

Water Treatment

Wastewater Treatment

Types of Treatment:-

- Water Treatment: prepares water for use in homes, businesses (drinking water)
- Waste Water Treatment: prepares sewage/wastewater to be returned to the environment

Water treatment stages:-

1. Screening
2. Aeration
3. pH correction
4. Coagulation and flocculation
5. Sedimentation
6. Pre-chlorination and dechlorination
7. Filtration
8. Disinfection
9. pH adjustment

Initial stages:-

- **Screening** - the removal of any coarse floating objects, weeds, etc. from the water.
- **Aeration** - dissolving oxygen into the water to remove smell and taste, promote helpful bacteria to grow, and precipitate nuisance metals like iron and manganese.
- **pH correction** - preparing for coagulation and to help precipitate metals.

Major Clean Up:-

- **Coagulation and flocculation** - causes the agglomeration and sedimentation of suspended solid particles through the addition of a coagulating agent (usually aluminum sulfate and/or iron sulfate) to the raw water along with a polymer to help form a floc.
- **Sedimentation** - Floc settles out and is scraped and vacuumed off the bed of large sedimentation tanks. Clarified water drains out of the top of these tanks in a giant decanting process.
- **Pre-chlorination and dechlorination** - mostly to kill algae that would otherwise grow and clog the water filters. Also kills much of the remaining unprotected bacteria.

Final Touches:-

- **Disinfection** - water completely free of suspended sediment is treated with a powerful oxidizing agent usually chlorine, chlorine then ammonia (chloramine), or ozone.

- A residual disinfectant is left in the water to prevent reinfection.
- Chlorine can form harmful byproducts (THMs) and has suspected links to stomach cancer and miscarriages.
- Many agencies now residually disinfect with Chloramine to prevent formation of THMs.
- **pH adjustment** - so that treated water leaves the plant in the desired range of 6.5 to 8.5 pH units.

Wastewater Treatment:

- Septic Tanks: typically treat small volumes of waste (e.g., from a single household, small commercial/industrial)
- Wastewater Treatment Plants (WWTP) : typically treat larger volumes of municipal or industrial waste.

Treatment Objectives:

- Wastewater treatment systems take human and industrial liquid wastes and make them safe enough (from the public health perspective) to return to the aquatic or terrestrial environment.
- In some cases, wastewater can be clean enough for reuse for particular purposes.
- Wastewater treatment systems use the same purification process that occurs in a natural aquatic system only faster and in a controlled manner.

Septic tanks:

- **Approx. 22 million systems in operation (30% of US population)**
- **Suitability determined by soil type, depth to water table, depth to bedrock and topography**
- **Commonly fail due to poor soil drainage**
- **Potential contaminants: bacteria, heavy metals, nutrients, synthetic organic chemicals (e.g. benzene)**

Sewage or Wastewater Treatment

- Sewage or wastewater is composed of sewage or wastewater from:
 - Domestic used water and toilet wastes
 - Rainwater
 - Industrial effluent (**Toxic industrial water is pretreated**)
 - Livestock wastes

Sewage Treatment:

Multistep Process

1. Pretreatment: Bar screening

large rack with bars to remove large objects that can damage equipment

These objects are sent to landfills

- **Primary Treatment: Settling Tanks**

- Primary Sludge: heavy solids that sink to the bottom - removed and sent to solids treatment facility
- Light grease/oil float to top--skimmed off and sent to solids treatment facility

This takes several hours

How are Liquids Treated

- **Secondary Treatment: Aeration Tank**

- Biological Treatment
- Activated sludge: contains bacteria/protozoa that eat organics in the liquid wastes
- Air bubbles pumped in to aid bacteria in digesting

- **Final Treatment: Disinfection**

- Chlorine: kills disease causing organisms
 - Can react with organisms to form chlorinated hydrocarbons that can cause cancer
- UV light or ozone: can be used instead of chlorine, but more expensive

Clean water is then sent to ocean, river, etc.

Advanced Sewage Treatment

Tertiary: Chemical and Physical

- Tertiary: Chemical and Physical
- Removes specific nutrients--such as phosphate, nitrate
- Expensive! Not used in many systems

Reusing Wastewater:

- Currently, treated wastewater, no matter how “clean” cannot be directly mixed with treated raw water and supplied as potable (from Latin *potare* = “to drink”) water (most places)
- However, if a dual plumbing system is available, wastewater can be piped into facilities for specific, approved uses for which non-potable water is adequate (process water, irrigation, sanitary use, etc.)
- Dual plumbing systems in America are colored purple to distinguish pipes, valves, taps, etc. from potable ones

Indirect Use of Wastewater:

- Increasingly, treated wastewater is being used in Aquifer Recovery and Storage projects, used to recharge and protect groundwater that will ultimately be used for potable supplies.
- In dual systems, the wastewater “gray water” can be used for irrigation
- Treated wastewater is frequently used as sources of saline intrusion barrier water.