

Sustainable Design

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Abstract:

Designing a product to be “sustainable” means that it may be

- Manufactured with less waste,
- Reused,
- Recycled, or
- Composted.

It also means that the product and its packaging is designed with these principles in mind, and in general it means that the materials used are readily available, and that the design is simple enough that the product can be easily reused, recycled or composted.

This module will examine some of the needs related to engineering materials and design that would allow the material to meet the principles of ISO 14000, an international standard for environmental management. In particular we look at the packaging and possible reuse of several commodity products and develop understanding of how redesigns of these products could better lend themselves to reuse, recycling or composting.

Student Learning Objectives: Students will be able to:

- Explain what sustainable design means for typical products
- Discuss design features that make products reusable
- Give examples of how redesign and make a product re-useable or recyclable.
- Discuss design approaches to making a product recyclable
- Explain how the economics of production of a product relate to sustainability

Key Words: ISO 14000, sustainability, design, re-use, recyclability

Mode of Presentation: Classroom PowerPoint presentation and/or activity

Time needed: Approximately 45 minutes with possible expansion

Prerequisite Knowledge: none

Equipment needed: PowerPoint projector

Grade Level: High school technology courses and community or technical college introductory courses in manufacturing and technology.

MatEdU Core Competencies Covered:

- 1.B Interpret technical drawings.
- 7.J Demonstrate how materials properties are used in engineering design.**
- 10.A Identify properties and applications of thermoplastic materials.
- 19.B Apply statistical, cost, life cycle and related management principles to manufacturing processes and management.

Instructor Notes:

Sustainability of resources depends on factors that have been defined in a set of international standard called ISO 14000. This is a family of standards related to environmental management that exists to help organizations (a) minimize how their operations (processes, etc.) negatively affect the environment (i.e. cause adverse changes to air, water, or land); (b) comply with applicable laws, regulations, and other environmentally oriented requirements; and (c) continually improve in the above.

The major objective of this module is to demonstrate that with careful design and some imagination, products can be packaged with less waste, and the product itself can be made more reusable, recyclable or compostable. This is an important component of ISO 14000, which looks at how to make products that have less impact on the resources of our planet. In the extreme, this could eventually lead to “product take-back” in which a manufacturer would, in the end, be responsible to take back their product and to reuse, recycle or compost its components.

Environmentally sustainable design is the philosophy of designing physical objects, the built environment and services to comply with the basic principles of ecological sustainability. Here we look at only one part of this equation:

Packaging, Re-use and Recycling

Sustainable package design means taking a life-cycle approach to package design. Can the packaging you design be reused? Or is it easy to recycle or compost? Designing for recyclability does not need to be difficult. Recycling of boxes is easy—recycling plastic is difficult. When we consider the pollution from plastic in our landscape and in our oceans, plastic is too easy to just toss away.

There are also products that can be packaged in different ways. An example is bread, which can come wrapped in cellophane, in a plastic bag, or in paper or waxed paper.

Another example is available at the pharmacy. Almost anything you buy is packaged in paper and/or hard plastic, a few in a plastic bag, many in a bottle.

Designing a product for re-use is easy in some cases. Used cars are an example—with repairs or rebuilds, they can be as good as new. But designing a toy or a motor or a system with multiple components is much more difficult when one wants to make it recyclable. Using an automobile engine as an example, one needs to disassemble then sort the materials into like types, etc. This is why cars end up in junk yards and eventually may be used as the source material for items like re-bar—rebar is used in concrete construction and its varied metal components are usually not critical to the ultimate strength of the concrete product.

Recycling provides reducing the need for basic sources for materials. Recycling of valuable materials is essentially a way to sustain the environment, save energy and enhance the economy. Recycling programs must, however, create products that can be used reliably, so there must be clear of contamination for reliable future use, as opposed to simply melting it down and using it for re-bar.

Here we use examples that are within most student's experience and discuss how they could be better packaged and better designed for possible reuse and/or recycling.

Procedure

1. Pre- class exercises and possible homework assignments: Ask the students to identify and bring to class one specific examples of the following:

- Products they have used that are difficult to unwrap, making the packaging not reusable or recyclable?
- Products they have used that are reusable
- Products they use that are recyclable
- Products they use that are compostable—Do they know what items they use daily are compostable?

Collect these examples for further use.

2. Use the PowerPoint presentation to look at the details of sustainable design. Then look at each of the examples noted and have the students discuss how they might change packaging or the design of the product. Depending on the background of the students, introduce cost and economics into the mix as appropriate .

3. After the PowerPoint, proceed to the small group discussions (below), depending on time available; alternately the discussions noted could be homework or projects or could fill up the class period the following day.

Accompanying PowerPoint presentation:

Use the accompanying PowerPoint presentation with the class, pausing at each of the slide for discussion:

- 1: Title slide
- 2: What does sustainable design mean?
What examples fit this category? (refer to the examples that the students found before class)
- 3: How do economics relate to sustainability
Discuss example trade-offs for raw materials, labor, manufacturing, etc.
- 4: Sustainable packaging
Continue discussion of examples from above
- 5: Designing for re-use
What additional examples might fit this category?
- 6: Example: Paper boxes designed for reuse
Also, easily recyclable
- 7: Designing for recycling
Again, discuss student examples as appropriate
- 8 :Example: Paper with plastic lining Why?
Ask how the students might re-design the packaging to be re-usable or recyclable
- 9: Example: Printer cartridge (reusable) with plastic container for shipping (photo)
Again, ask for ideas on how better to package the ink cartridge
10. Review the question of cost again
Discuss tradeoffs on cost and other variables,

Small Group Discussions

After the discussions on the PowerPoint, divide the class into small groups of about 4 students and give each an assignment to consider on the subject of sustainable design. These could include:

- Improve one of the products they initially brought to class by the students,
- New ideas that the students have on sustainable products, based on the PowerPoint, or
- Use one or more of the ideas listed in the “Defining Sustainability” module by Simoneau (see references below).

Depending on the time available and the level of the class, these could be in-class or homework—there is lots of information on all sustainability subjects on the Internet. The results of these studies could be presented to the class when time is available.

References

Defining Sustainability vis ISO 14001 by Robert W. Simoneau, educational module
available at www.materialseducation.org, 2008

Greener Package:

https://www.greenerpackage.com/source_reduction/10_tips_sustainable_package_design

ISO 14000 basics: http://www.iso.org/iso/iso_14000_essentials

ISO 14000 guide: <http://www.ehso.com/iso14000.php>

Sustainability: <https://en.wikipedia.org/wiki/Sustainability>

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Student evaluation questions (discussion or quiz):

1. Explain the concept of sustainable design
2. What makes a product recyclable? Not recyclable?
3. Explain how to redesign a product for reuse
4. Discuss economic tradeoffs related to sustainable design