Chapter 0

Volatilization

Volatilization, or evaporation, is the transfer of chemicals from solids or liquids to the gaseous phase. Depending on the contaminant and site characteristics, volatilization can be an important mechanism for the loss of hazardous compounds from soils and liquid waste systems. Volatilization may decrease the concentration of the wastes at a facility or site; however, because of the law of mass conservation, contaminants will subsequently be found in the atmosphere. Therefore, air emissions from contaminated sites and RCRA hazardous waste management facilities, which are regulated under the Clean Air Act, may become hazardous air pollutants (HAPs) and result in short- or long-term health effects. Volatilization can also be applied as a hazardous waste treatment process to clean up contaminated groundwater through air stripping and to remediate soils by soil vapor extraction. The fundamental principles covered in this chapter serve as a basis for process selection and the design of treatment systems that promote volatilization. These design applications will be introduced in Chapters 12 and 13.

If volatilization occurs, it will do so primarily as a function of the contaminant's va- por pressure (if the compound is in relatively pure form) and the Henry's Law constant (if it is in aqueous solution). In this chapter, these two physical properties will first be described before three source release volatilization calculations are presented: (1) volatilization from an open container; (2) volatilization from a soil surface, and (3) volatilization from deep soil contamination. These calculations serve as a basis for the models covered in Chapter 8 that describe the path of volatile chemicals in the atmosphere after they are released from the source.

6.1 THE GOVERNING VARIABLES: VAPOR PRESSURE AND HENRY'S LAW

Vapor Pressure. Volatility of a pure compound is a function of its vapor pressure: con- ceptually, *vapor pressure* may be thought of as the pressure exerted by a chemical on the atmosphere. Compounds with higher vapor pressures exert more pressure against the atmosphere and, as a result, an increased driving force for volatilization. Vapor pressures of organic compounds range from 10^{-10} mm Hg to 760 mm Hg at 20°C.

Vapor pressure increases with temperature; the temperature at which a compound's vapor pressure reaches atmospheric pressure (760 mm Hg) is the boiling point of the compound. The relationship between vapor pressure and temperature is described by