energy in plastics manufacture
   c. reducing the use of fossil fuels to create the monomers used in plastics production
   d. reducing waste in materials and energy

2. Reuse. This is achieved by:
   a. promoting a culture of reuse
   b. reusing products for the same function, e.g. using a plastic shopping bag over and over again
   c. reusing products for a different function, e.g. plastic ice cream box used to store other products
   d. reusing waste polymers in the plastics manufacturing industry
   e. disassembling waste and redundant products, then reclaiming and reusing plastic parts.

3. Recycle. This is achieved by:
   a. promoting a recycling culture
   b. processing waste plastics to make new products
   c. labelling polymers to ease the separation process for recycling
   d. providing all the facilities required to enable the recycling process to work effectively

4. Repair. This is achieved by:
    a. promoting a repair culture, i.e. changing a "throw-away" culture to one of repair and reuse
    b. providing education for repair and maintenance
    c. provide repair technicians with appropriate repair facilities and equipment
    d. designing for disassembly / dismantlement to aid maintenance and repair
    e. using standard components to aid maintenance and repair
    f. supplying spare parts to aid maintenance and repair

5. Rethink. This is achieved by:
    a. rethinking designs to minimise or eliminate the use of fossil fuels for energy and oil based plastics
    b. rethinking designs to ease the disassembly / dismatling of products for maintenance, repair and for recycling
    c. rethinking designs to minimise energy consumption in manufacture and in use
    d. rethinking the choice of materials, e.g.: bioplastics instead of oil based plastics
    e. naturally compostable instead of biodegradable
    f. biodegradable instead of non-biodegradable
    g. sustainable alternative materials to polymers

6. Refuse: This is achieved by:
    a. refusing to use products made from unsustainable materials or processes
    b. refusing to use materials and products that cause harm to the environment, the manufacturer, the repairer/maintainer, or the user of the product.
    c. refusing to discard and renew products unnecessarily.

Identifying new sources of hydrocarbons that can be used to manufacture polymers

All living things contain hydrocarbons. Trees and plants have been identified as renewable sources of hydrocarbons for the production of plastics. The advantages of plants, i.e. agricultural products are that:

- the technology to grow and harvest agricultural products is well established
- agricultural products grow in a variety of environments
- agricultural products can be harvested relatively quickly.

Plastics made from hydrocarbons wholly from renewable sources such as wheat, corn, potatoes, grass, palm fibre, sugar cane, rice, tapioca and cellulose are called bioplastics.

The benefits of using bioplastics include:

- a reduction in the use of fossil fuels
- a reduction in CO_2 emissions
- a reduction in the use of energy to create bioplastics
- bioplastics do not leach harmful chemicals
- bioplastics are biodegradable and can be composted unless they have been modified chemically or by polymerisation.
- bioplastics have greater steam permeability, i.e. they are breathable, useful for clothing and packaging
- bioplastics have a printable surface without the need for primers

The disadvantages of using bioplastics include:

- bioplastics and oil based plastics have different recycling methods, i.e. oil based plastics are reprocessed and made into new products, whereas bioplastics are composted
- some bioplastics cannot be broken down naturally by bacteria and need to be artificially heated in a humid atmosphere for extended periods, exaggerating the conditions in a normal compost heap
- the possibility of environmental pollution from the use fertilisers and chemical pesticides that may be used to enhance crop growth
- some plants used for bioplastics may be genetically modified, bringing risks of contamination of conventional crops
- switching land use from food crops that sustain Human and animal life to crops for the plastics industry, raises the question of the morality of using food to make plastics when there are starving people in the world.

Bioplastics and biobased plastics

Bioplastics are made using hydrocarbons wholly from renewable sources such as wheat, corn, potatoes, grass, palm fibre, sugar cane, rice, tapioca and cellulose.

An example of a bioplastic is Polylactic acid (PLA), also known as polylactide. PLA is a biodegradable thermoplastic aliphatic polyester that looks like polyethylene and is used for food packaging. At present, PLA has a recycling number of 7.

Biobased plastics are plastics that are made using a mixture of hydrocarbons from renewable sources and hydrocarbons obtained from finite fossil fuels.

Biodegradable plastics are plastics that are:

- made from agricultural products that can biodegrade naturally
- made from finite sources of hydrocarbons, usually oil, that have additives to break down the polymer, sometimes leaving behind a toxic residue.