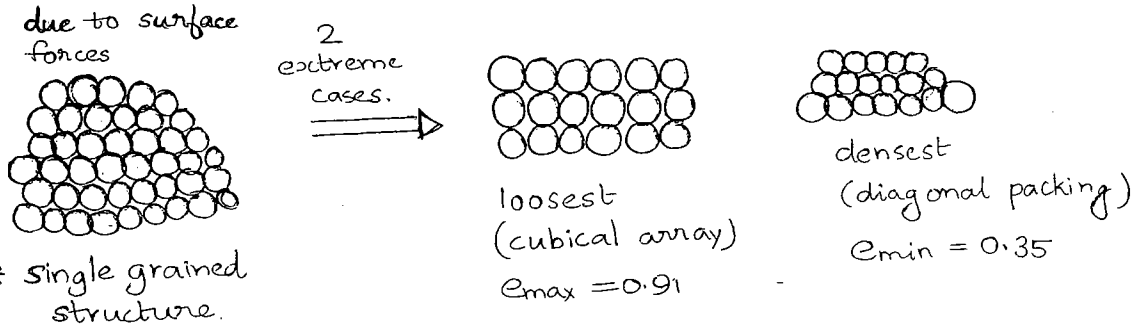
16th Aug,
SATURDAY

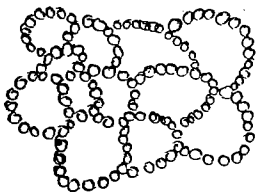
3. SOIL STRUCTURES & CLAY MINERALOGY

⟶ Types of Structures

1. Single Grained Structure ⟶ in gravel & coarse sand
2. Honey comb structure ⟶ in fine sand & silt
3. Flocculent structure ⟶ in clays
4. Dispersed structure ⟶ in remoulded clays
5. Combined structure ⟶ in soil mixtures



* single grained structure.



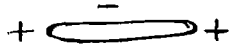
* Honey Comb Structure

- very sensitive to vibrations (decreases in vol. due to vibrations)
- It collapses on wetting. (volume decreasing)
- collapsible soils. Eg: loess, fine sand, silt

→ Particle Shapes.

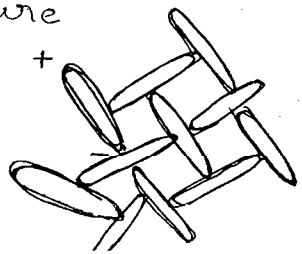
(i) Angular :- gravel & sand (ii) Rounded :- gravel & sand (iii) Flaky :- clay soils.

The clay particle is electrically charged as shown below. (-ve charge on surface)



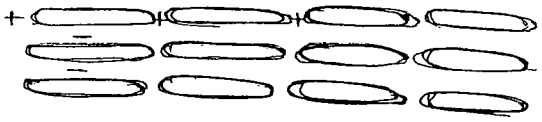
3rd Aug,
SATURDAY

* Flocculent Structure



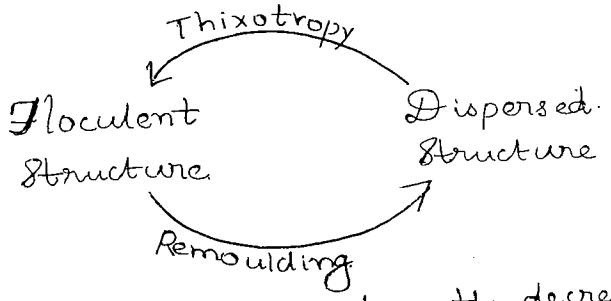
> relatively more strength
> stable.
> edge to face orientation
> net attraction.

* Dispersed Structure



> relatively low strength
> Unstable
> Face-to-face orientation
> net repulsion

Thixotropy : The phenomenon of regaining of strength with passage of time under const. water content is called Thixotropy



In clay,
Due to remoulding, strength decreases.
Due to thixotropy, strength regains.

Marine clay (Sea water) → flocculent structure.
Lake clay (Fresh water) → dispersed structure

The presence of salts in seawater and due to its alkaline nature, salts acts as flocculating agents. The marine clay has flocculent structure.

→ Minerals.

(i) Rock Minerals.
- no surface activity.
- Eg: Quartz, mica, feldspar.

(ii) Clay Minerals.
- have surface activity. (like cohesion, electrostatic, chemical forces)
- Eg: Kaolinite, Illite, Montmorillonite, Halloysite.

* Kaolinite
- causes no swelling & no shrinkage.
- it is present in china clay (used to make earthenware utensils)

* Illite:
  - causes medium swelling & shrinkage
  - present in most of the clays
* Montmorillonite:
  - causes large swelling and large shrinkage.
  - present, Bentonite clay & B.C soil.
* Halloysite:
  - similar to Kaolinite

NOTE:

⊙ Plasticity of Kaolinite < Plasticity of Illite < Plasticity of Montmorillonite.

⊙ SSA of Kaolinite < SSA of Illite < SSA of montmorillonite

SSA – Specific Surface Area (S.A per unit weight).

→ Specific Surface Area (SSA).

1. It is the surface area per unit weight $\Rightarrow \frac{A}{W}$
2. It is the surface area per unit volume $\Rightarrow \frac{A}{V}$

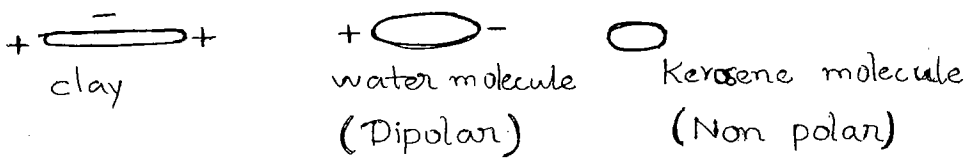
$$SSA = \frac{A}{V} = \frac{4\pi r^2}{\frac{4}{3}\pi r^3} = \frac{3}{r}$$

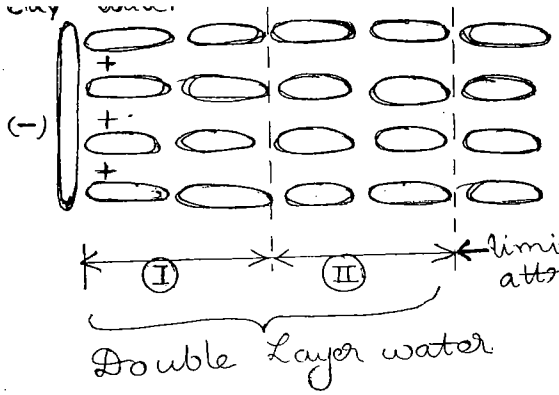
$$\Rightarrow \boxed{SSA \propto \frac{1}{\text{size of soil particle}}}$$

Gravel → least SSA
Sand
Silt
Clay → highest SSA

(↓ increasing order)

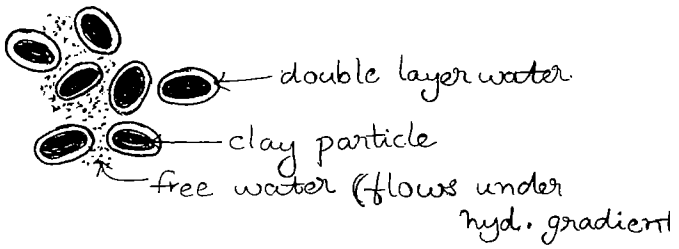
→ Diffuse Double Layer Water (or Adsorbed Water)





(I) → strongly held layer of water

(II) → loosely held layer of water



Double layer water :

- present only in clays
- causes plasticity property to the clay.