Drinking Water Treatment: Coagulation

Coagulation is one of the most important drinking water treatment processes used to remove suspended particles, colloids, and turbidity from raw water.
It involves the addition of coagulant chemicals that destabilize fine particles, allowing them to clump together into larger aggregates (flocs) which can be removed by sedimentation and filtration.

1. Objectives of Coagulation

- To remove suspended solids and reduce turbidity.
- To eliminate color, algae, and microorganisms.
- To improve taste and odor of drinking water.
- To enhance the efficiency of sedimentation and filtration.
- To reduce organic matter that may form disinfection by-products (DBPs).

2. Common Coagulants Used

- Alum (Aluminum sulfate): Mostwidely used coagulant.
- Ferric salts (Ferric chloride, Ferric sulfate): Effective in acidic water.
- Poly aluminum chloride(PAC): Works over a wide pH range.
- Natural coagulants: Plant-based materials like moring a seeds.

3. Process of Coagulation

1. Coagulant addition– Alum or ferric salts are rapidly mixed with raw water.
2. Destabilization of particles– Neutralization of charges on colloids.
3. Floc formation (Flocculation)– Gentle mixing causes particles to clump together.
4. Sedimentation – Heavy flocs settle down.
5. Filtration–Remaining particles are removed, producing clear water.

4. Factors Affecting Coagulation

- pH of water: Alum works best between pH 6.0–7.5.
- Temperature: Low temperatures low down floc formation.
- Dosage of coagulant: Under-dosing or overdosing reduces efficiency.
- Mixing conditions: Rapid mixing for dispersion; slow mixing for floc growth.

- Nature of impurities: Some pollutants may require coagulant aids (polymers).

5. Diagram: Coagulation Process in Water Treatment

Raw Water with Suspended Solids

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Addition of Coagulant (Alum, Fe Salts)

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Rapid Mixing → Destabilization of Particles

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Gentle Mixing → Formation of Flocs (Flocculation)

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Sedimentation of Heavy Flocs

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Filtration → Clear Drinking Water

6. Advantages of Coagulation

- Highly effective in reducing turbidity and color.
- Improves microbial removal efficiency.
- Reduces organic matter that causes taste and odor problems.
- Enhances disinfection effectiveness by lowering particle load.

7. Limitations of Coagulation

- Requires careful pH and dose adjustment.
- Produces sludge that needs proper disposal.
- Less effective for dissolved inorganic and organic pollutants.
- Operational costs increase if coagulant demand is high.

8. Conclusion

Coagulation is a fundamental step in drinking water treatment, playing a key role in improving water clarity, safety, and acceptability.
When combined with sedimentation, filtration, and disinfection, it ensures that water meets public health standards for safe consumption.
Continuous optimization of coagulant type, dosage, and operating conditions is essential for sustainable and cost-effective treatment.