Background levels of Ni, Cd, and Pb in soils are generally quite low (Adriano, 1986) except in areas where the parent material has high levels of these elements. Increased levels of these elements in soils also can occur as a result of air pollution and land disposal of industrial and municipal wastes (Adriano, 1986).

Nickel, Cd, and Pb have been grouped together in this chapter because they are not essential for plant growth and development, are regarded primarily as pollutant metals, and may reach potentially toxic levels in soils. New digestion methods have been developed since the previous edition and the sections on extraction methods have been expanded because of the continuing interest in their use.

**SAMPLING AND SAMPLE PREPARATION**

For details on the various approaches to soil sampling, refer to Petersen and Calvin (1986). See also Petersen and Calvin (1996, Chapter 1) of this edition for problems associated with soil sampling and storage. Generally, soil samples are air dried and ground to pass a 2-mm sieve before analysis. Air drying may affect some soil properties and alter the results of some of the selective extraction methods (Bartlett & James, 1980; Rapin et al., 1986). If this is the case, it may be more appropriate to analyze moist samples, which may be stored by refrigeration at less than 4°C. Results from extraction and analysis of moist samples are typically reported on a dry-weight basis. The water content of the sample can be determined gravimetrically (Gardner, 1986). For samples that are to be analyzed for total Ni, Cd, and Pb, oven drying the samples at 105°C is appropriate. It should be specified whether the sample was moist, air dried, or oven dried when reporting the results of analysis.

Generally, the less than 2-mm size fraction of a soil sample is analyzed. Digestion methods are more effective and precision is improved if smaller particle sizes are used. Samples can be ground to pass smaller size fraction sieves (e.g., 0.5, 0.25, 0.125 mm, etc.) if necessary to improve digestion efficiency and precision. In general, as sample size decreases, particle size also must decrease to achieve reproducible results. For sample sizes of 200 mg or less, the sample should be ground to pass a 0.125-mm sieve.