QUESTIONS	PATTERN
Definition	**--**
Large scale purification	**ESSAY**
Slow and Rapid sand filtration	**SHORT NOTE**
Biological Layer/Zoogleal Layer/ Schmutzdecke	**SHORT NOTE**
Backwashing	**SHORT NOTE**
Principles of chlorination/Break point chlorination	**SHORT NOTE**
Small scale water purification.	**SHORT NOTE**

WATER PURIFICATION

POTABLE WATER

Definition:- POTABLE WATER

- ✓ Free from pathogenic agents
- ✓ Free from harmful chemical substances
- ✓ Pleasant taste i.e. free from any odour and color
- ✓ Usable for domestic purposes

- **Purification of water on large scale**
- **Purification of water on small scale**

LARGE SCALE- WATERPURIFICATION

Basic steps

1. **Storage**
2. **Filtration**
   - Slow sand filter
   - Rapid sand
3. **Disinfection**

- Chlorination
- Ozonation
- Otheragents
- Membraneprocesses

❖ **STEP 1)STORAGE(only for slow sand filter)**

In natural or artificial reservoirs

Effects of storage:

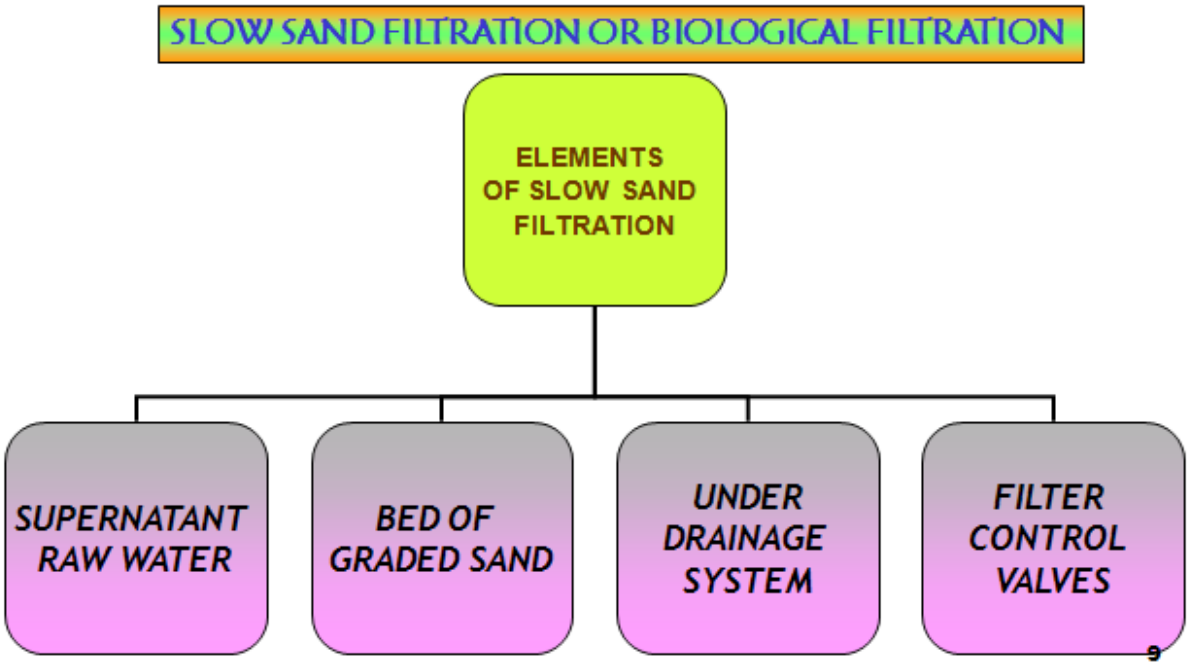
a. Physical: gravity – 90% suspended impurities settle down in one day
b. Chemical: oxidizing action
c. Biological: only 10% bacteria remains at the end of 1 week

Optimum period of storage: 2 weeks

❖ FILTRATION

- Water passed through porous media
  1. Slow sand filter: biological
  2. Rapid sand filter: mechanical

SLOWSAND (BIOLOGICAL) FILTERS



Cross-sectional view of the filterbed

❖ **ELEMENTSOF SLOW SANDFILTER**

- Supernatant water
- Sand bed
- Under drainage system
- Filter control valves

- **Supernatant water**
  - Depth: 1 to 1.5m
  - Promotes downward flow of water through the sand bed
  - Waiting time of 3-12 hours for raw water to undergo partial purification by sedimentation and oxidation

- **Sandbed**
  - Depth, 1 m (sand of diameter 0.2-0.3 mm), 0.3m (gravel with 0.2 - 1 cm diameter)
  - Sedimentation-The supernatant water acts as a settling reservoir. Settle-able particles sink to the sand surface.
  - Mechanical straining-Particles too big to pass through the gap between the sand grains are retained
  -

- **Vital/ Biological/ Zoogleal/ Schumtzdecke layer**
  - Slimy, gelatinous layer over sand bed Containing thread like algae, bacteria and diatoms
    'Heart' of the slow sandfilter
  - Ripening of filter: Formation of vital layer
  - Suspended particles are retained by adhesion to the biological layer
  - Removes organic matter, holds back bacteria and oxidizes ammoniacal Nitrogen to nitrates

- **Under drainage system**
  - Depth: 0.15m
  - At the bottom of filterbed
  - Porous pipes: Outlet for filtered water as well as support to the filter media bove
  - Rate of filtration 0.1-0.4m3/hr/m3

- **Filter control valves**

- To regulate the flow of water in and out

➢ **Filter cleaning --Increased bed resistance -> Necessary to open the regulating valves fully->Scrapping top portion of sand bed up to 2 cm depth ->Time for cleaning the filter**

- After 3-4 years new filter bed is constructed

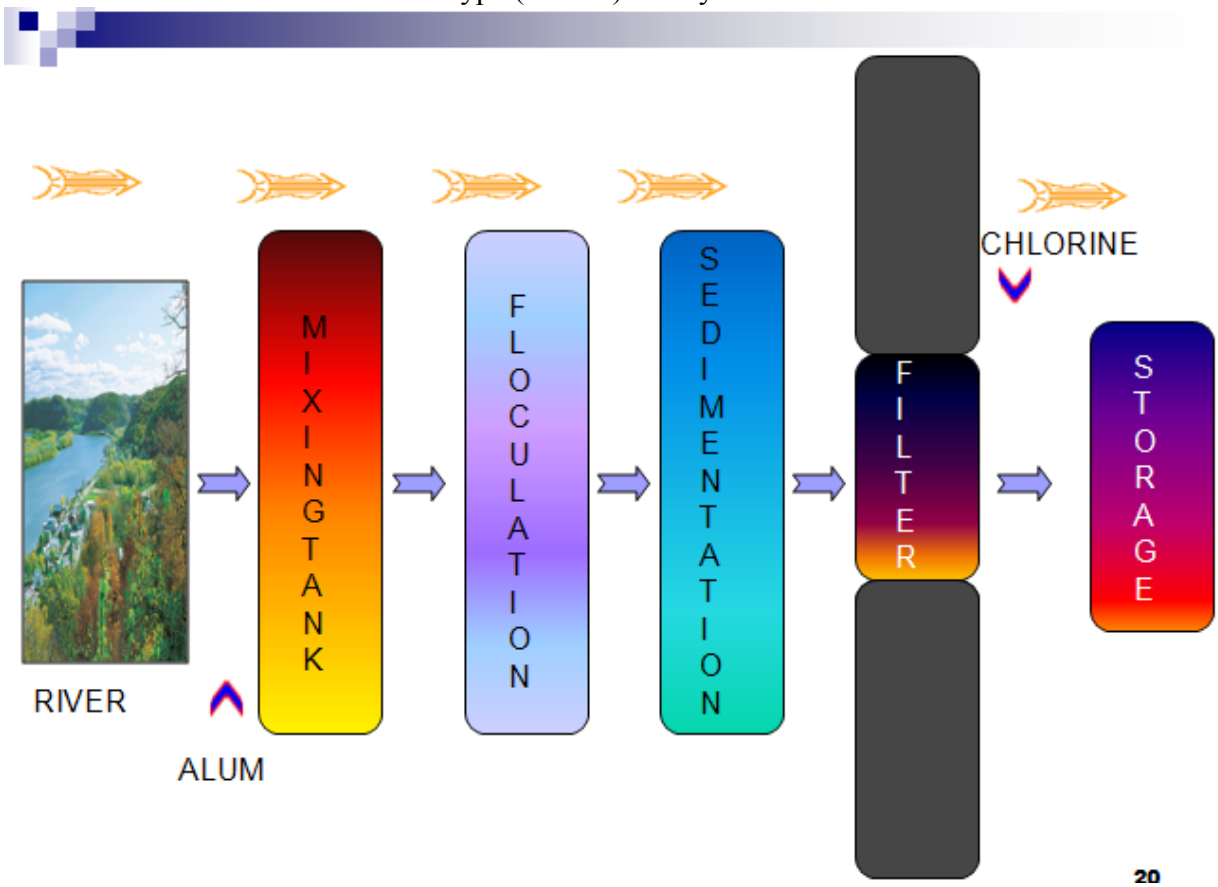
ADVANTAGES OF SLOW SANDFILTER

1. Simple to construct and operate
2. Construction is cheaper than rapid sand filters
3. Physical, chemical and bacteriological quality of filtered water is very high (99.9 to 99.99 per cent and E. Coli by 99 to 99.9 percent

RAPID SANDFILTER

First in1885 inUSA

- Gravity type (Open)/Paterson's
- Pressure type (Closed)/Candy's



STEPS OF RAPID SANDFILTER

1)Coagulation and rapid mixing

- Raw water is first treated with a chemical coagulant such as ALUM.
- Treated water is then subjected to violent agitation in MIXING CHAMBER for few minutes. This allows a quick and thorough dissemination of ALUM throughout the bulk of the water, which is very necessary.

2)Flocculation

- Slow and gentle stirring of treated water in a ***flocculation chamber*** for about ***30 minutes.***
- This slow and gentle stirring results in formation of thick, copious, white flocculent precipitate of ***aluminium hydroxide.***

3)Sedimentation

Coagulated water is now led into sedimentation tanks - detained for periods varying from 2-6 hours when the flocculent precipitate together with impurities and bacteria settle down in the tank.

4) Filtration

- Filterbed
- "Effective size" of the sand particles is 0.4-0.7mm
- Graded gravel, 30 to 40 cm
- Depth of the water on the top of the sand bed is 1.0 to 1.5m
- Rate of filtration is 5-15m3/m2/hr
- Remaining alum floc forms a slimy layer over sand bed, it holds back bacteria, oxidize organic matter
- Back washing: by air bubbles or water when floc layer becomes very thick, takes about 15min

ADVANTAGES OF RAPID SANDFILTER

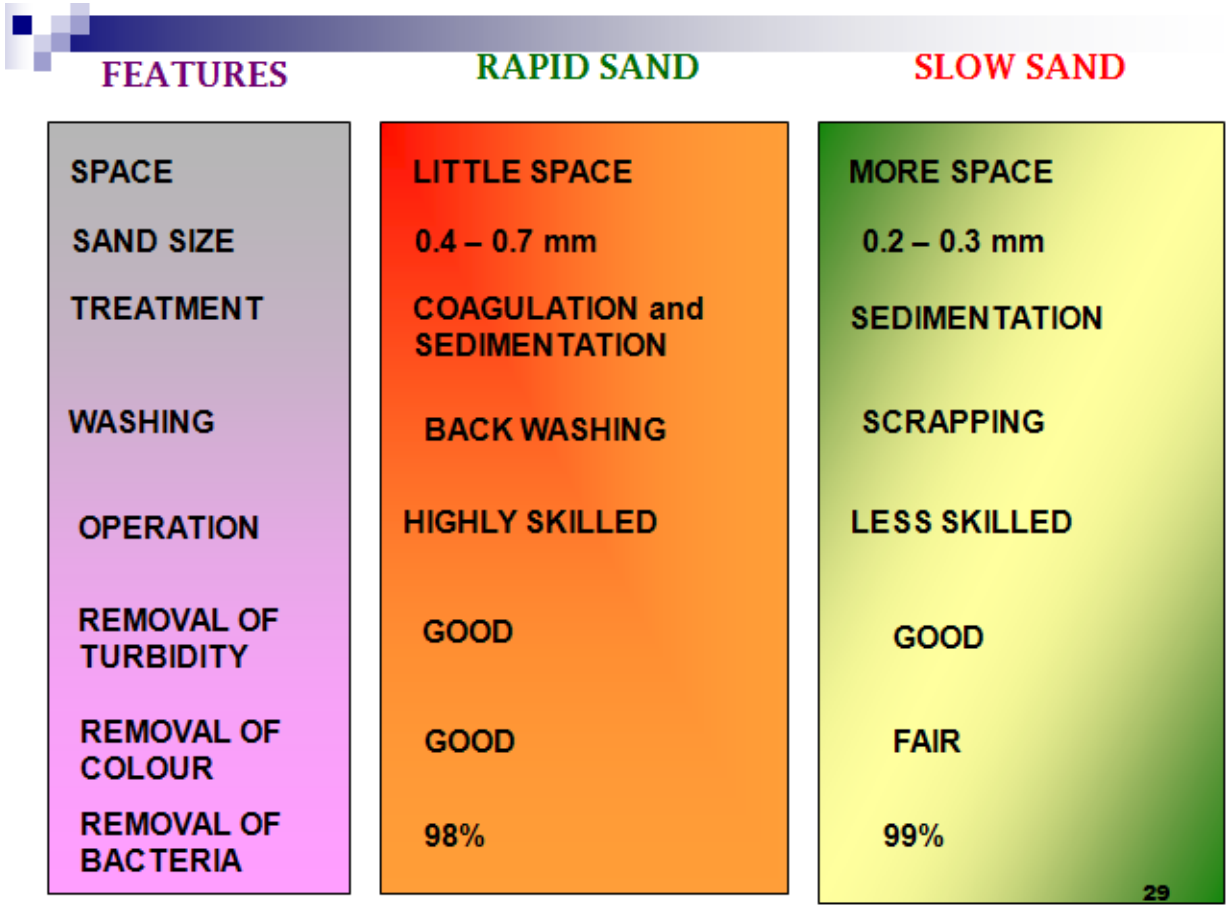
Rapid sand filter can deal with raw water directly.

No preliminary storage is needed

The filter beds occupy less space
Filtration is rapid, 40-50 times that of a slow sand filter

1. The washing of the filter is easy
2. There is more flexibility in operation

DIFFERENCES BETWEEN SLOWAND RAPID SAND FILTRATION



DISINFECTION

ACTION OFCHLORINATION

- Kills pathogenic bacteria (no effect on spores andviruses)
  - Oxidize iron, manganese and hydrogensulphide
  - Reduces taste andodours
  - Controlsalgae
  - Maintains residualdisinfection

PRINCIPLES OF CHLORINATION

Water should be clear, free from turbidity

Chlorine demand: Chlorine needed to destroy bacteria, to oxidize organic matter and to neutralize the ammonia in water

- Minimum recommended concentration of free chlorine : 0.5mg/L for one hour

- Sum of chlorine demand of specific water plus the free residual chlorine of 0.5mg/L constitutes the correct dose of chlorine to be added.

- Dose of Chlorine = Chlorine demand + Free residual chlorine
- Minimum recommended concentration of free chlorine is 0.5 mg/L for1hr

METHODS OFCHLORINATION

- Chlorine gas (Paterson's chloronome)
- Chloramine
- Perchloron or high test hypochlorite(HTH)

SUPERCHLORINATION

- Method of choice for highly polluted waters
- High dose of chlorine is added
- After 20 minutes of contact, dechlorination is done with sodium sulphate/ sodium thiosulphate to reduce the taste of excesschlorine

OTHER DISINFECTION METHODS

- Ozone
    - Used in Europe and Canada
    - Strong oxidizing agent
    - Strong virucidal
    - No residual effect
- Should be used with chlorination
- UV Rays
- Used in UK
- Water should beclear
- No residualeffect
- Expensive
- **Chloramine**
    - Chlorine + Ammonia -Chloramine
    - Less effective than chlorine

- **Purification of water on small scale**

Household purification of water

- Boiling
- Chemical disinfection

- Bleaching powder
- Chlorine solution
- High test hypochlorite
- Chlorine tablets
- Iodine
- Potassium permanganate

■ Filtration

Pasteur Chamber land filter, Berke feld filter, Katadyn filter

II. Disinfection of wells

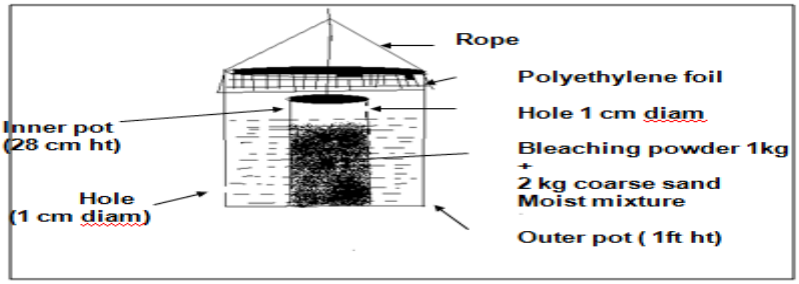
■ Wells are main source of water supply in rural areas

■ Need arises to disinfect them during epidemics of cholera, gastroenteritis etc.

■ Most effective method is by bleaching powder.

Double pot method

❖ By NEERI, Nagpur, India



❖ Placed 1 meter below the water level

❖ Effective for chlorination of well (4500 L water) with a daily withdrawal of 450 L water ---2-3 weeks

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