بسم الله الرحمن الرحيم

WATER QUALITY

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Water Quality

- Chemical, microbiological and Physical properties
- Water quality is determined according to purpose of use (drinking, agriculture or industrial)
- Water used for certain purpose is compared with standards for that type of water
- Standards put into account not to affect negatively public health, plant growth, or industrial processes

Water Quality of Drinking Water

- **Drinking water:** water used in houses, hotels, and institutions for drinking, cooking and bathing
- **Judgment: safe** or **not**; through examining the chemical, microbiological and physical properties
- **First judgment:** through physical properties (color, odor, taste, and turbidity)
- **Drinking water:** water used safely for domestic purposes

Safety of Drinking Water

- **Physical properties:** taste, odor, color, turbidity, pH and temperature)
- **Chemical properties:** (TDS, Cl, NO3, SO4, Ca, Mg, Na, total hardness, **heavy metals** (**Fe, Cu, Zn, Pb, Hg, Cd, Ni…etc**) and organic pollutants
- **Microbiological properties:** Total coliforms, fecal coliforms, pathogenic protozoa, Viruses, helminths

Safety of Drinking Water

Drinking water should have:

1- Values of: turbidity, color, taste, and odor within the acceptable level

2- Free from pathogenic microbes

3- Concentration of chemical parameters and compounds within the acceptable level

4- Free from any corrosive agents or dyes

Water quality of drinking water

Microbiological water quality:

- **Important to judge whether water is safe for domestic purposes or not**
- **Gastrointestinal diseases caused by waterborne microbes such as: bacteria, viruses, protozoa, parasites are the most common and widespread diseases**

Chemical water quality

What determines if water is safe for drinking purposes or not:

Increase of concentration of different ions that affects public health

Or cause color, taste, odor or hardness

Quality of water used for irrigation

- Water quality depends on its chemical, microbiological and physical properties

- Indicators that determine the quality of water used for irrigation:
  1. water contents of salts - salinity
  2. water contents of chloride - toxicity
  3. water content of boron - toxicity
  4. water content of sodium - alkalinity

Quality of water used for irrigation

- **Water salinity:**

  Salinity affects osmotic pressure of the soil solution in the root region

- **Types of salinity:**

1. Free use of water (<450 mg/l)
2. Simple constrains (450-2000 mg/l)
3. Strict constrains (>2000 mg/l)

Quality of water used for irrigation

- **Water chloride:**

  destroys leaves of plants when the content reaches 0.5% of dry weight of the leaf.

- **Types of water according to chloride:**

1. **Free use of water (<142 mg/l)**
2. **Simple constrains (142-350 mg/l)**
3. **Strict constrains (>350 mg/l)**

Quality of water used for irrigation

- **Water sodium:**
  - affects the soil structure (less permeability, low aeration).
  - Toxicity appears on old leaves (sensitive plants: citrus, beans..etc)
  - Enough calcium in the soil mitigates sodium toxicity

Quality of Treated Wastewater

- **Treated wastewater**

  in addition to chemical and physical properties, wastewater quality depends mainly on:

1. **cysts of helminths; and**
2. **fecal coliform bacteria.**

Quality of wastewater determines types of plants to be irrigated (edible, cooked, fodders, cereals, trees, gardens)

Water Pollution

- **Pollution:**

  Any changes in water composition or water properties that adversely affect the environment.

- **Water pollution:**

Anything that adversely affects water and makes it:

1. **unsafe for domestic purposes**
2. **unsafe for irrigation purposes**
3. **unsafe for husbandry.**

Water Pollution

- **Types and degree of pollution:**
  this needs: chemical, physical and microbiological tests.

Why these tests?

1- to evaluate whether water is safe or not for drinking, industrial, agricultural or tourism purposes

2- to evaluate the type and degree of treatment necessary to eliminate pollutants

3- to evaluate the efficiency of water treatment

Water Pollution

- **Sources of Water Pollution in WB:**

1. Municipal wastewater
2. Ground water over pumpage
3. Industrial pollution
4. Solid waste (leachate)
5. Agricultural activities
6. Settlements (wastewater and solid waste)

When pollutants gain access to water resources :

(i) increase in nitrate concentration
(ii) increase in total coliforms
(iii) increase in fecal coliforms

Water Pollution

- **Sources of Water Pollution in WB:**

1. wastewater (leakage from sewers, cesspits, wadis, tankers evacuating wastewater, slaughterhouses)

2. Fertilizers and pesticides that reach the aquifers through agriculture drainage

3. Using untreated wastewater for irrigation

4. Increase in salinity due to over utilization of groundwater (Exhaustion)

Water Pollution

- **Groundwater wells and springs pollution :**

1. **Total coliforms**
2. **Fecal coliforms**
3. **Nitrate**

Water Pollution

- **Water hardness :**

  Ca++ & Mg++ ions in water

  react with soap to form Ca an Mg oleate.

When using hard waters:

Consumes more water

Forms scales in boilers when Ca++ and Mg++ react with anions such as CO3--

Hardness as CaCO3 <75 mg/l soft, > 150 mg/l hard.

Water Pollution

- **Factors that determine groundwater suitability for drinking purposes:**

1- presence of coliform bacteria

2- increase of Cl- concentration

3- increase of NO3- concentration

4- increase of heavy metals concentration

Water Quality

1- Free from pathogens
2- Low turbidity
3- Low salinity
4- Free from taste and odor causing materials
5- Chemical and metallic contents do not adversely affect health
6- Free from materials that cause pipe rust and corrosion.

Microbiological Water Quality

- Presence of bacteria, viruses or protozoa in water causes diseases (cholera, typhoid, dysentery, hepatitis etc..)
- Pathogens could not be detected easily in water
- Indicators of contamination are being used
- Results could be obtained easily and shortly

Microbiological Standards

1. Total coliform (zero/100 ml when using MF method)

2. Fecal coliform (zero/100 ml)

3. Drinking water should be free from:

- Pathogenic protozoa
- Helminths
- Fungi and algae related to health issues
- Intestinal viruses

Physical Standards

- Drinking water should have turbidity, color and odor within the MCL standards
- Using local marketed filters could reduce the objectionable turbidity, color, and odor.

Physical Standards

Property	Accepted level	Max. Cont. Level (MCL)
Taste (20C)	Accepted to majority of consumers	
Odor	Accepted to majority of consumers	
Color	10 units (platinum cobalt)	15 units
Turbidity	1 NTU	5 NTU
pH	6.5-8.5	9.5
Temperature	8-25C	

Chemical Standards

- Drinking water should be free from any toxic materials such as **heavy metals** and **dyes**
- Composition should be within the MCL standards especially, **salinity** and **nitrate**.

Chemical Standards
(Toxic elements)

Parameter	Symbol	MCL (mg/l)
Lead	Pb	0.01
Selenium	Se	0.01
Arsenic	As	0.05
Chromium	Cr	0.05
Cyanide	Cn	0.05
Cadmium	Cd	0.005
Mercury	Hg	0.001
Antimony	Sb	0.005
Nickel	Ni	0.05

Chemical Standards

(Compounds affecting health and water suitability)

Element/Compound	Symbol	Acceptable Level (mg/l)	MCL (mg/l)	Type of effect
Total Disolves Solids	TDS	500	1500	Palatable
Total Hardness	TH (CaCO3)	100	500	Palatable
Detergents	ABS	0.5	1	Palatable
Aluminum	Al	0.2	0.3	Palatable
Iron	Fe	0.3	1	Palatable
Manganese	Mn	0.1	0.2	Palatable
Copper	Cu	1	1.5	Palatable
Zinc	Zn	5	15	Palatable
Sodium	Na	200	400	Palatable
Nickel	Ni	0.05	0.1	Toxic
Chloride	Cl	200	400	Palatable
Fluoride	F	1	1.5	Toxic
Sulfate	SO_4	200	500	Palatable
Nitrate	NO_3	45	70	Toxic
Silver	Ag	0.01	0.05	Toxic
Magnesium	Mg	50	120	Palatable
Calcium	Ca	100	200	Palatable
Potassium	K	10	12	Palatable

Effects of Exceeding MCL

- **Aluminium *(Al)***
  Related to Alzheimer's

- **Arsenic *(As)***
  Accumulate in the body
  Carcinogenic

- **Cadmium *(Cd)***
  Accumulate in the body
  Highly toxic
  adverse changes in arteries of human kidneys
  linked with certain human cancers

Effects of Exceeding MCL

- **Calcium *(Ca)***

  form harmful scales in boilers, pipes, and cocking utensils

  $CaCO_3$ contributes to the total hardness of water

- **Iron *(Fe)***

  cause staining of laundry and porcelain

  bittersweet taste is detected at levels above 1 mg/l

- **Magnesium *(Mg)***

  Important contributors to the water hardness

  forming scales in boilers

  have a cathartic مسهل and diuretic مدر للبول effect

Effects of Exceeding MCL

- **Manganese *(Mn)***

  cause objectionable stains to laundry

- **Mercury *(Hg)***

  Accumulate in the food chain

  very toxic and not allowed to exist in the environment or water

Effects of Exceeding MCL

- **Selenium *(Se)***

  toxic to animals and may be toxic to humans

- **Silver *(Ag)***

  cause argyria, a permanent blue-gray discoloration of the skin and eyes that causes a ghostly appearance

  pathological changes in the kidneys, liver, and spleen الطحال of rats

  Toxic effects on fish in fresh water have been observed at conc. as low as 0.17 ug/l

Effects of Exceeding MCL

- **Sodium *(Na)***

  Ratio of sodium to total cations (SAR) is important in agriculture and human pathology

  Soil permeability may be harmed by a high sodium ratio

  Persons afflicted with certain diseases require water with low sodium concentration

- **Vanadium *(V)***

  It plays a beneficial role in the prevention of heart disease

  In New Mexico, with low heart disease cases, water contained 20-150 ug/l

  In a state where heart disease is high, water did not contain vanadium

  Vanadium pentoxide dust causes gastrointestinal and respiratory disturbances

Effects of Exceeding MCL

- **Zinc *(Zn)***

  It is essential and beneficial element in plant and animal growth

  Concentrations above 5 mg/l can cause bitter taste and an opalescence تلألؤ in alkaline waters

Effects of Exceeding MCL

- **Chloride (Cl-)**
  High conc. of Cl- may harm: metallic pipes and structures and growing plants.

- **Cyanide CN-**
  Highly toxic

- **Fluoride F-**
  Fluorosis

- **Nitrate NO3**
  Blue baby syndrome (methemoglobinemia)

- **Sulfate SO4- -**
  Na2(SO4) and MgSO4 have cathartic effects.

5-day BOD test

- Biochemical Oxygen Demand
- A measure of oxygen consumed by microorganisms under specific conditions
- Measuring waste loadings to treatment plants and evaluating the BOD-removal efficiency of treatment systems
- Test measures the molecular oxygen utilized during the 5-day incubation period for the biochemical degradation of organic material at 20C.

COD

- Chemical Oxygen Demand
- Amount of a specific oxidant that reacts with the sample under controlled conditions
- A measurement of pollutants in wastewater and natural waters.

THANKS For

PATIENCE