Disinfection

It is the process of killing the microorganism causes disease (pathologic) that it may contain.

Method of disinfection:

1. Physical disinfection:

a) Boiling water for 15 – 20 min b) Exposed water to sun ray.

2. Chemical method: using chemical matter such as:

a) Halogen (Br, Fl and Cl) b) Potassium permanganate ($KMnO_4$)

c) Ozone (O_3)

CHLORINATION

Chlorination is the addition of chlorine to kill the bacteria Chlorination is very widely adopted in all developing countries for treatment of water for public supply.

Advantages

- Cheap
- Residual for network
- Available
- Easy to store, and stored for a long time.
- Simple equipment required.
- Easy to use.

Disadvantages

- High chlorine dose may cause change in the water colure and taste.
- Chlorine reacts with organic compound that appears in water and the results are cancer compounds.

Factors affecting efficiency of chlorination:

- Temperature directly proportional
- Ph value inversely proportional: more efficient at pH less than 7.
- Chlorine dose

Chlorine dose 0.5 – 1 mg/l is required to give the residual from 0.1 – 0.3 mg/l.

- Adequate mixing
- Retention period (½ hr)

Optimal dose of chlorine

Optimum dose depends up on:

a) Water quality (bacteria, suspended particles, elements content such (fe), and organic matter)

b) Boundary condition (temperature and pH)

c) Contact time

Point of chlorination

a) Prechlorination: Chlorine applied prior to the sedimentation and filtration process. It is practiced when the water is heavily polluted and to remove taste, odour, colour and growth of algae on treatment units. Pre-chlorination improves coagulation and post chlorination dosage may be reduced.

b) Post Chlorination

When the chlorine is added in the water after all the treatment is known as Post chlorination.

c) Re-Chlorination

In long distribution systems, chlorine residual may fall tendering the water unsafe.

Behavior of Chlorine in water

When chlorine is dissolved in water forms hypo chlorous acid and hydrochloric acid.

$Cl_2 + H_2O \rightarrow HOCl + HCl$ ---------- (1)

After some time hydo chlorous acid further ionizes as follows

$HOCl \longleftrightarrow H^+ + OCl^-$ ---------- (2)

The two prevailing species (HOCl) and (OCl^-) are called free available chlorine are responsible for the disinfection of water.

Chlorine reacts with ammonia in water to form Monchloramine, (NH_2Cl), dichloramine ($NHCl_2$) and trichloramine, (NCl_3) released and their distribution depends on the PH value of water.

Dosage of Chlorine

(A) Plain Chlorination

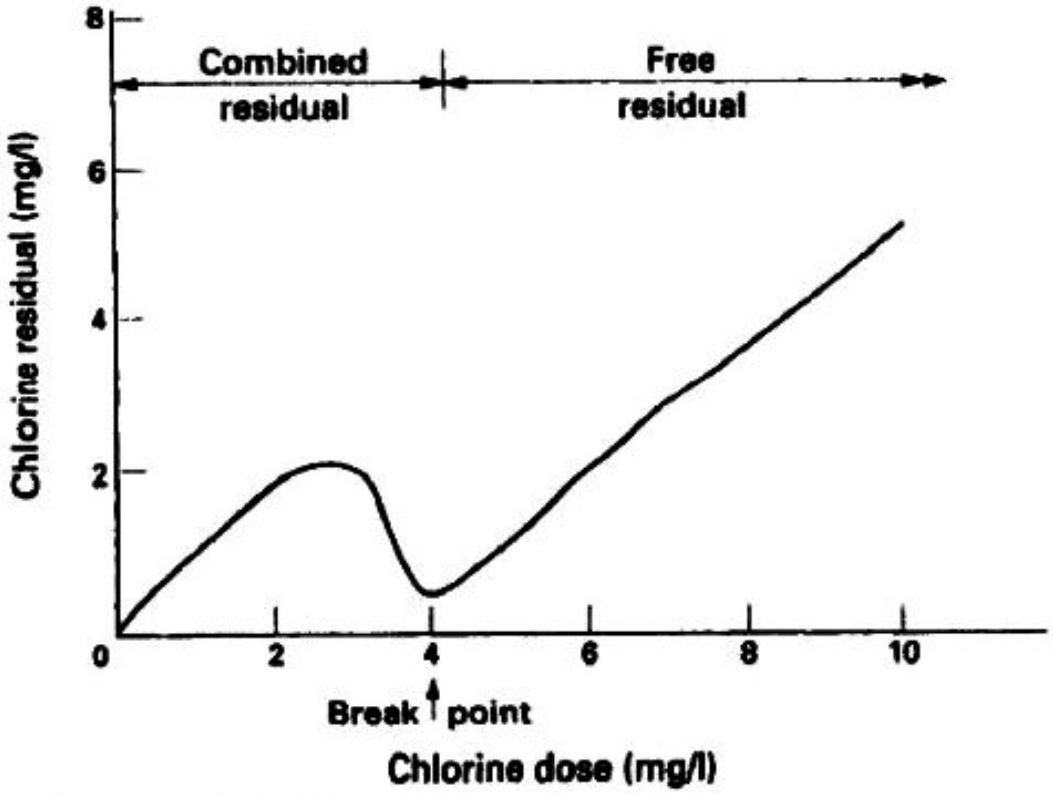
It is the process of addition of chlorine only when the surface water with no other treatment is required. The amount of chlorine should be maintained in resided chlorine of 0.2 mg/L.

(B) Super Chlorination

It is defined as administration of a dose considerably in excess of that necessary for the adequate bacterial purification of water. About 10 to 15 mg/L is applied with a contact time of 10 to 30 minutes.

(C) Break point Chlorination

When chlorine is applied to water containing organics, microorganisms and ammonia the residual chlorine levels fluctuate with increase in dosage as shown.



Break point chlorination:

It is refer to the amount of chlorine required to occur the minimum amount of residual chlorine.

Contact time:

It is refer to the time required for chlorine to killing pathological microorganisms such as bacteria.

Contact time can be obtained from Chick's low: $t = -\left(\frac{1}{k}\right) * log\ \frac{N}{N_o}$

Where:

t: time; k: constant $(\frac{1}{time})$

N: Number or percent of microorganisms in time t.

N_o: Number or percent of microorganisms in initial time (t=0).

Example: Find the contact time required for chlorine to kill 99.9% from microorganisms if k=0.06 sec^{-1}.

Solution:

$$t = -\left(\frac{1}{k}\right) * log\ \frac{N}{N_o}\ t = -\left(\frac{1}{0.06}\right) * log\ \frac{100-99.9}{100} = 67\ sec$$

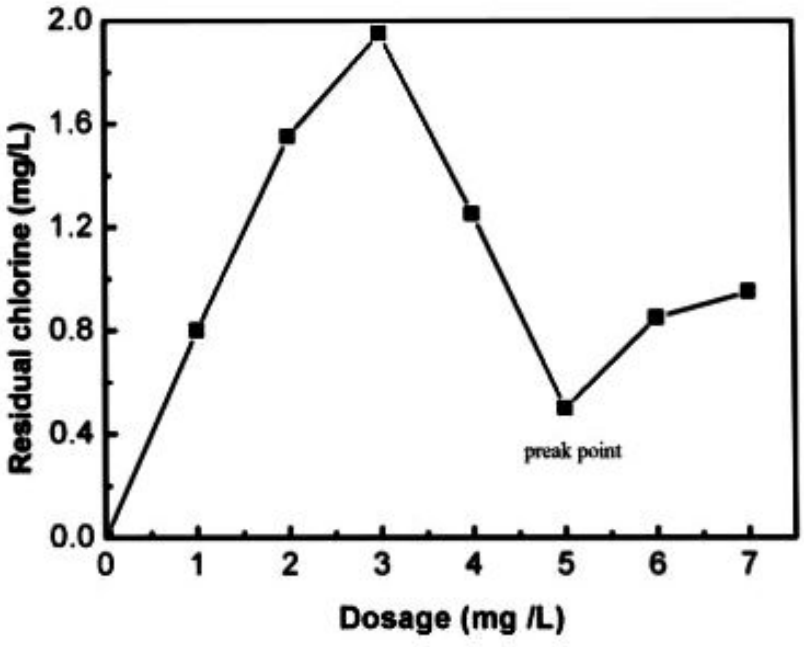
Example: determine thr preak point dosage of chlorine given the data below which was obtained from chlorination experiment.

Dosage (mg/L)	1	2	3	4	5	6	7
Required Cl_2 (mg/L)	0.2	0.45	1.05	2.75	4.5	5.15	6.03

Solution:

Residual chlorine (mg/L) = dosage – required

Dosage (mg/L)	Required (mg/L)	Residual (mg/L)
1	0.2	0.8
2	0.45	1.55
3	1.05	1.95
4	2.75	1.25
5	4.5	0.5
6	5.15	0.85
7	6.03	0.95



So break point chlorination obtained at dosage of 5 mg/L

5. Volume of water tank will need to hold

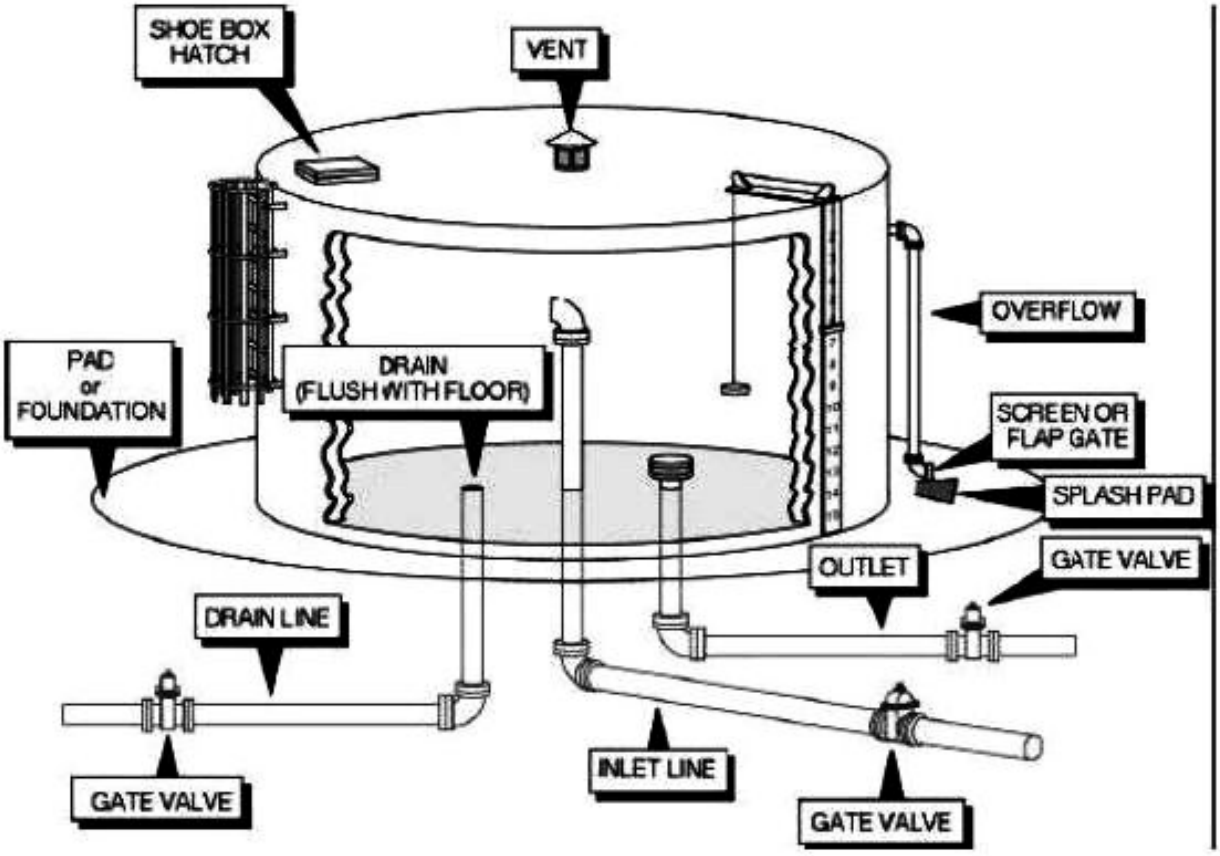
Large volume → ground

Small volume → elevated

Capacity= 15-20% of average daily consumption. For moderate size systems take 30 – 40%.

Note: Several smaller storage units are better than one central site;

Smaller distribution pipes &uniform water pressure.



Components of a Storage Tank