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Golden Notes for Community Health Nursing-I

As per the Revised Syllabus





Parimal Patel
Khushbu Makadia

JAYPEE

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3 CHAPTER

Environmental Science, Environmental Health, and Sanitation

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CHAPTER OUTLINE

3.1 Brief note: Natural resources, ecosystem and biodiversity
3.2 Concept of environment and health (house, water, air, noise, light)
3.3 Basics of different kinds of pollution
3.4 Climate Change and National Program on Climate Change and Human Health (NPCCHH)
3.5 Waste management
3.6 Acts related to environment
3.7 National Clean Air Program

3.1 BRIEF NOTE: NATURAL RESOURCES, ECOSYSTEM AND BIODIVERSITY

NATURAL RESOURCES

- India is rich in natural resources including human resources.
  - *Agriculture:* It is the main source of Indian economy. It provides employment to around 70% of India's population.
  - *Forestry:* It is a sources of timber, leaves, gum, bamboo, rubber, etc. Around 19.4% of area covered by forest.
  - *Minerals:* India is richly with minerals like iron, copper, coal, bauxite, diamond, gold, manganese, etc.
  - *Fisheries:* India has a vast sea-coast. The marine products earn foreign exchange.
  - *Manpower:* The greatest natural resource of the country is its Human Resource.
- Natural resources can be classified on the basis of availability into Renewable and Non-Renewable.
- Renewable resources can be renewed and sustainable in nature. Examples are Water, forest, wind, solar energy, etc.
- Non-renewable resources are limited in nature and cannot be renewed. Ex. Minerals, fossil fuels, coal, soil, etc.

Ecosystem

Concept: An ecosystem is defined as a community of lifeforms in concurrence with non-living components, interacting with each other. It is a chain of interactions between organisms and their environment.

Structure and Characteristics

- **Biotic components:** It includes autotrophs, heterotrophs and saprotrophs.
- Producers or autotrophs such as plants which can produce food through the process of photosynthesis. All other organisms higher up on the food chain rely on producers for food.
- Consumers or heterotrophs are organisms that depend on other organisms for food.
- Decomposers include saprophytes such as fungi and bacteria. They directly thrive on the dead and decaying organic matter. They are essential for the ecosystem as they help in recycling nutrients to be reused by plants.
- **Abiotic components:** It includes non-living component of an ecosystem. Examples are air, water, soil, minerals, sunlight, temperature, nutrients, wind, etc. **(Fig. 3.1).**
- The four main components of an ecosystem are:
  - Productivity
  - Decomposition
  - Energy flow
  - Nutrient cycling (biochemical process)
- **Types**
  - **Terrestrial ecosystem**
    - Forest ecosystem
    - Mountain ecosystem
    - Grassland ecosystem
    - Desert ecosystem

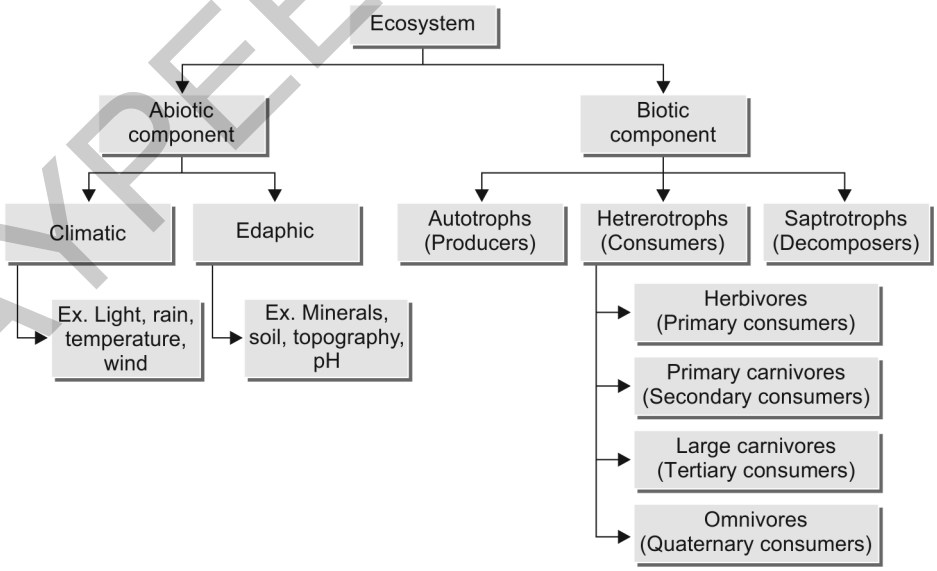


Fig. 3.1: Structure of ecosystem.

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- **Aquatic ecosystem**
  - Fresh water ecosystem
  - Marine ecosystem.

Function: Maintain balance in the earth. Its important function is of the exchange of energy from one life form to others. It regulates ecological processes, supports life systems and stability.

Biodiversity

- Biodiversity: It means Bio (life) and diversity (variety).
- It means the number and variety of organisms found within a specified geographic region.
- It includes to the varieties of plants, animals and micro-organisms, the genes they contain and the ecosystems they form.
- Biodiversity is the result of evolution.
- Biodiversity is important for human existence. All forms of life are so closely interlinked that disturbance in one give rise to imbalance in the others.
- It can be divided into: (i) Genetic diversity; (ii) Species diversity; (iii) Ecosystem diversity.
- Genetic diversity is the variation in genes within species. It is essential for healthy breeding of population species.

Loss of Biodiversity

- Extensive Natural resources consumption increased due to population explosion which leads to loss of species in different parts of the world.
- Deforestation.
- Destruction of natural habitats leads to disaster in entire biosphere.
- Natural calamities like floods, earthquakes, volcanic eruption.
- Injudicious use of pesticides destroys some species.
- If any species of plants and animals become endangered, they cause degradation in the environment which is threaten the human existence.

Corrective Actions

- There is an urgent need to educate people to adopt environment-friendly practices and reorient their activities without damaging other species.
- It is only possible if involvement of an individual and community.
- Following cumulative efforts to be made for conservation of biodiversity:
  - Preserve the species that are endangered.
  - Proper planning and management.
  - Varieties of food crops, forage plants, timber trees, livestock, animals and their wild relatives should be preserved
  - Each country should identify habitats of wild lives and protection.
- Direct pressure on biodiversity is reduced by use of agriculture, aquaculture and forestry in sustainable manner, reduce the rate of forest loss by at least 50%, reduce overfishing, reduce pollution and excessive use of fertilizer, minimize choral reflow destruction and ocean acidification, etc.
- In 1972, Government of India passed the Wild Life (Protection) Act to protect, preserve and propagate the variety of species within natural boundaries.
- The biological diversity Act, 2002 provides conservation of biological diversity, sustainable use of its components.

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3.2 CONCEPT OF ENVIRONMENT AND HEALTH (HOUSE, WATER, AIR, NOISE, LIGHT)

HOUSE AND HEALTH

- Standard of housing includes site, setback, rooms, kitchen, walls, roof, floor, windows, lighting, water supply, etc.
- **Site:**
  - Elevated from surrounding,
  - Surrounding pleasant environment,
  - Free from mosquito breeding places,
  - Away from nuisances such as noise, dust, smoke, etc.
  - Independent access to a street

According to census 2011, Pucca building may be treated as one which has its walls and roof made of the following material:

- **Wall material:** stones, galvanized iron/metal/asbestos sheets, burnt bricks, cement bricks, concrete.
- **Roof material:** machine made tiles, cement tiles, burnt bricks, stones, slate, GI/metal/ Asbestos sheets, concrete.
- **Buildings:** The walls and/or roof of which are predominantly made of materials other than those mentioned above such as unburnt bricks, bamboos, mad, grass, thatch, plastic/ polythene/loosely packed stone may be treated as kutcha building.
- **Set Back:**
  - The open space around the house which helps in having proper ventilation and lighting is called as **Set Back**.
  - In **rural areas** it is recommended that **two third** space of the plot should be left as set back it means the built up area should not more than **one-third** of the total area while for the **urban areas**, **one third** space of the plot should be left as set back it means the built-up area may be up to **two-third** of the total area.
  - The set back should be such that there is no obstruction to lighting and ventilation.
- **Floor:**
  - It should be impermeable so that it can be easily washed and kept clean and dry. Mud floors are prone to break up and create dust so they are not recommended.
  - There should be no cracks and crevices in the floor because they may be infested by insects **for example sand fly**.
  - The floors should be damp proof because it leads to skin problem (fungal infections) and allergic conditions (Asthma).
  - Plinth's height should be 2 to 3 feet (0.6 to 1 metre).

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- **Walls:** The characteristics of good wall is:
  - Strong
  - Low heat capacity means it should not absorb heat and conduct the heat
  - Weather Resistant
  - Unsuitable for Harborage of Rats and Vermin
  - Nine inch in thickness
  - Plastered (Smooth) and Colored (Cream or White Color)
- **Roof:**
  - The height of the roof should not be at least10 feet (3 m)
  - The roof should have a low heat transmittance coefficient.
  - Look over the roof to look for discarded items and collection of water and may be breeding of mosquitoes.
  - Check for any leakage.

Overcrowding: Overcrowding refers to the situation in which more people are living within a single dwelling than there is space for, so that movement is restricted, privacy secluded, hygiene impossible, rest and sleep difficult.

Minimum space for one adult person is 50 square feet.

The recommended standards with respect to overcrowding are as below:

- **Persons per room:** The degree of overcrowding can best be expressed as the number of persons per room, i.e., number of persons in the household divided by the number of rooms in the dwelling. The accepted standards are:
  - 1 room : 2 persons
  - 2 rooms : 3 persons
  - 3 rooms : 5 persons
  - 4 rooms : 7 persons
  - 5 or more rooms : 10 persons (additional 2 for each further room)
- **Floor space**: The accepted standards are:
  - 110 sq ft (11 sq m.) or more : 2 persons
  - 90–100 sq ft (9–10 sq m) : 1.5 persons
  - 70–90 sq ft (7–9 sq m) : 1 person
  - 50–70 sq ft (5–7 sq m) : 0.5 person
  - Under 50 sq ft (5 sq m) : nil

(A baby under 12 months is not counted; children between 1 to 10 counted as **half a unit).**

Sex separation (psychological overcrowding): Overcrowding is considered to exist if 2 persons over 9 years of age, of opposite sexes who are not husband and wife, are obliged to sleep in the same room.

Hazards of Overcrowding

- Physical hazards: infectious diseases like TB, influenza, scabies spread rapidly under conditions of overcrowding
- Psychosocial: irritability, frustration, lack of sleep, anxiety
- Social hazards: violence and mental disorders.
- Public health hazards: higher morbidity and mortality

Other housing criteria: Continuous water supply is also required. Kitchen must be a separate. Sanitary privy should be available. Washing and batching facility should be available. Regularly garbage and refuse should be removed.

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Water

- **Safe and wholesome water:**
  - Free from pathogenic agents
  - Free from harmful chemical substances
  - Pleasant to taste (free from color and odour)
  - Usable for domestic purposes

Water is said to be 'polluted' or 'contaminated' if it does not fulfill above criteria.

- **Water requirement:** Generally, it is recommended that 150 liters water per day per capita in urban area and 40 liters water per day per capita in rural area is required. As per the Jal Jeevan Mission, in urban area 135 liters per capita per day and for rural area 55 liters per capita per day water requirement is recommended.
- **Uses of water**
  - Domestic use: for drinking, cooking, bathing, washing and gardening, etc.
  - Agricultural purpose: irrigation
  - Public purposes: recreational purposes like swimming pools, public fountains, fire protection and public parks.
  - Industrial purposes: for processing and cooling
  - Power production from hydropower
  - Carrying away waste from all manner of establishments and institutions.

Hardness of Water

Classification

Level of hardness	*mEq /liter*
Soft water	Less than 1 (<50 mg/L)
Moderately hard	1–3 (50–150 mg/L)
Hard water	3–6 (150–300 mg/L)
Very hard water	6 (> 300 mg/L)

Types

Types	*Contain*
Temporary hardness	Calcium and Magnesium salts of Bicarbonates
Permanent hardness	Calcium and Magnesium salts of Sulfates, Calcium and Magnesium salts of Chlorides, Calcium and Magnesium salts of Nitrates

Measures to remove hardness of water (Fig. 3.2)

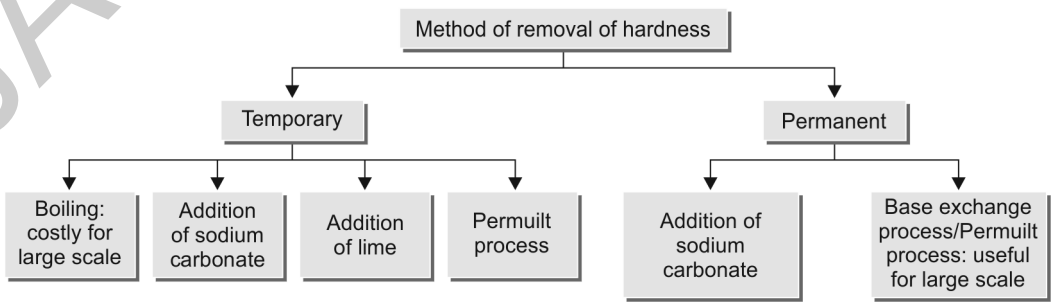


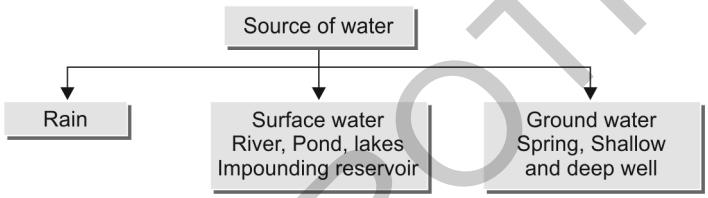
Fig. 3.2: Methods of removal of hardness of water.

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Classification of Diseases having Relation with Water

Types disease	*Remarks*
Water-borne diseases	Occur due to drinking contaminated water, transmitted by feco-oral route. e.g., Cholera, typhoid, dysentery, viral hepatitis A and E
Water washed diseases	Include infections of the outer body surface which occur due to inadequate use of water or improper hygiene, e.g., Scabies, trachoma, bacillary dysentery, amoebic dysentery
Water based diseases	Infections transmitted through an aquatic invertebrate animal, e.g., Dracunculiasis (Guineaworm disease), Schistosomiasis
Water related diseases/ Water breeding diseases	Infections spread by insects that depend on water, e.g., Malaria, dengue, filariasis, yellow fever, onchocerciasis

Source of Water



- **Rain:** It is a main source of water. Water is pure and soft. It became impure when suspended impurities like dust, gases such as sulphuric and nitric acid from environment react with atmospheric water and it leads to acid rain.
- **Surface water:** It is originating from rain water. Ex. River, lakes, tanks
  Main sources are: (1) river and streams, (2) tank and ponds (3) impounding reservoirs.
  - **Rivers:** The impurities in river are derived from industrial waste, sewage and sullage water and surface washings. Even pollution is also derived from the habits of the people like disposal of waste, bathing, animal washing, etc. Some amount of self-purification of water occur through natural method of water purification.
  - **Impounding reservoirs:** Artificial lake is constructed and water is stored. Drained area is known as catchment area. Generally, water is pure and soft. Impurities derives from catchment area which is affected by human habitation and animals.
  - **Tanks:** Water from tank is contaminated and aquatic vegetation also found in them. For prevention of tank contamination fence should be made, removal of weeds, periodically cleaning and elevated edges and platform of tank to prevent surface washing.
- **Ground water:** Sources: spring and wells. Types of wells: shallow well, deep well, dug well and tube well. Advantage of ground water—less chances of contamination in ground water that's why it is a free from pathogenic organism so, it does not require treatment. High content of minerals in water is the main disadvantage.

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Difference between Deep Well and Shallow Well

	Deep well	*Shallow well*
Level	Below the first impervious layer	Above the first impervious layer
Bacteriological quality	Pure	Highly contaminated
Seasonal variation	Constant source	Dry in summer
Chemical	Hard	Moderately hard water
Remarks of deep well	**Saline intrusion**: when infiltration of sea water into deep wells develops brackish taste to the water and it is not useful for domestic purpose. **Artesian well**: when the water level rises above the ground level	

Dug wells

- It is common in rural area.
- Types:
  - **Pucca well/Masonry well**: it is an open well. It is made of stones /bricks
  - **Steps well**: when steps are constructed on pucca well known as step well. Chances of contamination is higher
  - **Kutcha well**: here hole is dug into water bearing stream.
  - **Masonry well**: handpump is installed in kutcha well and making the upper 10 feet or more of the lining water-tight, raising the lining one foot above the ground, and providing concrete slab cover at the top

Sanitary well

- Location: minimum distance required 15 m or 50 feet from the source of contamination
- Lining: to prevent the side entry of water cement lining should be built up to 6 m depth.
- Platform: cement concrete platform extending 1 m in all direction
- Parapet wall: 70–75 cm height wall
- Hand pump: it should be installed to drawn the water in sanitary way
- Drain: pucca drain should be installed to provide water upto consumer level
- Covering: it should be covered to prevent entry of pollution inside the well.

Tube well: Lifespan is long lasting.

- Location: minimum distance required 15 m or 50 feet from the source of contamination
- Hand pump: pipe installed into water bearing stratum and fitted with strained at the bottom and hand pump at the top level.
- Different engineering method used to make hundred feet deep tube well or bored well.

Water Distribution

- There are two **systems of water distribution**, the intermittent supply and the continuous supply.
- **The disadvantages of the intermittent system are:**
  - When the pipes are empty, there is negative pressure and by what is known as **back-siphoning**, bacteria and foul gases may be sucked in through leaky joints that are with nearby passing sewage pipe lines. A number of recorded outbreaks of typhoid and other diseases, have been traced back to the contamination of water in the intermittent piped water supplies.

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- The pipes may be empty during times of emergency
- People need to store water in containers which may not be clean always and storage of water may be the source of mosquito breeding.

Key Guideline Aspects of WHO recommended Drinking Water Quality

- Color < 15 true color units (TCU)
- Turbidity < 5 nephlometric turbidity units (NTU)
- Hardness < 100–300 mg/litre calcium ion
- pH: 6.5–8.5
- Total dissolved solids (TDS) < 600 mg/litre
- Zero pathogenic microorganisms
- Zero infectious viruses
- Absence of pathogenic protozoa and infective stages of helminthes
- Fluorine < 1.5 ppm (0.5 – 0.8 ppm: Optimum level)
- Nitrates < 50 mg/litre
- Nitrites < 3 mg/litre
- Gross alpha radiological activity < 0.5 Bq/litre
- Gross beta radiological activity < 1.0 Bq/litre

Water Purification

Water purification is the process of removing contaminants from surface water or groundwater to make it safe and palatable for human consumption.

Purification of Water on a Large Scale

Components of typical water purification are:

- **Storage:** This is natural purification method in which all physical, chemical and biological mechanisms are involved.
  - **Physical:** About 90% of the suspended impurities settle down in 24 hours by gravity.
  - **Chemical:** Organic matter which is present in the water will be oxidized by the aerobic bacteria with the aid of dissolved oxygen. And due to this oxidation, the level of free ammonia is reduced and nitrates level increases.
  - **Biological**: Decrease bacteriological count. Up to 90% in first 5–7 days. It is the greatest benefit of storage.
- **Filtration:**
  - 98-99% bacteria are removed by filtration in addition to removal of the other impurities.
  - Two types of filters **(Fig. 3.3)**:
    1. Slow sand/biological filters
    2. Rapid sand/mechanical filters

Rapid Sand or Mechanical Filters

- Two types: Gravity type (Paterson's filter) and Pressure type (Candy's filter)
- After being pre-treated (coagulation and flocculation), fresh water flows through a sand and gravel bed.

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- **Steps:**
  - Coagulation: Alum 5-40 mg/lit depending upon turbidity, color, pH
  - Rapid mixing: In mixing chamber for a few minutes
  - Flocculation: It consists of paddles which rotates at 2–4 rpm. This slow and gentle stirring results in formation of thick, copious, precipitate of aluminum hydroxide. In Flocculation chamber for 30 minutes
  - Sedimentation: 2–6 hr at least 95% of flocculant precipitate needs to be removed.
  - Filtration: Alum flock which is not removed by sedimentation, it forms a slimy layer comparable to zoogleal layer. It adsorbs bacteria from water and effect purification. When loss of head approaches 6-8 feet, filtration is stopped and backwashing start.
- **Backwashing:** It takes 15 minutes. Cleaning of the filter-bed every 24–72 hours. Backwashing water and sludge often toxic in nature so, treatment required.

Difference Between Rapid and Slow and Filtrations

S. No.	*Characteristic*	*Rapid sand filter*	*Slow sand filter*
1.	Requirement of space	Occupies little space	Large space
2.	Rate of filtration	200 m.g.a.d	2–3 m.g.a.d.
3.	Effective size of sand	0.4–0.7 mm	0.2–0.3 mm
4.	Preliminary treatment	Chemical coagulation and sedimentation	Plain sedimentation
5.	Washing method	By backwashing	By scraping the sand
6.	Skill requirement	Highly skilled	Less skilled
7.	Loss of head at	6–8 feet (2–2.5 m)	4 feet (1.5 m)
8.	Removal of turbidity	Good	Good
9.	Removal of color	Good	Fair
10.	Removal of microorganisms	98–99%	99.9–99.99%

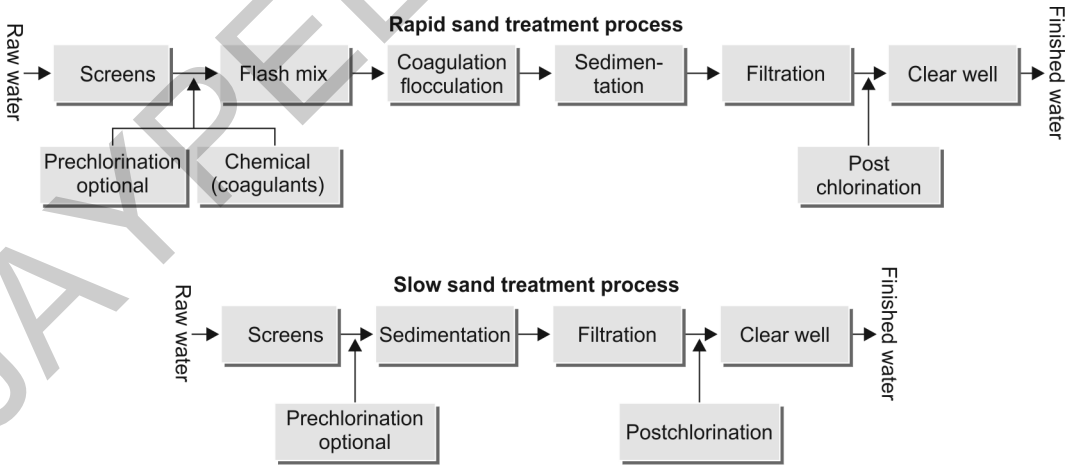


Fig. 3.3: Filtration process.

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Disinfection

Types of disinfection

- Physical disinfection techniques include:
  - Boiling and
  - Irradiation with ultraviolet light.
- Chemical disinfection techniques include:
  - Chlorine
  - Bromine
  - Iodine, and
  - Ozone

Chlorination of Water (Fig. 3.4)

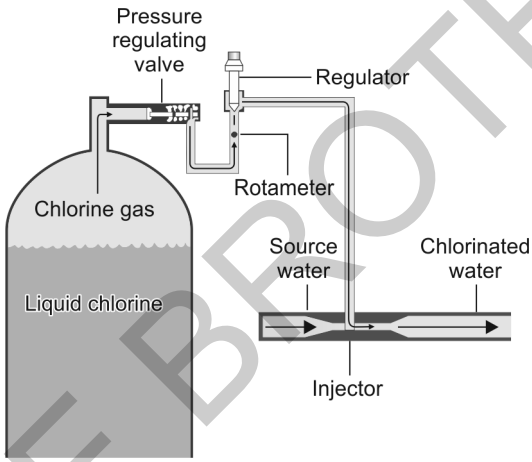


Fig. 3.4: Chlorination of water.

Chlorine demand: It is the difference between the amount of chlorine added and the amount of free, combined or total available chorine remaining at the contact period.

- Disinfecting action of chlorine in water is due to:
  - Hypochlorous acid (HOCl): Main role in disinfection
  - Hypochlorite ions (OCl): Minor role in disinfection
- Chlorine kills pathogenic bacteria, but has no effect on spores and certain viruses. Chlorine has residual germicidal effect (and not Ozone or UV rays): Provides a margin of safety against subsequent microbial contamination, as may occur during storage and distribution.
- When chlorine is added to water, there is formation of hydrochloric and hypochlorous acids. Disinfection action is due to Hypochlorous acid.
- Phases of chlorination:
  - Phase I: Formation of chloramines
  - Phase II: Destruction of chloramines
  - Phase III: Appearance of break-point
  - Phase IV: Accumulation of free residual chlorine.
- **Tests** for chlorination of water:
  - Orthtoluidine (OT) test: Measures
    - Free (residual) chlorine
    - Free and combined chlorine

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- Orthotoluidine arsenite (OTA) test: Measures
  - Free chlorine
  - Combined chlorine
  - It can detect both free and combine chlorine separately.

❒ **Break point chlorination**: It is a chlorination point at which the residual chlorine appears and combined chlorines have been completely destroyed is the breakpoint chlorination.

❒ **Superchlorination**: It is required for heavily polluted water. During this process large amount of chlorine is added and removal of excess chlorine after disinfection.

❒ **Instrument Utility:**
- Horrock's Apparatus: Chlorine demand estimation
- Chlorinator/ Chloronome: Mixing or regulating dose of chlorine
- Measuring residual level of chlorine: there are three methods:
  - Pool test kits (chloroscope is this type of instrument).
  - Color wheel test kit (use DPD tablet, water turns to pink if residual chlorine is present).
  - Digital colorimeters
- Desirable level of chlorination:
  - At household level = 0.2 mg/L residual chlorine
  - In the distribution system = 0.5 mg/L residual chlorine
  - In swimming pool = 0.7 mg/L residual chlorine
  - During disaster = 1.0 mg/L residual chlorine

Side effect of excess chlorine in water: Mouth ulcer, gallstone, cancer

PURIFICATION OF WATER ON A SMALL SCALE

Household Purification of Water

A. Boiling

Advantages of boiling:

❒ Boiling kills all bacteria, spores, cysts and ova

❒ Removes temporary hardness

Limitation:

❒ Boiling has no residual effect, so it does not provide protection against the re-contamination

❒ Boiled water should be stored properly and used within a few days

B. Chemical Disinfection

Bleaching powder

❒ Bleaching powder or chlorinated lime is a white powder with pungent smell of chlorine.

❒ It contains about 33% of available chlorine.

❒ Unstable compound when exposed to air loses its chlorine content. So, mix with excess of lime. This is called "stabilized bleach".

Chlorine solution

If 4 kg of bleaching powder with 25% available chlorine mixed with 20 litres of water, it will give 5% solution of chlorine.

High test hypochlorite (HTH)

❒ HTH or perchloron is a calcium compound which contains 60–70% available chlorine.

❒ More stable than bleaching powder.

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Chlorine tablet

- Available in market as trade name halozen tablet. But it is a costly.
- National environmental engineering research institute, Nagpur formulated tablet that is 15 times better than halogen tablet and it is less costly.
- A single tablet of 0.5 g is sufficient to disinfect 20 liters of water.

Iodine

- Used for emergency disinfection of water.
- Two drops of 2% ethanol solution of iodine will suffice for 1 liter of clean water.
- Contact time 20–30 min.
- Not react with organic compound but persist longer than chlorine.
- Disadvantage : high cost, physiological active (thyroid activity)

Potassium permanganate

- Powerful oxidizing agent, kills vibrio cholera
- But not useful due to altering color, smell and taste of water.

C. Filteration

- Ceramic filters such as Pasteur Chamberland filter, Berkefeld filter and Katadyn filter are used for domestic purpose.
- Candle is made of porcelain in chamberland type and infusorial earth in berkefeld type.
- In katadyn filter, surface coated with silver catalyst so bacteria killed by oligodynamic action of silver ions.
- Filter candle removes bacteria but not viruses.

D. Ultraviolet Irradiation

- Effective against bacteria, yeast, virus, fungi, algae, protozoa, etc.

Advantage

- Short period, No foreign matter introduce, no taste and odour produce

Disadvantage

- No residual effect, Expensive

Chlorination of Well

- Horrock's Apparatus is used to find bleaching powder requirement to disinfect 455 liters of water.
- First take 2 gm of bleaching powder with little water in black cup and make thin paste. Add some water is added to the circular mark and vigorous stirring is done to make a solution called as 'stock solution'.
- Then All 6 white cups are filled with the water which is to be tested.
- With help of pipette stock solution is added as follows: 1 drop to first cup, 2 drops to second cup, three drops to third cup and so on. Each glass is stirred with separate rod and left for half an hour as contact period.
- After that freshly prepared starch iodide indicator is added to all white cups by dropper and stirred.
- Development of blue color indicated the presence of free residual chlorine.
- If third cup showing blue color, it means $3 \times 2 = 6$ gm of bleaching powder is required to disinfect 455 liter of water. (2 gm is added amount of chlorine is multiplied with number of

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