Drinking Water Treatment: Sedimentation

Sedimentation is a fundamental unit process in drinking water treatment used to remove suspended solids and flocs formed during coagulation and flocculation.
The process relies on gravity settling, where heavier particle sink to the bottom of a sedimentation basin, leaving clearer water at the top.
It is one of the oldest and most widely used methods for water clarification, forming a key step before filtration.

1. Objectives of Sedimentation

- To separate and remove suspended solids and flocs.
- To reduce the turbidity and particle load on filters.
- Toimprovetheclarity,taste,andodorofwater.
- To enhance the overall efficiency of disinfection by lowering microbial load.

2. Principles of Sedimentation

- Gravitational settling: Particles with higher density than water settle down.
- Settling velocity: Determined by particle size, density, and fluid properties(Stokes' Law).
- Retention time: Adequate detention time(2–6hours)is needed for flocs to settle.
- Hydraulic flow patterns: Proper design ensures laminar flow, avoiding turbulence that re suspends solids.

3. Types of Sedimentation

- Type I–Discrete settling: Non-flocculent particles settle independently.
- Type II–Flocculent settling: Particles agglomerate and settle faster.
- Type III–Zone settling: High particle concentration causes a blanket-like settling.
- Type IV–Compression settling: Occurs at the bottom under high particle concentration.

4. Sedimentation Basin Design

- Rectangular basins: Water flows horizontally; simple and widely used.
- Circular (radial)basins:Water flows radially towards a central outlet.
- Up flow clarifiers:Water flows upward through as ludge blanket, improving efficiency.
- Tube settlers: Inclined plates/tubes shorten settling distance, enhancing removal.

5. Factors Affecting Sedimentation

- Particlesize and density: Larger and denser flocs settle faster.
- Water viscosity: Higher viscosity(coldwater)slows settling.
- Flow velocity: Must be controlled to prevent re suspension.
- Coagulant and flocculation efficiency: Well-formed flocs improve sedimentation.

6. Advantages of Sedimentation

- Reduces turbidity and suspended solids effectively.
- Decreases filter clogging, extending filter life.
- Improves microbial removal efficiency.
- Can handle large volumes of water economically.

7. Limitations of Sedimentation

- Ineffective for dissolved impurities.
- Requires large space and infrastructure.
- Performance is affected by temperature, flow variations, and turbulence.
- Generates sludge requiring safe disposal.

8. Applications of Sedimentation

- Drinking water treatment plants–clarification of river/lake water.
- Waste water treatment plants–removal of suspended solids.
- Industrial water treatment –clarification before reuse or discharge.

9. Diagram: Sedimentation Process

Coagulated & Flocculated Water

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Sedimentation Basin

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Settled Sludge at the Bottom

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Clear Water Sent to Filtration

10. Conclusion

Sedimentation is a vital process in water treatment, ensuring the removal of a large fraction of suspended impurities and flocs.

By providing clearer water to filtration units, it improves treatment efficiency, reduces operational costs, and enhances the safety of drinking water.

Despite its limitations, sedimentation remains an indispensable step in conventional water treatment systems worldwide.