Determination of Soil Texture

Soil Texture

Class	Diameter	Dominant Minerals
Sand	(2.0 – 0.05 mm)	Quartz
Silt	(0.05 – 0.002 mm)	Quartz /Feldspars/mica
Clay	(<0.002 mm)	Secondary minerals

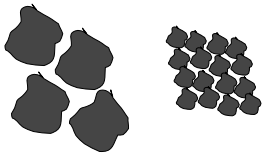
Importance of Soil Texture

(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



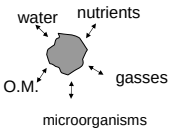
Water moves rapidly and is poorly retained in Coarse-textured sandy soils.

Water moves slowly and is strongly retained in Fine-textured, clayey soils.

Surface Area

$$\text{Specific Surface Area} = \frac{\text{Surface Area}}{\text{mass}} \qquad \frac{\text{units}}{\frac{cm^2}{g}}$$

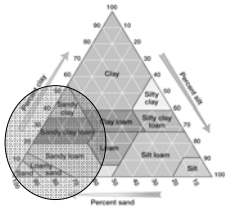
Interface with the environment



60% sand, 10% silt, 30% clay

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

Florida Soils

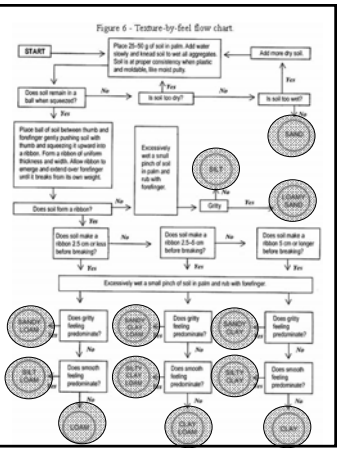


Texture by Feel

Sand = Gritty

Silt = Smooth

Clay = Sticky, Plastic



Soil Horizons

↓

Textural Class

↓

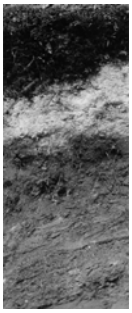
Clay Content

↓

Surface Area

↓

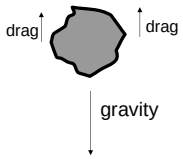
Potential Reactivity



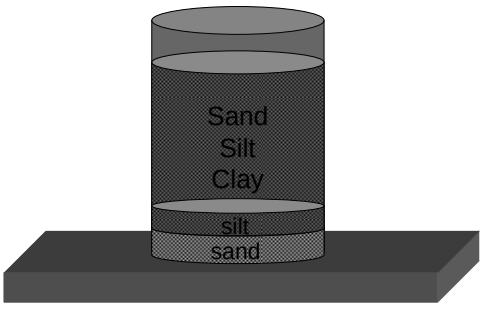
Laboratory Analysis of Soil Texture

Laboratory Analysis

Sedimentation – Sand, Silt, and Clay Fraction



Sedimentation



Quantifying Sedimentation Rates

Stokes' Law

Velocity $V(cm/s) = \frac{g\,(d_p - d_L)\,D^2}{18\mu}$

g = gravity
d_p = density of the particle
d_L = density of the liquid
μ = viscosity of the liquid

$V = K\,D^2$

$K = 11{,}241\ cm^{-1}\ sec^{-1}$

Stokes' Law

$V = K\,D^2$

$K = 11{,}241\ cm^{-1}\ sec^{-1}$

Sand: $D = 1\ mm \longrightarrow 0.1\ cm$

$V = 11{,}241 \times (0.1)^2$

$\frac{1}{cm \cdot sec} \times cm^2$

$= 112.4\ cm/sec$

Stokes' Law

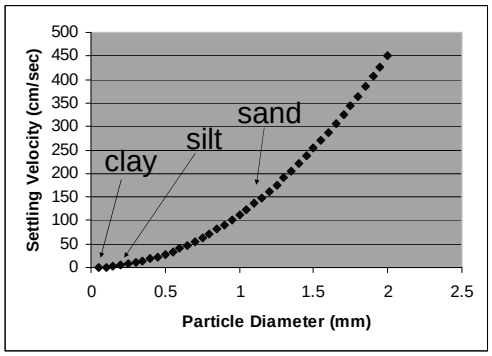
$V = K D^2$

$K = 11{,}241\ cm^{-1}\ sec^{-1}$

clay: $D = 0.002\ mm \longrightarrow 0.0002\ cm$

$$V = 11{,}241 \times (0.0002)^2 \frac{1}{cm \cdot sec} \times cm^2$$

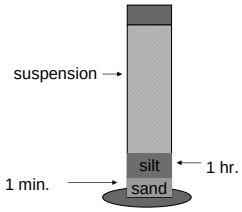
$= 0.00045\ cm/sec$



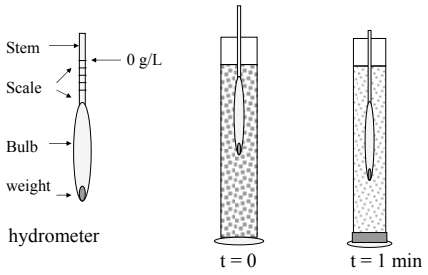
Sedimentation

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

1 minute	Sand settles out
2 hours	Silt settles 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

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

Hydrometer Method

Time = 2 hrs density = 4 g/L

What is being measured?

Clay content = 4 g

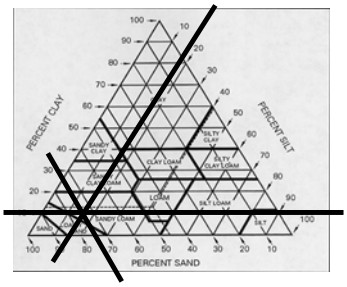
$$\text{Clay \%} = \frac{\text{4 g clay}}{\text{40 g soil}} = 0.10 = 10\%$$

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

Hydrometer Method

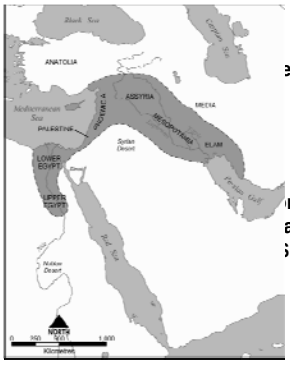
Sand = 75%
Silt = 15%
Clay = 10%

Sandy Loam



Texture and Civilization?

Civilization



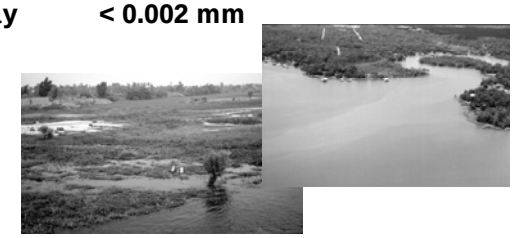
Nile
Jordan
Tigris
Euphrates

Neolithic Founder Crops
Wheat
Barley
Flax
Chick Pea
Lentil

cows, goats, sheep, and pigs

Flooding

Sand 2.0-.05 mm
Silt 0.05 – 0.002 mm
Clay < 0.002 mm

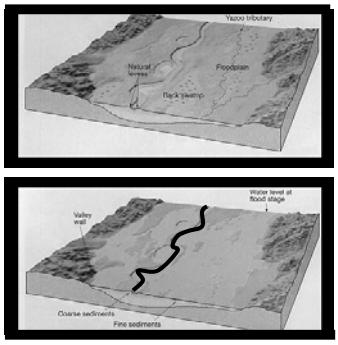


Stokes' Law: $V = kD^2$

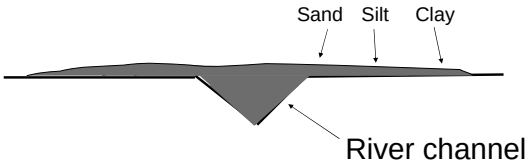
$K = 11{,}241\ cm^{-1}\ sec^{-1}$

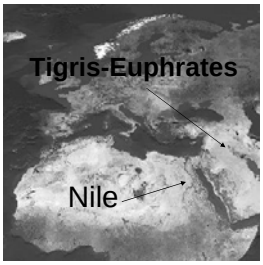
Sand	**1 mm**	**V = 112**	**cm/sec**
Silt	**0.05 mm**	**V = 0.281**	**cm/sec**
Clay	**0.002 mm**	**V = 0.0004**	**cm/sec**

Flooding



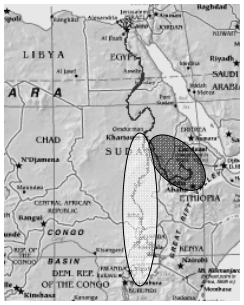
Sedimentation





Egypt

Khemia signifies black earth: flood deposition



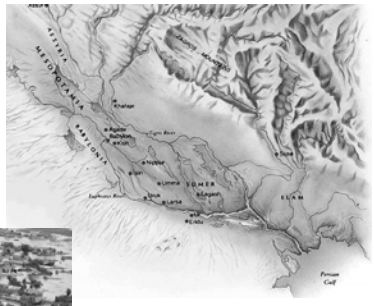
Blue Nile

White Nile

Flood peaks in mid-September

Mesopotamia

Alluvial Plain



Euphrates

Flood: March through June
Less predictable

Agriculture and Irrigation

Irrigation

Canals
Dikes
Weirs
Reservoirs
channels

Early Mesopotamia

Enki

water

Sumerian deity of Water (lord of the watery abyss)

Creation myth

The gods were dredging the rivers, were piling up their silt on projecting bends-- and the gods lugging the clay began complaining

Symbols: goat, fish

History and Soil Texture

(clay and stone)

Stone and Clay

Egypt ⟶ **Stone**

Sumer ⟶ **Clay**

Sumerian receipt

hieroglyphics

The Language of Power

Architecture and Sculpture