

# UNDERSTANDING TURF MANAGEMENT

The second in a series by  
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## SAND, SILT and CLAY

Any sample of soil is made up of a continuous array of particles which may range from the very smallest clay particles to large gravel. In order to describe soils scientist have established a classification system for ranges of particle sizes; size ranges which reflect their role in many of the soil properties we are familiar with. This classification system divides the particles into four classes - gravel and stone, sand, silt, and clay. Table 1 lists the Canadian classification system for the size range of particles which may be found in a soil sample.

### CLAY

The scientists have assigned the name *clay* to the finest particles and not without reason. Clay size particles are the source of most of the chemical properties of soil. They are

responsible for the retention of many of the plant nutrients in the soil, such as calcium, magnesium, potassium, trace elements and some of the phosphorus. Clays react with the breakdown products of organic matter to stabilize the humus in the soil. A soil without clay particles can be a very infertile soil.

Clays, because of their very small size and very large surface area, are able to retain greater amounts of water than sandy soils. On the other hand, as will be discussed in a latter article, clays hold the water more closely and do not release the water as readily to grass roots as sands. Clay particles have a vastly greater tendency to stick together than sand, thus it is common farmer knowledge that soils high in clay are difficult to till. When a small sample of a clay soil is wetted and rubbed between the fingers it will feel very

sticky and is easily formed into a string.

### SILT

The particles classified as *silt* are intermediate in size and chemical and physical properties between clay and sand. The silt particles have limited ability to retain plant nutrients, or to release them to the soil solution for plant uptake. Silt tends to have a spherical shape, giving a high silt soil a soapy or slippery feeling when rubbed between the fingers when wet and is more difficult to form into a string than clays.

Because of the spherical shape, silt also retains a large amount of water, but it releases the water readily to plants. While silt soils are generally considered very fertile for the growth of plants, largely due to their water characteristics and ease of cultivation, engineers dread working with them due to their relatively easy release of water and lack of ability for the particles to stick together.

### SAND

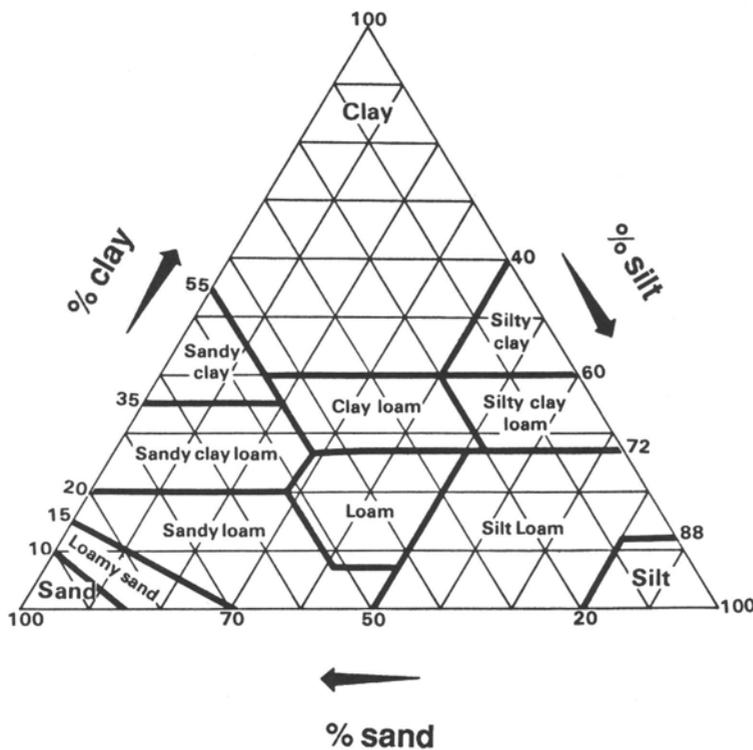
*Sand* particles are essentially small rock fragments, and as such, have little or no ability to supply grass with nutrients or to retain them against leaching. As rock fragments, sandy soils feel gritty between the fingers. The sand grains have little ability to stick together; thus sandy soils can not be rolled into a string when wetted.

It is well known that sandy soils are droughty soils because they retain little water when wetted. Nevertheless what water is retained is

**Table 1:** The classification system for soil particles; their sizes, surface area and visibility.

| Soil Separate    | Size Range<br>(mm) | Surface area<br>(cm <sup>3</sup> /gm) | Visibility          |
|------------------|--------------------|---------------------------------------|---------------------|
| Clay             | less than .002     | 23,000                                | electron microscope |
| Silt             | .002 to .05        | 2,100                                 | light microscope    |
| Very fine sand   | .05 to .10         | —                                     | light microscope    |
| Fine sand        | .10 to .25         | 210                                   | human eye           |
| Medium sand      | .25 to .50         | —                                     | human eye           |
| Course sand      | .50 to 1.0         | 21                                    | human eye           |
| Very coarse sand | 1.0 to 2.0         | —                                     | human eye           |
| Gravel           | 2.0 to 100         | —                                     | human eye           |
| Boulders         | larger than 100    | —                                     | human eye           |

**Fig. 1:** The textural triangle used for assigning textural class names. (A straight line drawn along the grid for the percentage clay and for the percentage silt will intersect within a class name area. Try it using the numbers in Table 2.)



**Table 2:** Some typical particle size analysis and the corresponding class name.

| Particle size analysis |      |      | Textural class name |
|------------------------|------|------|---------------------|
| Sand                   | Silt | Clay |                     |
| - % by weight -        |      |      |                     |
| 92.5                   | 5.5  | 2.0  | Sand                |
| 61.0                   | 28.0 | 11.0 | Sandy loam          |
| 40.0                   | 41.0 | 19.0 | Loam                |
| 20.0                   | 61.0 | 19.0 | Silt loam           |
| 3.5                    | 89.0 | 7.5  | Silt                |
| 28.5                   | 42.0 | 31.0 | Clay Loam           |
| 10.0                   | 31.0 | 59.0 | Clay                |

released to plants easily. When rain or irrigation occurs the water readily penetrates the soil surface, the excess moves through rapidly and the soil remains well aerated. These properties make sands a desirable medium for growing sports turf where there is no limitation in applying water and nutrition, as needed, throughout the season.

The analysis for the distribution of the various particles in a soil sample (particle size analysis) for the sand portion is done using a set of screens which have mesh sizes that retain the various ranges of sand particles. Estimating the silt and clay is more complicated as it requires measuring the rate of settling of the particles in water. The analysis is based on a law of physics which says that small diameter particles settle more slowly in water than larger diameter particles. By dispersing a sample of soil in a column of water so that all particles will settle independently of each other and taking samples at a set depth and time interval, the technician can calculate how much silt and clay is in the sample.

Because there can be an infinite array of percentages of sand, silt and clay in soils, scientist have devised a procedure for classifying the potential combinations into 12 groups which reflect broad soil properties. These groups are called textural class names and are obtained by applying the particle size analysis to a textural triangle (Figure 1). Thus a soil which contains 40% sand, 40% silt and 20% sand would be called a loam soil. Table 2 lists several textural class names and a typical particle size distribution for each.

Some confusion occurs between the use of these terms by many turf managers and the soil scientist. The soil scientist considers the name loam or clay to refer to a range of particle sizes in a soil. The turf manager often refers to a loam as a soil which is easy to till or is not compacted whereas a clay is dif-

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difficult to work, is compacted or may be a subsoil.

In summary many chemical and physical properties of a soil can be assessed in rough terms from a knowledge of a particle size analysis or the textural class name. For example in comparing a clay to a sandy loam it can be expected that

- 1) the clay will be relatively more fertile,
- 2) the clay will have greater nutrient holding capacity for potassium, calcium and magnesium,
- 3) the clay will have more organic matter,
- 4) the clay will hold more plant available water and be less droughty,
- 5) the clay will have smaller pores resulting in slower air and water movement within the soil, and
- 6) the clay will have greater stickiness, ability to be retain a shape when moulded and be harder when dry.

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