
Water Pollution

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I. Overview

Water Properties

1. Expands when freezes so less dense than liquid water
2. Liquid water has a higher density than most other liquids
3. High heat capacity
4. High heat of vaporization
5. Universal polar solvent

Water is 72% of earth, 70% of the human body

A. Water Sources

- 1. Surface Water (lakes, rivers)**
- 2. Groundwater aquifers – large pools of water in rock and sand**
 - Ogallala – Midwest (S.D. to TX)**
1920 – 58 ft thick
Today – less than 8 ft thick
 - Ocala**
- 3. Ground level is falling in some areas due to water table depletion – San Joaquin Valley, Florida, Texas**
- 4. Less than 1% of water is available as fresh water**

B. Water Usage – over 400 billion gallons/day withdrawn (250 billion gallons put back)

- 1. Public supplies - 10%**
 - 95 gal per person per day used directly**
- 2. Agricultural irrigation - 35%**
- 3. Industry - 55% (much recycled)**
- 4. Total per capita use would be about 1725 gal per day**

C. Water Pollution

Polluted when it contains any substance in sufficient amount to prevent it from being used normally

D. Categories of pollutants

- 1. oxygen-demanding wastes**
- 2. disease-causing agents**
- 3. plant nutrients**
- 4. suspended solids**
- 5. dissolved solids**
- 6. acids**
- 7. heat**
- 8. toxic substances**

E. Wastewater Treatment

II. Oxygen-demanding wastes

- A. Fish and bacteria require oxygen (>5ppm)**
- B. Solubility factors (Temp and Pressure)**
- C. Removal of oxygen caused by presence of oxygen demanding wastes that are used by aerobic bacteria.**

Sources - (1) sewage, (2) industry, (3) meat packing and slaughterhouses

- D. Measurement is through the BOD - biochemical oxygen demand**

(1 ppm pure water, 5 ppm doubtful purity)

E. Consequences of low DO

1. Disappearance of plant and animal life

2. Shift from aerobic to anaerobic bacterial activity

Waste	Aerobic	Anaerobic
C	CO₂	CH₄
N	NH₃ and HNO₃	NH₃ and amines
S	H₂SO₄	H₂S
P	H₃PO₄	PH₃ and others

III. Disease Causing Agents

- **Coliform bacteria used as a marker**
- **Drinking water standard 1 colony per 100 ml**

IV. Plant nutrients

A. Eutrophication

- Cause excessive growth of aquatic plants.
- Leads to excessive bacterial use of oxygen on decaying plants
- Low oxygen leads to removal of fish

B. Phosphate content is most important pollutant

- Detergents - builder ties up calcium, magnesium and iron ions
- Fertilizer runoff - N, P, K

V. Suspended Solids -undissolved organic and inorganic particulates

A. Erosion major factor - loss of topsoil

B. Effects

reduced photosynthesis by aquatic plants

abrasion and wear on pumps

sediment adsorption of toxic material

VI. Dissolved solids - "salinity"

A. Sources

1. dissolution of rock and soil
2. atmospheric deposition
3. human activities

B. Problems

1. Damage to aquatic life
2. Damage to plant life

VII. Acids

A. Sources

mine drainage (primarily coal, but also Pb, Zn and Cu ores)

B. Effects

1. aquatic life
2. corrosion
3. crop damage

VIII. Heat

A. Sources

industrial cooling water

B. Effects

1. depletion of DO level
2. increases rate of chemical reaction
3. false temperature clues to aquatic life
4. lethal temperature levels

IX. Toxic Substances substances which at low concentrations can impact human health or the aquatic environment

A. Types

1. Inorganic metals
2. Organic solvents, herbicides and pesticides
(herbicides>pesticides)
3. Radiation

B. Bioaccumulation a problem

X. Wastewater - water used by a community and discharged into a natural body of water

A. Sources

1. sewage
2. commercial waste
3. industrial waste
4. storm runoff

B. Treatment

1. Primary - filtering and sedimentation

- **coagulation/filtration**
Alum forms aluminum hydroxide floc that traps particles
- **Chlorination or ozonation**

2. Secondary - biological processes that use bacteria to break down soluble organics

- **trickling filter**
- **activated sludge**

3. Tertiary - specialized treatment for dissolved inorganics and organics

- (a) **carbon adsorption**
- (b) **foam flotation**
- (c) **reverse osmosis**
- (d) **ion exchange**
- (e) **distillation**