

SOLID WASTE

INTRODUCTION

In natural systems there is no such thing as waste. Everything flows in a natural cycle of use and reuse. Living organisms consume materials and eventually return them to the environment, usually in a different form, for reuse. Solid waste (or trash) is a human concept. It refers to any variety of discarded materials, not liquid or gas, that are deemed useless or worthless. Unfortunately, what is worthless to one person may be of value to someone else. Solid wastes are really misplaced resources. Therefore, learning how to effectively reduce the amount wastes and to recycle valuable resources from them is important if humans wish to maintain a liveable and sustainable environment.

Solid waste disposal has been an issue with which humans have had to deal with since they began gathering together in large, permanent settlements. With the migration of people to urban settings, the volume of solid waste in a given area greatly increased. Ancient cultures dealt with waste disposal in different ways: dump it outside their settlements; incorporate some of it into flooring and building materials; recycle some of it. Dumping and/or burning solid waste has been a standard practice over the centuries. Most communities in the United States dumped or burned their trash until the 1960's when the Solid Waste Disposal Act of 1965 (part of the Clean Air Act) required environmentally sound disposal of waste materials.

SOURCES AND TYPES OF SOLID WASTE

There are two basic sources of solid wastes: nonmunicipal and municipal. Nonmunicipal solid waste is the discarded solid material from industry, agriculture, mining, and oil and gas production. It makes up almost 99% of all the waste in the United States. Some common items that are classified as nonmunicipal waste are: construction materials (roofing shingles, electrical fixtures, bricks); waste-water sludge; incinerator residues; ash; scrubber sludge; oil/gas/mining waste; railroad ties; and pesticide containers.

Municipal solid waste refers to the discarded solid materials from residences, businesses, and city buildings. It makes up a small percentage of the waste stream in the United States, only a little more than 1% of the total. Municipal solid waste consists of materials from plastics to food scraps. Generally, the most common waste product is paper (about 40% of the total). Other common components are yard waste (green waste), plastics, metals, wood, glass and food waste. The composition of the municipal wastes can vary from region to region and from season to season. Food waste, which includes animal and vegetable wastes resulting from the preparation and consumption of food, is commonly known as garbage.

Some solid wastes are unsafe to the health and well-being of humans. These materials are classified as hazardous wastes. Hazardous wastes are defined as materials which

are toxic, carcinogenic (cause cancer), mutagenic (cause DNA mutations), teratogenic (cause birth defects), highly flammable, corrosive or explosive. Although hazardous wastes in the United States are supposedly regulated, some obviously hazardous solid wastes are excluded from strict regulation: mining wastes and hazardous household and small business wastes.

WASTE DISPOSAL METHODS

Most solid waste is either sent to landfills (dumped) or to incinerators (burned). Ocean dumping was also popular way for coastal communities to dispose of their solid wastes. Large barges would carry waste out to sea and dump it into the ocean. That practice is now banned in the United States due to pollution problems it created. Most municipal and nonmunicipal waste is sent to landfills. Landfills are popular because they are relatively easy to operate and can handle a lot of waste material. There are two types of landfills: sanitary landfills and secure landfills.

In a sanitary landfill solid wastes are spread out, compacted in a hole, canyon area or a giant mound. Modern sanitary landfills are lined with layers of clay, sand and plastic. The garbage is dumped in the landfill and covered with clay or plastic to prevent redistribution by animals or the wind. Rainwater that percolates through the landfill is collected in the bottom liner. This liquid leachate may contain toxic chemicals such as dioxin, mercury, and pesticides. Therefore, it is removed so as not to contaminate local aquifers. The groundwater near the landfill is closely monitored for contamination from the leachate.

As the buried wastes are decomposed by bacteria gases such as methane and carbon dioxide are produced. Because the methane gas is very flammable, it is usually collected with other gases by a system of pipes, separated and then either burned off or used as a source of energy (e.g., home heating and cooking, generating electricity). Other gases such as ammonia and hydrogen sulfide may also be released by the landfill, contributing to air pollution. These gases are also monitored and, if necessary, collected for disposal. Finally, when the landfill reaches its capacity, it is sealed with more layers of clay and sand. Gas and water monitoring activities, though, must continue past the useful life of the landfill.

Secure landfills are designed to handle hazardous wastes. They are basically the same design as sanitary landfills, but they have heavy plastic and clay liners. Also, wastes are segregated and stored according to type, typically in barrels. This prevents the mixing of incompatible wastes. Some hazardous waste in the United States is sent to foreign countries for disposal. Developing countries are willing to accept this waste to raise needed monies. Recent treaties by the U.N. Environment Programme have addressed the international transport of such hazardous wastes.

Federal regulation mandates that landfills cannot be located near faults, floodplains, wetlands or other bodies of water. In many areas, finding landfill space is not a problem, but in some heavily populated areas it is difficult to find suitable sites. There are, of

course, other problems associated with landfills. The liners can eventually leak and contaminate groundwater with toxic leachate. Landfills also produce polluting gases, and the landfill vehicle traffic can be very noisy for any nearby community.

About 15% of the municipal solid waste in the United States is incinerated. Incineration is the burning of solid wastes at high temperatures between 1000°C and 1500°C. Though particulate matter, such as ash, remains after the incineration, the sheer volume of the waste is reduced by about 85%. Ash is much more compact than unburned solid waste. In addition to the volume reduction of the waste, the heat from the trash that is incinerated in large-scale facilities can be used to produce electric power. This process is called waste-to-energy. There are two kinds of waste-to-energy systems: mass burn incinerators and refuse-derived incinerators.

In mass burn incinerators all of the solid waste is incinerated. The heat from the incineration process is used to produce steam. This steam is used to drive electric power generators. Acid gases from the burning are removed by chemical scrubbers. Any particulates in the combustion gases are removed by electrostatic precipitators. The cleaned gases are then released into the atmosphere through a tall stack. The ashes from the combustion are sent to a landfill for disposal.

It is best if only combustible items (paper, wood products, and plastics) are burned. In a refuse-derived incinerator, non-combustible materials are separated from the waste. Items such as glass and metals may be recycled. The combustible wastes are then formed into fuel pellets which can be burned in standard steam boilers. This system has the advantage of removing potentially harmful materials from the waste before it is burned. It also provides for some recycling of materials.

As with any combustion process, the main environmental concern is air quality. The incineration process releases various air pollutants (particulates, sulfur dioxide, nitrogen oxides, and methane) into the atmosphere. Heavy metals (e.g., lead, mercury) and other chemical toxins (e.g., dioxins) can also be released. Many communities do not want incinerator within their city limits. Incinerators are also costly to build and to maintain when compared to landfills.

WASTE MANAGEMENT

One of the best ways to handle solid waste is to reuse as much of it as possible. In the United States, about 22% of the solid waste generated by municipalities is recycled. Recycling is the process by which the materials in consumer goods are returned to the production facility and remade into new products. There are two basic types of recycling: postconsumer and preconsumer.

Postconsumer recycling involves products that consumers, rather than industry or producers, have recycled. Aluminum cans, plastic bottles and newspapers are typical materials involved in postconsumer recycling. Preconsumer recycling involves recycling the materials at the production facility. For example, a plant that makes plastic bottles

may recycle any rejected bottles which do not fit certain specifications. It is material that a consumer has never purchased. Preconsumer recycling is much more common and makes up a larger percentage of the total.

Recycling has several environmental benefits. It removes some solid waste materials from the waste stream and prevents them from ending up in a landfill or being incinerated. It also conserves precious natural resources which would be needed to produce virgin materials. The energy saved through recycling is considerable. For example, the energy required to produce recycled paper is at least 50% less than that required to make virgin paper. An aluminum can made from recycled aluminum rather than processed from bauxite ore requires 95% less energy. Plastic bottles made from recycled materials require 50% less energy. The lower energy requirements also mean less fossil fuel resources are needed for power production. By lessening the need for producing virgin materials, recycling also indirectly aids the battle against air pollution. Production of paper and aluminum products from recycled materials generates about 95% less air pollution than production from virgin materials.

Aluminum and plastics are materials commonly recycled in the United States. There are many different types of plastics (polymers) and generally only similar types of plastics can be recycled together. The different types must be sorted at the recycling facility. The type of polymer is usually identified on the plastic item. Some common recyclable plastic polymers are high-density polyethylene (HDPE) and the polyethylene terephthalate (PET) is called thermoplastic. Milk bottles and water bottles are made from HDPE, and soda bottles are made from PET. A commonly used plastic that is usually not recycled is low-density polyethylene (LDPE). This plastic is used in sandwich and shopping bags. The price of raw materials usually determines how effectively materials can be recycled. For example, when the price of oil (the raw material for plastics) is low, it is usually cheaper to produce products from new plastic, than to recycle old plastic.

Worldwide, recycling is a growing trend. Japan is currently the world leader in recycling with about 60% of their products being recycled. Many communities in the United States have curbside recycled material collection programs or drop-off collection facilities. One way some states use to encourage recycling is to require deposits on the purchases of recyclable containers. Some cities use materials recovery facilities (MRFs) in addition to or instead of curbside programs. Trash containing both recyclable and non-recyclable materials is sorted in recyclable materials at the MRF. MRFs makes it easier for everyone to participate in recycling. In order for recycling to be a viable option, however, there must be a demand for the recycled materials.

Composting is the biological decomposition of organic material under aerobic conditions. This process is used to recycle organic yard wastes and household food wastes. During the composting process, bacteria and other microorganisms convert the organic matter into humus, an important component of fertile soil. The composting process takes about a year. Some communities ban the disposal of yard waste with regular trash and instead require the use of "green bins." The "green bins", filled with

leaves, grass clippings and tree trimmings, are sent to a municipal compost facility. Residents close to such a facility often complain, though, of the odor from the compost. Composting is one way to ensure that the nutrients from waste materials are returned to the soil to be used by other organisms, just like they would be in natural systems.

WASTE REDUCTION

Environmental scientists have set out a waste management protocol that defines the disposal methods that benefit the environment the most. Their protocol declares the following: reduce, reuse, recycle, compost, bury, and burn. The most effective way to decrease the amount of trash is to reduce the amount produced in the first place. The second most effective way is to reuse materials. These actions would lengthen the useable lives of landfills and lessen the load on incinerators.

Some ways to reduce consumption include: reducing the amount of packaging; reducing the number of individual packages; using less material to make a product and buying only what you can consume. Can producers have reduced the amount of aluminum in soda cans by 40% since 1970. Concentrated juices and laundry detergents require fewer packaging materials.

Reusing materials multiple times or for another purpose can also save on solid wastes. Some examples of this include: reusing newsprint as a paper towel to clean items and soak up liquids; refilling a water bottle rather than buying a new one; using reuseable cloth napkins instead of paper napkins; reusable cups instead of paper cups; reusing the backside of printed paper as scratch paper; and reusing grocery bags for garbage collection.