

		0.002	0.006	0.02	0.06	0.2	0.6	2.0		
British Standards Institution	Clay	Fine		Medium	Coarse	Fine		Medium	Coarse	Gravel
		Silt			Sand					
International Society of Soil Science	Clay	Silt			Sand				Gravel	
		Fine		Coarse						
		0.002	0.02		0.2		2.0			
		0.002			0.05	0.10	0.25	0.5	1.0	2.0
United States Department of Agriculture	Clay	Silt			Very fine	Fine	Med.	Coarse	Very coarse	Gravel
					Sand					
United States Public Roads Administration	Clay	Silt			Sand				Gravel	
		Fine		Coarse						
		0.005			0.05	0.25		2.0		
Particle diameter (mm, log scale)										

FIGURE 4.1

Classification of soil particles according to size by four systems. The U.S. Department of Agriculture system is used in this book.

To study the mineral particles of a soil, scientists separate them in groups according to size. The groups are referred to as *separates*. The analytical procedure by which the particles are separated is called *particle-size analysis*, the determination of the particle-size distribution.

A number of different classifications have been devised. The size ranges for four of these systems are shown in Figure 4.1. The classification established by the U.S. Department of Agriculture is used in this text.

PARTICLE-SIZE ANALYSIS

A particle-size analysis is done by using sieves to mechanically separate the very fine sand and larger separates from the finer particles. Then the weight of each separate is measured. The silt and clay contents are then determined by measuring the rate of settling of these two separates from suspension in water.

The principle involved is simple. When soil particles are suspended in water, they tend to sink. Because there is little variation in the density of most soil particles, their velocity (v) of settling is proportional to the square of the radius (r) of each particle. Thus, $v = kr^2$, where k is a constant. This equation is referred to as Stokes's law.

With knowledge of the velocity of settling, Stokes's law can be used to calculate the radius of the particles as they settle and the percentage of each size fraction in the sample. These percentages are used to identify the soil textural class, such as sand, silt, or loam.

Although stone and gravel are considered in the practical examination and evaluation of a field soil, they do not enter into the analysis of the finer particles. Their amounts are rated separately. The organic matter, comparatively small in quantity, usually is removed by oxidation before the mechanical separation.

A particle-size analysis gives a general picture of the physical properties of a soil. The analysis also is the basis for assigning each soil to a textural class. This phase is considered in more detail in Section 4.5.