Agricultural Extension Service
University of Minnesota

Extension Folder 550—1980
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Evaluating Soil Texture for a House Site

The largest single investment many people make during their lives is buying or building a house. Each person has an individual idea of how the house and lawn should look. It is important that the selected site fits the house planned.

Existing soils will to a large extent determine the property's potential as a building site, a lawn, a garden, and in an unsewered area, the septic tank-soil absorption field.

Soil texture, when properly evaluated, can be used as a clue to a site's potential.

It is necessary to understand the relationships between soil texture and site suitability and how to determine this in the field.

Soil Types and Soil Texture

There are two major types of soils: mineral (inorganic) and organic. Mineral soils are a mixture of weathered minerals and decayed plants and animals. There are four main components to consider when studying a mineral soil: mineral matter, organic matter, water, and air (figure 1). A loam soil in an ideal condition for plant growth consists of 45 percent soil mineral particles, 5 percent organic matter, 25 percent air, and 25 percent water by volume. The amount of air and water in the soil can be extremely variable depending on the frequency and amount of precipitation. The combination of these four components helps determine a soil's potential as a building site.

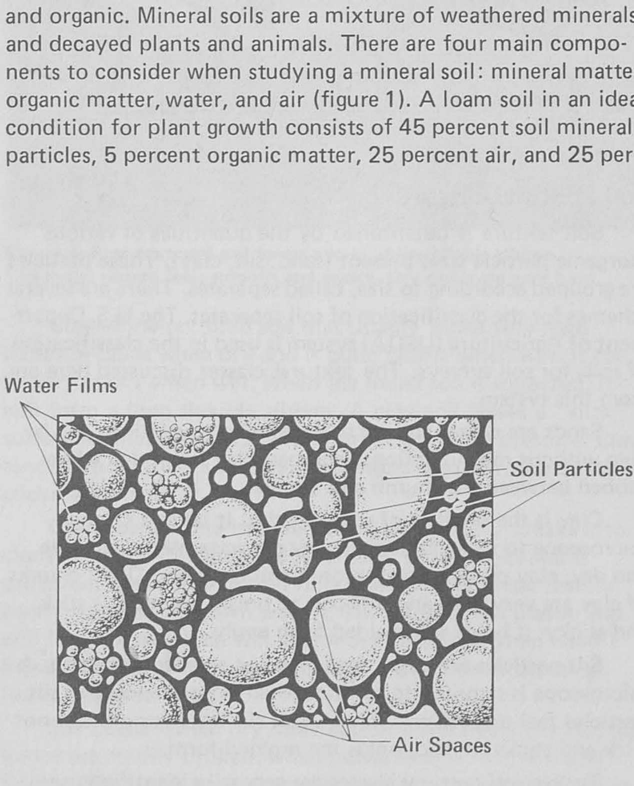

Figure 1. Representation of the physical relationship between soil particles, water films, and air space in a soil. A silt loam soil in a condition ideal for plant growth consists of 45% soil mineral particles, 5% organic matter, 25% air, and 25% water by volume.

The size range of individual mineral particles (sand, silt, clay) is expressed by soil texture. This size range or texture, influences the amount of the other three components present at any one time in a specific volume of soil.

Organic soils consist mostly of decayed plant material (figure 2) and occur in swamps, bogs, and marshes. Such soils feel very light when dry. Well-decayed muck and peat are powdery when dry but partially decayed peat contains easily identified plant stems and leaves.

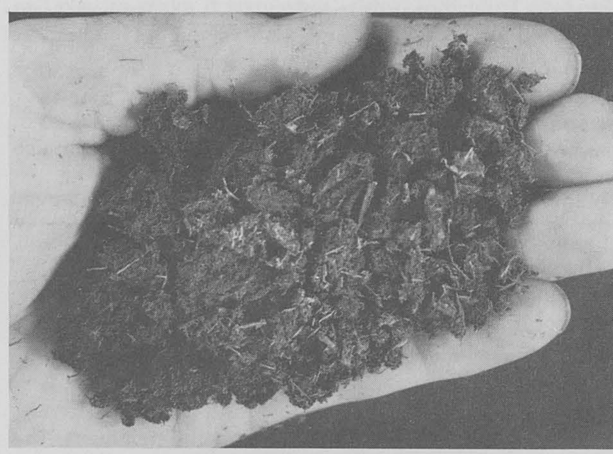

Figure 2. Organic soil (peat)

Importance of Texture to Building Site Characteristics

The texture of the subsoil indicates the building site potential. If the subsoil is coarse (sand, loamy sand), water drains through it rapidly (assuming there is no high water table). Coarse-textured soils are easily excavated and quite stable during both dry and wet conditions.

Fine-textured soils have a tendency to expand as the amount of moisture increases and to contract as moisture decreases. Cracks at the soil surface are evidence of this during dry periods. This same expansion and contraction takes place during the winter and spring as the moisture in the soil freezes and thaws. This lack of stability can crack foundations, sidewalks, and driveways if precautions are not taken.

The properties that make the coarse-textured soils good building sites are the same ones that make them poor for establishing and maintaining lawns and gardens. The fact that water moves rapidly through these soils means that, during dry periods, the water will not remain within the rooting depth of grass and trees. Lawns and gardens will have to be watered frequently during dry periods to provide adequate moisture.

The moderate (loams, silt loams) and fine-textured soils generally have a higher inherent soil fertility which makes them desirable for establishing lawns and gardens.

Organic soils (peat and muck), if adequate drainage can be provided, may make good garden sites. However, the fact that these soils are easily compacted, resulting in settling if foundations are installed, makes them unsuited for building.

Importance of Texture to Treatment of Septic Tank Effluent

Texture has a significant influence on the ability of a soil to accept and treat septic tank effluent.

Percolation rates are largely determined by soil texture. Sandy soils tend to have faster rates, while finer-textured soils have slower rates. The following ranges in percolation rates can be expected for the six general soil textures (table 1).

Table 1. Soil textural classes and estimated percolation rates

General texture classes	USDA texture classes	Estimated percolation rate range (minutes/inch)
1. Sand	1. Sand, loamy sand	less than 10
2. Sandy loam	2. Sandy loam	3 to 30
3. Loam	3. Loam	10 to 45
4. Silt loam	4. Silt loam, silt	45 to 90
5. Clay loam	5. Clay loam, sandy clay loam, silty clay loam	greater than 45
6. Clay	6. Sandy clay, silty clay, clay	greater than 60

The size requirements for a soil treatment system are determined by the soil's percolation rate. This means texture has a direct bearing on the size treatment system required.

Most physical and chemical processes used to treat septic tank effluent take place at the surface of the soil particles. Generally, the more soil particles available for nutrients, bacteria, and virus to attach themselves to, the better the treatment. The finer-textured soils (clay, clay loams) are more effective for treatment because there are more soil particles present and smaller spaces between particles. Water moves very slowly through the small spaces between the fine soil particles. This provides an excellent opportunity for treatment to take place. However, since the flow through the fine-textured soils is so slow it takes a larger area to provide a sufficiently fast rate of flow through the soil for disposal.

Moderately coarse-to-medium-textured soils (sandy loams, silt loams) have a larger variety of soil particle and void sizes. From a treatment and disposal point of view, these soils are ideal combining a moderate rate of water movement with a large amount of soil particle surface for treating the effluent.

If soils with a high clay content are compressed or smeared when the moisture content is high, the larger soil pores can be effectively sealed off, further reducing the ability of the soil to transmit water. In a dry clay soil the microscopically small clay plates are linked to create a strong stable condition (figure 3). This condition does not change much when the soil is slowly wetted. However, changes will occur if the moist soil is compacted by equipment such as a backhoe or bulldozer. The clay plates separate and the larger pores are destroyed. In the absence of these larger pores, water movement through these soils is further reduced. This means when on-site waste treatment systems are installed in soils with fine textures, great care must be taken not to smear the soil infiltrative surface of seepage trenches.

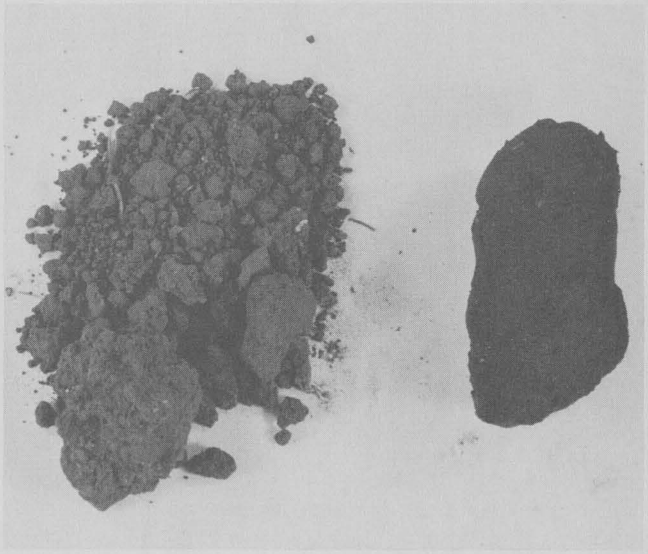

Figure 3. Effect of mechanical action on fine-textured soils.

Soil Textural Classes

Soil texture is determined by the quantities of various inorganic particle sizes present (sand, silt, clay). These particles are grouped according to size, called separates. There are several schemes for the classification of soil separates. The U.S. Department of Agriculture (USDA) system is used in the classification of soils for soil surveys. The textural classes discussed here are from this system.

Sands are coarse soil particles. Most sand particles can be seen without magnification. Sand particles feel rough when rubbed between the thumb and fingers.

Clay is the smallest of soil particles. It takes a strong microscope to show individual clay particles. When separate and dry, clay particles feel smooth and powdery. Dried chunks of clay are very hard and difficult to break. Wet clay is slick and sticky; it holds the molded form easily.

Silt particles are larger than clay but smaller than sand. A microscope is required to see individual silt particles. Dry silt particles feel smooth and floury. Wet silt feels smooth but not slick and sticky; it, too, holds the molded form.

Twelve soil textural classes are generally identified using the USDA system. However, an adequate evaluation of the soil texture can be made by being able to distinguish in the field between six general textural classes (table 1).

Estimation of Soil Texture by the Feel Method

Knowledge of the soil texture at the surface is not a basis for conclusions about the soil texture for the entire soil depth. Usually the texture changes with the depth of the soil. Soil texture should be estimated for an intended use at the depth of the intended use. For example, if the basement foundations will be installed at an 8-foot depth that is where the texture should be estimated.

An experienced soil scientist or engineer can determine the texture of soil material quite accurately using both feel and sight. A good estimate of the textural class can be made using the following procedures.

First, moisten a marble-sized portion of the soil and hand knead it until it is the consistency of putty. Then, squeeze the ball of soil between thumb and forefinger, pressing the thumb forward over the forefinger to push the soil into a ribbon (figure 4). Whether or not a ribbon forms the type of ribbon indicates the textural class.

Figure 4. Fine-textured soil forms a long, shiny pliable ribbon. The moist ribbon feels smooth and sticky. Dry clods are very hard.

Clay—Fine-textured soil that usually forms very hard lumps or clods when dry and is quite plastic when wet. It can be very sticky when wet. When the moist soil is squeezed, it will form a long flexible ribbon. A clay soil leaves a "slick" surface when rubbed with a long stroke and firm pressure. Clay tends to hold the thumb and forefingers together, due to its stickiness (figure 4).

Clay Loam—Fine-textured soil which usually breaks into clods or lumps that are hard when dry. When moist soil is squeezed, it will form a thin ribbon which will break readily, barely sustaining its own weight. The moist soil is plastic and will form a cast which will bear more handling. When hand kneaded it does not crumble readily, but tends to become a heavy, compact mass.

Silt Loam—When dry, may appear quite freely cloddy, but lumps are readily broken; when pulverized, it feels soft and floury. When wet, the soil readily runs together. Either dry or moist, it will form casts which can be handled freely without breaking, but when moistened and squeezed, it will not ribbon but will have a broken effect (figure 5).

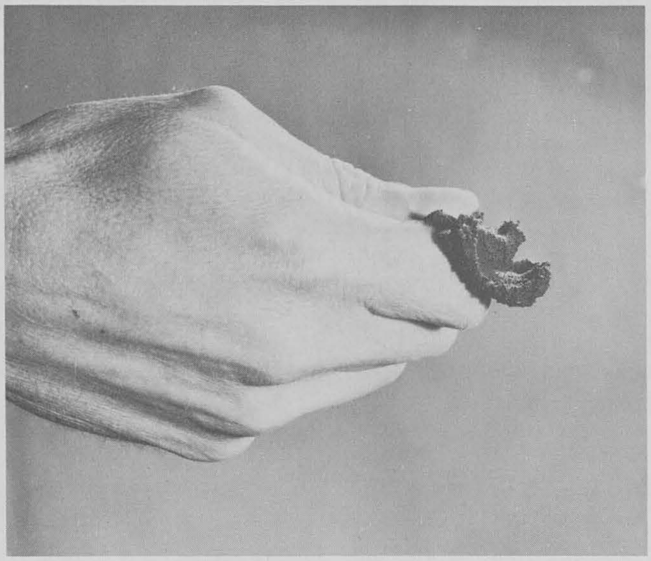

Figure 5. Medium-textured soil does not form ribbons. Medium-textured soil feels fairly smooth and floury. Dry clods are readily broken.

Loam—Has a relatively even mixture of sands, silt, and clay. A loam feels somewhat gritty, yet fairly smooth and highly plastic. Squeezed when moist, it will form a cast which can be handled quite freely without breaking and it will not form a ribbon (figure 6).

Sandy Loam—Contains much sand, but has enough silt and clay to make it somewhat sticky. Individual sand grains can be seen readily and felt. Squeezed when dry, it will form a cast which will fall apart and not form a ribbon, but if squeezed

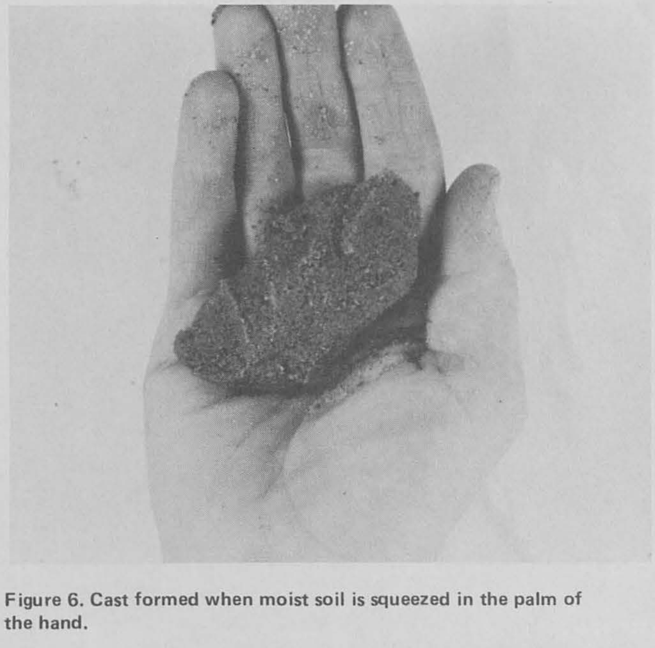

Figure 6. Cast formed when moist soil is squeezed in the palm of the hand.

when moist, a cast can be formed which will bear careful handling without falling apart (figure 7).

Sandy—Loose and single grained. The individual grains can be readily seen or felt. Squeezed in the hand when dry, it will fall apart when the pressure is released and will not form a ribbon. Squeezed when moist, it will form a cast, but will crumble when the pressure is released.

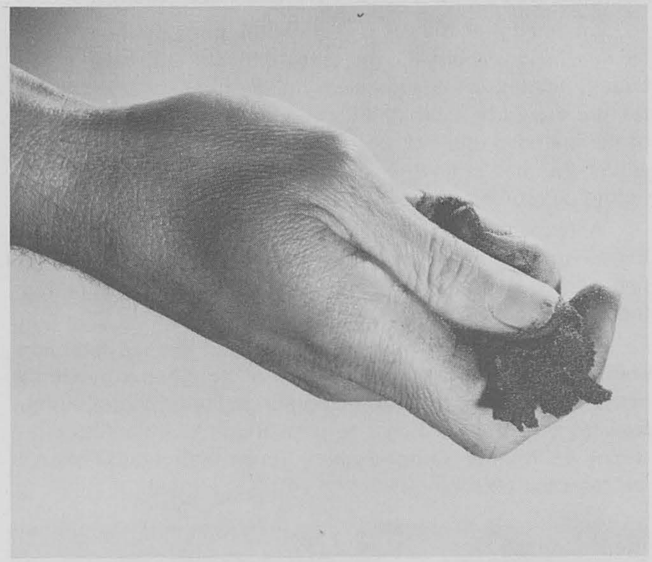

Figure 7. Coarse-textured soil feels very gritty. It is not slick or smooth, formed casts of such soils fall apart when touched.

Conclusions

Soil texture is an important physical property and a major factor to consider when evaluating the suitability of a lot as a building site. Knowing the texture helps determine this and offers an opportunity to make site comparisons. Using texture to determine site suitability will result in fewer disappointments and problems for the owner.

Additional Information

These publications about sewage treatment systems are available at local county extension offices or by writing the Bulletin Room, 3 Coffey Hall, 1420 Eckles Ave., University of Minnesota, St. Paul, MN 55108.

How to Run a Percolation Test, Extension Folder 261.
Town and Country Sewage Treatment, Extension Bulletin 304.
Locating On-Site Home Sewage Treatment Systems, Extension Folder 522.
Get to Know Your Septic Tank, Extension Folder 337.
Shoreland Sewage Treatment, Extension Bulletin 394.

Other Information Sources

County Extension Director
City or County Zoning Administrator
Extension Agricultural Engineers and Soil Scientists at the University of Minnesota
Local Soil and Water Conservation District Offices
Minnesota Pollution Control Agency
Minnesota Department of Natural Resources
Minnesota Department of Health
Minnesota On-Site Sewage Treatment Contractors Association

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