SNS COLLEGE OF TECHNOLOGY
Vazhiampalayam, Coimbatore-35
(An Autonomous Institution)
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Environmental Pollution

Water Pollution

Water

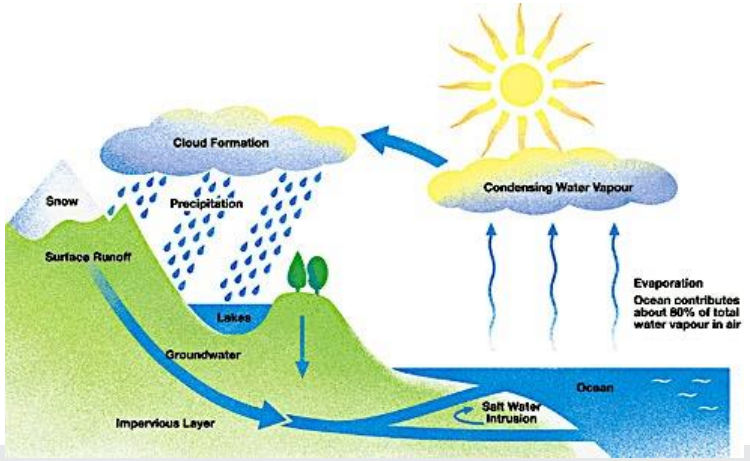
Two Imp. Types –

1. Fresh water
    i) Surface or terrestrial water
    ii) Ground water
2. Marine water

Terrestrial or Surface water: “Water stored on the surface”.

It is of two types a) Standing water

b) Flowing water



Properties of Water - Surface

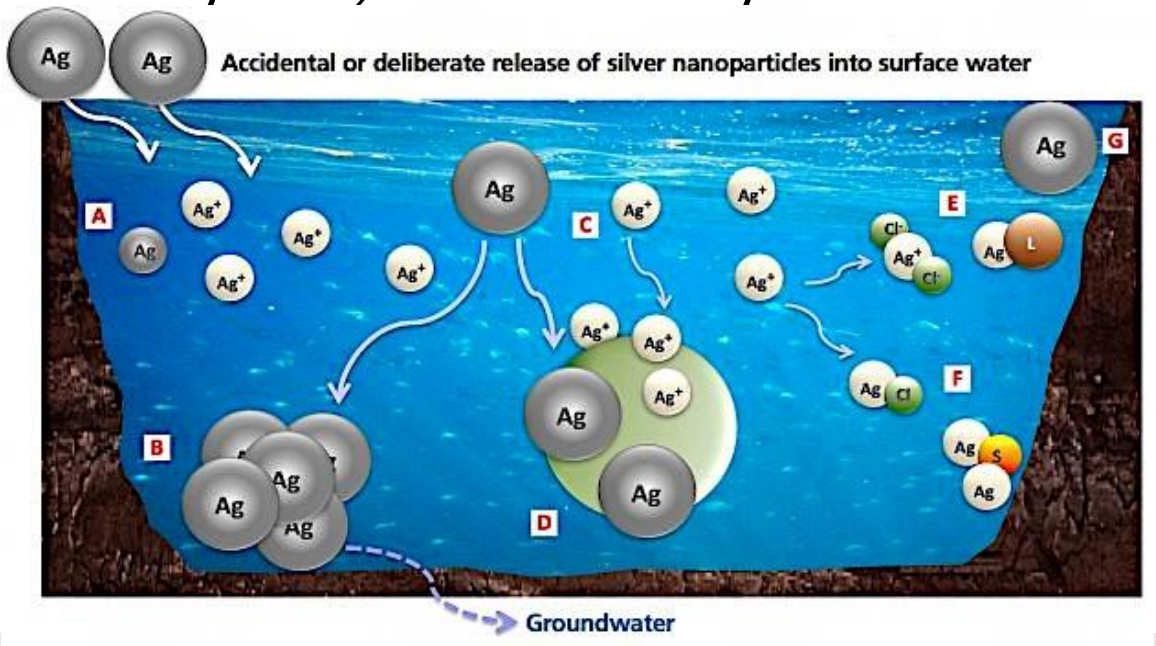
Physical & Chemical Properties of Terrestrial water:

1. Colorless at room temp.
2. Universal solvent – many substance are soluble
3. High sp. Heat – need high energy before it gets hot
4. Pure water is neutral in pH
5. Good conductor of heat – many living organisms live
6. BP wide range 0 – 100 ^{0}C

Properties of Water

Environmental significance:

1. CO_2 dissolves in water – carbonic acid H_2CO_3 – pH balance
2. Metal – carbonate decreases pH.
3. Substrate for many metabolic reactions – photo., hydroly.
4. Potentiality of H_2O decreases by addition of solutes.



Properties of Water - Marine

Physical & Chemical Properties of Marine water:

1. High salt conc. 35000 mg/L – high denser
2. pH – 7.5 to 8.4
3. Speed of sound is 1500 m/s

What is the difference between surface and marine water –

1. Salt conc.
2. 2.8 times higher bicarbonates in marine
3. This diff. is because of salts residence time.

    Ex: Na and Cl than Ca, that gets ppt. quickly.

Water Quality Parameters

Quality of water is very Imp. parameter to decide its order of application.

1. Physical parameters
2. Chemical parameters
3. Biological parameters

1. Physical parameters:

a) **Color:** Change in the appearance of water by organic and inorganic materials.

Natural water – pale straw to dark brown through yellowish brown.

Water Quality Parameters

Sources:

i) Organic – humic substances, algae, tannins, organic dyes etc.

ii) Inorganic – Fe and Mn etc.

Sanitary significance:

i) Color water is not acceptable for drinking – bcz. Of pollutants present.

ii) Color is an index for various pollutants

Ex: Yellow tinge – Cr and organic matter; Yellowish red – Fe; Red brown – peaty matter; Black – Fe and Mn

Removal Methods: Coagulation, settling, adsorption and filtration.

Water Quality Parameters

b) Taste and Odors:

Disagreeable odor and taste is not acceptable in drinking.

H_2S inorganic and Organic matter.

Sources:

Organic – Decay vegetation, algae, etc.

Inorganic – Mercaptans, amines and sulphides etc.

Removal method:

Organic taste and odor – aeration or activated carbon treatment.

Inorganic – oxidation, chlorination or ppt.

Water Quality Parameters

C) Turbidity:

Reduction of clarity by insoluble suspended particles.

Sources:

Inorganic – clay, slit, salts of Fe and Ca etc.,

Organic – divided plant and animal matter, oil, micro-organisms etc.,

Removal methods:

i) Coagulation and filtration

ii) Coagulation and settling

iii) Coagulation, settling and filtration.

Water Quality Parameters

2. Chemical Parameters:

a) pH: $-\log_{10}[H^+]$ pH scale: 0 to 7 to 14

Drinking water 6.5 to 8; Irrigation 6 to 9 pH

Rain water having SO_2 and NO_x is acidic.

b) Acidity: measure of base neutralizing ability.

CO2 and mineral acids responsible for acidity mostly.

Source:

Mineral acids – iron pyrites FeS2, S compounds

$2S + 3O_2 + 2H_2O \rightarrow 2H_2SO_4$

$2FeS_2 + 7O_2 + 2H_2O \rightarrow 2FeSO_4 + sH_2SO_4$

CO_2: Smoke form vehicles and industries.

Significance: mineral acids are dangerous, undesirable for use

Water Quality Parameters

c) Alkalinity: measure of acid-neutralizing capacity.

It is imparted by OH^-, CO_3^{2-}, HCO_3^- ions.

Source:

Industries like fertilizers, detergents, paints and etc.

Significance:

i) High alkalinity is dangerous to health of aq. Organisms.

ii) In boilers causes caustic embrittlement.

Removal : by adding dil. HCl

d) Nitrogen: inert gas, so un imp. gas.

Sources: Plant materials and fertilizers.

Removal: by boiling water.

Significance: no corrosive effect and no much significance.

Water Quality Parameters

E) Fluoride:

By the dissolution of geological compounds it occurs. Little conc. is possible in surface water.

Sources:

Cryolite Na_3AlF_6, Fluorapatite, some rocks having F.

Significance: good from 0.7 to 1.2 mg/L

Low F causes caries in childrens

High F contains fluorosis.

Removal:

PPt using Al salts in basic medium

By using strong anion exchange resin and by adsorption on AC

Water Quality Parameters

f) Chlorides: 250 mg/L is limit in drinking water; (200 ppm US)

Cl_2 must be zero.

g) Sulphates: 250mg/L limit, high level – cathartic effect.

h) Nitrate: 45 mg/L

i) As: <o.o5 mg/L

3) Biological Impurities:

Microorganisms

Significance – causes diseases, pipe carrying capacity decrease, fouling in membrane filtration

Control: Chlorination, starilization using CuSO4. UV radiation.

Water Quality Parameters

SNo	Parameter	WHO, ppm	ISI, ppm
1	Color, odor and taste	Colorless, odorless and taste less	Colorless, odorless and taste less
2	pH	6.5 to 8	6.5 to 8
3	TDS, total dissolved solids	500	-
4	DO	-	3
5	Cl	250	600
6	SO_4	400	1000
7	NO_3	45-50	45
8	CN	0.2	0.01
9	F	1.5	3
10	Cr, Pb, As	0.05	0.05, 0.1

Characteristics or Testing

Testing or characteristics of water –

1. Dissolved Oxygen (DO): amount of O2 dissolved in given amount of water at cont. temp. and pressure.

Significance:

i) Very imp. for aq. Organisms

ii) DO measures control of river or water pollution.

iii) DO must be min of 4 mg/L

2. Biological Oxygen Demand (BOD):

The amount of oxygen required for the biological decomposition of organic matter in a given sample of water at 20°C over a period of 5 days. It is expressed as BOD_5.

Significance: measure of amount of organics and pollutions.

Characteristics or Testing

3. Chemical Oxygen Demand (COD):

The amount of oxygen required for chemical oxidation of organic matter using some oxidizing agents like $K_2Cr_2O_7$ and $KMnO_4$.

Significance: measure of pollution.

Water Pollution and Sources

Definition: The alteration of water quality in terms of physical, chemical and biological characteristics that causes harmful effects in human and aq. organisms.

Types, effects and sources of water pollution:

1. **Infectious agents:**

Ex: Bacteria, viruses, protozoa.

Human sources: Human and animal waste

Effects: variety of diseases like cholera, diarrhea.

2. Oxygen demanding waste:

Ex: Organic waste such animal manure, plant debris.

Human sources: sewage, paper mills, food industries.

Effects: decrease of DO in water leads to loss of aq. Organics.

Sources of Water Pollution

3. Inorganic chemicals:

Ex: Water soluble chemicals – acids, Pb, As, Cr, F etc.

Human sources: industrial effluents, household cleaners

Effects: heavy metals are very dangerous to human health they causes kidney, liver problems and few cancers and leads to death.

4. Organic chemicals:

Ex: Pesticides, detergents, oils, solvents.

Human sources: Industrial effluents, household cleaners, agricultural waste.

Effects: nervous system damage, cancers.

Sources of Water Pollution

5. Plant nutrients:

Ex: water soluble compounds like NO3, PO4, NH4 ions etc.

Human sources: Sewage, agricultural fertilizers, manure.

Effects: causes excessive growth of algae, decreases DO and stops allowing light deep in to ponds and lacks.

6. Sediments:

Ex: Soil, slit etc.

Human sources: Land erosion

Effects: reduces photosynthesis

Disturbs aq. Food web.

Carry bacteria

Clog streams, reservoirs.

Sources of Water Pollution

7. Radioactive materials:

Ex: isotopic Iodine, Radon, Uranium, thorium etc.

Human sources: nuclear and power plants.

Effects: genetic mutations, skin cancer

8. Point and non-point sources:

i) Point Sources – single identified source of pollution from which pollutants are discharge.

Ex: industrial discharge, municipal sewage etc.

i) Non-point Sources – if the source of pollution is not readlly identified or if they are diffused or scattered they are called non-point sources.

Ex: Run off form form lands, construction sites, agricultural and animal waste.

Effects of water pollution

On human:

1. Cholera, diarrhea
2. Typhoid fever
3. Skin cancer, etc.
4. Generic mutations.
5. Hepatitis
6. Damage to nervous system

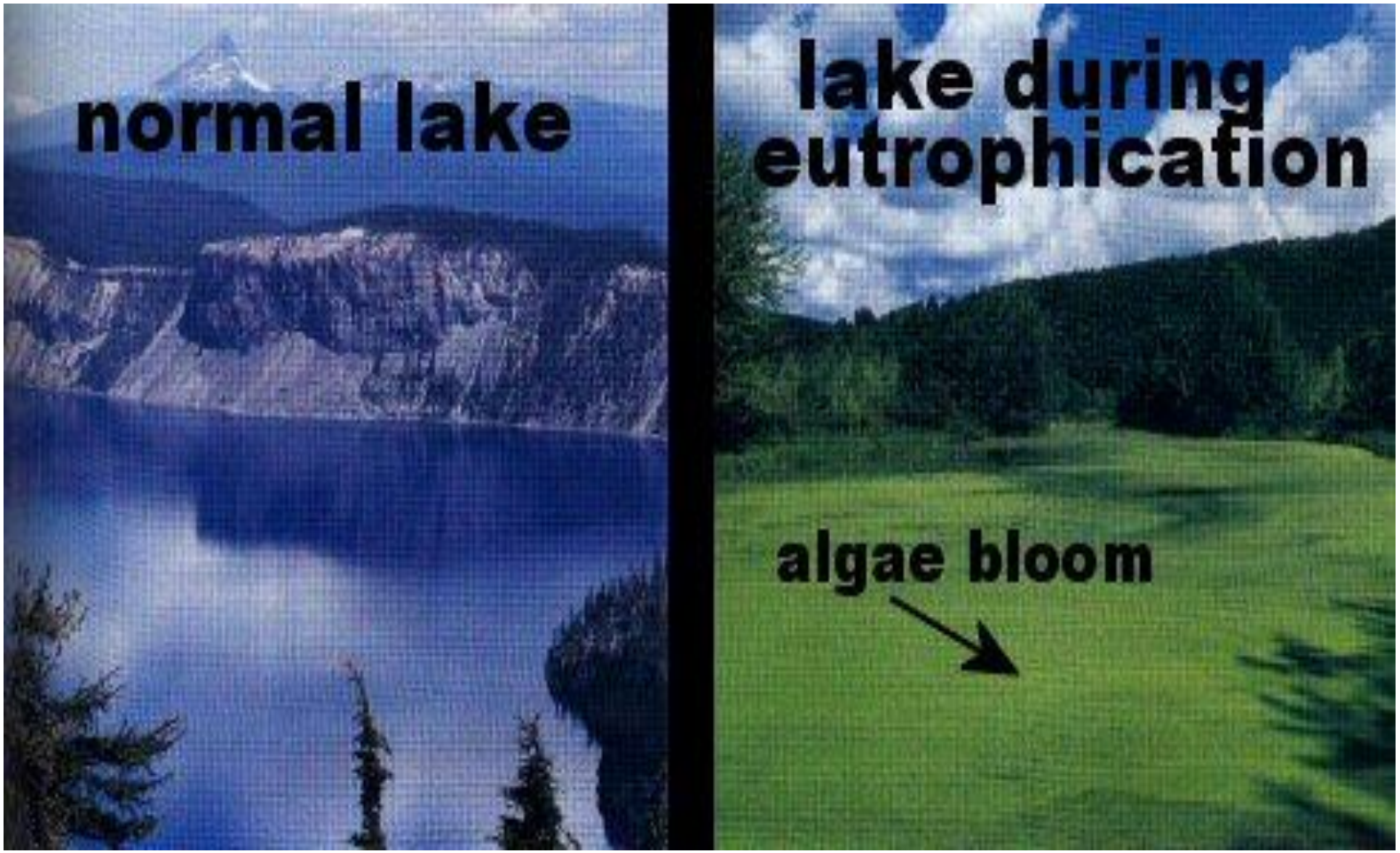
On pants and animals:

1. Lower crop yields
2. Reduce photosynthesis
3. Excess growth of algae kill aq. Life
4. Disturb food chain and food web.

Control measures of water pollution

1. Setting up of wastewater treatment plant
2. Industrial effluents must be treated before releasing into environment
3. Recycling of water must be encourages with proper treatment.
4. Strict enforcement of water pollution control etc.
5. Continuous monitoring of various sources by govt. bodies
6. Rivers, streams and other water bodies must be well protected form industrial releases.
7. Development of economical treatment methods
8. Feasibility to get quality water for all people.

It can cause excessive growth of algae and other aquatic plants, which die, decay, deplete dissolved oxygen in water and kill the fish.


normal lake
lake during eutrophication
algae bloom

EFFECTS OF EUTROPHICATION

Dissolved oxygen depletion

Loss of desirable fish species

Reductions in harvestable fish and shellfish

Decreases in aesthetic value of the water body

Colour, smell, and water treatment problems