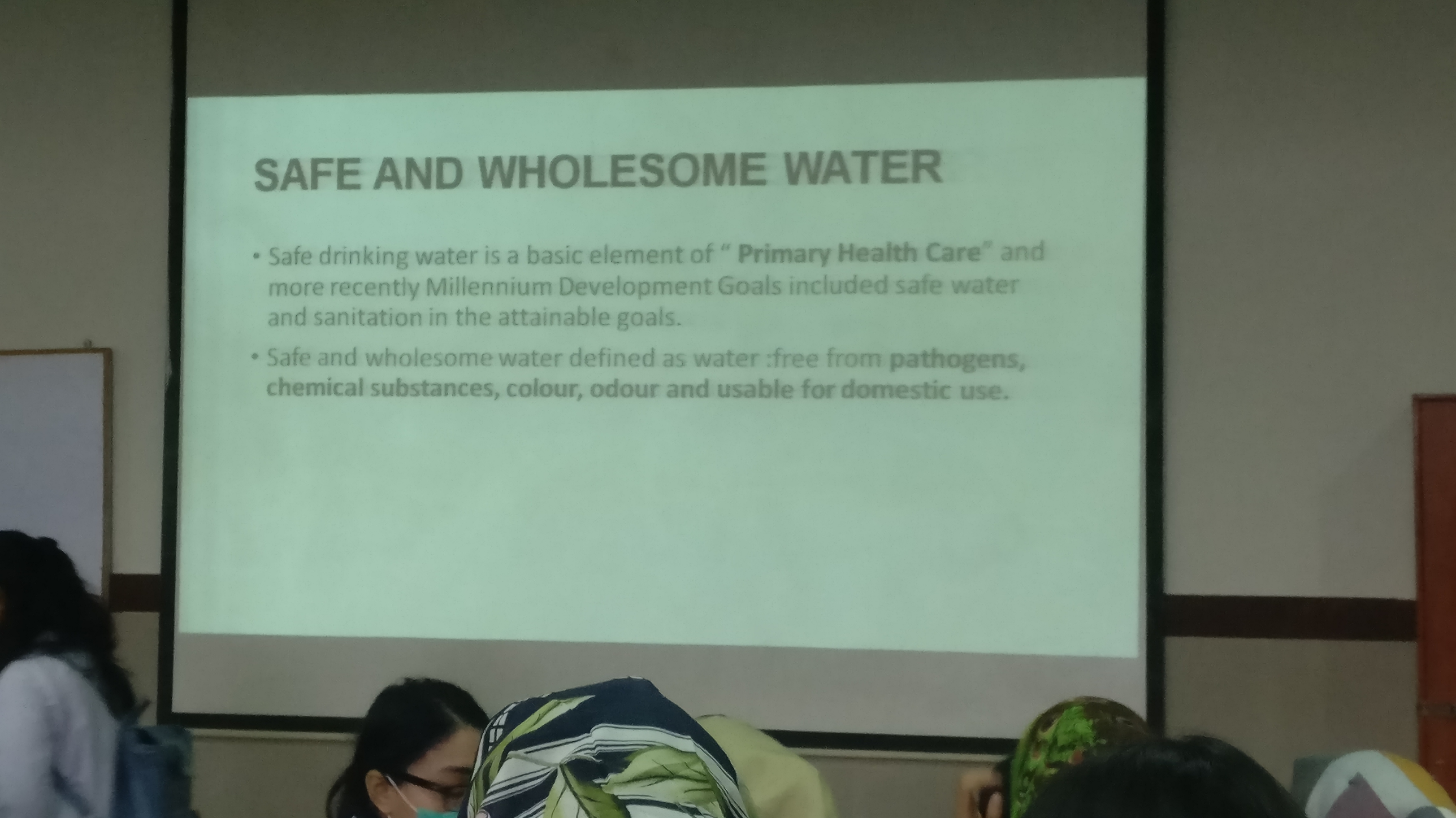

SAFE AND WHOLESOME WATER
• Safe drinking water is a basic element of " Primary Health Care" and more recently Millennium Development Goals included safe water and sanitation in the attainable goals.
• Safe and wholesome water defined as water :free from pathogens, chemical substances, colour, odour and usable for domestic use.

Methods of purifying Water

- Purification on Large scale
- Purification on Medium Scale
- Purification on Small Scale(Domestic Methods)

PURIFICATION ON LARGE SCALE

When sources of water are rivers, streams, dams, lakes and sea etc. then water is purified by the following methods

1/ Storage

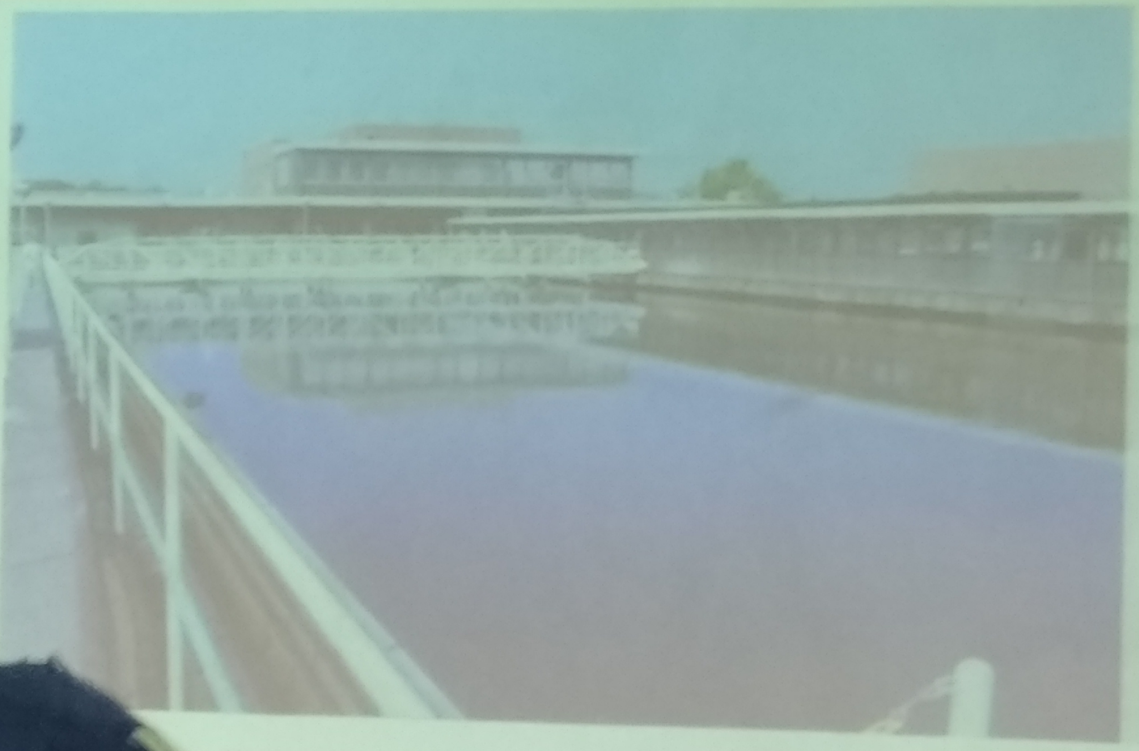
2/ Filtration

- slow sand or biological filters
- rapid sand or mechanical filters

3/ Disinfection

- Chlorination :**Water is disinfected by the addition of chlorine after filtration.**

STORAGE



STORAGE

- Impounding water from source to natural or artificial reservoirs
- Natural purification
- Physical: quality improve,90% impurities settled down in24 hours, reduces work of filters
- Chemical: aerobic bacteria oxidize organic matter by using dissolved oxygen,↓ free ammonia and ↑ in nitrates
- Biological: tremendous drop in bacterial count, 90% ↓in 5-7 days
- Optimum period of storage :10-14 days

FILTRATION

- Second stage of purification
- 98-99% bacteria removed by filtration
- Two types

SLOW SAND OR BIOLOGICAL FILTERS:

Elements: a/supernatant water

b/a bed of graded sand

c/an under drainage system

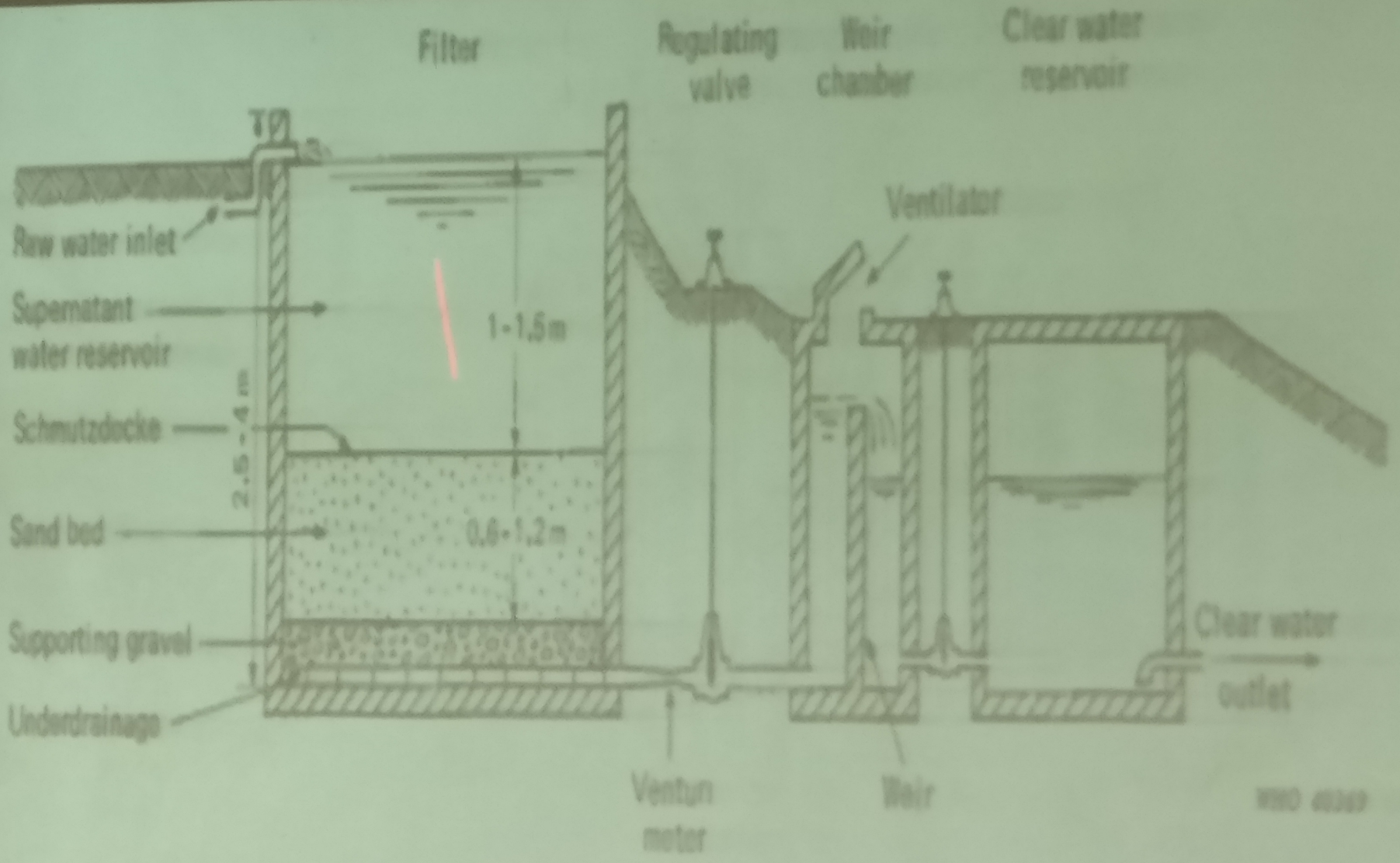
d/a system of filter control valves

a/Supernatant water: depth

2 important purposes i.e. constant head → to overcome the resistance of filter bed, Secondly provide waiting period of 3-12hours for raw water

b/Sand bed: most important part

sand grains supported by graded gravel, water percolates through sand bed very slowly 2-more hours(purification through mechanical straining, sedimentation ,oxidation and bacterial action


Filter
Regulating valve
Weir chamber
Clear water reservoir
Ventilator
Raw water inlet
Supernatant water reservoir
Schmutzdecke
Sand bed
Supporting gravel
Underdrainage
1-1,5 m
2,5-4 m
0,6-1,2 m
Clear water outlet
Ventur meter
Weir
WHO 4589

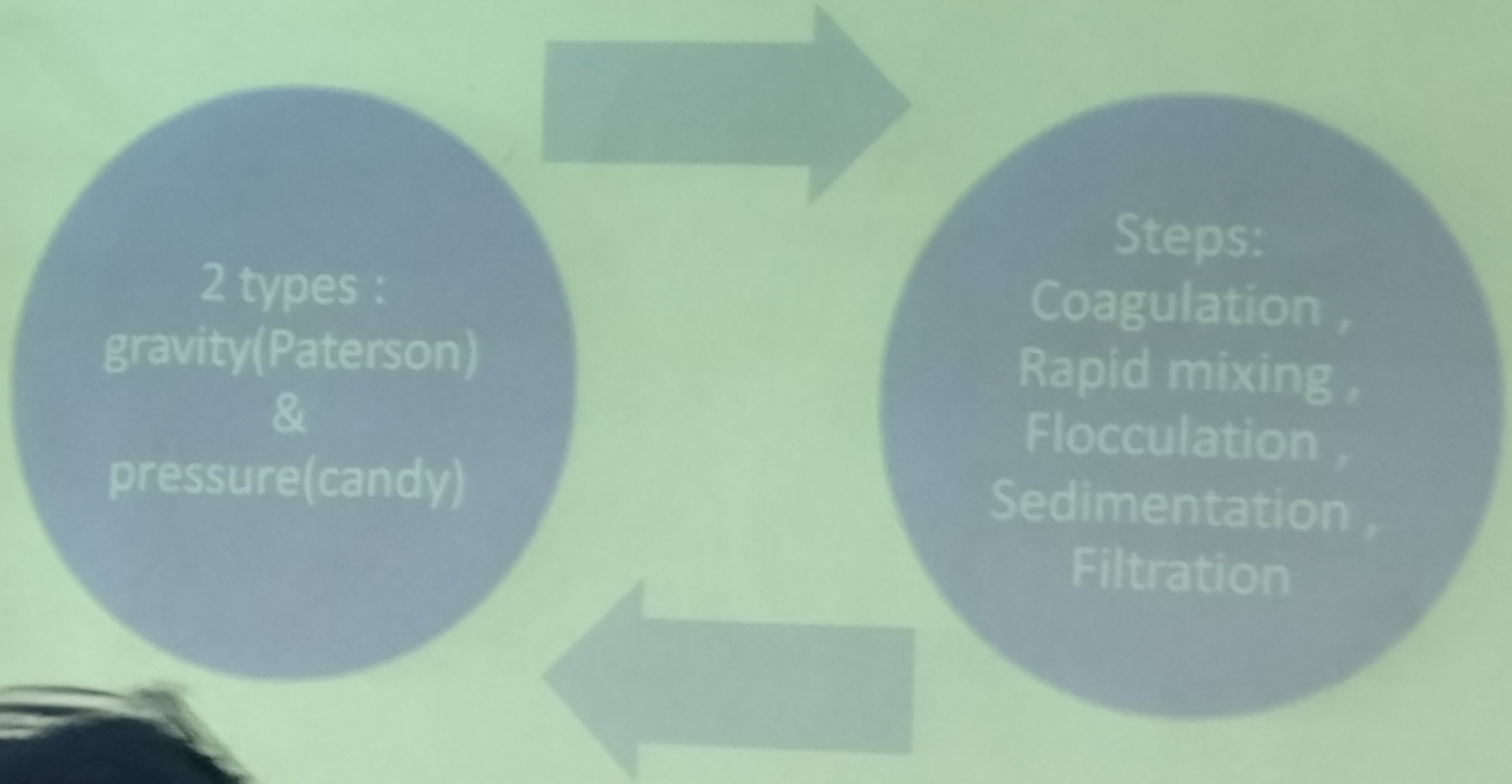
D/ FILTER CONTROL

Venturi meter- measures bed resistance or loss of head

Filter cleaning- supernatant water drained off & by scraping of sand bed, thickness reduce to 0.5-0.8m , new bed is constructed

ADVANTAGES : simple, cheap , high quality filter water, reduce bacterial count 99%

RAPID SAND FILTER OR MECHANICAL FILTER



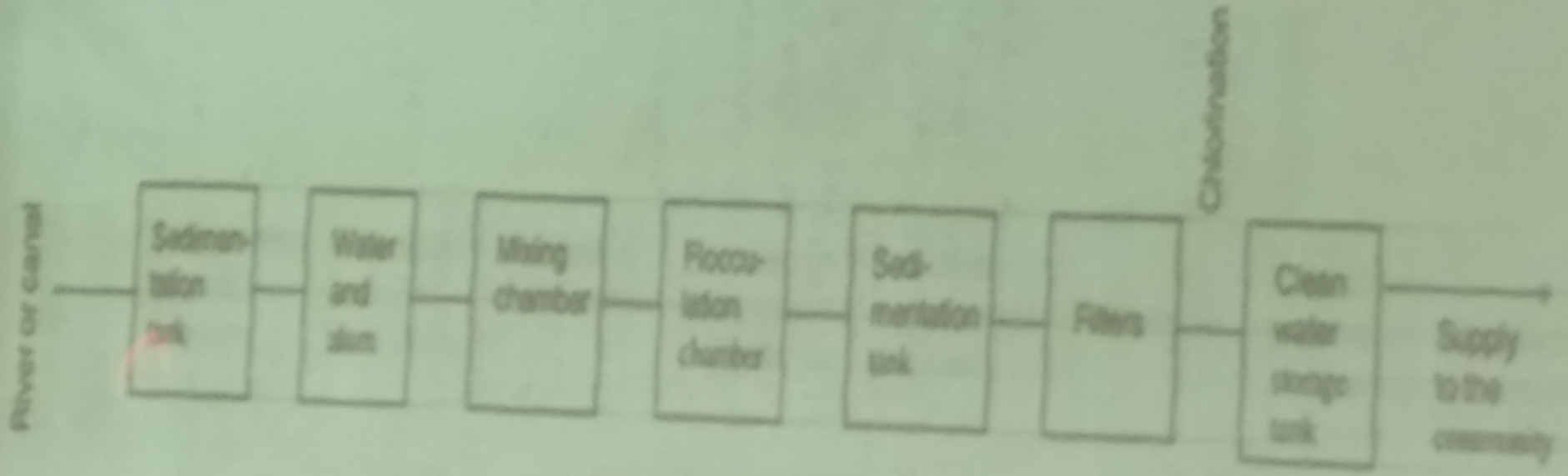


Fig 5.4 : Flow diagram of rapid sand filtration plant.

Comparison of Rapid & Slow Sand Filters.

	Slow Sand Filter	Rapid Sand Filter
Space	Occupies large space	Occupies very little area
Rate of filtration	0.1 -0.4 $m^3/m^2 h$	5- 15 $m^3/m^2 h$
Effective size of sand	0.15-0.35 mm	0.6 - 2.0 mm
Preliminary treatment	Plain sedimentation	Chemical coagulation
Washing	By Scraping the sand bed	By back-washing
Operations	Less skilled	Highly skilled
Removal of turbidity	Good	Good
Removal of colour	fair	Good
Removal of bacteria	99.9-99.99 per cent	98 - 99 per cent

DISINFECTION

- Qualities
- Chlorination
- Action of chlorine
- Principles of chlorination
- Break point chlorination
- Super chlorination
- Orthotolidine test(OT)
- Other agents and ozonation

Disinfection of wells

- By bleaching powder(chlorinated lime $CaOCl_2$)
- Steps: a/ find the volume of water in a well:

Measure the depth of water column.....(h)m

Measure the diameter of well.....(d)m

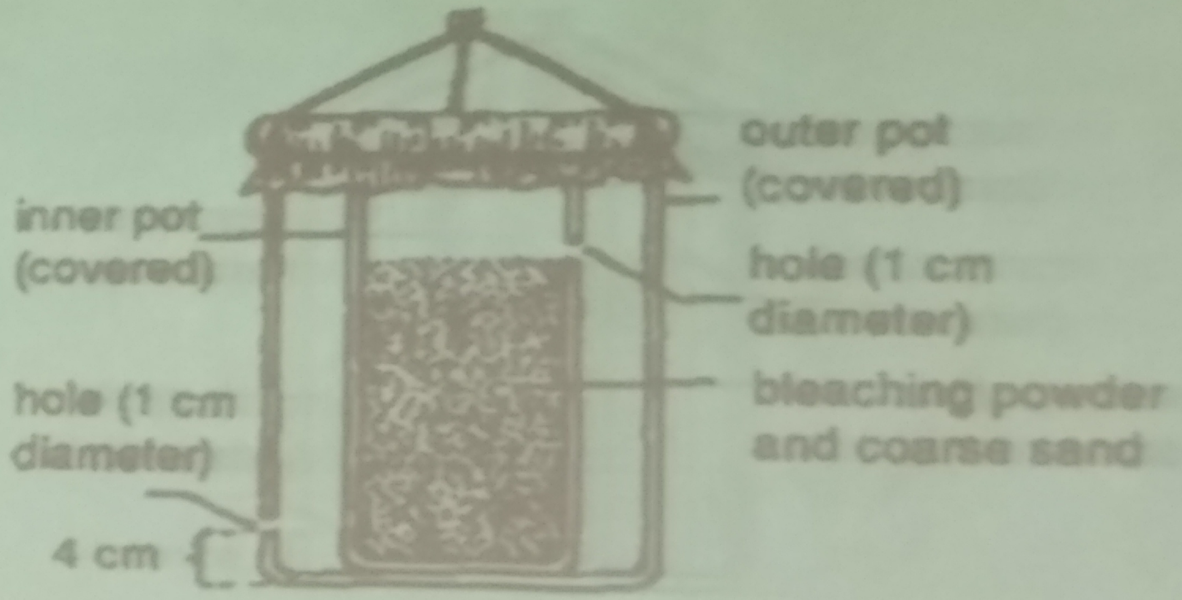
Take the average of several readings of the above measurements.

- Substitute h and d in : Volume(liters)$=\frac{3.14\times d_2\times h}{4}\times 1000$
- One cubic meter= 1000 liters of water

b/ find the amount of bleaching powder required for disinfection(2.5gms for 1000 liters of water)

Double Pot Method

- Disinfection of Wells during an Emergency – The Double Pot Method
  E.g. an outbreak of cholera
  • During an emergency, it is desirable to ensure a constant dosage of chlorine to well water



ACTION OF CHLORINE

- When chlorine is added to water, it forms Hydrochloric Acid (HCL) & Hypochlorous Acid (HOCI). The disinfecting action of chlorine is mainly due to hypochlorous acid and to a small extent due to hypochlorite ions.

PRINCIPLES OF CHLORINATION

1. Water to be chlorinated must be free from turbidity.
2. Chlorine demand of water should be estimated.
3. Contact period for one hour is essential to kill the bacteria and viruses.
4. Minimum recommended concentration for free chlorine is 0.5 mg per liter for one hour.

Actual dose of Chlorine:

It is the sum of chlorine demand plus free residual chlorine

Chlorine Demand:

It is the difference between the amount of chlorine added to the water and the amount of residual chlorine remaining at the end of a specific period of contact (1 hour) at a given temperature and pH of water.

Residual Chlorine:

Amount of untreated chlorine, remaining in the water after some time as an effective disinfecting agent i.e. 0.2 ppm

Break point chlorination:

The point at which the chlorine demand of water is met and if further chlorine is added free chlorine begin to appear in water.

Super Chlorination:

It is addition of large doses of chlorine to the water and removal of excess of chlorine after disinfection.

Break point chlorination

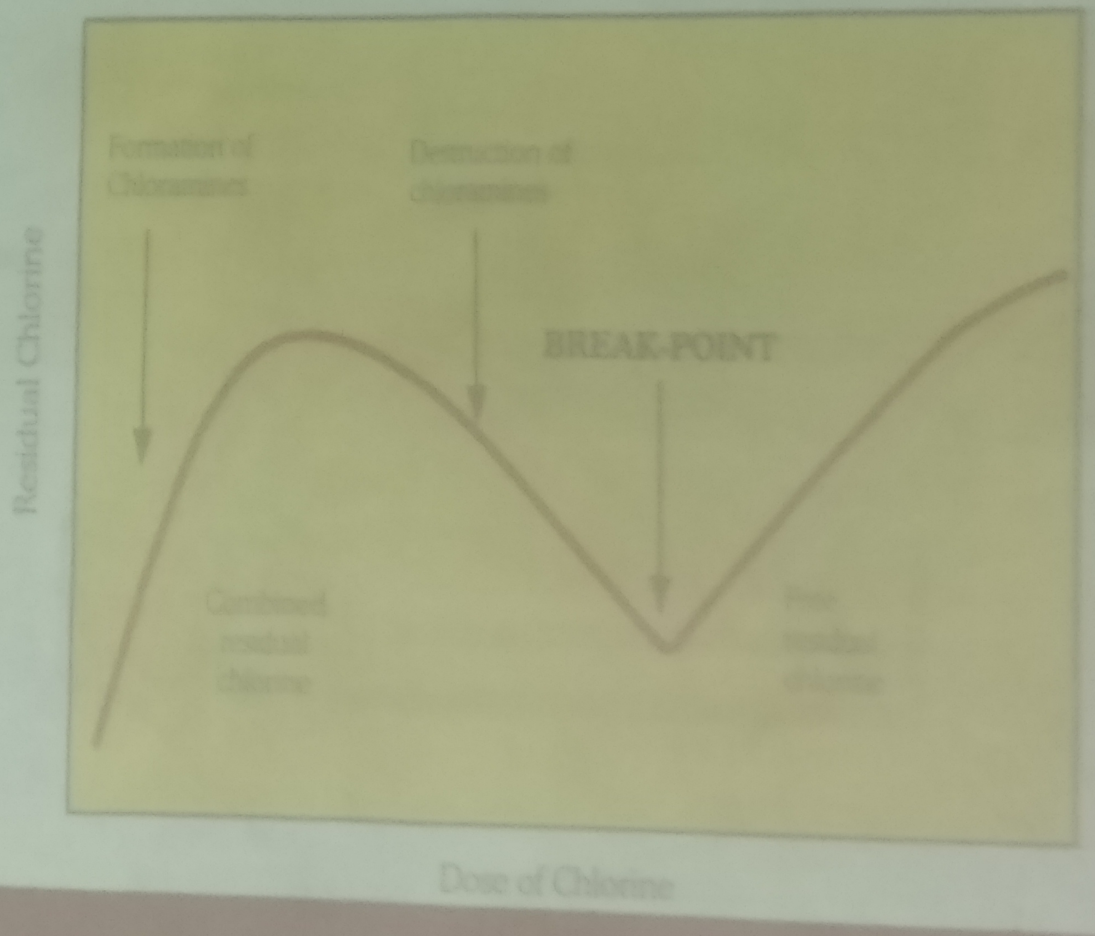
Break point chlorination is a systematic and scientific process and involves several steps. There are essentially four phases of chlorination:

Phase I: Formation of chloramines

Phase II: Destruction of chloramines

Phase III: Appearance of break-point

Phase IV: Accumulation of free residual chlorine



PURIFICATION ON MEDIUM SCALE

When sources of water are wells, springs, tanks etc. then water is purified by the addition of bleaching powder / chlorinated lime as it is cheap, easy to use, reliable and safe.

PURIFICATION ON SMALL SCALE

(DOMESTIC METHODS)

Boiling

Distillation

Addition of Chemicals:

- Bleaching Powder
- Chlorine
- Iodine solution
- $KMnO_4$
- Alum

4. Filtration