13.4: Kinds of Products

In considering life-cycle assessments, it is useful to divide products into three major categories. The first of these are **consumable products** which, by the nature of their use, are used up or dispersed to the environment with no possibility of recovery. Such materials include laundry detergents that are flushed down the drain with wash-water or windshield washer fluid, which is squirted onto windshields, then wiped off. Another class of product consists of **recyclable commodities**. Engine antifreeze and motor oil are potentially recyclable commodities in that, in principle (though somewhat rarely in practice), they can be reclaimed after use, purified, reformulated, and sold again. **Service products** (sometimes called durable products) are usually devices that have multiple uses and last for a long time. The washing machine in which consumable laundry detergent is used is a typical service product.

Since consumable products are dispersed to the environment, it is important that they have environmentally friendly characteristics. They should first of all be **nontoxic** at the levels and manner in which organisms are exposed to them. In addition to not causing acute toxicity, they should not be carcinogenic or mutagenic and should not cause birth defects. Another characteristic that consumable products should have is that they should not be **bioaccumulative**. As discussed under the topic of "Biological Interaction with Environmental Chemicals" in Section 12.9, **bioaccumulation** is the term given to the uptake and concentration of xenobiotic materials by living organisms. Poorly biodegradable, lipid-soluble materials such as PCB compounds have a strong tendency to bioaccumulate, and such substances should be avoided in consumable products. Consumable products should also be **degradable**. The most common type of degradation is biodegradation, which occurs primarily through the action of microorganisms. The practice of green chemistry can aid in making biodegradable products by, for example, avoiding branched-chain hydrocarbon structures in organic compounds and by attaching functional groups, such as the organic carboxylic acid group, $-CO_2H$, that are amenable to microbial attack.

Recyclable commodities should be designed with durability and recycling in mind. In order for them to last through a normal life cycle, such commodities should not be as degradable as consumables. An example of making a product more amenable to recycling is the use of bleachable and degradable inks on newsprint, which makes it easier to recycle the newsprint to produce a grade of recycled paper that meets acceptable color standards.

Although service products are designed to last for relatively long times, they do reach a stage requiring disposal or recycling. A key factor in recycling is the availability of channels through which such products can be recycled. Proposals have been made for "de-shopping" centers where items such as old computers and broken small appliances can be returned for recycling. Service products should be designed and constructed to facilitate disassembly so that various materials can be separated for recycling.