

## **WATER TREATMENT**

- The objective of the municipal water treatment is to provide a potable supply: one that is chemically and microbiologically safe for human consumption.
- For domestic uses, treated water must be aesthetically acceptable-free from apparent turbidity, color, odor and objectionable taste.
- Quality requirements for industrial uses are frequently more stringent than for domestic water supplies. Thus additional treatment may be required by the industry.
- Water quality can be improved both by reducing the number of contaminants that go into the water supply and by cleaning up wastewater –water that already contains contaminants.
- The techniques employed in making water safe for household use and drinking depend strongly on the initial water quality.
- Common treatment methods include advanced oxidation, ion exchange, sedimentation, carbon filtration, sand filtration and disinfection.

# TREATMENT OF WATER AND WASTEWATER

## A. Drinking Water Quality Standards

Water is evaluated for quality in terms of its:

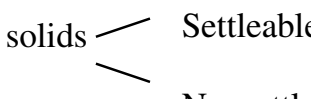
- (1) Physical Properties
    - turbidity --- suspended particles
    - tastes \ due to VOC, decomposing organics
    - odors /
    - color --- ions, minerals
  - (2) Chemical Properties
    - Inorganic and organic compounds dissolved in water which are harmful
  - (3) Microbiological properties
    - pathogens (Coliform bacteria)
- Two categories
    - \* primary standards : based on health criteria
    - \* secondary standards : based on aesthetic and non-aesthetic characteristics

## B. Water Treatment Systems

Purpose : to reduce any risks to human health and to bring raw water up to drinking quality standard

How a water treatment plant be designed depends very much on the quality of the source water!

e.g. River/stream

- solids 
  - Settleable
  - Nonsettleable
- bacteria

Lake/Reservoir

- algae
- solids
- bacteria

Groundwater (well water)

- particle free
- lack of fluoride
- bacteria
- hardness

## **An Overall View of Water Treatment Processes**

### *I. Schematic for Treating River or Stream Water*

River or Stream Water → Low Lift Pumping → Plain Sedimentation →  
Chemical Coagulation & Flocculation → Sedimentation →  
Rapid Sand Filtration → Chlorination → Clearwater Storage Well →  
High Lift Pumping → Transmission Line → Distribution Network

### *II. Treatment Schematic for Lake or Reservoir Water*

Lake or Reservoir Water → Low Lift Pumping → Possibly  
Prechlorination for Taste & Odor Control → Chemical Coagulation &  
Flocculation → Rapid Sand Filtration → Chlorination Disinfection →  
Clearwater Storage Tank → High Lift Pumping to Transmission Line →  
Distribution Network

### *III. Schematic for Treating Well Water*

Well Water (pumps) → Chlorine Disinfection → Possibly Fluoridation →  
Clearwater Storage Tank → High Lift Pumping to Distribution System →

OR

Well Water (pumps) → Water Softening → Chlorination → Fluoridation  
→ Clearwater Storage Tank → High Lift Pumping to Distribution System

## **General setting :**

Low lift pumping --- to take raw water from the intake structure to the site of water treatment plant

Clearwater storage tank --- to allow the treated water to be temporarily stored at the treatment site to equalize the supply and demand for the community

High lift pumping --- to deliver the finish water to the community's distribution system by a large water head (~60 to 85 psi pressure)

## **Water Treatment Processes:**

*Plain sedimentation:* to allow raw water to settle in a rectangular sedimentation tank for a period of 6-8 hours so that large and settleable suspended solids will be removed. Most of the settled solids are inorganic matter.

Screening: to remove relatively large floating and suspended solids/debris.

*Chemical coagulation (in a mixing tank):* addition of chemicals (coagulant) in a mixing tank to encourage the small and non-settleable solids (suspended solids) to coagulate into large particles (chemical flocs) that will more easily settle.

*Flocculation:* a gently mixing process which induces particle collision and allows the formation of large particles of floc. It takes about 15-20 minutes to complete.

*Sedimentation or settling tank:* to settle out the produced chemical flocs by gravity.

*Rapid sand filtration:* to filter out those broken chemical flocs which fail to settle in the previous sedimentation tank. The filtered water is normally particle- and turbidity-free.

### **Water Treatment Processes (Continued)**

*Disinfection or chlorination:* to disinfect the filtered water so that all pathogenic bacteria will become killed. Chlorination using chlorine gas ( $\text{Cl}_2$ ), sodium hypochlorite ( $\text{NaOCl}$ ) or calcium hypochlorite [ $\text{Ca}(\text{OCl})_2$ ] is the most commonly used method of disinfection.

*Prechlorination:* to add a relatively large dose of chlorine (3 to 5 ppm) to water to oxidize the taste- and odor-causing chemicals which are produced by the presence of algae, and to kill algae cells.

*Fluoridation:* Normally groundwater (or well water) is particle free, thus not requiring for coagulation & flocculation process. However, the fluoride may be absent and it is desirable to add fluoride for strengthening the dental care of baby infants.

*Water softening:* If groundwater contains a high concentration of divalent metal ions (which cause hardness in water), lime ( $\text{CaO}$ ) and soda ash ( $\text{Na}_2\text{CO}_3$ ) are used to remove calcium and magnesium from water.