TenStep, Inc.

TenStep Supplemental Paper

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DFE - Materials and Recycling

The Materials and Recycling strategy depends largely on the assumption that there can be many trade-offs when making decisions regarding materials selection. Factors to be considered:

- Can materials be recycled?
- The priority of material recyclability for short-lived products as compared to long-lived products.
- Products that disperse or wear out may need to be recycled as compared to products that can be easily collected at their end-of-life phase.
- How will material chemistry influence environmental and human health through traditional disposal methods (where product disposal is important)?

Use of environmentally hazardous materials involves health, safety, handling and waste disposal costs. This strategy focuses on selecting the most environmentally appropriate materials, substances and surface treatments for product manufacture.

Life Cycle Assessment (LCA) is a method that provides companies with useful tools for determining how to make decisions based on these factors and trade-offs. ISO 14040 is the international standard for LCA, which evaluates the environmental and resource loading associated with products.

Some materials or additives are best avoided because they cause hazardous emissions during production, when they are incinerated, or if they are used as landfill. Examples are:

- Colorants
- Heat or UV stabilizers
- Fire retardants
- Degreasers
- Antioxidants

Some colorants and fire-retardants are especially hazardous, and in many countries are restricted by law.

Many substances that contribute to ozone layer depletion are now forbidden or restricted, such as CFCs and HCFCs. Many large corporations are practicing materials de-selection by developing their own lists of banned substances.

Renewable materials are substances derived from a living tree, plant, animal or ecosystem, which can regenerate. The use of renewable materials can represent a good environmental choice since these materials:

- Do not get depleted if managed properly as a renewable resource.

- Have reduced net emissions of CO2 throughout their lifecycle, unlike materials derived from fossil fuels.
- Result in biodegradable waste.

However, when considering the use of a renewable material, its full environmental impact must be assessed. For instance, the plastic sack may be a better environmental choice than one made of paper. In a lifecycle analysis, a factor that becomes important is the superior ratio of strength to weight of plastics that leads to lower energy requirements and transportation costs.

This strategy focuses on the productive use of recycled materials, i.e. those used in products before. If suitable, companies can use and reuse these materials in order to maximize invested resources.

Recycling provides cost benefits, can enhance product production, and is an excellent environmental choice.

- By implementing product take-back programs, companies have a cost-effective source of materials and/or parts.
- Using recycled materials can lower the embodied energy needed for production by avoiding the energy costs associated with extraction.
- Unique features of recycled materials, such as variations in color and texture, can be advantageous when used appropriately in production. This could include using recycled paper, steel, aluminum, other metals and plastics.

There are two sources for recycled materials.

1. Industrial off-specification material that was generated from an industrial process and not used.
2. Post-consumer material recovered after use from an industrial or domestic setting. This material is typically collected, sorted and cleaned, but may still be contaminated by foreign material.

Currently, many recycled materials come from industrial sources and have minimal impurities and only slightly inferior properties than the originals.
Some guidelines for designing with recycled plastics are:

- Co-extrusion - this process, which can be used in sheet, film and blow-molding operations, makes a multi-layered product that can have a middle layer of recycled plastics sandwiched between layers of new plastic.
- Sandwich Injection Molding - this technique is similar to co-extrusion, where recycled plastics are injected as the bulky core of thick-walled plastic products and new plastic is used only for the outer skin.
- Foamed Extrusion and Foamed Injection Molding - these techniques use gases to form bubbles in plastics that reduce the weight of thick-walled products and produce a textured skin on the surface. They provide good rigidity through enlarged thickness.

- Extrusion and Injection Molding of Mixed Plastics - these processes provide good potential for the use of recycled material because they eliminate the need for sorting or cleaning before processing. However, the products may have limited strength due to the incompatibility of different plastics and contaminants. These processes usually use polyethylene as a "binder" for plastics and contaminants, thereby limiting a product's physical characteristics to those of polyethylene, i.e. generally low in rigidity and strength and prone to displaying "creep" behavior.

In addition, the color is usually dark due to the variety of incorporated colorants.

Recyclable materials are those that can be easily recycled, depending on the type of material and the available recycling infrastructure. Reducing the amount of waste your company sends to a landfill can significantly increase cost-savings. Your waste materials could even be a source of income.

If recyclable materials are to be used, then:

- Find out which materials are recyclable.
- Ensure the material will produce high-quality material when recycled.

Product design can significantly contribute to recyclability. Here are some criteria to be followed:

- One type of material only may be selected for the product.
- Don't mix metals, which often leads to contamination, e.g. mixing steel components with copper; aluminum with copper or iron; or copper with mercury or beryllium.
- Avoid materials that are difficult to separate, such as compound materials, laminates, fillers, fire-retardants and fiberglass reinforcements.
- Avoid polluting elements that interfere with recycling, like glues and small components that are not removable.