Environmental Engineering –Chapter -1

I . ARITHMETIC INCREASE METHOD:-

1.Most simple method   2.For saturated city like : Kolkata

$P_n = P_o + n\bar{x}$ P_n=population after n decades

                                                        P_o=population at present

                                                    n=Number of decades.

                    $\bar{X}$=average of population increase.

II.INCREITMENTAL INCREASE METHOD:-

$P_n = P_0 + n\bar{x} + n(n+1)\bar{y}/2$ [$\bar{x}$=avg increase

                            $\bar{Y}$=incremental increase]

Geometric increase method:-

$P_n = p_0(1 + r/100)^n$

1.$r = \sqrt[n]{p_2/p_1} - 1$ P_2=Final Population P_1=initial Population

2.$r = r_1 + r_2 + r_3 + \ldots\ldots + r_n/n$

3.$r = (r_1 \times r_2 \times r_3 \times \ldots\ldots r_n)^{1/n}$

This method gives the most value .

Rapidly Growing cities population can be determined by this process.

Water Demand

Domestic:-   **200 Lpcd$\Rightarrow$High Income Group**

                            135 Lpcd$\Rightarrow$Low Income Group

Industrial: **50 Lpcd**

Office:-   **45 Lpcd**

Restaurants:-   **70Lpcd**

Cinema and Theatre : -   **15 Lpcd**

Hospital :-   340   (upto 100 beds)

450(above 100 beds)

Commercial :-   20 Lpcd

Public :-   10 Lpcd

Fire demand :-   1 Lpcd

Fire demand:- It depends upon size of population.

Kuichling's Formula:- $Q=3182\sqrt{P}$ Lit/min

Where   P=Population in thousand

Freeman Formula:- $Q=1136(P/10+10)$ Lit/min

National Board Of Fire   Population<=200,000

$Q=4637\sqrt{p}(1-0.01\sqrt{P})$Lit/min

If Population>200,000 .

$Q=54600$ Lit/min

Buston's   Formula:-$Q=5663\sqrt{p}$

Water Demand for losses and theft

This is 15% of total demand   : 54 Lpcd

Total Maximum Demand or per capita Demand=335 lpcd

Total Minimum Demand or per capita Demand=270 lpcd

Domestic :   200 Maximum   135 Minimum

Industrial :   50

Commercial: 20

Public: 10

Water theaft:-   54

    Fire:-   1

      335 Lpcd as per IS

FACTOR AFFECTING Water Demand:-

1. Size Of population And Water Demand.
2. Climate Condition
3. Habit Of people.[HIG means High Demand]
4. Pressure in Line And Demand.
5. Quality Of Water And Demand.

What is per capita Demand?

Per capita demand or Lpcd [Liter per capita per day]

$$\frac{Total\ yearly\ Water\ demand\ in\ liter}{365 \times population}$$

Maximum Daily Demand:-   1.8×Lpcd (avg daily Demand)

Avg Hourly Demand On Maximum Daily:

$$\frac{1.8 \times Lpcd}{24}$$

Maximum Hourly Demand =   1.5×1.8×Lpcd/24

                =2.7×Lpcd/24

Maximum Weekly Demand =1.48×Avg Weekly

Maximum Monthly Demand =1.28×Avg monthly

What is Coincident Draft:

The Maximum Daily Demand +Fire Demand is called coincident Draft.

Design Of Water supply Unit:

1. Dam +reservoir =Avg Annual Demand
2. Pipe Main=   maximum Daily Demand
3. Water Treatment Unit = maximum Daily Demand
4. Distribution Network = Peak Hourly demand or Maximum Hourly Demand
5. Service reservoir or Over Head Tank =Coincident Draft.

Design Periods

Unit	Design period
1.water treatment unit	15 years
2.dam+resiervior	50 years
3.pipe mains	30 years
4.Distribute Networks	30 years
5.Service reservoir/overhead tank	15 years

Quality of Water

1. Physical Water Quality Parameter.

I. **Suspended Solid**:- Inorganic $\Rightarrow$ Silt, Clay, Oil

                            Organic $\Rightarrow$ Plant, Algae

*****Suspended solid is only Seen in Surface Water but not in ground Water**.

Suspended solid are obtained by filtration and heating of filter at 104°.

Total Solid= Dissolved Solid +Suspended Solid.

II.Turbidity :-Turbidity is a measurement of resistance of water to the passage of light through it.

Cause :- Silt ,clay, finely divided organic matter.

Measurement :- Silica Scale in PPM and NTU

Method of Measurement

1. Turbidity Rod
2. Jackson's turbidity Meter
3. Baylis turbidity meter
4. Nephelometer

NTU $\Rightarrow$ Nephelometric turbidity unit.

III. **Colour**:- Cause   i. Floating organism

ii. Organic matter   iii.Fe & Mn   iv. Industrial Waste.

Unit :-   Platinum Cobalt scale

Due to Suspended matter :-Apparent Colour$\Rightarrow$apparent colour. $\Rightarrow$removed by the filtration.

Due to Dissolved solid : True colour. $\Rightarrow$Can't be removed by filtration.

Type of Chemical	Colour
FeO_2/Fe_2O_3	Red
MnO_2 in bottom of Lake	Black
Humic Acid	Yellow

TCU:- True Colour Unit.

1 mg of Platinum in the form of choloro platinum ions in one Liter of Distilled water.

IV.Taste and Odour: Causes

i.H_2s ii.CH_4(methane) iii. Organic matter(Decomposing) iv. Phenol   v. Residual Cl_2

Unit: Ton :-Threshould   Odour Number.

Limiting/Permissible Value

1. Turbidity $\Rightarrow$ 5-10   Silica Scale
                                   1 NTU

2. Colour$\Rightarrow$ 5 TCU
                                   20 ppm in platinum cobalt Scale

3. Taste Odour$\Rightarrow$ 1-3 TON

4. Temperature $\Rightarrow$ 10°-25°

5. Suspended Solid $\Rightarrow$ 30 ppm

6. Total dissolved Solid $\Rightarrow$ 500 ppm   Rejection $\Rightarrow$2000 ppm

Chemical Properties Of Water:

Alkalinity :- Cause of Alkalinity : Co_3^{2-}, HCo_3^-, OH^-

Minor cause of Alkalinity : HS^-, HPO_4^-, NH_3^-

Alkalinity imparts bitter taste to water.

pH

pH= $- \log_{10}[1/H^+]$

= $\log_{10}[1/H^+]$

H^+= hydrogen in moles/Liter.

0-7 $\Rightarrow$ pH value $\Rightarrow$ acid
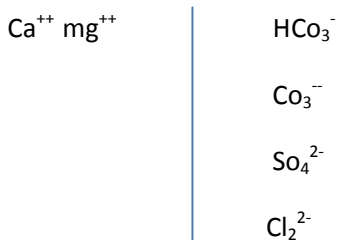
pH value varies from 0 -14

$$[H+] \times [OH] = 10^{-14}$$

Hardness

Hardness is called which prevent lathering of soap.

Cause of Hardness:-

Ca^{++} mg^{++} | HCo_3^-
| Co_3^{--}
| So_4^{2-}
| Cl_2^{2-}

Carbonate Hardness (Hco_3^-, co_3^{2-}) is also called temporary hardness. As it can be removed by simply boiling.

Non Carbonate Hardness (so_4^{2-}, cl^-) called permanent hardness .As it cannot be removed by simple method.

Determination Of Hardness :-

i.   Shop test Method
ii.   EDSTA method(Ethylene diamine tetra acetic Acid)
iii. Hardness in measured /expressed gm-equivalent of $caco_3$.

Cl_2

Residual $cl_2$is the free cl_2 remaining in water after about 5-3 mins of contact between the water and cl_2 dose.

Method of determination of Resudual cl_2:-

i.   Starch-iodide method
ii.   Orthotolidine method
iii. Orthotolidine-Arsenite Method(OTA)

Limiting Value

Hardness$\rightarrow$ 75-115 ppm

Fluoride $\rightarrow$ 1.5 ppm

Phenol Compound $\rightarrow$ 0.001 ppm

Dissolved o_2 $\rightarrow$ 5 to 6 ppm

pH $\rightarrow$ 6.5 to 8.5 ppm

cl_2(Chloride) $\rightarrow$ 250 ppm

Iron $\rightarrow$ 0.3 ppm

Nitrate $\rightarrow$ 0.45 ppm

Arsenic $\rightarrow$ 0.05 ppm

Residual cl_2 $\rightarrow$ 0.5 to 0.05 ppm

Lead $\rightarrow$ 0.05 ppm

BOD $\rightarrow$ 0

Polluted water and contaminated water:-

Polluted water:

        i.   Contain pas pathogenic Bacteria.

        ii.   Contains undesirable matter making unfit for Drink

Contaminated Water:-

Presence of Organic matter and inorganic matter.

Contaminated is not always polluted.

Polluted is always contaminated.

Example:-

A waste water sample contains $10^{-5.6}$ millimole /Lit of (OH^-) .What is the pH value of the water?

Ans- $[OH]^- = 10^{-5.6}$ milimole/Lit

          $= 10^{-5.6} \times 10^{-3}$ mole/Lit

$= 10^{-9.6}$ mole/Lit

$[OH]\ [H^+] = 10^{-14}$

$[H^+] = 10^{-14}/10^{-9.6} = 10^{-5.4}$

$PH = \log_{10}[1/H^+] = \log_{10}[10^{5.4}]$

                $= 5.4$

For removal of temporary hardness of water

A. Water is filtered B. Water is boiled

C. Alum is added to water D. Lime is added to water

E. Chlorine is passed through water

The presence of algae in water indicates that the water is

A. Hard B. Soft

C. Acidic D. Pune

E. Free from turbidity

The hardness limit for portable water ranges between

A. 10 - 50 ppm B. 50 - 65 ppm

C. 75 - 117 ppm D. 150 - 250 ppm

E. 300 - 700 ppm

The chloride content in the water for public supplies should not exceed

A. 250 mg/litre B. 100 mg/litre

C. 50 mg/litre D. 20 mg/litre

E. 1 mg/litre

The flouride content in the drinking water should not exceed

A. 200 mg/litre B. 150 mg/litre

C. 100 mg/litre50 mg/litre D. 50 mg/litre

E. 1 mg/litre

The total count of bacteria in portable water should not exceed

A. 10,000 per c.c. B. 5000 per c.c.

C.   998 per c.c.   D.   10 per c.c.

The main disadvantage of hard water is

A.   Higher density   B.   More turbidity

C.   Foul smell   D.   Bad taste

E.   Increased soap consumption

The becteria that can survive without oxygen is called

A.   Facultative bacteria   B.   Anerobic bacteria

C.   Aerobic bacteria   D.   Furobic bacteria

E.   All of the above

The presence of which of the following material in water is not considered to be dangerous?

A.   Lead   B.   Copper

C.   Mercury   D.   Calcium

E.   Zinc

Water with least contamination can be be obtained from

A.   Rivers   B.   Lakes

C.   Wells   D.   Reservoirs

E.   Spring along the hill slope

A hard water may contain

A.   Calcium carbonate   B.   Magnesium sulphate

C.   Magnesium bicarbonate   D.   Any of the above

E.   None of the above

Which of the following industry will usually have the highest concumption of water for processing?

A.	Foundry	B.	Steel plant
C.	Automobile industry	D.	Paper mill

E.   Aluminium industry

The process of removal of permanent hardness of water is

A.	Zeolite process	B.	Sedimentation process
C.	Filtration process	D.	Boiling process

E.   Lime process

The odour of water is expressed in terms of threshold number. The maximum threshold number permitted for public supplies is

A.	10	B.	5
C.	3	D.	2

E.   1

Which organisms cause infections diseases?

A.	Viruses	B.	Worms
C.	Protozoa	D.	Fungi

E.   All of the above

The water borne bacterial infections may cause

A.	Typhoid fever	B.	Dysentery
C.	Cholera	D.	Any of the above

E.   None of the above

Mottling of teeth is associated with the presence of

A.	Chloride in water	B.	Calcium in water

C. Sodium chloride in water

D. Sulphur in water

E. Fluorides in water

The cycle of life, death and decay involving organic nitrogeneous matter is called

A. The sulphur cycle

B. The nitrogen cycle

C. The carbon cycle

D. The hydrological cycle

E. None of the above

Zeolite is

A. A naturally occurring salt

B. Hydread silica

C. Silicon carbide

D. Hydrated calcium silicate

E. Hydrated alumino-silicate

Identify the incorrect statement if any

A. If the pH value of water is 14 the water has maximum alkalinity

B. pH value of 6 represents acidic water

C. Water having pH value 4 will be more acidic than water having pH value of 6

D. Maximum acidity of water is indicated by pH value of zero

E. None of the above

The pH value of sea water is usually

A. 1

B. Between 3 and 5

C. Between 5 and 7

D. Between 8 and 8.3

E. Between 13.7 and 14

The permissible hardness of water for low pressure boiler is

A. 50 mg/litre

B. 150 mg/litre

C. 250 mg/litre

D. 350 kg/litre

E. 450 mg/litre

The permissible hardness of water for public supplies is

A. 10 mg/litre

B. 25 mg/litre

C. 75 mg/litre

D. 115 mg/litre

E. 400 mg/litre

Alum increases

A. Hardness of water

B. Carbonates of water

C. Sulphates in water

D. Acidity of water

E. None of the above

Bleaching power is

A. Lime

B. Stacked lime

C. Chloride of lime

D. Hypo-chloride of lime

Hypo-chlorite of lime

E.

The process used for the removal of dissolved carbondioxide from the water, is known as

A. Coagulation

B. Agitation

C. Aeration

D. Sedimentation

E. Zeolitc

The maximum concentration of lead in drinking water should not exceed.

A. 0.0005 mg/litre

B. 0.005 mg/litre

C. 0.05 mg/litre

D. 0.5 mg/litre

E. 5 mg/litre

The maximum permissible level or pesticides, in general, in drinking water is nearly

A. 1 to 50 ppm   B. 50 to 100 ppm

C. 100 to 250 ppm   D. 250 to 500 ppm

E. 500 to 1000 ppm

The bad smell due to decomposition of sewage, on account of the action of bacteria, is mainly due to the presence of

A. Dead bacteria   B. Oxygen

C. Carbondioxide   D. Hydrogen sulphide

E. None of the above

Which of the following chemical is least poisonous?

A. Arsenic   B. Lead

C. Sodium   D. Cyanide

E. Mercury