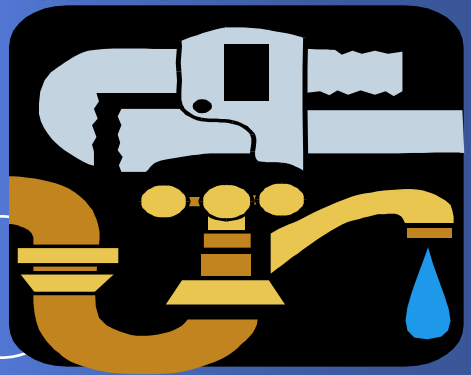
Water Chemistry

B. Corrosion,

C. Coagulation and flocculation

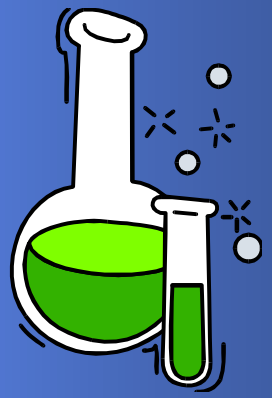
Controlling corrosion:

- **Dissolved oxygen and carbon dioxide which contribute to corrosion can be removed by *de-aeration (*e.g., through heating water).**
- **Chemical additives like sodium hydroxide and sodium hexametaphosphate (SHMP) may be added to water to reduce corrosion.**
- **Non-corrosive materials can be used for distribution systems**
- **Metal pipes can be lined with non-corrosive coverings**



Clarification - Three step process:

- ***Coagulation,*** **accomplished by rapid mixing of chemical coagulant with "raw" (untreated) water, followed by**
- **Slow mixing or *flocculation*, in which floc attracts colloidal solids, and**
- ***Sedimentation*, in which gravity settles solids out of solution.**



Coagulation:

- *Coagulation* is the destabilization of colloidal particles.
- Coagulants include iron and aluminum salts, synthetic cationic, anionic and nonionic polymers
- The ability of an agent to coagulate a water is related to its charge and size of synthetic polymer.

Chemical Coagulants:

- **Aluminum sulfate (alum, or $AlSO_4$) is the most common chemical coagulant used in drinking water treatment due to low cost.**
  - **Insoluble aluminum hydroxide forms.**
  - ***A floc* forms, which forms larger particles that fall out of solution (*precipitation*).**
  - **Addition of lime (calcium carbonate) or soda ash (sodium carbonate) increases alkalinity of water to facilitate floc formation.**

Other coagulants and aids:

- ***Ferrous sulfate*** **($FeSO_4$),**
- ***Ferric salts*** **(ferric sulfate or ferric chloride),**
- ***Sodium aluminate*** **(alumina dissolved in sodium hydroxide),**
- ***Synthetic polymers*** **(high MW charged, organic compounds)**
- ***Coagulant aids*** **(polymers, silica, clays, acids, alkalies, etc.)**

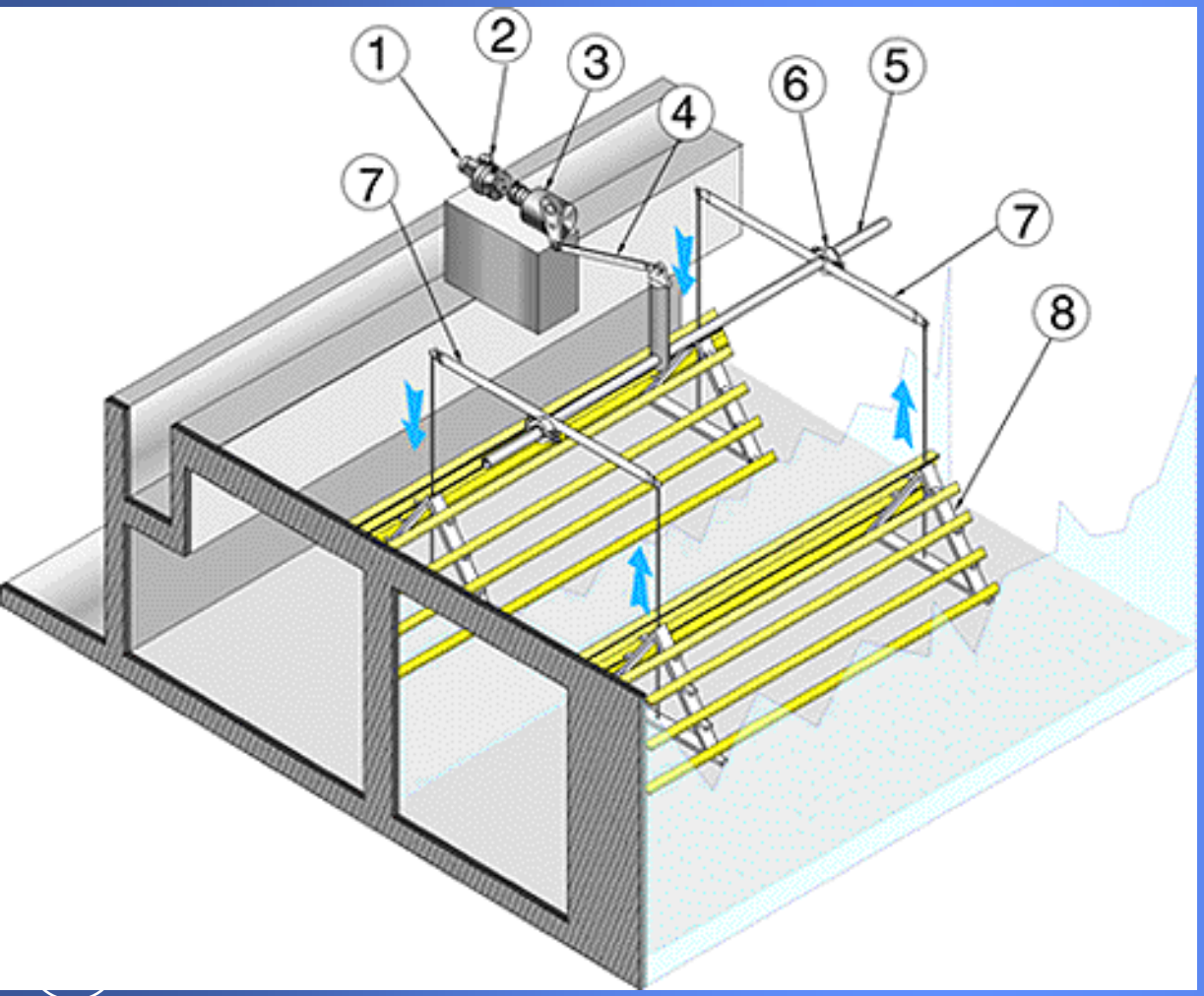
Flocculation:

- *Flocculation* is process to promote aggregation and sedimentation of particles.
- Success of the flocculation is dependent first on
  - The effectiveness of the coagulation in the raw water
  - The flocculation process must provide adequate time for the desired floc size and density to form

Measuring Treatment efficiency:

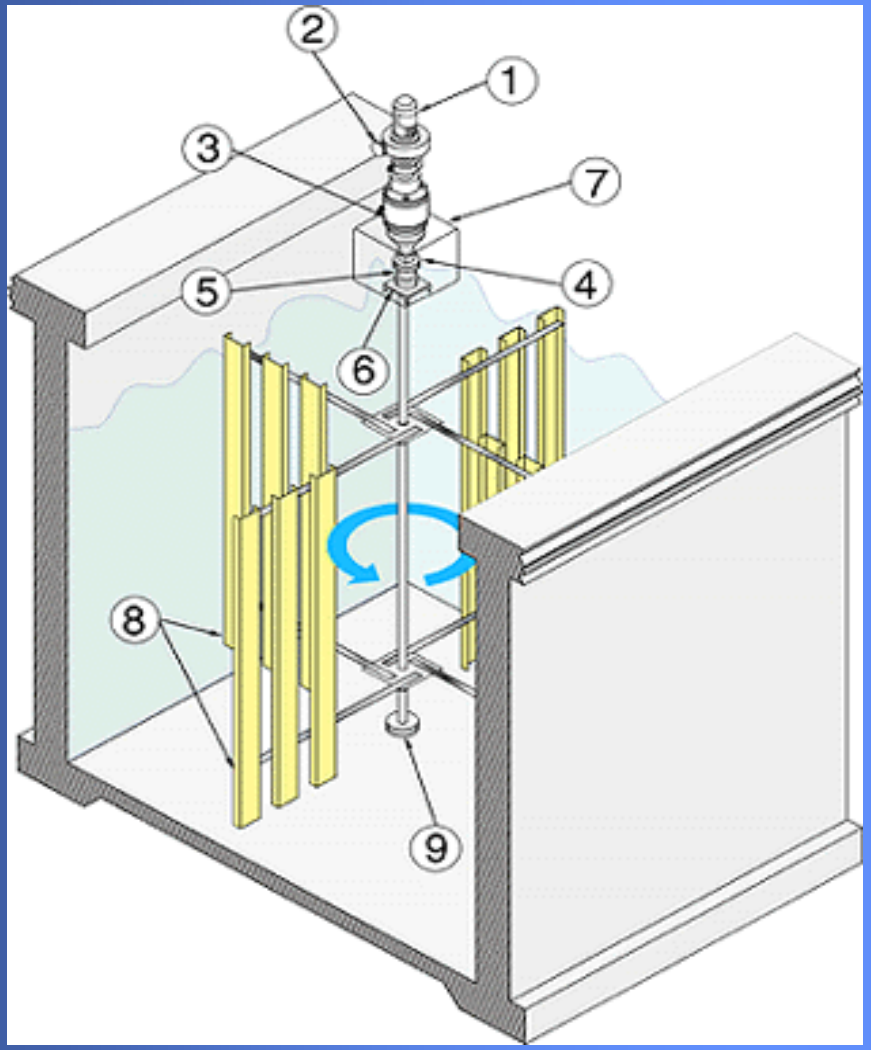
- A *jar test* is often used to determine the efficiency of flocculation.
  - A water sample is placed in a beaker and the pH adjusted.
  - A coagulant is added in a variety of concentrations.
  - The sample is mixed and allowed to settle.
  - The amount of sediment is measured.

Walking Flocculator



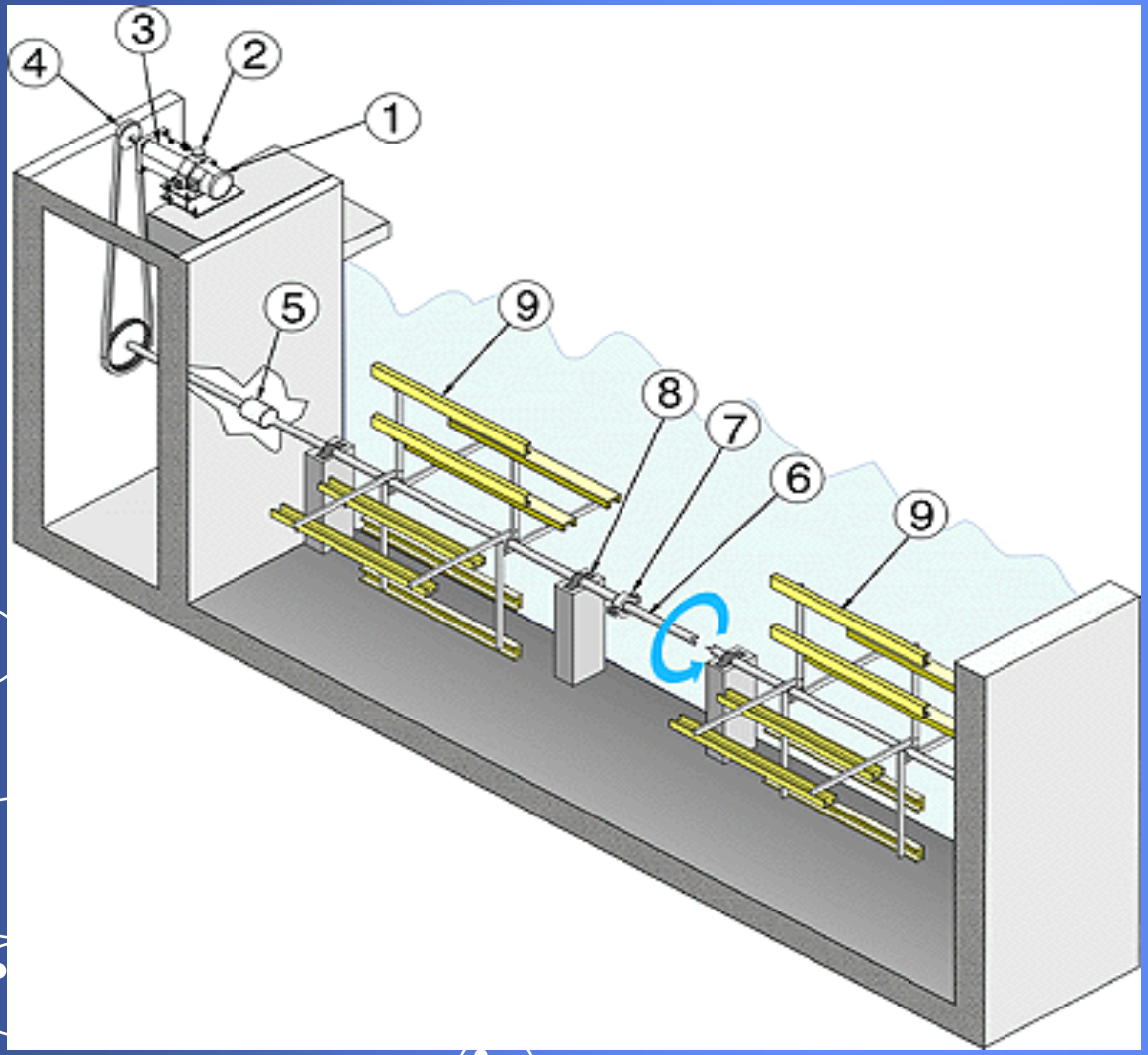
1. Driver Motor
2. Variable Speed Device
3. Gear Reducer
4. Drive Linkage
5. Flocculator line shafting
6. Bearings
7. Walking Beams
8. Paddle Assemblies

Vertical flocculator



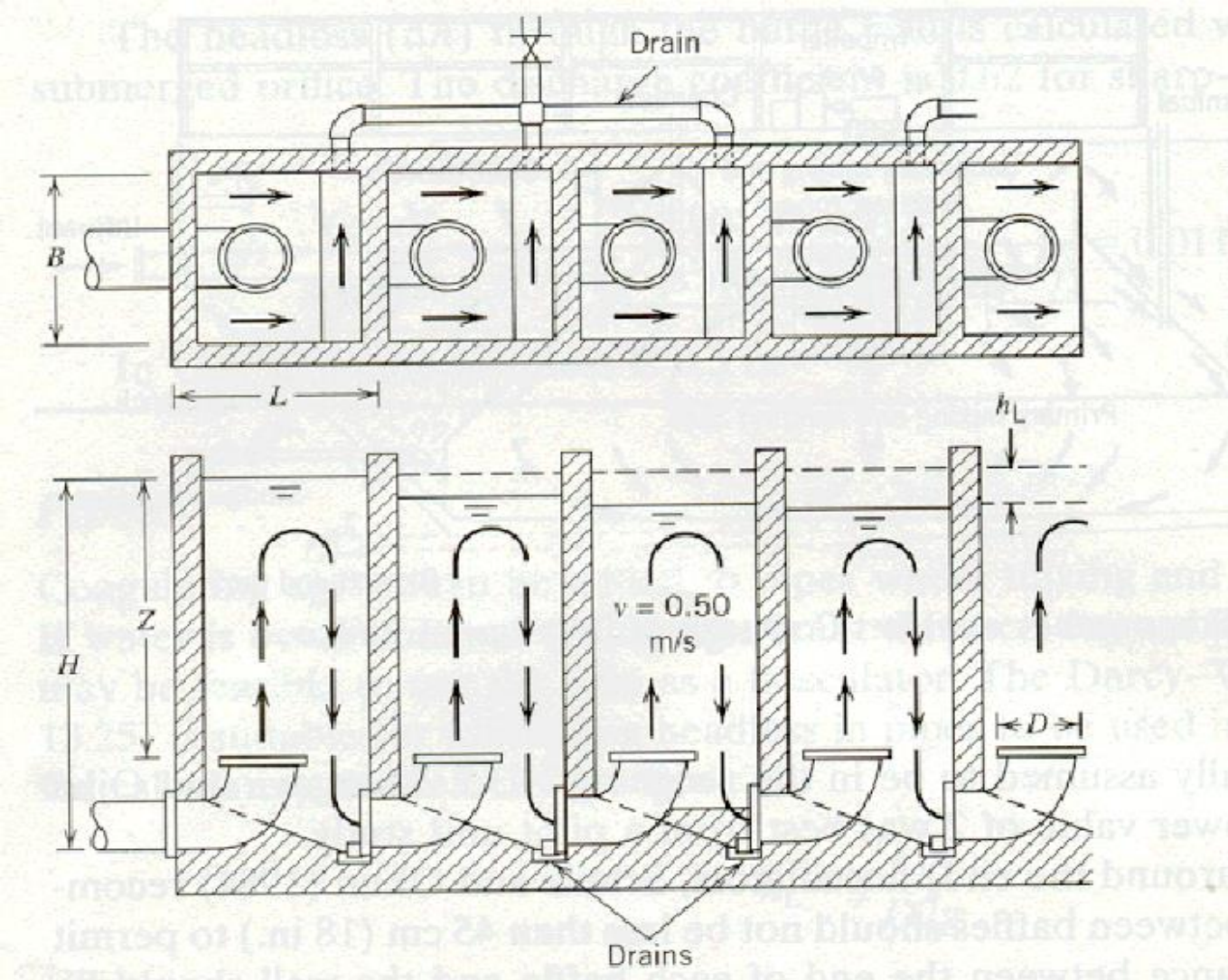
1. Driver Motor
2. Variable Speed Device
3. Gear Reducer
4. Drive shaft coupling
5. Thrust Collar
6. Radical Thrust Bearing
7. Drive Base
8. Paddle Reel Assemblies
9. Bottom Steady Bearing

Horizontal Flocculator



1. Driver Motor
2. Variable Speed Device
3. Gear Reducer
4. Power Transfer
5. Stuffing Box
6. Flocculator Line Shafting
7. Shaft Connections
8. Bearings
9. Paddle Reel Assemblies

“Alabama” flocculator



Upflow Solids Contact Clarifier

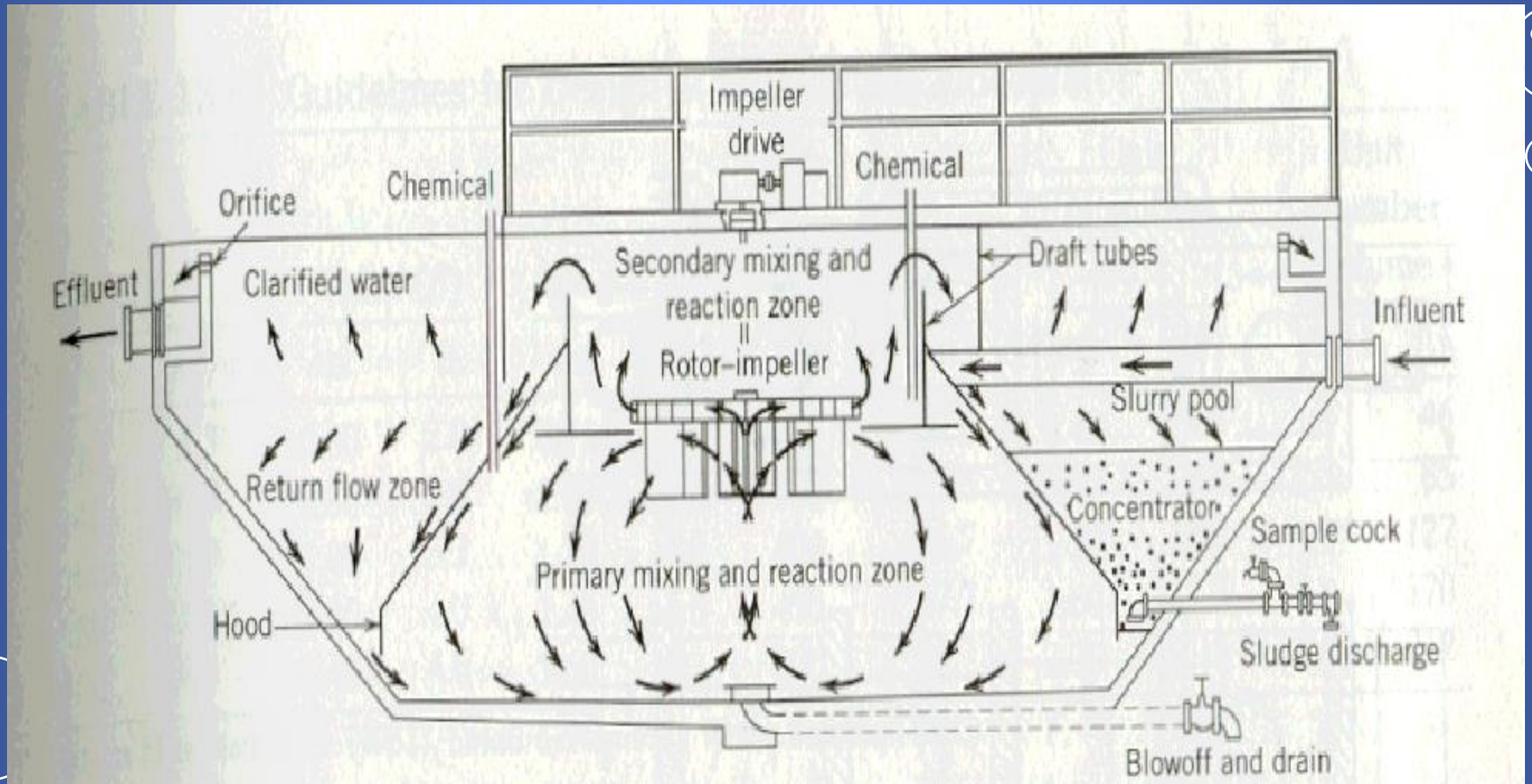


Figure 13.16 Upflow solids contact clarifier. Courtesy of Degrémont Infilco.

Summary:

- Corrosion is the complex electrochemical process that can damage water distribution systems (pipes, tanks, etc.)
- Corrosion can be controlled by using non-corrosive materials, coating pipes, etc.
- Coagulation, flocculation, and sedimentation remove particulates and some bacteria as well as organics from water with the aid of various chemicals.