

GCE LEVEL

FACT FILES

Environmental Technology

For first teaching from September 2013

For first award in Summer 2014

Pollution and Plastics



environmental
technology

Pollution and Plastics Fact File



Specification Content

Students should be able to:

- understand that the pollution problems associated with plastics fall into two main areas:
 - polymers and plastics made from crude oil derivatives cannot be broken down by micro-organisms or easily recycled (for example the great Pacific garbage patch); and
 - toxic gasses, such as carbon monoxide, hydrogen cyanide and hydrochloric acid, are released by incinerating plastic materials.
- describe some of the uses of plastics that are designed to be either biodegrading or photodegrading, including agricultural films, packaging and labelling;
- describe how modern plastic manufacturing processes can use the following options:
 - incorporating additives into the polymer during the manufacturing process to enhance biodegradability;
 - modifying the process to enhance thermal and photodegradation;
 - producing compostable plastics that can be used to improve soil composition in regions where soil structure is poor;



Course Content

Pollution problems associated with plastics

Pollution caused by plastic is a world wide problem of enormous proportion.



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By their very nature plastics cannot be broken down by micro organisms in the way that other materials can. In addition there are difficulties in recycling plastics. The main issues surrounding the use of plastics and hence the pollution caused by them are:

- Its widespread use.
- Its “throw away” nature.
- The fact that it does not degrade naturally in the same way as some other materials.
- If it is burnt, this in itself can cause significant pollution problems.

An example of the “non-degradability” of plastics can be found in what is known as the **Great Pacific Garbage Patch**. This is the name given to a large section of the Pacific Ocean



Vimeo.com

which has been turned into what some call the largest floating landfill site in the world. This part of the ocean is also known as the North Pacific Subtropical Gyre. It is

a slow moving spiral of currents filled with plankton but contains very few large fish or mammals. Due to the effect of the various sea currents which compose the gyre it has attracted tons of floating debris, a great deal of which is plastic which floats in the middle of the ocean. There are actually two “patches”, one which floats off the coast of the California and the other off the coast of Japan.



Activity 2

Use the following link to investigate some of the dangers associated with burning plastics. http://www.wecf.eu/cms/download/2004-2005/homeburning_plastics.pdf In your research identify the following:

- The dangers to health of burning plastic in uncontrolled conditions.
- The types of toxic gasses released when plastic is burnt.
- The types of everyday plastic products which people are tempted to burn rather than recycle.

Uses of plastics designed to be biodegradable and photodegradable.

In an attempt to address the pollution problems caused by the use of plastic a range of materials have been developed which will:

- Break down biologically – biodegradable plastic,
- Break down due to absorption of light – photodegradable plastic

Biodegradable plastics are made from oil or plant based products. They are designed to break down after a period of time under attack from bacteria and other micro-organisms with the aim of eventually returning to compost.

Photodegradable plastic is made from oil based polymers in a way similar to ordinary plastic. However, the bonds in the structure of the material weaken on absorption of sunlight or it can contain an additive which itself absorbs sunlight which in turn attacks the plastic bonding so breaking down its structure. A certain amount of care has to be taken with a photodegradable plastic as it will start to degrade when exposed to sunlight even if it is still in use. These can be used as plastic mulch in agricultural situations where growth can be promoted in areas of poor land where the plastic will eventually degrade under exposure to sunlight.



Activity 1

The following link can be used to gain an understanding of the scale of the problem in one particular part of the world - Monterey Bay in the USA:

<http://www.saveourshores.org/what-we-do/pollution-prevention.php>

Use the link to research information on the issue of plastic pollution and make a presentation which outlines the following points:

- The means by which plastic causes marine pollution.
- The impact of plastic pollution on animals.
- The impact of plastics on humans.
- An indication of the scale of consumption of plastic.
- The costs involved in cleaning up plastic pollution.
- How each individual can help to ease the problem of plastic pollution.



There are several difficulties associated with recycling of plastic one of which arises from the highly toxic gasses which are released when plastic is burnt.

Often incineration is seen as an alternative to landfill but with plastics this causes problems of a different type. In fact incineration of plastics tends to lead to toxins that are more persistent and poisonous than the plastics themselves.

When many plastics are burnt they give off carbon monoxide, carbon dioxide and dioxins. The burning of PVC in particular leads to the production of dioxins. Dioxins are a group of dangerous chemicals. They are highly toxic and once they enter the body they are easily absorbed into fat tissue where they can remain for a long time.

The other toxic gas produced when plastics containing nitrogen are burned is hydrogen cyanide. It is very toxic and even a relatively small concentration of hydrogen cyanide in air can be fatal to humans.



Activity 3

Use the following links, and any others of your choice, to investigate some uses of biodegradable and photodegradable plastic. You should identify, where possible, examples of their use in the areas of;

- Agriculture (e.g. mulch films)
- Packaging and labelling of everyday products. (e.g. bags)



myzerowaste.com

http://ecopond.com.cn/company/Organic_Waste_Management_EN.html

<http://www.biodeg.org/faq/>

<http://www.ferrisfarm.net/plasticmulch.html>

Modern Plastics Manufacturing Processes

There are several ways in which bioplastics or degradable plastics can be made. For example:

- Incorporating additives such as d2w into the polymer during the manufacturing process. This additive is included in the polymer resin at the manufacturing stage. After use the molecular chains in the structure break allowing the material to break down through the process of oxidation which is itself accelerated by light, heat and stress.
- Modifying the process to enhance thermal and photodegradation which involves the addition of different chemical links into long chain molecules of plastic which break up when exposed to ultra violet light from sunlight.
- Producing compostable plastics from base materials such as corn starch which can then be fully biodegradable and compostable.



Activity 4

The following links can be used to investigate some of the ways in which the process of manufacturing plastic can be altered in order to produce a more "eco-friendly" product.

<http://www.degradable.net/d2w-controlledlife-plastic/what-is-d2w/>

<http://worldcentric.org/biocompostables/bioplastics>

<http://ecopolyuae.com/d2w.html>

