Water Quality Criteria and Standards

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AIM

Protection of the health of the people

GUIDELINES

- **Given by WHO**
- **For use by other Nations to set their own standards**
- **Recommended but not mandatory**

The Criteria

- Acceptability aspects
- Microbiological aspects
- Chemical aspects
- Radiological aspects

ACCEPTIBILITY ASPECTS

Physical parameters

- Turbidity
- Colour
- Taste and odour
- Temperature

TURBIDITY

- Water should be free from turbidity on aesthetic ground
- Caused by Particulate matter due to inadequate treatment

  Re-suspension of sediment in the distribution system

  Inorganic particulate matter in ground water

  Interferes with disinfection and microbiological determination

  GLV < 5 NTU nephlometric turbidity unit

COLOUR

- Water should be free from Color on aesthetic ground
- Due to Coloured organic matter primarily humic substances Metals like Fe, Mn
- GLV Up to 15 TCU (True Color Units)

TASTE AND ODOUR

- Indicative of some form of pollution or malfunction during water treatment (Storage) or distribution.
- May be due to contamination by chemicals or as a by product of water Rx (Chlorination)
- Must be investigated since it might be an indication of presence of potentially harmful substances
- No health based guidelines value is proposed for taste and odour.

TEMPERATURE

Cool water is more palatable

Low Temp – decreases the efficiency of treatment process including disinfection

High Temp enhances growth of micro organisms and taste, odour, colour and corrosion problem

INORGANIC CONSTITUENTS

- Chlorides : 200mg/l
- Hardness : 150-300mg/l
- Ammonia : 0.2mg/l
- pH : 6.5-8.5
- H_2S : 0.05mg/l
- Iron : 0.3mg/l
- Sodium : 200mg/l

INORGANIC CONSTITUENTS

- Sulphates : 250mg/l
- Total dissolved solids : 600-1000mg/l
- Dissolved Oxygen
- Zn : 3mg/l
- Mn : 0.1mg/l
- Cu : 1mg/l
- Al : 0.2mg/l

CHLORIDES

All waters incl rain water contain Chlorides

Widely distributed in nature as NaCl, KCl and $CaCl_2$

Normal values – 200 mg/L

Max Permissible – 600 mg/L

2L water – drinking water if consumed accounts for 0.33 – 1.6% of total intake

CHLORIDES

Excess Cl – Means CONTAMINATION

Normal Adult contains 81.7 g of chloride

Loss – 530 mg /day

Req. – 9 mg / kg Bodyweight – 1 g of Table salt /day

Excess – Hypertension

Renal Problems

CCF

HARDNESS

AMMONIA

Term AMMONIA includes Non-Ionized (NH_3)

Ionized (NH_4+)

Ammonia in Environment originates from

- Metabolic, agricultural process
- Disinfection with chloramines

Acceptable levels up to 1.5 mg/L

HARMFUL EFFECTS OF HIGH AMMONIA

NH3 in water is an indication of bacterial, sewage and animal waste pollution.

Harms the distribution system by formation of Nitrites

Compromise disinfection efficiency

Failure of filters to remove Mn

Taste and odour problems.

pH

Normal 6.5 – 8.5

Main objective of controlling PH is to MINIMIZE CORROSSION and INCRUSTATION in distribution system.

pH < 7 – corrosion of metals in distribution system

pH > 8 progressive decrease in the efficiency of the chlorine disinfection process

H_2S

Taste and Odour threshold : 0.05 – 0.1 mg/L

Rotten Egg odour in some ground water/stagnant water due to O_2 DEPLETION and subsequent reduction of SO_4 by bacterial activity

Normally sulphides are oxidized to SO_4 in well aerated water and H_2S level is low.

IRON

Normal up to 0.3 mg/L levels above this stain laundry and plumbing fixtures.

Anaerobic ground water contain FERROUS Iron without causing any discoloration or turbidity in water when directly pumped from the well.

On exposure to atmosphere ferrous ion oxidizes to ferric ions giving objectionable Reddish-Brown colour to the water

Iron also promoted the growth of “iron bacteria” which derive their energy from the oxidation of ferrous iron to ferric iron and in the process deposit a slimy coating in pipe lines.

SODIUM

Up to 200 mg/L

Excess can cause Reproductive Toxicity

Embryo toxicity

Teratogenicity

Carcinogenicity

Minor excesses – Convulsion, Muscular twitching & rigidity cerebral and Pulmonary edema

SULPHATE

Presence in drinking water can cause noticeable taste

< 250 mg/L taste impairment minimal

TOTAL DISSOLVED SOLIDS (TDS)

Effects Taste

600-1000 mg/L

<600 mg/L – Palatability good (acceptable is 300mg./L)

> 1200 mg/L - Unpalatable

Very low – Flat, insipid taste

High levels cause scaling in water pipes, heaters, boilers and household appliances.

ZINC

Taste threshold conc is upto 4 mg / L

>5mg/L makes water appear opalescent and develop greasy film on boiling

Imparts unpleasant astringent taste. Used in plumbing

MANGANESE

< 0.1 mg / L

Staining of sanitary ware and laundry

Undesirable taste in beverages

Coating on pipes which may slough off as a black precipitate

DISSOLVED O2

No laid down standards

Depletion of Dissolved O_2 – Microbial reduction

of NO_3 to No_2

And SO_4 to Sulphide

Odour

also causes increase in Ferrous Iron

COPPER

Up to 1 mg/L

Corrosion and staining of laundry & sanitary ware

ALUMINIUM

Upto 0.2 mg /L

Excess leads to deposition of Al(OH)3 floc in distribution system and exacerbation of discoloration of water by Fe.

MICROBIOLOGICAL ASPECTs

MODES OF TRANSMISSION OF MICROBES

(a) **Drinking water** – Most widespread

- Directly / Indirectly – Food preparation
- By human/animal excreta
- Especially faeces.

(b) **Bathing** - Water contact rather than oral route

(c) **Recreation**

(d) **Inhalation** - When the microbes are present in large numbers in water droplets, such as those produced by showers and some AC systems or in the irrigation of agricultural land.

(e) **By production of toxin** - e.g. Cyanobacteria (The toxin may remain in the water even when the cyanobacteria themselves have been removed)

Bacteriological Indicators

- Coliform organisms
- Faecal streptococci
- Clostridium perfringens

BACTERIOLOGICAL QUALITY OF DRINKING WATER

- Guidelines
  - 95%samples from distribution system should not contain coliform organisms in 100ml
  - No sample to be contaminated with E. coli in 100ml
  - No coliform organisms in 2 consecutive samples

For Viral Quality

- One PFU per litre of water
- Complete absence of enteropathogenic viruses and faecal bacteriophages

RADIOLOGICAL ASPECTS

- Health effects
  - Somatic
  - Hereditary

- Unit of measurement-Bacquerel(Bq)
  - 1Bq = 1 disintegration per second
- Gross alpha activity < 0.1 Bq/l
- Gross beta activity < 1.0 Bq/l

PRESUMPTIVE COLIFORM TEST

- Estimating MPN
- Collection of water samples in sterilized bottles
- Culture medium is McConkey's broth
- Small inverted tube is placed in the bottles
- Faecal organisms produce acid and gas

CHEMICAL EXAMINITION

- Contamination with industrial and agricultural chemicals
- Chemical examination alone not adequate and bacterial examination required

THE STANDARDS

- Complete prevention though ideal, is beyond achievement
- Standards laid down to minimize pollution

CHEMICAL ASPECTS

Inorganic

Organic

Inorganic compounds

Compound	Upper limit
Arsenic	0.01mg/l
Cadmium	0.003µg/l
Chromium	0.05mg/l
Cyanide	0.07mg/l
Fluoride	1.5mg/l
Lead	0.01mg/l

Inorganic constituents

Mercury	0.001mg/l
Nitrates	50mg/l
Nitrites	3mg/l
Selenium	0.01mg/l

Organic compounds

- Polynuclear Aromatic Hydrocarbons
- Pesticides
  - Chlorinated hydrocarbons
    - DDT
    - Lindane
    - Chlordane
    - Dieldrin
  - Others
    - Herbicides
    - Insecticides

Small community supply

- Coliform count < 10 per 100ml

TOXIC CHEMICAL SUBSTANCES

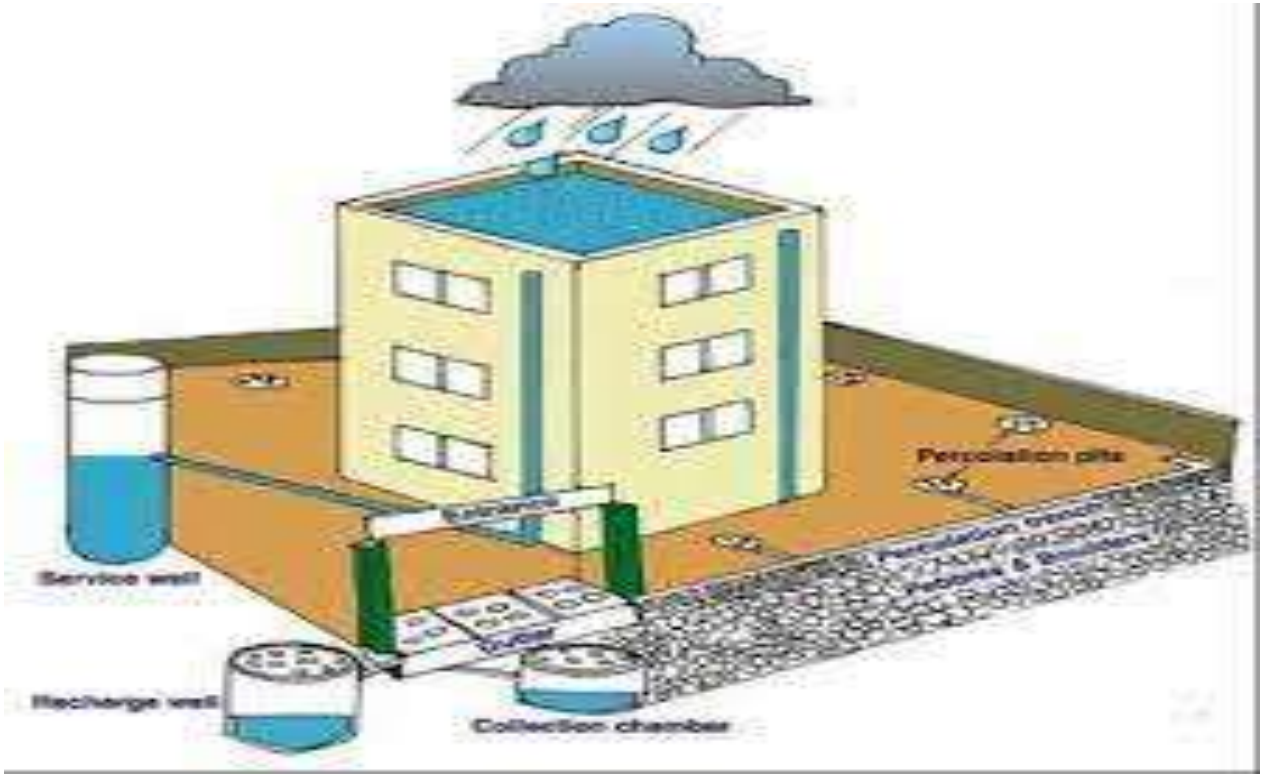
Substance	Upper limit(mg/l)
Arsenic	0.05
Cadmium	0.005
Cyanide	0.05
Lead	0.05
Mercury	0.001
Selenium	0.01

Other chemical substances

- Fluorides : 1ppm
- Nitrates : 45mg/l
- Polynuclear aromatic hydrocarbons : 0.2mg/l

Water conservation

- Measures



Six ways to save water at home

Save Water