

FACTFILE: GCE TECHNOLOGY & DESIGN

ENVIRONMENTAL ISSUES



1.50 Environmental Issues Part 2

Learning outcomes

Students should be able to:

- Consider sustainability (embodied energy, responsible sourcing, recycled content) when selecting a material.
- Demonstrate a knowledge and understanding of:
 - the sustainable use of metals (for example recycled content; responsible sourcing and use of scarce metals);
 - the issues regarding sustainability in the manufacture and disposal of plastics;
 - the properties, working characteristics and uses of biodegradable and photodegradable plastics; and
 - the need for and benefits of innovation in product design with reference to improved performance and more sustainable use of resources

Course content

Embodied Energy

Embodied energy is the name given to the collective sum of all the energy required to produce any material, product or service. This is the total energy associated with a product. It is not the chemical energy stored within the product (if for instance you were to burn it.). The embodied energy of a product can be regarded as encompassing a whole range of processes from the manufacture of the product through its transport to place of use and in its use for the particular application.

For example, a timber chair will have gone through a number of processes from its initial manufacture through to its use such as;

- forestry of the base material (timber) required to make the chair;
- transport to the place of manufacture;
- processes involved in the manufacture of the chair (machining; assembly; finishing);
- transport to the warehouse/ retailer; and
- transport to place of use.

In the modern marketplace, sustainability is seen as a key criterion and therefore most designers are well aware of the embodied energy of their products. This may well inform decisions about what materials they will wish to use in their designs.

Responsible Sourcing

Many experts claim that there are no materials which are inherently harmless or sustainable, just



materials used in a sustainable way. Responsible Sourcing of Materials is an ethos of management of the supply chain and the materials and products obtained from it, taking into account social, economic and environmental dimensions.

Examples of failures to responsible source materials include low payment of workers, over-long workshifts, use of child labour, poor environmental controls.

Responsible sourcing is now a major issue for many consumer groups and major manufacturers. This is particularly so for large multi-national companies who source many components and materials from a wide range of countries all over the world. For instance, Apple gained a lot of bad publicity in 2010 when 14 workers (at the factory of one of its Chinese suppliers) committed suicide, allegedly because of the excessively pressurised working conditions.

Examples of where responsible sourcing is being implemented include the insistence by both government and many major companies that any wood used in their products must be endorsed by the Forestry Stewardship Council (FSC). This guarantees that the wood has been sourced from sustainable forests.

Recycled Content

Using materials with recycled content reduces the need for virgin (new) materials. This therefore



reduces the direct environmental impact from extracting the materials (e.g. quarrying stone; cutting down trees; mining ores) and the indirect environmental impact (because it takes less energy to make a product with recycled content than a product made completely with virgin materials. There may also be less overall material needed (because the recycled materials are partly manufactured already) and less waste generated.

Common examples of materials with high recycled content include: recycled cardboard is widely used for packaging; recycled plastic is used for products such as park benches).

Sustainable Use of Metals



Metals are widely used in the manufacture of modern products such as cars, drinks cans and electronic appliances. They generally have a high embodied energy because of all the energy required at the various stages in their production (mining ores; manufacture and transport). Aluminium, for instance, uses a lot of electricity during the smelting process.

However, metals are often recycled nowadays. For example metal cans are 100% recyclable. 75% of the aluminium ever produced is still in productive use today. In construction about 50% of steel is recycled. This saves hugely on the amount of energy required in the manufacturing processes.

However, some virgin metals must still be extracted as ores from the ground. These ores have to be responsibly sourced as the mines are often located in sub-saharan African countries where working conditions and environmental protection measures leave much to be desired.

Many metals that we use widely nowadays (e.g. Hafnium, Indium, Lead, Silver and Zinc) may run out in another few decades because of the rate at which man is currently using them up. Many modern electronic products such as LED TV screens, computers etc. also require 'rare earth' metals for their special properties within electronic circuits for example. These are dangerous to extract from the earth.

Plastics and sustainability - the issues

Plastic is very widely used. This is due to the useful physical and mechanical properties which make it suitable for use in many diverse products. Plastic is:

- durable;

- resistant to chemicals and water;
- safe and hygienic product for use as food packaging; and
- a material with excellent thermal and electrical insulation properties.

However plastic has a number of issues relating to its impact on the environment. These include:

- the manufacture of plastics normally uses a non-sustainable raw material, i.e. oil, both as an energy source and as an industrial feedstock;
- it generates a huge amount of waste but on land at in the oceans;
- it will not degrade quickly and can pollute the environment for a large number of years; and
- it contributes to the world's pollution problem in terms of litter and release of harmful gases and emissions both during manufacture and when it is incinerated.

What are Biodegradable plastics?

Biodegradable plastics are plastics that will breakdown in natural aerobic (composting) and anaerobic (landfill) environments. This can be achieved by enabling microorganisms in the environment to metabolize the molecular structure of plastic films to produce a material that is less harmful to the environment.

They may be composed of either:

- bioplastics -plastics whose components are derived from renewable raw materials; and
- or petroleum -based plastics which use an additive.

Biodegradable plastics produced by injection molded are typically in the form of disposable food service items, and films, typically for fruit packaging.

Advantages of Biodegradable plastics

The main advantages of biodegradable products are:

- biodegradable plastics takes less time to break down after being thrown away. This results in less plastic dominating our landfills;



- biodegradable plastics are made from biomass and are completely renewable resources;
- biodegradable plastics are better for the environment, as little or no harm is done to the earth when recovering fossil fuels; and



- biodegradable plastics are easier to recycle non toxic and reduce the dependence on foreign oil.

Disadvantages of Biodegradable plastics

There are some disadvantages to biodegradable plastic waste:

- in certain situations, when dumped in landfills biodegradable plastic breaks down under anaerobic conditions, which creates methane, a greenhouse gas; and
- biodegradable waste can contain toxins.

What are Photo-degradable Plastics?

These are plastics that are made from oil-based polymers in the same way as ordinary plastics, but either:

- the bonds in the structure of the plastic break



- down on absorption of sunlight or; and
- it contains an additive which absorbs sunlight and starts to break down the plastic bonding.

However, photo-degradation can occur while product is still in use so care is needed. Photodegradable plastics are used widely as plastic mulch in agriculture where it provides shelter for initial plant growth before eventually degrading in sunlight.

Advantages of Photo-degradable Plastics?

The main advantages of photo-degradable plastics are:

- they will break down after a period of time when exposed to sunlight; and
- they can help to consolidate soils whilst plants are growing.

Disadvantages of Photo-degradable Plastics?

The main disadvantages of photo-degradable plastics are:

- they can break down whilst still in use if exposed to sunlight; and
- they still may take several months to break down and meanwhile can have an adverse impact on the environment.

Innovation in Product Design

Innovation is critical to the design of modern products for a number of reasons of sustainability and improved performance.

Sustainability

A common trend in portable product design is for miniaturization. This basically means that newer versions get progressively smaller and easier to carry. An excellent example is the mobile phone, which has gone, over a few decades, from being something the size of a brick to a light wafer-thin device which can be slipped into one's pocket. Smaller devices use up less raw materials. Other products like TVs may have got bigger but are still much slimmer and therefore still use less material. Innovation has allowed the incorporation of recycled content into the manufacture and packaging of many products which also improves sustainability. Many plastic and aluminium products contain recycled content.

Performance

All design strives for improved performance. This means more efficient use of power supplies. An example would be the improved fuel consumption of modern cars. This has been the result of a combination of innovative engine design and also the use of new composite materials which reduce the weight of the car.

REVISION QUESTIONS

1. Describe what is meant by the following:

- Embodied energy
- Responsible sourcing

2. Outline the main issues that the designer should consider with regard to the sustainable use of metals in product design.

3. State **two** advantages and two disadvantages each of:

- Biodegradable Plastics
- Photodegradable plastics

4. Give **two** examples of common products that, through innovation, designers have made them both more sustainable and better performing.

