



**Ministry of Higher Education and Scientific
Research Al-Mustaqbal University College**

**Department of Chemical Engineering and
petroleum Industrials**

Pollution

2nd Stage

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Conventional Water Treatment

Processes

- Remove solids before removing bacteria
- Remove solids using sedimentation process before using filtration
- Remove organic compounds and ammonia-based compounds before disinfection

Sequence of unit processes:

Pre-sedimentation mixing, flocculation, settling
filtration adsorption disinfection

Function of unit processes: solids removal of ions, and solids using chemical addition removal of smaller particles removal of organic compounds and ions oxidation of oxygen demanding wastes and chemical killing of pathogens in water.

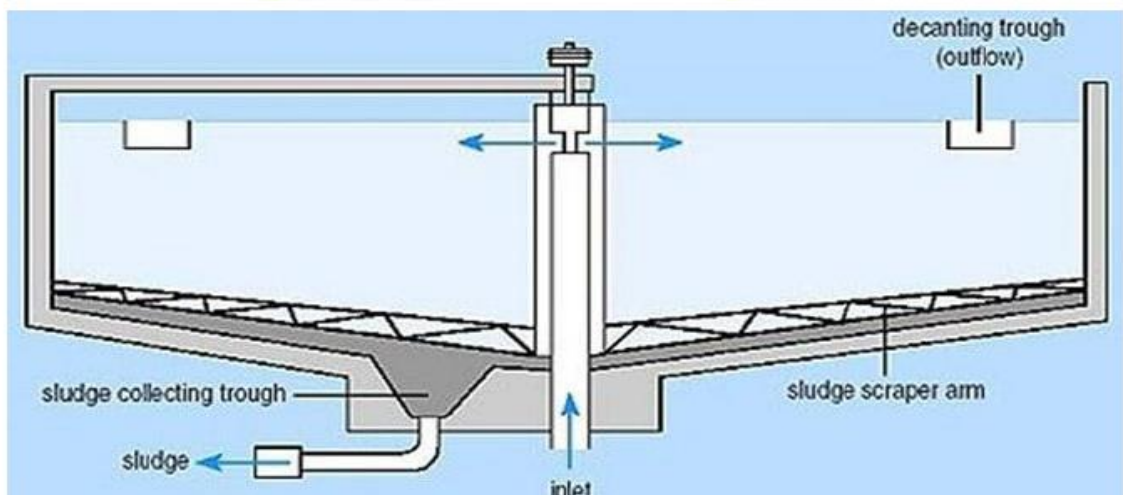
- Chlorine is added in sedimentation and filtration tank to avoid microbial growth
- Chlorine is used as an oxidizing agent as well as a disinfection solution.

Solids removal

Method1. Sedimentation

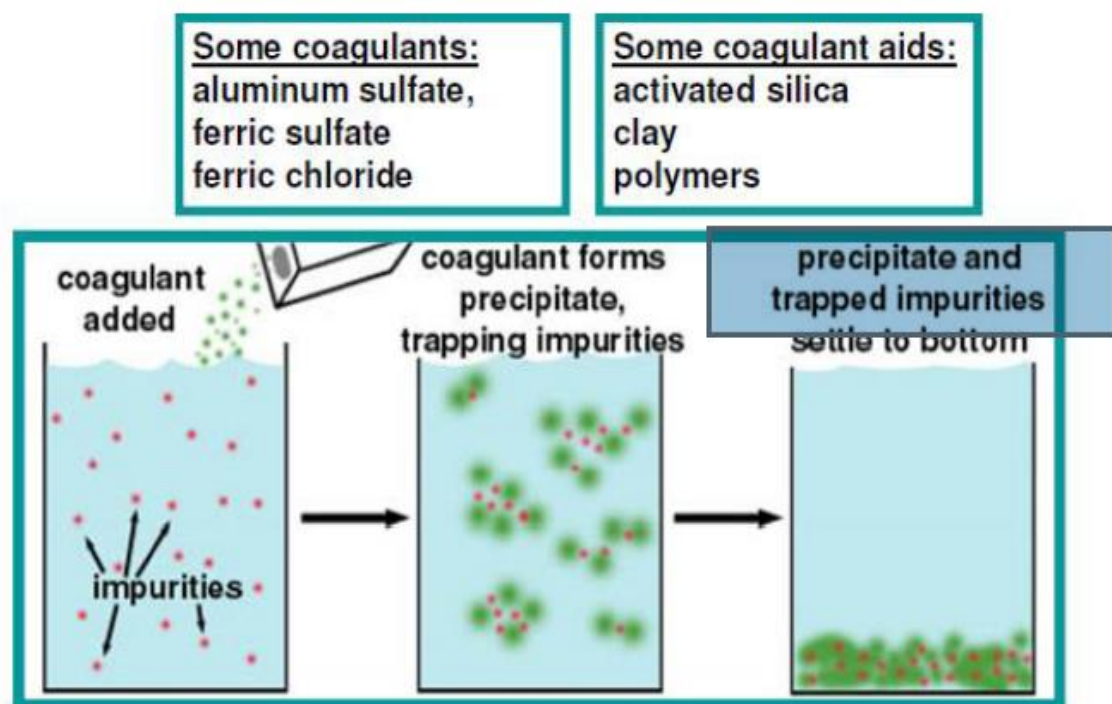
Solids settle based on their gravitational force (with and without externally added chemicals).

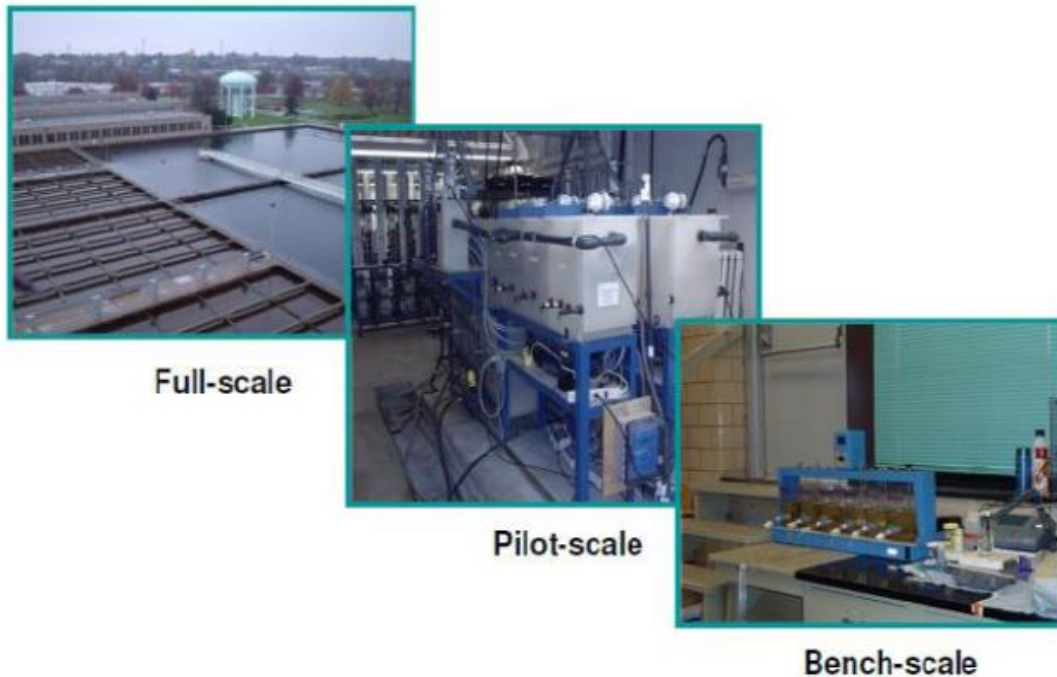
- Settling depend on solid physical characteristics (diameter, density) and medium temperature, viscosity, density, etc.
- Some solids **do not interact** with each other during settling (i.e., **discrete particles**) (no change in their size and shape). The settling is called **discrete settling** (Type 1 settling). Ex: settling of sand.
- Some solids **interact** during their settling and change their size and shape (i.e., **flocculent particles**) (Type 2 settling). Ex: settling of clay; bacteria.



Method 2. Coagulation-Flocculation

- Some solids take very long time to settle (size in submicron range or in nanometer range).
- Chemicals (ex: alum; ferric chloride) are added in solution to (1) increase size of particles, (2) capture them in hydroxide flocs and then precipitate them.





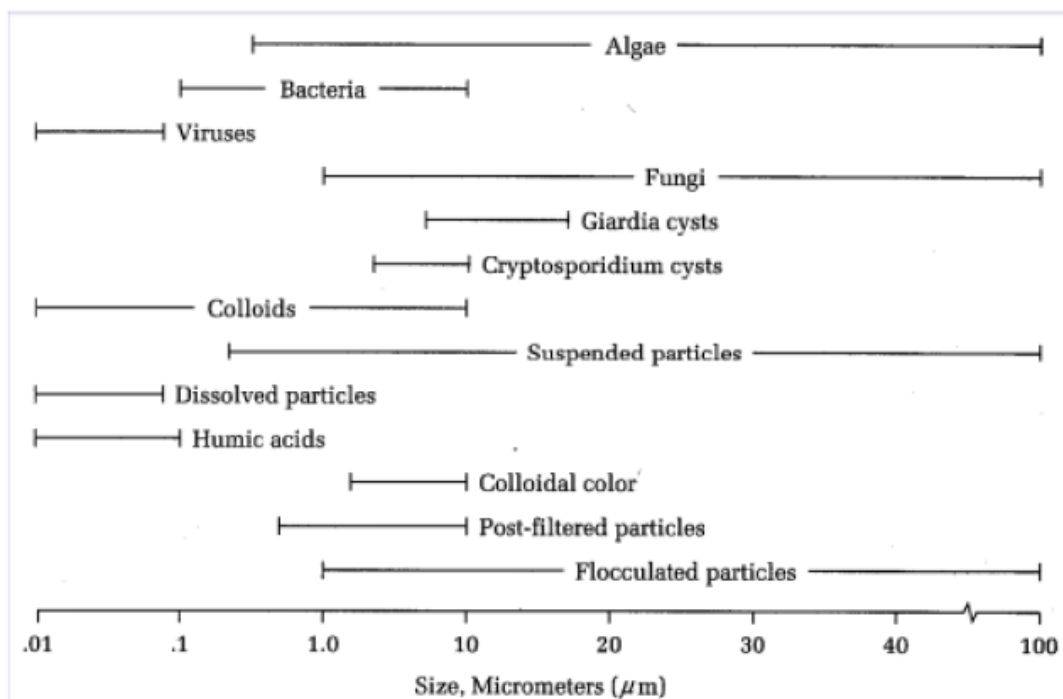
Colloids are very small particles (turbidity and color causing particles) that cannot be removed neither by sedimentation (due to their light weight) nor by filtration. Examples of colloids: soil particles, bacteria, viruses and color causing materials. These colloids are stable in solution and theoretically will stay there forever unless an action is done to destabilize them.

Coagulant is the chemical used to destabilize the colloidal particle so that the floc formation can result.

Flocculent is a chemical, typically organic, added to enhance the flocculation process. Typical flocculants and coagulants include natural and organic polymers,

metal salts such as alum or ferric sulfate. The term flocculation is used to describe the process whereby the size of particles increases as a result of particle collisions. Solids in water present into two forms, colloidal and suspended solids (greater than 1 micron) and can be removed by sedimentation.

Sizes of Particles in Water



Coagulation - Flocculation

