ENVIRONMENTAL ENGINEERING

Notes by-

Pravin S Kolhe,

BE(Civil), Gold Medal, MTech (IIT-K)

Assistant Executive Engineer,

Water Resources Department,

www.pravinkolhe.com

The water coming after re process of sedimentation, filteration it may contains - i) bacteric
ii) Taste & colour
iii) Iron & Magnesium.
iv) Dissolved organic salt.

Disinfection of water is the process of removing bacteria from the water; sterilization is the process of removing all type of bacterias which are harless harmless or harmful. to the health.

∞ Requirement of the good disinfectant :-
1) It should kill all the harmful pathogenic organisms.
2) Economical, harmless, easily available.
3) Skilled labour or supervision or pparatus not reqd.
4) Process should be fast.

& Theory of disinfection :-
→ The rate of kill is exprecessed by chick's law as,

$$\frac{dN}{dt} = -k \cdot Nt$$

where N = No. of viable organisms.
Nt = No. of organisms at any time
k = Reaction rate constant.

$$\therefore \int \frac{dN}{dt} = -k \int Nt \Rightarrow \int \frac{dN}{Nt} = -k \int Nt \cdot dt$$

$$\therefore \log Nt = -kt + C$$

at t=0, Nt = No

$$\therefore \log No = -k(0) + C$$

$$\therefore C = \log No$$

$$\therefore \log Nt = -kt + \log No$$

$$\therefore \log \left(\frac{Nt}{No}\right) = -k \cdot t$$

$$\boxed{\therefore t = \frac{1}{k} \cdot \log \left(\frac{No}{Nt}\right)}$$

the most common disinfectant is chlorine which follows following eqn,

$$\frac{-dN}{dt} = -K \cdot N_t \cdot t$$

$$\int \frac{dN}{N_t} = -K \int \cdot t \cdot dt$$

$$\therefore \log N_t = -K \cdot \left(\frac{t^2}{2}\right) + C$$

at $t = 0$, $N_t = No$

$$\log No = C$$

$$\therefore \log N_t = -K \cdot \frac{t^2}{2} + \log No$$

$$\therefore \log \cdot \left(\frac{N_t}{No}\right) = -K \cdot \frac{t^2}{2}$$

$$\therefore t^2 = \frac{-2}{K} \cdot \log \left(\frac{No}{N_t}\right)$$

$$\boxed{\therefore t = \sqrt{\frac{2}{K} \log \left(\frac{No}{N_t}\right)}}$$

* <u>Methods of disinfection</u> :-
  1) Boiling method.
  2) Excess lime treatment (↑ pH)
  3) Iodine & bromine treatment (8 ppm for 5 min)
  4) Ozone treatment ($O_2 + O$)   B~~EIOPS~~U
  5) Potassium permangate
  6) Silver treatment $\boxed{BPO\ SUEI}$ -
  7) UV ray treatment

* <u>Factors affecting selection of disinfectant</u> :-
  1) Concentratn & time of contact of chemical agent
  2) Nature & ~~phys~~ intensity of agent
  3) Nature of water
  4) Temp. of water.

* chlorination:-
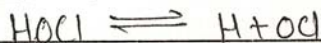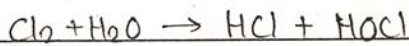* Advantages of chlorination:-
1) Available in gas, liquid & powder form
2) Efficient
3) It leaves harmless residue in the water, which does not affects working of distribution system.
4) Effect is for longer time.
5) cheap & reliable.

* Properties of chlorine:-
1) It is an element (Cl)
2) Atomic wt. = 35.46 & 2.49 times heavier than air.
3) Cl_2 gas has greenish yellow colour
4) Non cumbustible but supports combustion.
5) Metal corrosive.

* Reaction of chlorine:-

$$Cl_2 + H_2O \rightarrow HCl + HOCl$$
$$HOCl \rightleftharpoons H + OCl$$

The HOCl & OCl are responsible for disinfection of water.
According to recent theory, chlorine combines with cell structure of bacteria & forms certain products which are toxic for bacteria.

clorine dosage is varies from 0.2 to 1 ppm. If dose is less, disinfection will be insufficient & on the other hand, it doeses are more it will cause bad smell & taste.

* Application of chlorine:-
1) As bleaching powde.
2) As chloromines
3) free chlorine gas.