2.4 Particle-Size Analysis

GLENDON W. GEE, Battelle, Richland, Washington
DANI OR, Utah State University, Logan, Utah

2.4.1 Introduction

Particle-size analysis (PSA) is a measurement of the size distribution of individual particles in a soil sample. The major features of PSA are the destruction or dispersion of soil aggregates into discrete units by chemical, mechanical, or ultrasonic means and the separation of particles according to size limits by such means as sieving and sedimentation, as well as other methods (diffraction).

Soil particles span a large size range, varying from stones and rocks (exceeding 0.25 m in size) down to submicron clays (<1 µm). Various systems of size classification have been used to define arbitrary limits and ranges of soil-particle size. Soil particles smaller than 2000 µm are generally divided into three major size groups: sands, silts, and clays. These groups are sometimes called soil separates and can be subdivided into smaller size classes. Figure 2.4–1 shows the particle size, sieve dimension, and defined size class for the system of classification used by the U.S. Department of Agriculture (USDA), the Canadian Soil Survey Committee (CSSC), the International Soil Science Society (ISSS), and the American Society for Testing and Materials (ASTM). Geologists and geomorphologists typically use the Wentworth classification scheme (Wentworth, 1922) and that of Folk (1954), and variations of the Folk scheme (Folk, 1980; Prothero & Schwab, 1996). The Soil Science Society of America has adopted the USDA classification, that is: sands (<2000–50 µm), silts (<50–2 µm), and clays (<2 µm). Although the USDA classification scheme will be emphasized in the following methods, it should be recognized that other systems are frequently cited, particularly in engineering literature; hence, when reporting results, care should be taken to specify clearly which system is being used.

Particle-size analysis data can be presented and used in several ways, the most common being a cumulative particle-size distribution curve. An example is shown in Fig. 2.4–2. The percentage of particles less than a given particle size is plotted against the logarithm of the effective particle diameter. Particle-size distribution curves, when differentiated graphically, produce frequency distribution curves for various particle sizes. Frequency curves usually exhibit a peak or peaks representing the most prevalent particle sizes.

Particle-size distribution curves are used extensively by geologists in geomorphological studies to evaluate sedimentation and alluvial processes, and by civil engineers to evaluate materials used for foundations, road fills, and other con-