

# Chapter 30

## WASTE MANAGEMENT

### Case Study – ‘e-waste’: A Growing Environmental Problem

● Disposal of millions of computers, ipods, cell phones and other high tech equipment is becoming a serious problem. This is a waste stream that we have failed to regulate. These products contain gold, tin, copper, cadmium and mercury that are toxic, nondegradable, and that may cause cancer if breathed, ingested or inhaled. They contains plastics that relase toxic gases when burned. These products are placed in landfills in the U.S. and increasingly are shipped to waste dumps in developing nations that lack environmental regulations

### 30.1 EARLY CONCEPTS OF WASTE DISPOSAL

● Originally, with only a small population size, waste was simply disposed of in the most convenient place, in the river, the sea, or a pile at the edge of town. A decade ago the cost of disposing of solid waste was about \$5-10 per metric ton. Some cities today in the U.S. pay \$75/t. Disposal and treatment of liquid and solid waste in the U.S. now costs about \$20 billion annually.

### 30.2 MODERN TRENDS

● A movement toward zero waste has led to the development of the new field of industrial ecology, which is the study of the relationships between industrial and natural systems.

### A CLOSER LOOK 30.1: Industrial Ecology

In an ecosystem, waste generated in one part of the system is a resource used in another part of the system. This same concept is being applied to industrial systems. Industrial ecology examines how industries can be linked together so as to minimize overall waste production and resource consumption, and maximize energy efficiency.

### 30.3 INTEGRATED WASTE MANAGEMENT

- or IWM is best defined as a suite of management alternatives that includes reuse, source reduction, recycling, compositing, landfill and incineration. Studies of our waste stream indicate that we could cut the weight by 50-70% by a combination of better packaging, recycling, and composting. Intensive recycling could reduce the waste stream by 80-90%. The guiding principles are ‘reuse, recycle, and reduce’.
  - Reduce the amount of packaging (would reduce waste by 10%)
  - Compost (another 10%)
  - Recycle (another 30%)
- success depends on public support

- success depends on markets. In some areas the markets for recycled products have become saturated, resulting in a price collapse.
- Human waste also is a solid waste disposal problem. In theory it could be recycled back onto the land (called night soil), but currently the solids collected at waste water treatment plants are often contaminated with toxic chemicals used at home and in industry.

### 30.4 MATERIALS MANAGEMENT

- The goal of reducing the waste stream could be realized by 1) eliminating subsidies for extraction of virgin materials, 2) establishing ‘green building’ incentives that encourage use of recycled materials, 3) establish financial penalties and incentives that encourage industries to adopt best materials management practices, and 4) training a workforce in the new technology of reuse and recycling.
- Progress is being made. For example, 50% of the steel produced in this country is now from recycled scrap.

### 30.5 SOLID-WASTE MANAGEMENT

- Continues to be a problem of cost, location, adequate space, monitoring, safeguarding, etc.
- The composition is mostly paper products that contribute as much as 50% by volume and 40% by weight (see Fig. 30.2). The largest single item is newspaper, which accounts for 18% by volume.
- Methods of solid waste disposal include 1) on site disposal, e.g. the disposal unit in the kitchen sink, which results in a transfer of the solids to the waste water treatment plants; 2) composting; 3) incineration, which can provide energy as well as air pollutants; 4) ocean dumping, mostly prohibited now; 5) sanitary landfills.
- Sanitary landfills are covered with a layer of soil to make them ‘sanitary’. The most significant hazard from a landfill is groundwater pollution from **leachate**. Site selection is important so as to minimize the hazards and the cost. The cost issue often results in the landfills being located where land values are lowest, and this has given rise to charges of environmental injustice.
- Monitoring of ground water is required for chemicals such as heavy metals (lead, chromium, cadmium, mercury etc.), nitrates, and organic toxins. The Resource Conservation and Recovery Act of 1980 specifies that landfills opened after 1993 must comply with stricter requirements related to site location, monitoring, and installation of barriers to leaching. Modern landfills are engineered to include multiple barriers (clay, plastic liners) to leaching.

#### **A CLOSER LOOK 30.2: Environmental Justice: Demographics of Hazardous Waste**

Environmental justice is an emerging field in the social sciences.

### 30.6 HAZARDOUS WASTE

- About 35,000 chemicals used in the U.S. are classified as definitely or potentially hazardous (see Table 30.2). We produce 700 million metric tons annually. In the U.S. there are 32,000 – 50,000 waste disposal sites where past dumping was unregulated. As

#### A CLOSER LOOK 30.3: Love Canal

- Located in a neighborhood of Niagara Falls, NY, used as a chemical waste dump from 1920 to 1952 and sold to the state by the Hooker Chemical Co. in 1953 for \$1. Homes and an elementary school were built on and near the site. High rates of cancer, miscarriages, and birth defects were found in the population near the dump, and in 1978 and 1980, President Carter issued two environmental emergencies for the Love Canal area. As a result, approximately 950 families were evacuated from a 10squareblock area surrounding the landfill. The government purchased their homes. Approximately 10,000 people are located within one mile of the Site; 70,000 people live within three miles.

many as 2,000 of these contain sufficient hazardous waste to be a threat to human health.

### 30.7 HAZARDOUS-WASTE LEGISLATION

- Management of hazardous waste began with the 1976 Resource Conservation and Recovery Act (RCRA), which requires ‘cradle to grave’ management of hazardous chemicals, including record keeping and reporting. The 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) established procedures for release of hazardous substances into the environment, mandated the identification of hazardous waste disposal sites, and established the Superfund to clean up the worst abandoned waste sites. CERCLA was strengthened in 1984 and 1986. Landowners are liable for the cost of cleanup on their properties unless they complete an environmental audit prior to the purchase of the property (a provision of the 1986 Superfund Amendment and Reauthorization ACT or SARA). SARA also required that industries report all releases of hazardous materials, and a list of companies releasing hazardous compounds was made public.

### 30.8 HAZZARDOUS-WASTE MANAGEMENT: LAND DISPOSAL

- Alternative land disposal options (see Table 30.3) include dumping in a secure landfill, land application and microbial breakdown, surface impoundment of liquids, and deep-well injection.

### 30.9 ALTERNATIVES TO LAND DISPOSAL OF HAZARDOUS WASTE

- Alternatives include source reduction, recycling and resource recovery, chemical treatment, or incineration.

### 30.10 OCEAN DUMPING

- In 1972 the Ocean Dumping Act as passed in the U.S. for meeting U.S. commitments under the 1972 Convention on the Prevention of Marine Pollution, an international treaty signed by 80 countries. The law bans ocean dumping of radiological, chemical and

biological warfare agents and high-level radioactive waste. Amendments in 1988 extended this ban to sewage sludge, industrial and municipal wastes. Many pollutants still enter the oceans from nonpoint sources (nutrients, pesticides) and illegally, and solid waste enters the oceans from many sources including monofilament fishing nets lost at

#### **A CLOSER LOOK 30.4: Plastics in the Ocean**

- Plastic products do not degrade quickly and are entering the oceans by a number of avenues. Recent surveys have shown that these products can be found floating everywhere in the ocean. They pose a threat to marine life.

sea.

### **30.11 POLLUTION PREVENTION**

- Management in the 1970s and 1980s was focused on cleanup, disposal and treatment of pollutants, the focus of management in the 1990s shifted toward pollution prevention.

#### **CRITICAL THINKING**

- Can we Make Recycling a Financially Viable Industry?

#### **Web Resources**

<http://www.epa.gov/tri/> This is the entry to EPA's toxic release inventory. You can search by zip code, type of chemical, or view summary statistics.

<http://www.blueoceansociety.org/plastics.htm> A web site with facts about plastics in the ocean.

[www.whoi.edu/science/B/people/kamaral/plasticsarticle.html](http://www.whoi.edu/science/B/people/kamaral/plasticsarticle.html) A Woods Hole Oceanographic Institution site.

[www.epa.gov/epaoswer/non-hw/muncpl/disposal.htm](http://www.epa.gov/epaoswer/non-hw/muncpl/disposal.htm) An EPA site with solid information about municipal waste disposal.

<http://uffalo.edu/libraries/projects/lovecanal/> The University at Buffalo's comprehensive collection of documents and online resources related to Love Canal.

