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Know Your Soils

Texture and structure are the two basic variables that provide clues to long-term acceptance rate and other critical measurements

By Jim Anderson, Ph.D., and David Gustafson, P.E..

We have written before about soil characteristics, but recently we've received a variety of questions that revolve around identifying soil properties. So it appears we should address these issues again.

It is also important to do this because as part of a national project conducted by the Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT) to develop educational materials for installers, we hear some people saying that there is too much emphasis on soils, and that installers only need to be able to read a plan and install what a site evaluator or engineer puts on it.

As we have pointed out several times, if something goes wrong with a system, you as the installer will be the first person called. For better or worse, you are the one who will be expected to fix the problem. Obviously the best fix is to avoid the problem altogether.

You can do this most effectively when you start excavating for the tank and the piping, because this is where you start getting a close look at the soil. The question then becomes: What should I look for?

Key characteristics

In the past we have stated the two most important properties to evaluate are soil texture for sizing the system and soil color to identify saturated soil conditions. There is really much more to know and factor into the soils and site when installing the system, but these are good properties to start with. We will discuss these and a few more characteristics in future articles.

Soil texture is the primary characteristic used to determine the long-term acceptance rate, and from this an allowable loading rate, which then can be used with the estimated daily sewage flow to determine how large a system has to be. (See the Minnesota sizing table.)

These loading rates are tied to the United States Department of Agriculture (USDA) classification for determining soil texture classes, the system used to classify soils mapped in the United States and the system that relates best to pore sizes and water movement.

Soil texture simply refers to the percent of sand-, silt- and clay-size particles. In the USDA system, texture refers only to particles less than 2 mm (0.01 inch) in diameter. Other soil particle classification systems are used for different purposes. These include:

- A system used by the Association of State Highway and Transportation Officials related to bases for road construction
- The Unified Engineering Classification System for Civil Engineering
- The OSHA soil classification for trenching.

Soil Sizing Factors Based on Perc Rates

percolation rate (minutes per inch)	soil texture	sizing factor (sqft/gal/day)	loading rate (gal/day/sqft)
faster than 0.1[a]	coarse sand	0.83	1.20
0.1 to 5[b]	medium sand, loamy sand	0.83	1.20
0.1 to 5	fine sand	1.67	0.60
6 to 15	sandy loam	1.27	0.79
16 to 30	loam	1.67	0.60
31 to 45	silt, silt loam	2.0	0.50
46 to 60	sandy clay loam, silty clay loam, clay loam	2.2	0.45
61 to 120[c]	silty clay, sandy clay, clay	4.2	0.23
slower than 120[d]		—	—

[a] Systems installed in or on these soils must be either mound systems *or* trench systems with at least 1 foot of clean sand between the distribution medium and the coarse soil of the trench bottom and sidewalls.

[b] Systems in or on these soils must use pressure distribution *or* must be divided into at least 4 parts, none of which is more than 25% of the total system area, and which are in series.

[c] Mounds must be used for systems on these soils.

[d] Systems installed in or on these soils are not standard.

How soil texture relates to system sizing. (Images from University of Minnesota Onsite Sewage Treatment Program, 2009 Subsurface Sewage Treatment Professional Manual, St. Paul, Minn.)

A dozen classes

There are 12 soil textural classes based on particles less than 2 mm in size in the USDA system. These are often represented by the USDA Soil Textural Triangle. Sand-size particles range from 0.5 to 2 mm, silt-size particles from 0.002 to 0.05 mm, and clay-size particles less than 0.002 mm. (See the textural triangle).

For soils that have rock fragments from larger than sand-size to boulders, there are modifiers as a part of the standard soil descriptions. (These modifiers can be found in a USDA publication, *Field Book for Describing and Sampling Soils*). The obvious question is: How do I determine those percentages?

It can be done in the laboratory by the hydrometer or pipette methods. Installers can do it in the field, by hand, using a method called soil texture by feel. (See flow chart to determine soil texture in the field.)

As we have pointed out several times, if something goes wrong with a system, you as the installer will be the first person called. For better or worse, you are the one who will be expected to fix the problem. Obviously the best fix is to avoid the problem altogether.

The method is also provided in ASTM "Standard Practice for Subsurface Site Characterization of Test Pits for On-Site Septic Systems," D 5921-96, published by the American Society for Testing and Materials. The state of Arizona and perhaps others have adopted this reference as their standard to determine soil characteristics in the field. (There are errors in other parts of this reference, so the standard should be used with caution.)

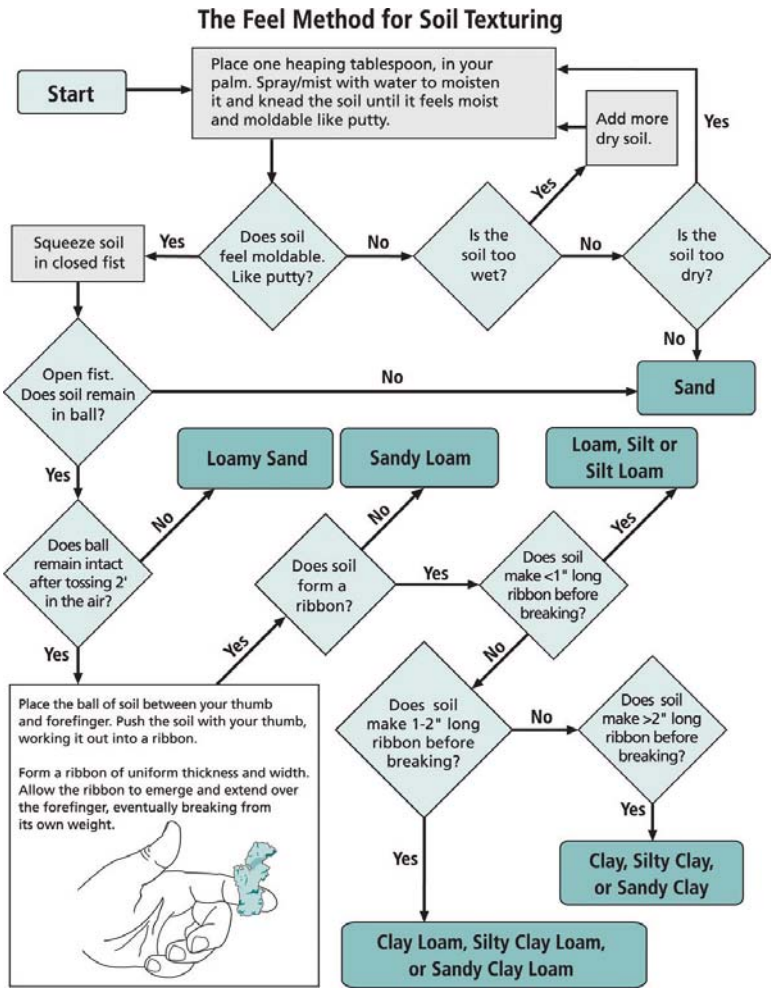
Determining texture by feel involves moistening a golf-ball-size sample of soil. The way it holds together and how it feels will enable you to estimate the soil textural class. For our purposes, a number of textural classes group together from the standpoint of how the system is sized, so this method is usually good enough to differentiate between these groups and gain a reasonably accurate estimate of the design loading rate.

Looking for issues

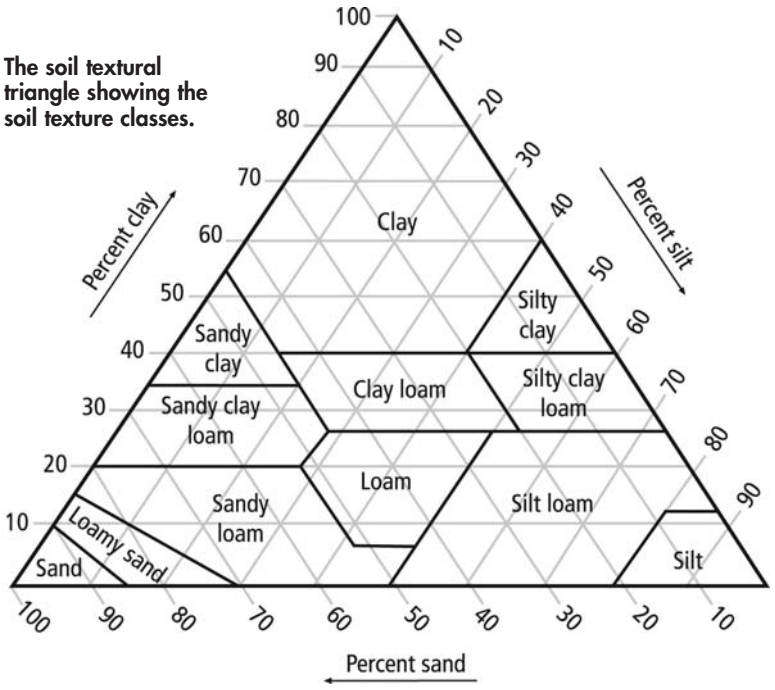
Knowing the soil texture allows you to check system design parameters for sizing to make sure the system is properly sized. It can also help you identify other potential issues with the soils. These include the potential for compaction.

We have discussed many times the need to avoid compacting fine textured or clayey soils to maintain their ability to accept septic tank effluent. Remember KIDD (Keep it Dry, D___), and KINN (Keep It Natural N____).

If there are large numbers of coarse fragments or stones present, there may be excavation problems. All of these are reasons to have a familiarity with soil texture and to have confidence that you can make sound determinations in the field. ■



A flow chart for determining soil texture in the field.



The soil textural triangle showing the soil texture classes.

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