The use of hearing protection is main form of receiver protection. Creation of silent zone, prohibition of entry of heavy vechicles in local area used as loudspeaker is public area should be regulated through ~~Incorporation~~ registation.

Water Treatment

Objective of water Treatment

1. To improve the quality of water which is safe for consumption. To improve the aesthetic property of water (taste, odour, colour)
2. To provide water at reasonable cost.

Type of impurities

1. particulate matter (size is $> 10^{-1}$ mm)
2. suspended (10^{-3} mm to 10^{-1} mm)
3. colloidal (10^{-6} mm to 10^{-3} mm)
4. dissolved (size $< 10^{-6}$ mm).

Process

1. pretreament process:
   1. Screening: During this process most of the floating material are removed from impure water.

→ Storage :- Water is to be stored in a specified tank for 5 to 7 days (max 10 days). During this time the pathogenic bacteria are destroyed. Due to exposure to sunlight. However the storage time shouldnot be long. This is beoz growth of undesirable algae occurs, which affect the taste and odour of water.

3- Aeration :- This process is required to supply adequate amount of oxygen to water bodies. This is common treatment process for ground water.

This treatment provides the following benefits to water,

1- undesirable H_2S gas is removed which affects the taste and odour of water.

2- carbon dioxide is removed which may corrode the equipments during advanced water treatment processes.

3- It increases the oxygen contained of water which helps in removing iron and manganese contained of water.

4- Chemical pretreatment :-

This process is required to remove undesirable properties of water. This treatment is carried out by following processes

1- By adding chlorine (Pre-chlorination method)
2- By using activated carbon.

2- Secondary Treatment (Standard Treatment)

It involves following methods:

a) Sedementation.

This process of separating insoluble solids from its liquid component by using gravity settling process or coagulation.

Two types of sedementation process

ⓐ Type I

It is settling of discrete and nonflocculent particles by gravity settling process. (which doesn't coagulate)

ⓑ Type II

Settling of flocculent particles by adding coagulants. (which coagulates)

26/09/2011

Type I

→ Settling of discrete particles is carried out in either rectangular or circular settling tank. During this process the particle accelerate downward until drag force is equal to driving force (impelling force).

→ After that particle will attain a constant velocity and settle down easily. This is called stoke's velocity. of settling of discrete particles.

$$V_s = \frac{g}{18\mu}(\rho_s - \rho_w)\ d^2 m/sec.$$

μ - Dynamic viscosity.

ρ_s - Density of particles

ρ_w - Density of water

g - Acc^n due to gravity (9.81)

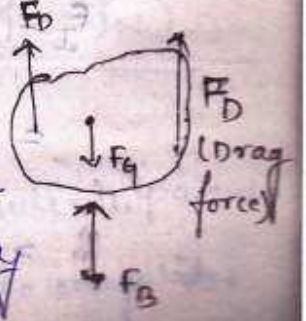
Derivation

When a particle is falling freely in a non reactive fluid, the frictional resistance or drag force is equal to driving force Then particle will attain a constant velocity.

Three forces acting on particle are

1) Gravitational force.

$$F_G = \rho_s g V_p$$



ρ_s - Density of solid particle

g - Acceleration due to gravity

V_p = volume of particle.

2) Buoyancy force

$F_B = \rho_w g V_p$

ρ_w - Density of water.

3) Drag force

$F_D = C_D A_p \rho_w \left(\frac{V_s^2}{2}\right)$

C_D = Drag ~~const~~ coefficient = $\frac{24\nu}{V_s \cdot d}$

A_p = cross sectional area of particle.

V_s = velocity of solid particle

ν = ~~Dynamic~~ viscosity.

$\nu = \frac{\mu}{\rho_w}$

← The particle will attain a constant velocity then drag force is equal to driving force or impelling force.

$F_I = F_G - F_B$

$= \rho_s g V_B - \rho_w g V_p$

$= g V_p (\rho_s - \rho_w)$.

$f_D = f_I$

$$C_D A_p \rho_w \left(\frac{v_s^2}{2}\right) = g V_p (\rho_s - \rho_w)$$

$$v_s^2 = \frac{2 g V_p (\rho_s - \rho_w)}{C_D A_p \rho_w}$$

$$v_s^2 = \frac{2 g V_p (\rho_s - \rho_w)}{\frac{24 \mu^2}{\rho_w \cdot d \cdot v_s} \cdot A_p \rho_w} \qquad A_p = \frac{\pi d^2}{4}$$

$$= \frac{2 g \cdot V_p (\rho_s - \rho_w)}{\frac{18 \mu v_s \times \pi d^2}{4}}$$

$$= \frac{2 g V_p (\rho_s - \rho_w)}{3 \mu \pi d}$$

$$= \frac{2 g \times \frac{4}{3} \pi \times \frac{d^3}{8} \times (\rho_s - \rho_w)}{3 \mu \pi v_s}$$

$$= \frac{g d^2 (\rho_s - \rho_w)}{18 \mu}$$

Type II

When impure water contains flocculent particles. They do not settle down easily to coagulate are required for settling of flocculent particle.

Coagulation :-

(Colloidal particles)

Process of agglomerating the colloidal particles by adding chemicals. This chemicals are called coagulants.

1- Alum,
2- ferric chloride ($FeCl_3$)
3- ferrous sulphate ($FeSO_4$)

Reaction :

Alum

$$Al_2(SO_4)_3 \cdot 14H_2O + Ca(HCO_3)_2 \longrightarrow 2Al(OH)_3 + 3CaSO_4 + 14H_2O + 6CO_2$$

$Al(OH)_3$ (ppt)
(floculent particle)

Help in agglomerating colloidal particle

formation of Aluminium Hydroxide (4.7 to 7.6 pH range) (stay in insoluble state).

Dt:- 29/09/10

Coagulant aids :-

Sometimes the coagulants are not capable of forming a floc of optimum size. So certain chemicals are required which helps in forming a floc of optimum size. This compound are called coagulant aids.

Ex:- polyelectrolytes

Filtration:

→ It is the process of passing water through a porous medium with expectation that the filtrate has the better quantity than the influent (impure substance)

→ Generally, Sand is used as porous medium

→ Slow sand filtration Method offers more advantages than Rapid sand filtration method.

→ This beds it can increase the aethetic properties of water.

→ Most of pathogenic Bacteria can be reduced.

Disinfection Methods

→ It is the process of killing microorganism by adding chemicals to produce water which is safe for human consumption.

Sterilization:

→ Process of killing microorganism by boiling water ~~upto~~ atleast 15 min.

→ costlier

→ Disinfection is better than sterilization.

→ Complete Destruction of the microorganism by boiling water for certain period of time.

→ Since it is a costly process, it is used only by individuals particularly during time of breakup of epidemics.

→ otherwise disinfection is better.

→ The requirement of good disinfectant are as follows:-

(a) It should be toxic to microorganism at concentration well below toxic threshold limit for human base.

(b) It should have a fair rate of killing the microorganisms.

→ Rate of killing of microorganism follow 1st order kinetics which is proposed by Chick.

Chick's law

$$\frac{dN}{dt} = -kN^1$$

$$\ln \frac{N_t}{N_0} = -kt$$

$$\frac{N_t}{N_0} = e^{-kt}$$

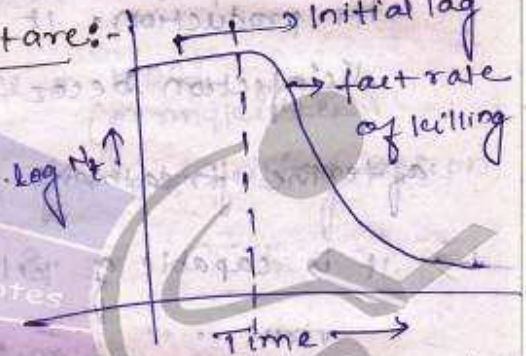
$$N_t = N_0 e^{-kt}$$

N_0 - No. of organism present at 0 and 0 respectively

N_t - No. of microorganism left at time t after adding the disinfectant.

N_0 = No. of microorganism initially before adding the disinfectant.

k - Specific rate constant and characteristics of time of disinfectant used and no. of microorganism present in impure water.



Names of Disinfectant are:-

1- Chloramine

2. Ozone

3. UV radiation

4. Cl_2.

Chloramine :- formed when both chlorine and Ammonia are present in water.

Three types of chloramine are formed

$Cl_2 + H_2O \longrightarrow HCl + HOCl$.

a) Monochloramine.

b) $NH_3 + HOCl \rightleftharpoons NH_2Cl + H_2O$ (pH > 8)

b) Dichloramine:

$NH_2Cl + HOCl \rightleftharpoons NHCl_2 + H_2O$ (pH 4.3 to 5.8)

c) Trichloramine:

$NHCl_2 + HOCl \rightleftharpoons NCl_3 + H_2O$ (pH < 4.3).

→ Disadvantage

→ Production of HOCl acts as disinfectant.
→ pH has to be maintained
→ It is not used as good disinfectant in comparision to chlorination.
→ Effect odour and taste

Ozone :-

→ Powerful oxidising agent. It is highly unstable so it should be used immediately after its production. It is the safest method of disinfection becoz no residue is left after the treatment.
→ It is capable of killing both bacteria and virus.
→ It can decompose the chemical hazard compounds present in the water.

Disadvantages

→ Costlier process in comparision to chlorination and Addition of chloramine.
→ It cannot give long time protection of regrowing the microorganism.

Dt:- 15/10/11

Chlorination :-

Chlorine is a powerful oxidising agent so it can react with No. of reducing compound as well as the organic compound. By this process the inorganic and organic impurities are removed along with killing of micro-organism.

At room temp. chlorine can be liquified so it can be stored and transported easily.

$$Cl + H_2O \rightleftharpoons HCl + HOCl$$

(germ killer)

Effective pH range for disinfecting action of chlorine is 6 to 8.

Breakpoint chlorination :-

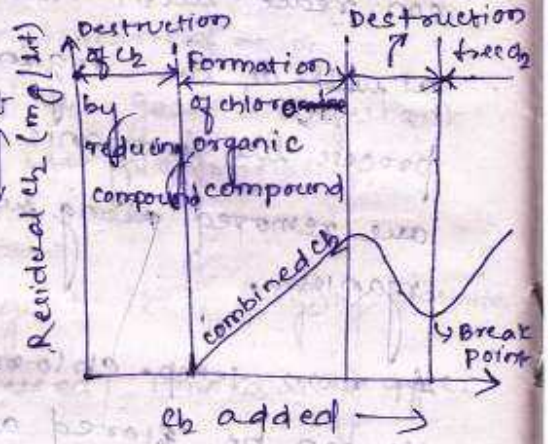
Since chlorine is highly reactive, it reacts with no. of reducing compounds and organic compound as it is a powerful oxidising agent

→ This reactions occur fast for a particular concentration of chlorine.

During this stage No disinfecting action takes place after a certain concentration the continued addition of chlorine is directly proportional to free chlorine available in water for disinfection.

This process is called Breakpoint chlorination.

concentration at which disinfecting action of chlorine take place is called breakpoint.



Advance Water Treatment

Following process are include

1- Removal of soluble impurities by chemical precipitation method

2- Removal of soluble impurities by ion exchange process

3- Oxidation process

4- Adsorption

5- Membrane process.

6- Removal of iron & Magnesse.

1- Removal of soluble impurities by chemical ppt method

→ During this process, lime ($Ca(OH)_2$) and soda (Na_2CO_3) are added to impure water.

→ Calcium salts are precipitated as calcium carbonates which are insoluble.

→ Magnesium salts are converted to magnesium hydroxide which precipitated along with other impurities are called sludge.

→ Sludge can be removed by filtration.

$CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2NaCl$

All the calcium hardness salt required addition of soda [Na_2CO_3].

for magnesium hardness salt, lime and soda are added.

$MgCl_2 + Ca(OH)_2 \longrightarrow Mg(OH)_2 + CaCl_2$.

$CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2NaCl$.

1 mole of Mg salt required 1 mole of lime and soda.

DT:- 17/10/11

Ion Exchange Process

→ During this process the soluble impurities are removed from water by using naturally occurring mineral called ~~zeolite~~. zeolite.

→ During the process calcium and magnesium ions are exchange with sodium ions of zeolite

→ zeolite - hydrated sodium alumino silicate

$Na_2O \cdot Al_2O_3 \cdot x SiO_2 \cdot y H_2O$

$x = 2$ to 10

$y = 2$ to 6

→ zeolite can be prepared synthetically and offer more advantage over natural zeolite. (its porosity can be improved).

So, zeolite = Na_2Z.

$Na_2Z + CaCl_2 \rightarrow CaZ + 2NaCl$

↓
Calcium zeolite

→ After certain time, zeolite is exhausted due to heavy deposition of calcium and magnesium. It is regenerated by passing the zeolite through sodium chloride solution.

$CaZ + NaCl \longrightarrow Na_2Z + CaCl_2$.

Advantage

→ Hardness is reduced to 10 ppm after this treatment.

→ No sludge is formed. (No danger in disposing this sludge)

Precaution

Disadvantages:

→ water should not be turbid because turbidity can close the pores of zeolite.

→ Water should not be hot (zeolite dissolved in hot water)

→ Temporary hardness should be removed before it is used for this treatment.

(Hardness due to bicarbonates of Ca & Mg. Water will contain high conc. of Sodium bicarbonate if after the treatment at high temp. $NaHCO_3$ is decomposed to produce

sodium hydroxide which leads to 'caustic embrittlement' in boiler).

Oxidation :-

→ The impurities can be removed by oxidation process. eh

→ Chemical oxidation is a common phenomenon within water treatment plant. for this process, chlorine is used as the best oxidant.

→ Other oxidant which are used for this process are chloramine, ozone, potassium permanganate and clorine dioxide.

Membrane process

→ It includes the following methods of removing soluble impurities.

1- Reverse Osmosis
2- Electrodialysis.

Osmosis is process by which solvent flows from low conc. region to higher conc. region when through semipermeable membrane when pressure is applied two solution are seperated by semipermeable membrane

→ This flow continued till the conc. of both the solution become equal.

→ The driving force for osmosis is osmotic pressure.

→ If the hydrostatic pressure and excess of osmotic pressure are applied on concentrated side the flow of solvent reverses i.e. concentrated side to ~~dilu~~ diluted side.
This is the principle of reverse osmosis

Electrodialysis :- (Fig from book)

→ Electrodialysis is based on the fact that ions present in saline water migrate towards their respective electrodes through ion selective membrane under the influence of applied emf.

→ The dialysis chamber consists of cathode, anode and ion selective membrane.

→ This membrane are either permeable to cation or anion.

→ Anode is placed near anion selective membrane and cathode is placed near cation selective membrane.

→ Under the influence of applied emf, cations move towards cathode through cation selective membrane and anions move towards anode through anion selective membrane.

→ So the net result is the depletion of ions in the central compartment of dialysis chamber.

→ pure water is taken up from central compartment and conc. saline water is taken of from side compartment.

Module-2 Air pollution :-

→ Type of pollutants

ⓐ primary air pollutants:-

pollutants which are obtain directly from source and mix with are

Ex:- Oxide of sulphur, Oxides of nitrogen, particulate hydrocarbons,

ⓑ Secondary Air pollutants:-

This are formed in atm. by chemical and photochemical action of primary pollutants.

Ex:- Ozone, peroxy acetyle nitrate. oxidised hydrocarbon.

Criteria Air pollution

There are 6 criteria air pollutant.

(a) Carbon Monoxide
(b) Oxides of Nitrogen
(c) Oxides of Sulphur
(d) lead (Pb)

} Source of emission, Impact on health, Brief.