

**Session 5**  
**Septic Tank Drainfield Site Suitability and Evaluation Workshop**  
**5-Texture\_Structure DEQ Septic.doc**

This power point provides in-depth information about soil texture, particle size analyses, and soil structure. The focus of the presentation is on soil texture and structure – as indicators, as diagnostics, as factors affecting water movement in soil.

**“... the quality of field description and sampling ultimately defines the utility of any subsequent ..... analyses. A keen eye that can discern specific features and their relationship to adjoining features, coupled with **well-calibrated fingers** that can distinguish among relative differences in physical properties of soil material are essential and can only be acquired and maintained through practice.”**

**([www.soils.wisc.edu/courses/SS325/morphology.htm](http://www.soils.wisc.edu/courses/SS325/morphology.htm))**

**Frame 1:** You will recall that we discussed the notion that soil physical and hydrologic properties are the principal metrics (measures used to indicate progress or achievement) used to assess site suitability for septic drain fields. As with color, it is essential that evaluators have a working knowledge of the soil properties most directly associated with the hydraulic characteristics. Those properties are: texture, structure, porosity, water transmission and storage capacity.

For a few minutes, let's take a look at

**Texture**  
**Structure**  
**Consistence**

**Frame 2:** A little review about these physical properties before we investigate them in detail.

**Texture** is the composition (percentage sand, silt, and clay), the feel, and the classification. Texture affects/influences micropore water storage and transmission. Texture is assessed as: 1) the feel, for example - clay, the 2) particle size composition, and 3) a method of classifying or categorizing soil material; for instance – loam is a texture which appears in the ‘textural triangle’. Texture relates most specifically to micropore size and configuration, overall porosity, drainability, and compressibility.

**Structure** is the term applied to how the individual particles are aggregated together, bound together to form discrete ‘clods’ or peds. Structure is specifically related to macropore characteristics, rapid water transmission.

**Consistence** is the term applied to how the soil holds together, when wet and when dry. Consistence is used as a descriptor of the ability of the soil to be shaped, formed, worked; whether the soil is plastic (will flow), friable (will crumble and break apart) when

moist/wet. Consistence is expressed as ‘workability’ and ‘workability’ is used to assess texture.

**Frame 3: Texture is probably the single most-important and most revealing soil property that the site evaluator will assess.** Texture influences porosity, water and air flow, compaction, aeration status, structure, microbial behavior, and soil chemistry.

In soil science, the term ‘**texture**’ has two distinct meanings:

1. texture = a ‘**textural classification**’, i.e., a name of a soil physical category, based on the the percentage of sand, silt, and clay.
2. texture = **the feel of the soil**, i.e., it feels like clay

Texture is defined as: the distinctive physical composition or structure of something, especially with respect to the size, shape, and arrangement of its parts: *the texture of sandy soil*;

**Frame 4:** There are **two** generally accepted **methods for assessing texture**: one is by **feel and appearance** and the other is **by mechanical analysis**.

For all practical purposes, feel and appearance is the method most frequently used by the site evaluator. If there is a question or desire for confirmation, that can be obtained by either referring to a published soil survey or submitting samples to a laboratory for mechanical analysis. Data from the soil survey will provide general representation, but site validation is more reliable. For our purposes, we will focus on the feel and appearance method.

With regard to particle size analysis, by one of several methods the percentages of a soil sample comprised of various particle sizes is plotted and the points are then connected. With respect to drain field suitability, soil with a wide and uniform distribution of pore sizes is preferred. This particle size distribution illustrates four distinct pore size distributions. A soil with particles of all one size will also have pores of generally a narrow size range. Thus, all pores fill with water simultaneously and all pores drain of water simultaneously – not a preferred situation.

**Frame 5:** Before we look at the details of feel and appearance, we should first take a look at how ‘soil texture’ – the category – is determined and the use of what is known as the textural triangle.

**Texture – in the context of ‘soil classes’ or ‘soil categories’ – is the name applied to the soil to reflect the predominant mineral material comprising the soil. Sand, silt, clay.**

**Texture is a relatively permanent physical property** in that it can not be easily changed. Texture is changed when soil is physically moved – either eroded away or deposited on top of existing soil. However, the texture of soil will not physically

change in place. The texture of a soil horizon is determined mainly by soil parent materials, which are modified by the soil forming processes.

In the laboratory, texture is determined by measuring the percentage of a soil sample passing through sieves of various sizes or by measuring the percentage of the particles in a sample which settle out of suspension over a given period of time.

**Frame 6:** If laboratory test results are available, the **textural class can be determined from the 'textural triangle. Twelve textural classes** are recognized and represented in the textural triangle. The **soil textural class** is a name given to **a group of similar soil textures**. Soil is assigned to one of twelve generic textural classes, the four major ones being sand, silt, clay, and loam.

In the field, you can attempt to estimate percentage of the various particle sizes. As you can see from the triangle, it's necessary to quantify only two of the three separates, in other words – sand, silt, clay. Similarly, the same is true with a laboratory analysis.

To use the textural triangle, the process is one of identifying the textural category which represents the sample in question. For example, if a soil is 40% silt and 30% sand, the textural category is clay loam, because the balance, i.e., 30% is clay and there are approximately equal proportions of sand, silt, and clay. Note that a soil with as little as 20% clay can have a 'clay' notation in the classification, as is the case with sandy clay loam.

Also note that 'loam' is a textural category, and it does not have equal parts of sand, silt, and clay. In fact, a soil material which has equal parts of sand, silt and clay is a clay loam. The last word of the name represents one of the four major groups. The first or first and second words are modifiers which tell where the soil texture lies on the triangle among the four major groups.

**Frame 7:** In the field, the **"feel" method provides a good approximation or qualitative assessment** of the predominant texture of the soil. By following a well-defined and frequently used process of steps, it is possible to approximate the textural class of soil material with good reliability and repeatability in the field.

For now, that's all we'll say about the 'feel and appearance' method. We'll go through some exercises that will let you gain some experience with the 'feel and appearance' method. As you will see, the objective is to work your way through the feel and appearance chart, using a selection of questions with YES/NO answers.

**Frame 8:** With regard to texture, there are some obvious characteristics of different soils which help identify the texture. For instance: **sandy soil feels gritty and does not bind together** when dry. The individual particles can be seen and identified. Sandy soil won't form a ribbon when wet. Sandy soil presents a distinct grinding sound when rubbed between the forefinger and thumb.

**Silt is like talcum powder, flour, or corn starch when dry** and like talcum powder or corn starch when wet - **slippery, but not sticky**. Soft and smooth when moistened and rubbed between the thumb and forefinger. Forms a weak, short ribbon which cracks on the edges. Silt is often very hard and crusty after wetting and drying and it usually does not crack much when it dries. Silt is very uniform in size.

**Clay** can't be seen with the unaided eye. When dry, clay feels a lot like silt - soft, smooth, very fine - talcum powder, baby powder, flour, corn starch. When clay is wet it is "sticky", not smooth. A couple of good examples are 'tacky' dough and white wood glue. Clay usually dries very hard. Soils which swell and shrink are clay.

**Frame 9:** There are some key lessons that can be learned from years and years of collegiate soil judging contests. Unless you are a professional soil classifier and/or have many years of experience, a pit that is large enough to access safely is the best way to complete the soil characterization associated with a septic drain field site evaluation.

Additionally, a pit with an open access that you can walk into and safely exit is highly recommended. Obviously, there are some key tools that you should bring along – and we'll tell you a little more about those later.

**Frame 10:** Let's take a look at one example of a description of a soil profile. This example of the **Shaak soil** presents **four identifiable horizons**. Being able to identify horizons takes some practice and experience as well. As you can see, the texture of each horizon is identified in the description. You'll also note that the evaluator did provide a narrative description of color but did not provide a Munsell color notation for each horizon.

You'll also notice that the descriptions of the horizons contain words such as **weak, thin plates, friable, neutral, abrupt, firm, very coarse prisms**. These terms refer to either the **consistence**, i.e., the workability of the soil, or the **structure**, how the soil particles are grouped together into discrete aggregates, shapes, or forms.

**Frame 11: Soil structure is the grouping or arrangement of individual particles into larger groupings. Structure breaks apart into aggregates and peds.** Soil scientists generally consider structure to be either: 1) naturally occurring, 2) absent, as in a structureless soil, and 3) artificially or anthropogenically altered.

**Naturally occurring soil structure types are:**

- Granular or crumb (typical of loam, silt loam, silty clay loam)
- Platy (typical of silts and clays)
- Angular blocky (typical of loam, sandy loam)
- Sub-angular blocky (typical of silt loam, sandy clay loam)
- Wedge (typical of silty clays, clay)
- Prismatic (typical of clays, silty clays)
- Columnar (typical of clays, silty clays)

**Frame 12:** Here's an example of blocky structure

**Frame 13:** Here's an example of granular or crumb structure.

**Frame 14:** Accurate assessment of structure is important when considering the likelihood of hydraulic failure and associated 'failure to treat' waste water. Structure represents the macro-pore configuration of the soil – the large pores. These large pores are the primary conduit for air and water movement – both above and below the drain field. By considering texture and structure, it is possible to gain a good appreciation for the ability of the soil below and above the drain field to function properly.

As these images illustrate, macro-pore flow is a significant component of water movement in the soil. Structure, texture, and porosity also relate to soil water retention, root penetration, and soil compression-settling.

**Frame 15:** Let's take a look at some examples of soil structure. This first image illustrates a transition of three different structures, all in a single profile. The upper part of the profile, the A horizon, has moderate, coarse granular structure. This transitions to a medium prismatic structure, and finally to a subangular blocky structure.

**Frame 16:** In this particular case, the upper part of the profile has a moderate coarse prismatic structure, transitioning to a weak to moderate medium to coarse subangular blocky structure

**Frame 17:** Another concept that site evaluators need to gain comfort and experience with is '**consistence**', which is how easy or hard it is for a soil ped to break apart when it is squeezed. Sometimes consistency is the term used to express how easily the soil can be worked, formed into shapes, or will hold a shape when wetted. Consistency is used as an aid in assessing texture.

**Frame 18:** **Soil consistency** is actually the strength with which soil materials are held together or the resistance of soils to deformation and rupture. Soil consistency is measured for wet, moist and dry soil samples. For wet soils, it is expressed as both stickiness and plasticity, as defined here. Soil consistency may be estimated in the field using simple tests.

The relevance or application of assessment of consistency, relative to septic tank drain field, is not readily apparent or obvious – other than as an index of the stability of the overburden soil of the drain field. A soil which is plastic, very plastic, sticky, or very sticky when wet may be subject to failure due to consolidation or slumping. A soil which is hard when dry may shrink and crack or may be sufficiently consolidated to restrict water flow. A sandy soil will be nonsticky, nonplastic, loose when moist or dry.

Terms used to describe soil consistency at these three moisture levels are shown in the accompanying table.

Wet soils		Moist soils	Dry soils
Stickiness	Plasticity		
Nonsticky	Nonplastic	Loose	Loose
Slightly sticky	Slightly plastic	Very friable	Soft
Sticky	Plastic	Friable	Slightly hard
Very sticky	Very plastic	Firm	Hard
		Very firm	Very hard
		Extremely firm	Extremely hard

**Frame 19:** That concludes this session. Questions?

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