Taxonomy of Hazardous Wastes

This chapter is devoted to the classification of waste. Different classes of waste and their intrinsic properties are examined. Among hazardous wastes, broad categories of inorganic compounds or heavy metals, specific organic compounds, and biomedical and radioactive wastes are presented along with their adverse effects on health and the environment.

Classification of Waste

In order to develop effective strategies to manage and control wastes and at the same time protect human health and the environment, it is imperative to identify and classify toxic and hazardous wastes properly. There have been numerous attempts at the classification of hazardous wastes. Toxic wastes are usually treated as a subcategory of hazardous wastes (Asante-Duah, 1993; Epstein et al., 1982; LaGrega et al., 2001). One crude approach is to group wastes according to the degree of risk they pose to humans and the environment. Thus, wastes are put into high-, intermediate-, and low-risk categories. High-risk wastes have the properties of being highly toxic, persistent, mobile, ignitable, and bioaccumulative. Examples of this type of wastes include chlorinated solvents, persistent organic pollutants (POPs), heavy metals such as lead and cyanide wastes, and polychlorinated biphenyl (PCB) wastes. Intermediate-risk wastes are mostly insoluble and have low mobility, for example, metal hydroxide sludges. Low-risk wastes generally include high-volume, nontoxic, and malodorous wastes, for example, municipal solid waste (see Asante-Duah, 1993). A waste is considered hazardous or toxic if it meets any of the four properties set by the Environmental Protection Agency (EPA) under the provisions of the Resource Conservation and Recovery Act (RCRA), that is, ignitability, corrosivity, reactivity, and toxicity.
Any liquid with a flash point of less than 140 degrees Fahrenheit or a solid that is capable of causing fire either through friction or through absorption of atmospheric moisture, or can undergo spontaneous chemical change resulting in fire, is defined as an ignitable or flammable waste. Ignitable wastes are given an EPA hazardous waste number of D001. Corrosivity is determined by using a pH scale. Thus, any waste with a pH less than or equal to 2 or a pH equal to or greater than 12.5 is considered a corrosive waste. The EPA number D002 classifies corrosive wastes. Reactive wastes are materials that are unstable and can undergo violent chemical change without detonating, can react violently with water to form possible explosive mixtures, or may generate poisonous gases. They are coded as D003 waste by the EPA. Acute toxicity is defined as the lethal dose of a chemical that takes less than 50 mg/kg of body weight to kill 50 percent of the population exposed (< LD50), for example, hydrogen cyanide or hydrogen sulfide. Other toxicity thresholds have been established by the EPA based on oral, dermal, and inhalation toxicity (see Tammemagi, 1999: 80). Thus, any waste that may cause death or severe injuries to the exposed victims is considered a toxic waste (see table 3.1a).

Hazardous wastes are produced and transported across the nation and in some cases cross-nationally. There are numerous cases of shipment and dumping of toxic wastes that originated from affluent nations of the global North to impoverished or underdeveloped societies of the global South. Within the country, the US Department of Transportation (DOT) has developed a system of classification of hazardous and toxic substances transported within the interstate commerce. Table 3.1b presents the DOT classification scheme and representative hazardous substances the agency regulates. Flammable and combustible substances are involved in most cases of accidents. Hazardous materials that are explosive, poisonous, corrosive, and radioactive are of greatest concern.

Toxic wastes have also been classified by source, industry, chemical composition and degree of toxicity, persistence in the environment, radioactivity, and public health threats (see Epstein et al., 1982; Tammemagi, 1999; Asante-Duah, 1993; McGinn, 2000; LaGrega et al., 2001). For the present purpose, toxic wastes are classified by type, that is, inorganic and organic compounds, industry, and sources. The EPA has developed a system of classification of hazardous wastes by industry. The typical industry and the types of toxic and hazardous wastes generated are shown in table 3.2. The most hazardous and toxic wastes are produced by chemical manufacturing, petroleum,