


Fundamental Concepts: Sedimentation

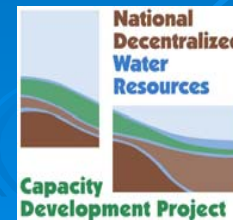
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Management



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Sedimentation

- **Sedimentation** is the gravitational accumulation of solids at the bottom of a fluid (air or water)

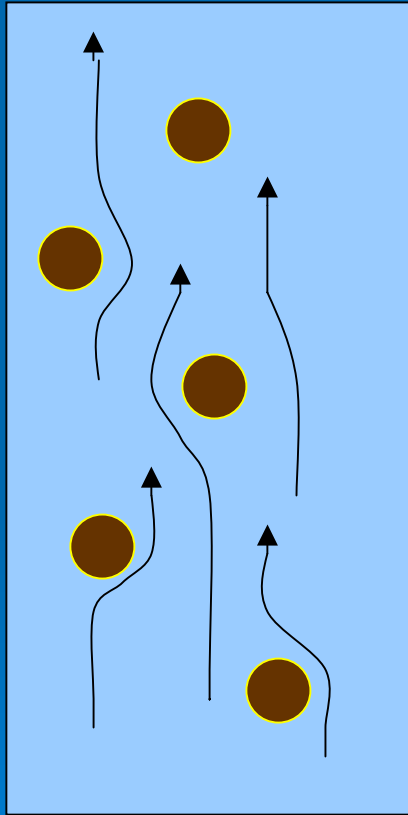


Types of Settling

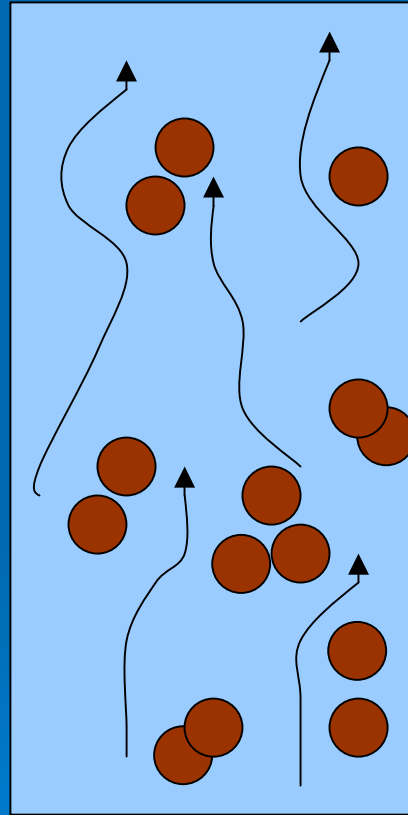
Four types of sedimentation:

- Discrete settling
- Flocculant settling
- Hindered settling
- Compression

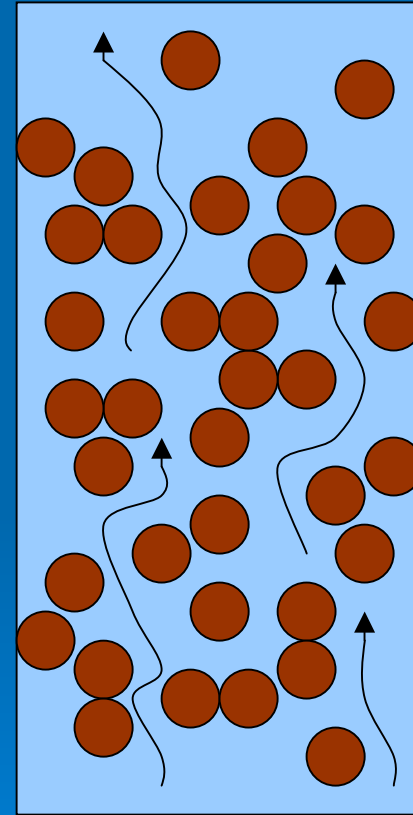
Examples of Settling Types



Discrete



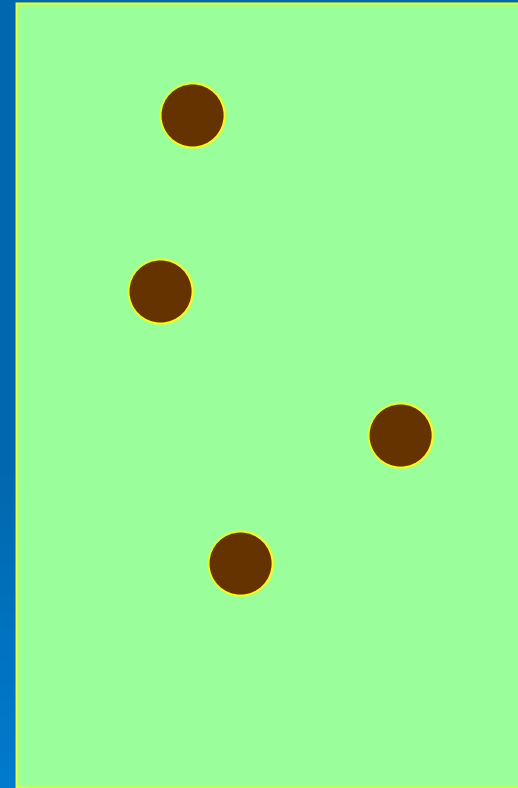
Flocculant



Hindered

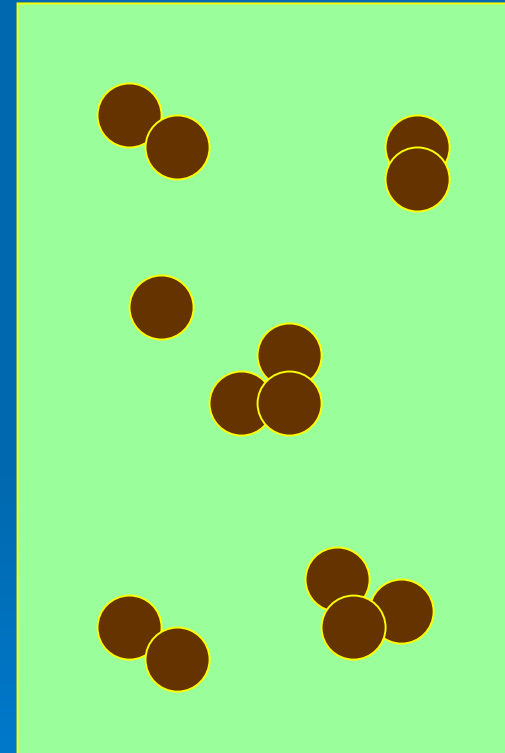
Types of Sedimentation

- In **discrete settling** individual particles settle independently
- It occurs when there is a relatively low solids concentration



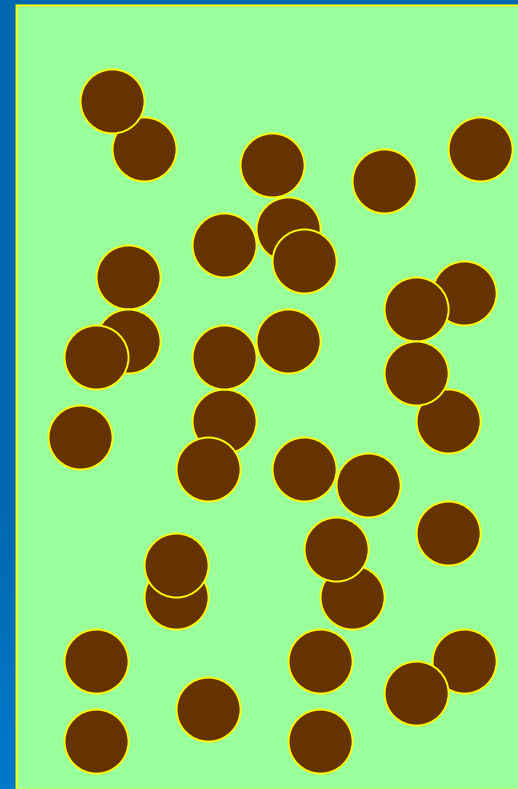
Types of Sedimentation

- In **flocculant settling**, individual particles stick together into clumps called flocs
- This occurs when there is a greater solids concentration and chemical or biological reactions alter particle surfaces to enhance attachment



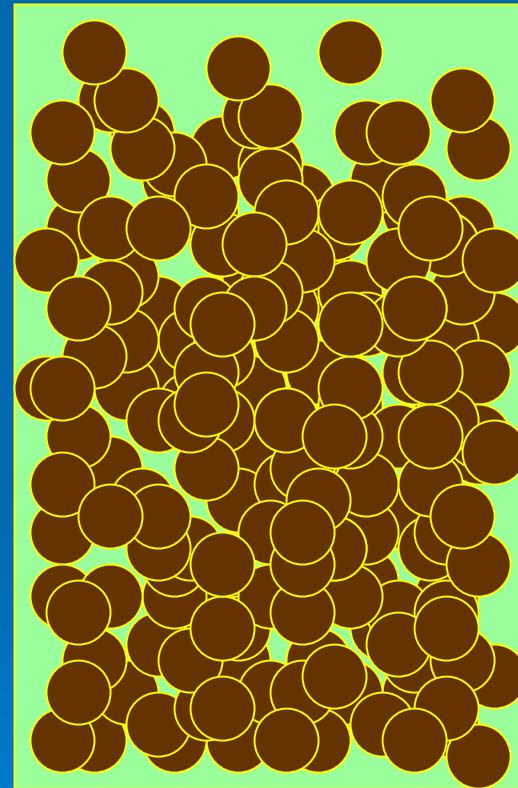
Types of Sedimentation

- In **hindered settling**, particle concentration is great enough to inhibit water movement
- Water must move in spaces between particles



Types of Sedimentation

- **Compression settling** occurs when particles settle by compressing the mass below



Sedimentation Rate

➤ Stoke's Law

- Used for spherical particles
- Assumes no fluid mixing, so usually will not work for gasses

$$V_p = \frac{(\rho_p - \rho_w)d^2g}{18\mu}$$

Sedimentation Rate

$$v_p = \frac{(\rho_p - \rho_w)d^2 g}{18\mu}$$

- v_p = particle settling velocity (m/s or ft/s)
- ρ_p = particle density (kg/m^3 or lb/ft^3)
- ρ_w = fluid density (kg/m^3)
- d = particle diameter (m or ft)
- g = gravitational acceleration (9.81 m/s^2 or 32.2 ft/s^2)
- μ = dynamic viscosity (Ns/m^2 or lbs/ft^2)

Applications

- Stoke's Law can be used to determine the surface area of a settling tank
 - Set the critical velocity equal to the settling velocity of the smallest particle
 - The overflow rate is equal to the flow rate into the tank divided by the surface area
 - Setting the overflow rate equal to the critical settling velocity allows time to capture smallest particles of interest

Applications

$$\text{OFR} = v_c = \frac{Q}{A}$$

- OFR = over flow rate (m/s or ft/s)
- v_c = critical settling velocity (m/s or ft/s)
- Q = the flow rate into the basin (m^3/s or cfs)
- A = the surface area of the basin (m^2 or ft^2)