Soil texture

Texture describes the mixture of different particle sizes in soils and names such as sandy loam and clay are used to describe these mixtures. Soils may also be referred to as heavy (clays) and light (coarse textured) to indicate their ease of cultivation. Texture is a fundamental soil property influencing key characteristics such as drainage, water storage, workability, susceptibility to soil erosion and suitability for different uses. It also plays a major part in defining soil 'structure'.

Particle size

The particle size classes are based on the particle size grades of the British Standards Institution and the Massachusetts Institute of Technology (Table 1).

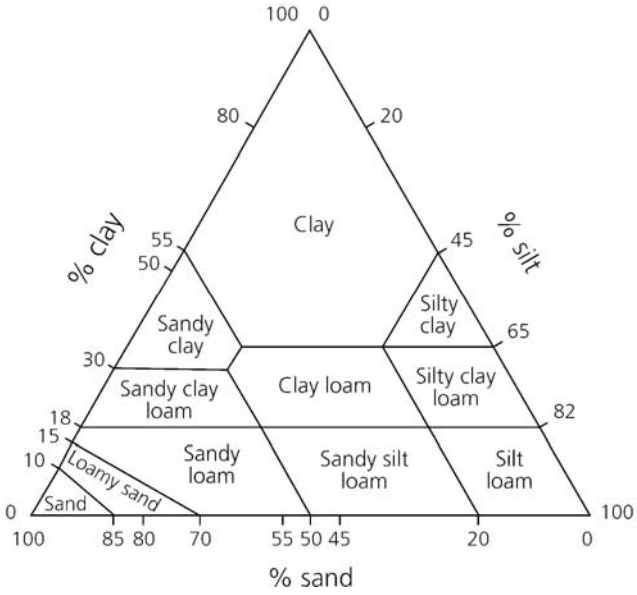
Table 1 Particle size fractions

Particle class	Particle subclass	Particle size (mm)
Clay		<0.002
Silt		0.002-0.06
Sand		0.06-2.0
Sand	Fine	0.06-0.2
	Medium	0.2-0.6
	Coarse	0.6-2.0

Texture classification

Mineral soils

The texture class of a soil is defined on the relative proportions of sand, silt and clay. The UK uses a system of clasification developed by the former soil survey of England and Wales, which is different from others in use around the world such as the United States Department of Agriculture (USDA). There are 11 major classes, for mineral soils, which are defined by the relative proportions of clay, silt and sand particles within the soil (Figure 1).



Soil texture triangle

Organic mineral and peat soils and calcareous soils

Soils with high contents of organic matter or calcium carbonate are not included in Figures 1, 2 and 3. See Appendix 1 for details of the classification of these soils.

Notation

The texture classes are usually denoted by abbreviations (Table 2).

For the sand, loamy sand, sandy loam and sandy silt loam classes the predominant size of the sand fraction (see Table 1) may be indicated by the use of prefixes, thus:

First edition 21 February 2008
www.naturalengland.org.uk

- C - coarse (more than 1/3 of sand greater than 0.6 mm) eg CS.
- M - medium (less than 2/3 fine sand and less than 1/3 coarse sand) eg MSL.
- F - fine (more than 2/3 of sand less than 0.2 mm) eg LFS.

Subdivisions of clay loam and silty clay loam classes are sometimes made according to their clay content as follows:

- M - medium (less than 27% clay) eg MCL.
- H - heavy (27-35% clay) eg HZCL.

Other notations are as follows:

- The prefix 'Calc' is used to identify naturally calcareous soils containing more than 1% calcium carbonate eg Calc MCL.
- For organic mineral soils, the texture of the mineral fraction is prefixed by the term 'organic' or the abbreviation 'org', eg organic clay loam (Org CL).
- Peaty textures, as a group, are denoted by the abbreviation 'PTY'.

Assessment of soil texture

Accurate determination of soil texture requires laboratory analysis (Particle Size Distribution, PSD), but for practical purposes texture can be assessed by hand (Hand Texturing). For most soils there is a close relationship between PSD and hand texture and the latter is sometimes a better indicator of the 'workability' of the soil.

The clay, silt, sand and organic matter impart distinctive qualities to the feel of the soil. Sand particles are large enough for the individual grains to be seen and the larger grains can be heard to grate together when the sample is worked near the ear. Fine sand grains are less obvious but can be distinguished in most samples. The individual grains of silt cannot be detected but soils with a large silt content have a smooth soapy feel and are only slightly sticky. Where present in significant amounts most clay minerals cause soil to cohere strongly and give it a characteristically sticky or plastic feel though some soils need much wetting and working between the fingers before stickiness is fully apparent.

Table 2 Texture class abbreviations

Texture	Abbreviation
Sand	S
Loamy sand	LS
Sandy loam	SL
Sandy silt loam	SZL
Silt loam	ZL
Sandy clay loam	SCL
Clay loam	CL
Silty clay loam	ZCL
Clay	C
Silty clay	ZC
Sandy clay	SC
Peat	P
Sandy peat	SP
Loamy peat	LP
Peaty loam	PL
Peaty sand	PS
Marine light silts	MZ

Hand texturing procedure

Take about a spoonful of soil. If dry wet up gradually kneading thoroughly between finger and thumb until crumbs are broken down. Enough moisture is needed to hold the soil together and for the soil to exhibit its maximum stickiness. The soil should be 'worked' between the fingers to get a feel for the particle components. Follow the paths in Figure 2 to get the texture class.

Experienced surveyors will make regular comparisons with laboratory analysis to fine tune their texturing abilities.

Soil texture

The following textural descriptions for each class can help confirm the decision from the flow chart:

Sands do not stain the fingers when wet. They feel gritty, lacking cohesion when wet and are loose when dry. Any water squirted onto the surface quickly disappears and the surface returns to matt.

Loamy sands feel gritty but when moist can form a weak fragile ball, but are not sticky. The ball quickly collapses. Unlike sands the surface will retain a glistening wet look when water is applied.

Sandy loams feel gritty, but easily mould to form an easily deformed ball. Rolling causes the soil to break into short threads. The wet soil is slightly sticky, unlike loamy sands.

Sandy silt loams when moist mould more easily than sandy loams because of the silt content. They feel equally gritty and soapy. The wet soil clings to fingers.

Identification by hand texturing

Clays mould to form durable balls, which are difficult to deform. The soil smears to give a polished surface. The soil can be rolled into long threads provided it is sufficiently moist. Wet clays are very sticky but do not adhere to fingers. They do not feel smooth and soapy.

Sandy clays bind together strongly. Deformation of a ball is difficult. Sand is obvious on the smeared surface. When wet it is very sticky.

Silty clays are similar to clays but feel smoother and more buttery when moist. They adhere to the fingers and are very sticky.

The feel of the soil when rubbed between the thumb and finger is affected, not only by the proportion of clay, silt, sand and organic matter, but also by the composition of the fractions, for example, some soils rich in clay-size calcium carbonate (chalk) or 'free' iron oxides, with clay fractions of unusual mineralogy, or with abnormal amounts of exchangeable sodium. Allowance must be made for these factors when texturing.

Laboratory analysis

If laboratory assessment is required then Particle Size Distribution of the sample should be requested. A value for organic matter content may also be desirable. Different laboratories may provide slightly different results depending on the method used. Results will usually be provided as a percentage of each particle size. Sand and silt are often subdivided and the values will have to be added to obtain a single value for sand, silt and clay. The values can then be plotted onto the texture triangle in Figure 1.

Texture groups

For agricultural purposes individual soil texture classes with similar properties are grouped. Texture groups are relevant to farm operations such as ease of cultivation or susceptibility to soil damage by grazing livestock. Current Defra publications on soil management and erosion use a simplified texture triangle with three groupings, sandy and light silty, medium and heavy (Figure 3). These are grouped by soil texture of mineral soils (ie less than 6% organic matter).

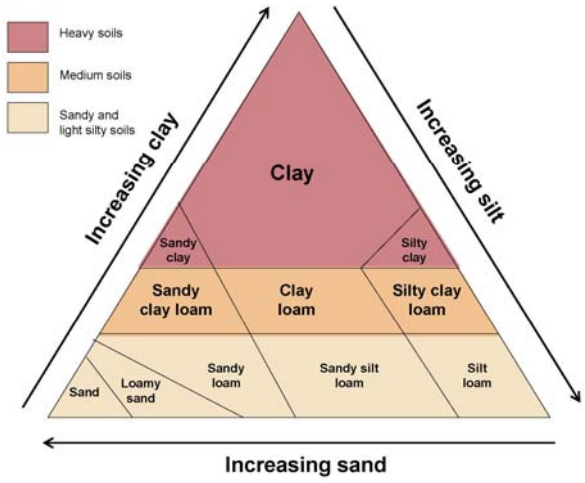
Soil texture

Single Payment Scheme cross compliance guidance for soil management uses five soil types:

- Sandy and light silty soils
- Medium soils
- Heavy soils
- Peaty soils

For fertiliser advice other characteristics, such as depth or organic matter are included, for example Fertiliser Recommendations for Agricultural and Horticultural Crops (RB209) uses 7 soil types:

- Light sand soils
- Shallow soils
- Medium soils
- Deep clay soils
- Deep fertile silty soils
- Organic soils
- Peaty soils



Simplified texture triangle and groupings (after Defra Cross Compliance Guidance)

Health & safety

Those involved in work out of doors and touching soils, are advised to have tetanus immunisation. The occasional death from this completely preventable disease emphasises the need for all involved in work on the land to take this simple precaution. Spores of tetanus bacillus are commonly found in soil and may affect quite minor wounds where skin is broken. The recommended maximum interval between inoculations is now ten years.

Further information

Natural England Technical Information Notes are available to download from the Natural England website: **www.naturalengland.org.uk**. For information on other Natural England publications contact the Natural England Enquiry Service on 0845 600 3078 or e-mail **enquiries@naturalengland.org.uk.**

Further advice and assistance in texturing soils can be obtained from the Geology, Landscape and Soils Team.

The following publications are useful reference material:

Single Payment Scheme Cross Compliance Guidance for Soil Management 2006 Edition: **URL://www.defra.gov.uk/farm/capreform/pubs/pdf/soil-hb.pdf**

Controlling Soil Erosion - A manual for the assessment and management of agricultural land at risk of soil erosion in lowland England, revised September 2005: **URL://www.defra.gov.uk/environment/land/soil/pdf/soilerosion-lowlandmanual.pdf**

Controlling soil erosion: incorporating former advisory leaflets on grazing livestock, wind, outdoor pigs and the uplands, revised September 2005: **URL://www.defra.gov.uk/environment/land/soil/pdf/soilerosion-combinedleaflets.pdf**

Hodgson, J.M. (1997) Soil Survey Field Handbook. Cranfield University

This Technical Information Note has been written by the Geology, Landscape and Soils Team led by Gill Shaw, with comments provided by other Natural England Advisers.

Soil texture

Appendix 1

Organic mineral and peat soils

High organic matter (OM) is normally associated with a darker colour, a smoother feel, better aggregation in sandy soils, and weaker clods and fine tilth in clays. Soils are classified as 'peaty' if they contain more than 20% OM (25% OM for soils with more than 50% clay content) or 'organic' if between 6-20% (10-25% for over 50% clay content) of humified organic matter.

Class limits for organic mineral and peaty textures are defined in Figure 4. For references to peat soils and textures, the following terminology is used:

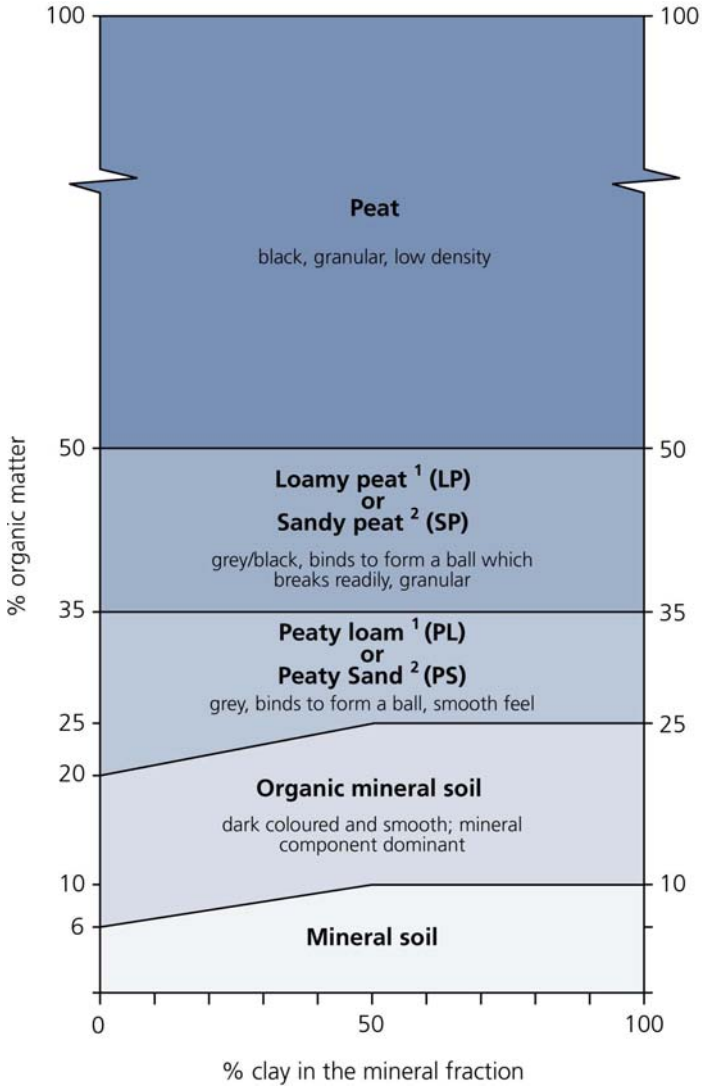
- Peat is a soil texture class.
- Peaty refers to a soil texture group comprising peat, loamy peat, sandy peat, peaty loam and peaty sand textures.
- Peat soil is a soil which meets both of the following criteria:

1. More than 40 cm of peaty textured material within the upper 80 cm of the soil profile; and

2. Organic mineral or peaty textures present within 30 cm depth.

Calcareous soils

Soils formed on chalk and limestone usually contain natural calcium carbonate which makes them better structured and more workable. Clay size particles of calcium carbonate are treated as silt when placing soils in their appropriate particle size classes. Small amounts of calcium carbonate can be estimated in the field by observing the reaction when a few drops of 10% hydrochloric acid are applied (Appendix 2). Eye protection should be worn against acid spray during effervescence.



Limiting percentages of organic matter, clay, and sand for peaty and organic mineral texture classes

Appendix 2

Table 3 Estimating calcium carbonate content

Field description & $CaCO_3$ class limits	Typical effects of HCl application at known $CACO_3$ contents		
	Audible (held close to ear)	Visible	% $CaCO_3$
Non-calcareous (Less than 0.5%)	None	None	0.1
Very slightly calcareous (0.5-1%)	Faintly increasing to slightly audible	None	0.5
Slightly calcareous (1-5%)	Faintly increasing to moderately audible	Slight effervescence confined to individual grains, just visible	1.0
	Moderately to distinctly audible heard away from ear	Slightly more general effervescence visible on closer inspection	2.0
Moderately calcareous (5-10%)	Easily audible	Moderate effervescence; obvious bubbles up to 3mm diameter	5.0
Very calcareous (more than 10%)	Easily audible	General strong effervescence; ubiquitous bubbles up to 7mm diameter; easily seen	10.0