Determination of Soil Texture

Soil Texture

<table>
<thead>
<tr>
<th>Class</th>
<th>Diameter</th>
<th>Dominant Minerals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>(2.0 – 0.05 mm)</td>
<td>Quartz</td>
</tr>
<tr>
<td>Silt</td>
<td>(0.05 – 0.002 mm)</td>
<td>Quartz / Feldspars / mica</td>
</tr>
<tr>
<td>Clay</td>
<td>(&lt;0.002 mm)</td>
<td>Secondary minerals</td>
</tr>
</tbody>
</table>

Importance of Soil Texture

(Distribution of particle sizes)

Soil Porosity
Particle Surface Area
Texture and Pore Sizes

Large particles yield large pore spaces
Small particles yield small pore spaces

Water moves rapidly and is poorly retained in Coarse-textured sandy soils.
Water moves slowly and is strongly retained in Fine-textured, clayey soils.

Surface Area

Specific Surface Area = \( \frac{\text{Surface Area}}{\text{mass}} \)
\( \text{units} = \frac{\text{cm}^2}{\text{g}} \)

Interface with the environment
water, nutrients, gases, O.M., microorganisms

60% sand, 10% silt, 30% clay
Sand <10%
Loamy sand 10 – 15%
Sandy loam 15 – 20%
Sandy clay loam 20 – 35%
Sandy clay 35 – 55%
Clay > 50%

Texture by Feel
Sand = Gritty
Silt = Smooth
Clay = Sticky, Plastic

Soil Horizons
Textural Class
Clay Content
Surface Area
Potential Reactivity
Laboratory Analysis of Soil Texture

Laboratory Analysis

Sedimentation – Sand, Silt, and Clay Fraction

Sedimentation
Quantifying Sedimentation Rates

Stokes’ Law

\[ V = \frac{g (d_p - d_L) D^2}{18 \mu} \]

- \( V \) = Velocity (cm/s)
- \( g \) = gravity
- \( d_p \) = density of the particle
- \( d_L \) = density of the liquid
- \( \mu \) = viscosity of the liquid

\[ V = K D^2 \]

- \( K = 11,241 \text{ cm}^{-1} \text{ sec}^{-1} \)

Sand: \( D = 1 \text{ mm} \rightarrow 0.1 \text{ cm} \)

\[ V = 11,241 \times (0.1)^2 \]

\[ = 112.4 \text{ cm/sec} \]
Stokes’ Law

\[ V = K D^2 \]

\[ K = 11,241 \text{ cm}^{-1} \text{ sec}^{-1} \]

clay: \[ D = 0.002 \text{ mm} \rightarrow 0.0002 \text{ cm} \]

\[ V = 11,241 \times (0.0002)^2 \]

\[ \frac{1}{\text{cm} \cdot \text{sec}} \times \text{cm}^2 \]

\[ = 0.00045 \text{ cm/sec} \]

Sedimentation

The density of a soil suspension decreases as particles settle out.

1 minute Sand settles out
2 hours Silt settles out

The density of a soil suspension decreases as particles settle out.
Hydrometer Method

Pure distilled water (18°C) = 0 g/L

Hydrometer Method

Add 40 g soil to 1 liter of water

Time = 0 sec  density = 40 g/L
Time = 1 min.  density = 10 g/L

Sand settled = 40 g - 10 g = 30 g

Sand (%) = \[
\frac{30 \text{ g sand}}{40 \text{ g soil}} = 0.75 = 75%
\]

Hydrometer Method

Time = 2 hrs  density = 4 g/L

What is being measured?

Clay content = 4 g

Clay % = \[
\frac{4 \text{ g clay}}{40 \text{ g Soil}} = 0.10 = 10%
\]

Silt % = 100% - (75% + 10%)
100% - 85%
= 15%
Hydrometer Method

Sand = 75%
Silt = 15%
Clay = 10%

Sandy Loam

Texture and Civilization?

Civilization

- Nile
- Jordan
- Tigris
- Euphrates

Neolithic Founder Crops
- Wheat
- Barley
- Flax
- Chick Pea
- Lentil
- Cows, goats, sheep, and pigs

Year-round supply of water
Enduring Sunlight
Trustworthy harvests
Building materials
Population increases
Substantial homes
Relative Safety, peace
Flooding

Sand 2.0 - 0.05 mm
Silt 0.05 - 0.002 mm
Clay < 0.002 mm

Flooding

Stokes’ Law: \( V = kD^2 \)

\( K = 11,241 \, \text{cm}^{-1} \, \text{sec}^{-1} \)

<table>
<thead>
<tr>
<th>Particle Size</th>
<th>Velocity ( V )</th>
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<tbody>
<tr>
<td>Sand 1 mm</td>
<td>112 cm/sec</td>
</tr>
<tr>
<td>Silt 0.05 mm</td>
<td>0.281 cm/sec</td>
</tr>
<tr>
<td>Clay 0.002 mm</td>
<td>0.0004 cm/sec</td>
</tr>
</tbody>
</table>
Sedimentation

River channel

Sand  Silt  Clay

Tigris-Euphrates

Egypt

Nile

Khemia signifies black earth: flood deposition

Blue Nile

White Nile

Flood peaks in mid-September
**Mesopotamia**

Alluvial Plain

Flood: March through June
Less predictable

**Agriculture and Irrigation**

Irrigation
- Canals
- Dikes
- Weirs
- Reservoirs
- Channels

**Creation myth**

Enki, the Sumerian deity of Water (lord of the watery abyss)

Symbols: goat, fish

The gods were dredging the rivers, were piling up their silt on projecting bends—and the gods lugging the clay began complaining.
History and Soil Texture
(clay and stone)

Stone and Clay

Egypt —— Stone
Sumer —— Clay

Sumerian receipt
Hieroglyphics

The Language of Power
Architecture and Sculpture