

15 / 4 / 2009

Water purification

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Faculty of pharmacy , 3th class



Overview :

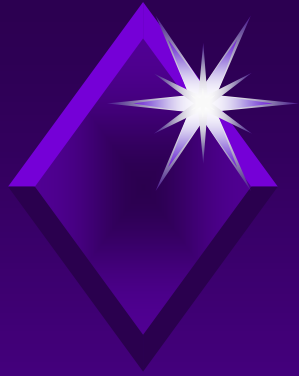
1. Definition
2. History
3. Methods





Definition :

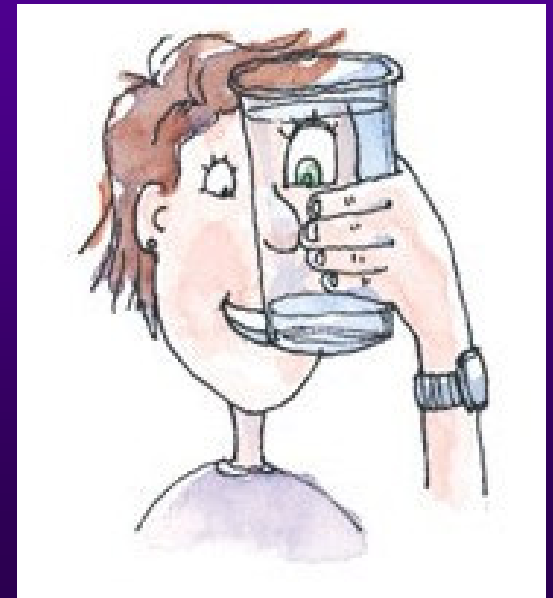
- ❑ **Water purification** is the process of removing undesirable chemical and biological contaminants from raw water.
- ❑ The goal is to produce water fit for a specific purpose



Contaminants :

- ❑ Substances that are removed during the process:
 1. Bacteria and Viruses
 2. Algae and fungi
 3. Minerals, and man-made chemical pollutants.

- ❑ It is not possible to tell whether water is safe to drink just by looking at it.



History :

- ❑ Hippocrates (the father of medicine) mentioned clearly how water could be purified. He invented "Hippocrate's sleeve," which was cloth bag and was used for water purification. This treatment was helpful in removing hardness and bad smell from the water.
- ❑ The Greek and Romans too developed various methods for treating water in order to control tastes and odor.





Methods

Distillation

Double distillation

Deionization

Reverse osmosis

Sedimentation

Flocculation

Filtration

UV-ray

Ultra filtration

Electro dialysis

carbon filter

Electro deionization

Micro porous filter

Water Treatment Methods

Screening

The first step in purifying surface water is to remove large debris like sticks, leaves, trash and other large particles which may interfere with subsequent purification steps.

Groundwater does not need screening before other purification steps





Distillation

Dissolved solids less than 10mg/lit

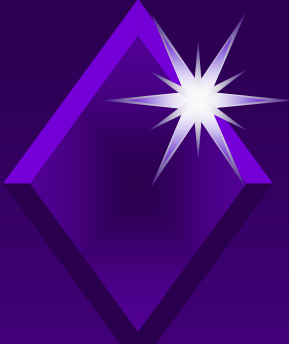
Electrical conductivity less than 10 μ s/cm

Boiling $\rightarrow$ condensing steams $\rightarrow$ clean tank

#Yellow/white precipitate mineral above
instruments $\rightarrow$ cleaning

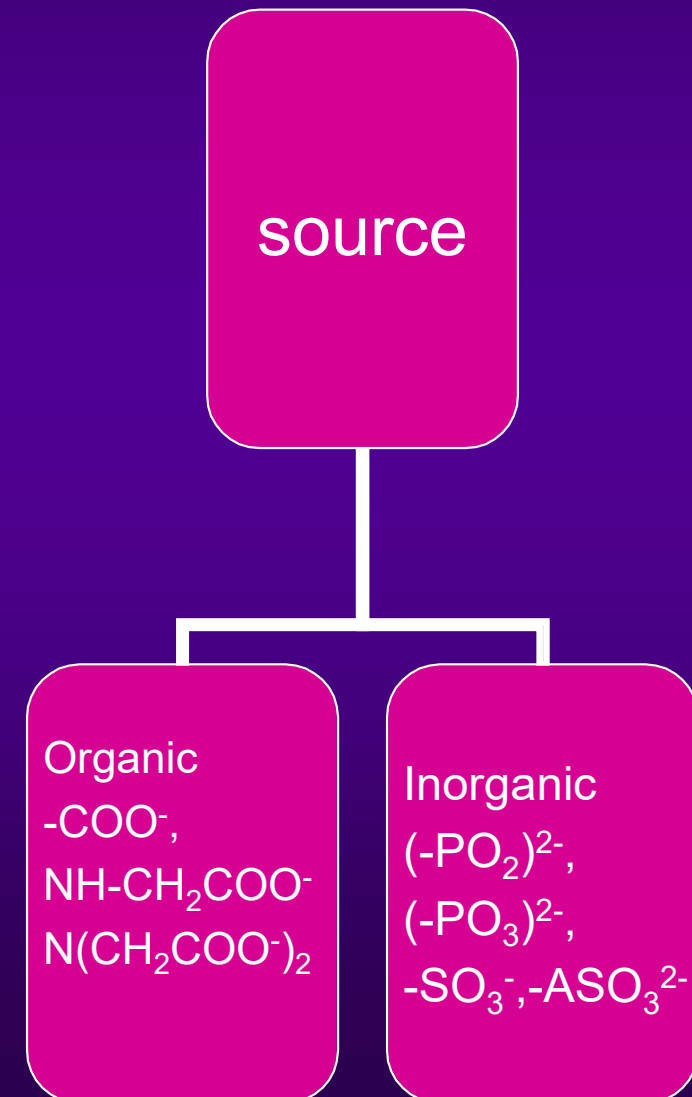
#Bacteria's existing

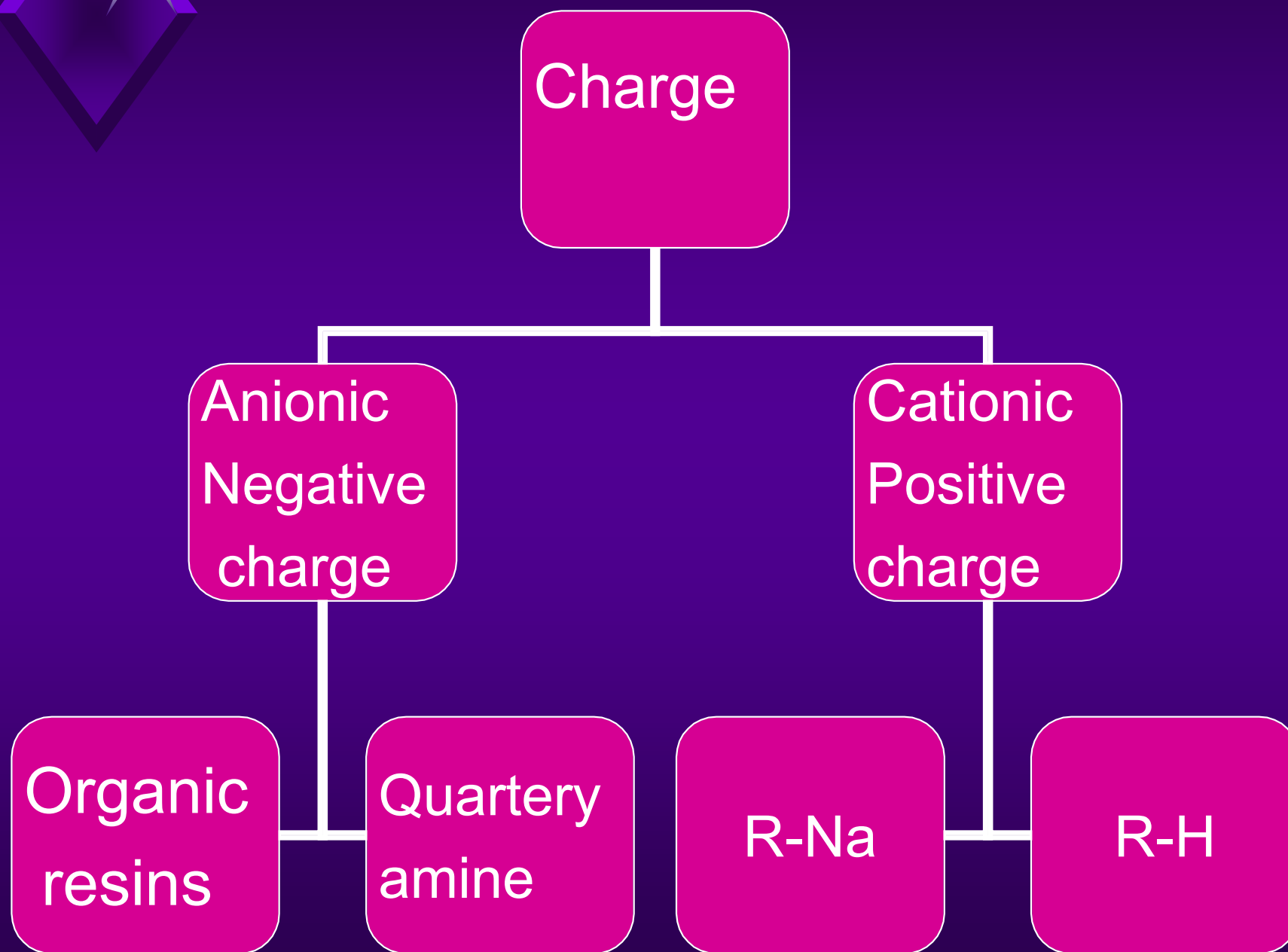
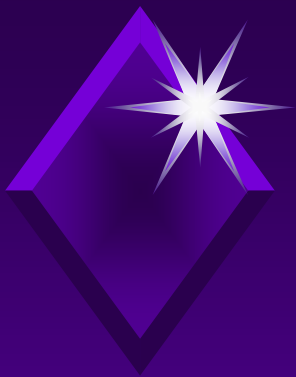




Deionization (Ion exchange resin), DIW

- ❑ Ion exchange: insoluble mater, change own ion with ions in around solution
- ❑ Demineralized(cation:Ca,Na,K,Mg-toxic anions:nitrite,nitrate,As,Hg)
- ✓ Dissolved mineral salt
- ✓ Without mineral ppt
- ✓ Fast
- ✓ Incidental trapping in resin→strong base anion resin→negative gram bacteria
- #Cant remove: uncharged organic molecule, viruses







Coagulation and Flocculation

- Together coagulation and flocculation is a traditional purification method which works by using active chemicals called coagulants that effectively "**glue**" small suspended particles together so that they settle out of the water or stick to sand or other granules in a granular media filter.

➤ **Coagulation**

Many of the suspended water particles have a negative electric charge. The charge keeps particles suspended because they repel similar particles. Coagulation processing reduces the surface charge to encourage attraction which forms floc which can settle.

➤ **Flocculation**

is the clumping together of small particles to form larger particles, called floc, which is more readily settled out of the water.



Louisville Water Company

Figure 28-8a Brock Biology of Microorganisms 11/e
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- 
- ❑ Clarify(removing turbidity,colores)
 - ❑ water clear & colorless
 - ❑ Preparing ppt with simple physical methods
 - ❑ Combining particles→floccule→filtering (sand+granulated anthracite)
 - ❑ Flocculating agents:
 - 1- $\text{Fe}(\text{OH})_3$
 - 2- $\text{Al}(\text{OH})_3$
 - 3- PolyDADMAC(synthetic,more use, high μ ,stable, expensive)

In a relatively new and economically attractive development polymer film with chemically formed microscopic pores called micro or ultrafiltration membranes can be used in place of granular media to filter water effectively without coagulants. The type of membrane media determines how much pressure is needed to drive the water through and what sizes of microbes can pass.

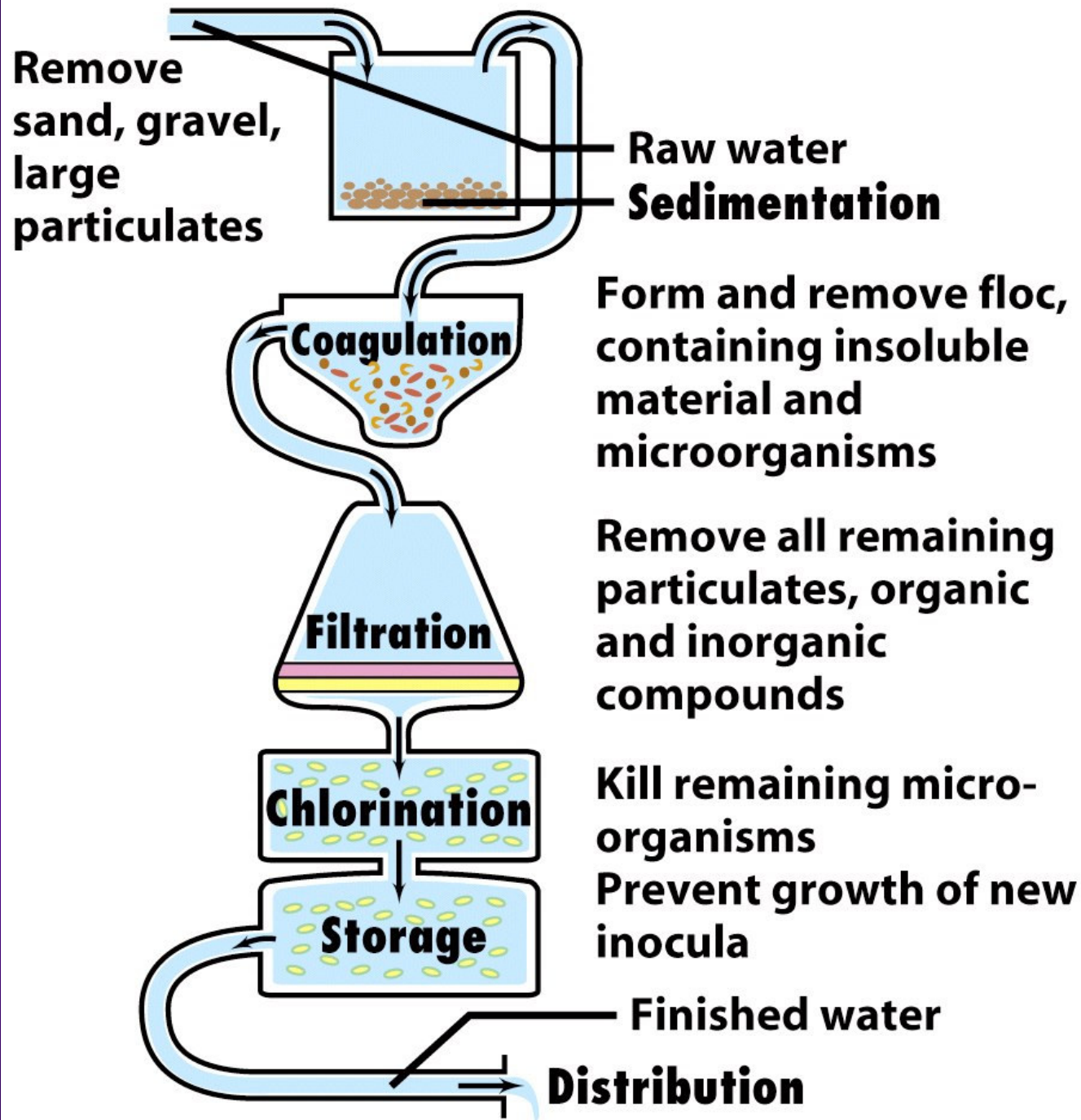
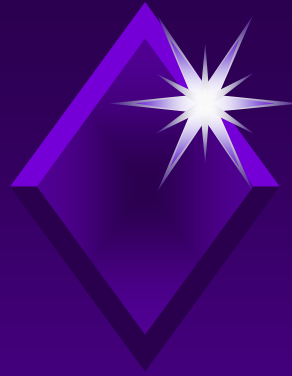
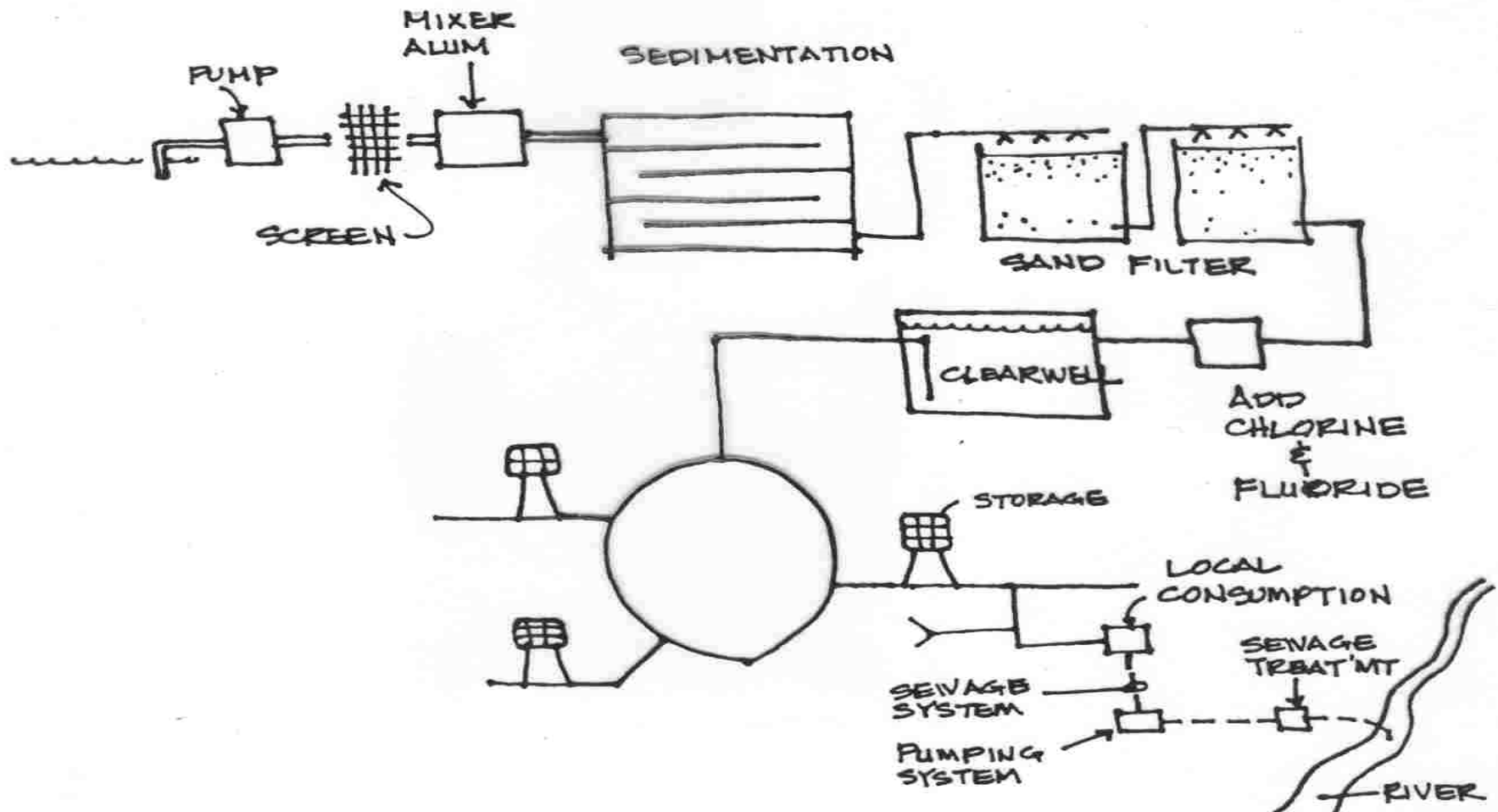


Figure 28-8b Brock Biology of Microorganisms 11/e
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Sedimentation

- Water exiting the flocculation basin enters the sedimentation basin, also called a clarifier or settling basin. It is a large tank with slow flow, allowing floc to settle to the bottom.



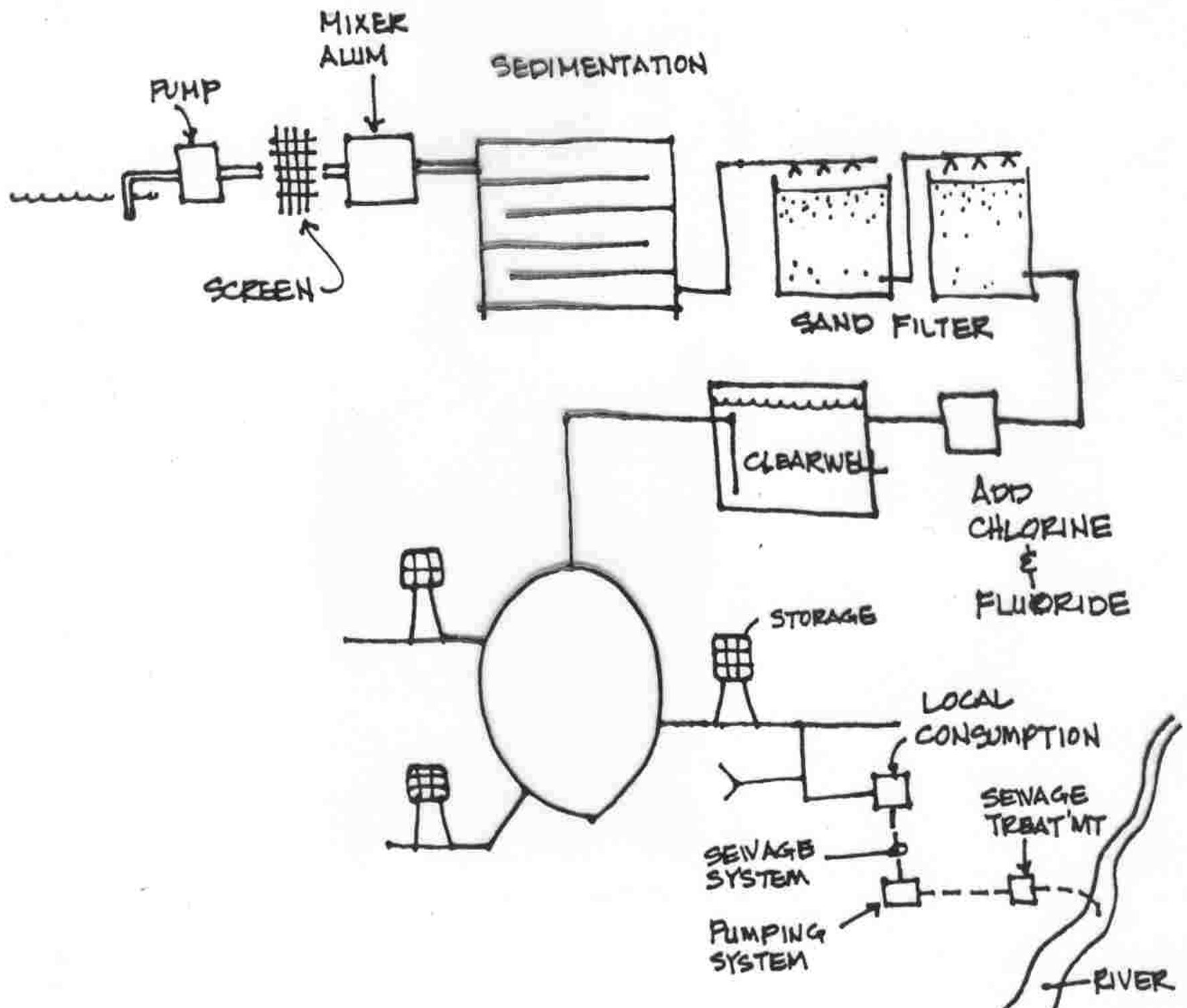


Sedimentation

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Filtration

After separating most floc, the water is filtered as the final step to remove remaining suspended particles and unsettled floc. The most common type of filter is a rapid sand filter. Water moves vertically through sand which often has a layer of activated carbon or anthracite coal above the sand.

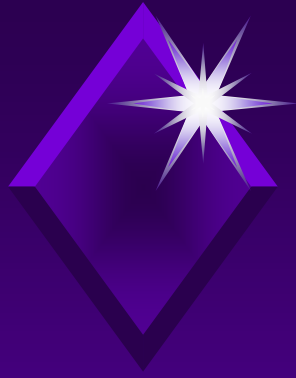




Electro deionization

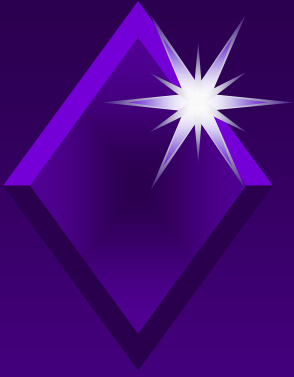
- Passing water from + & - electrodes
- ✓ Continuously
- ✓ reach



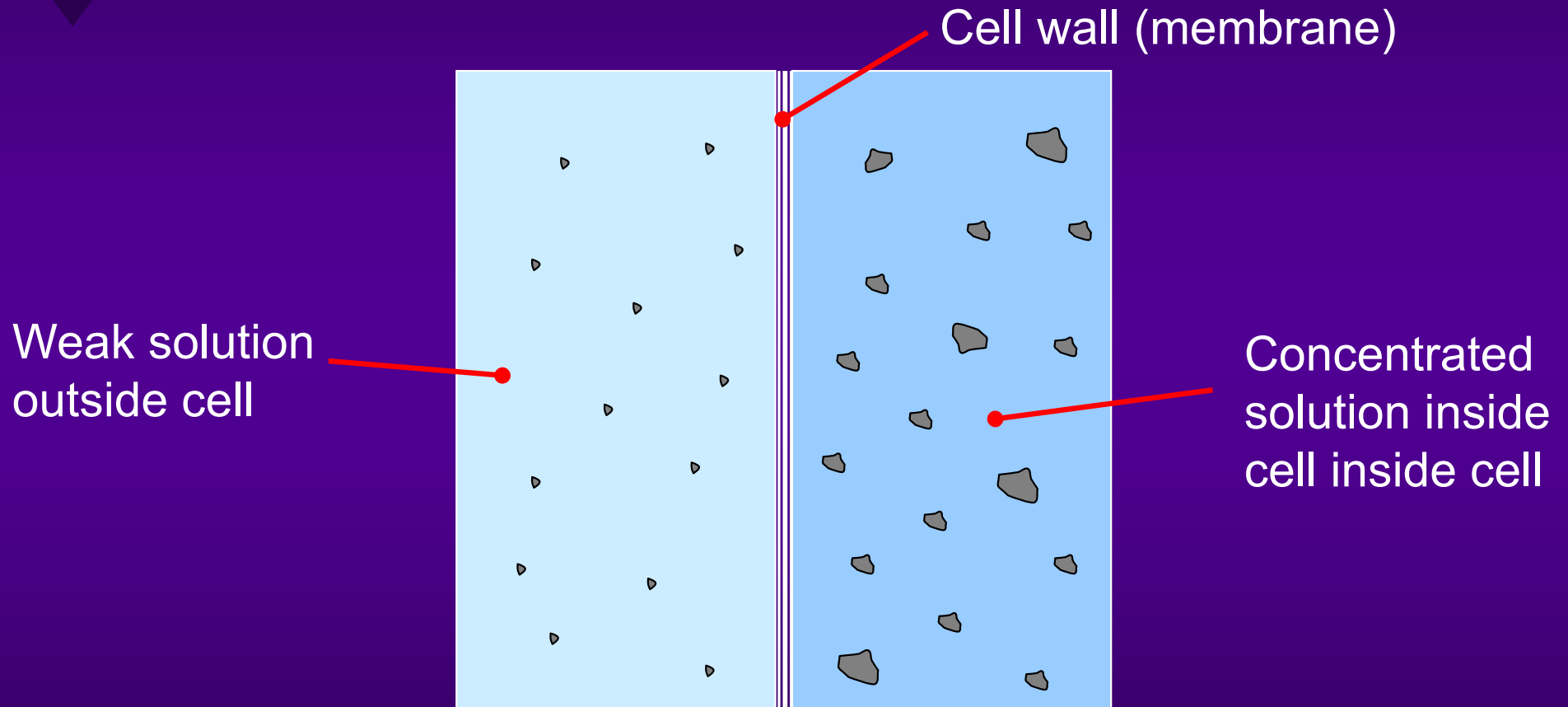


Reverse osmosis

- Mechanical, impure solution(water)
- Moving solvent from high con. to low con. From semi permeable membrane With external pressure (more than osmotic pre.)
- Pressure:
 - 2-17 bar(fresh w)
 - 40-70 bar(sea w) normal=24 bar



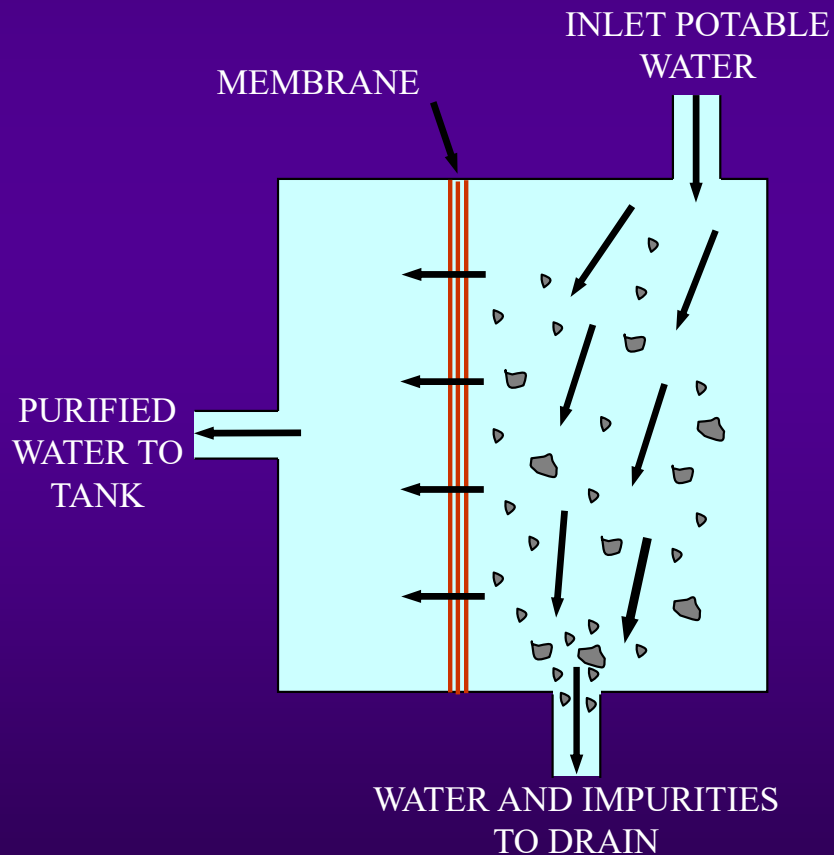
Osmosis



Weak solution will pass through the membrane into the concentrated solution by osmosis



Reverse Osmosis Water Purification System



- Removes dissolved substances such as salts, metals, minerals and organisms
- 15 - 25% of inlet water passes through membrane as treated water and is stored in the tank
- 75 – 85% of inlet water goes to drain – flows across membrane and flushes impurities down drain

REVERSE OSMOSIS PROCESS



membrane

- ❑ Algae, life forms colonized that
- ❑ Only solvent passing
- ❑ 2 force: osmotic pre, external pre

- ✓ Most application & high purity
- ✓ From 1970 for fresh.w,
 medicin,industry
- #Making membrane is difficult
- #Only purifying 5-15% of entering
 water



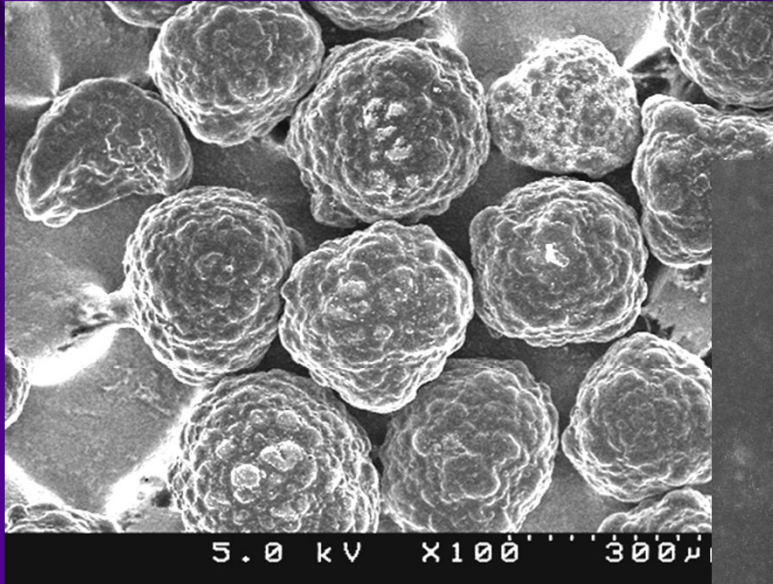
Connects to potable water
supply with pressure
between 3.0 and 7.0 bar.g



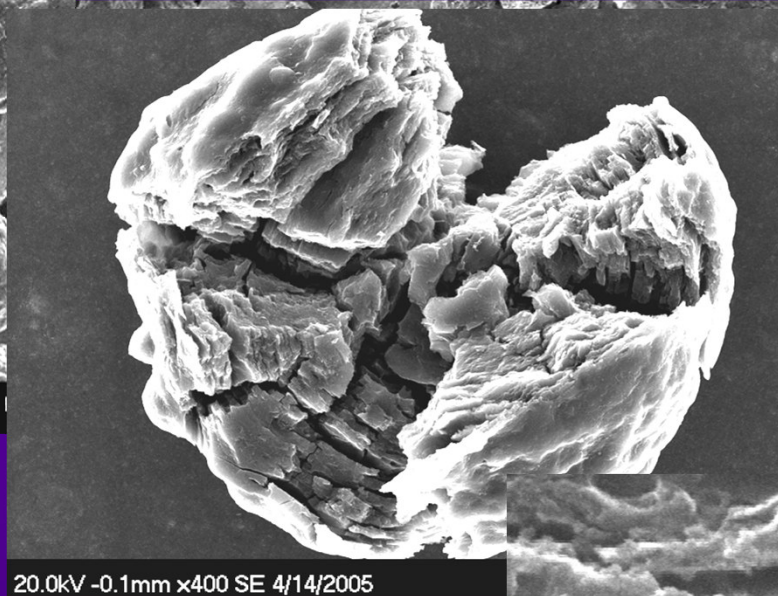
Granulated active carbon filter

- ✓ Big surface area
- ✓ Absorbing more toxic compounds

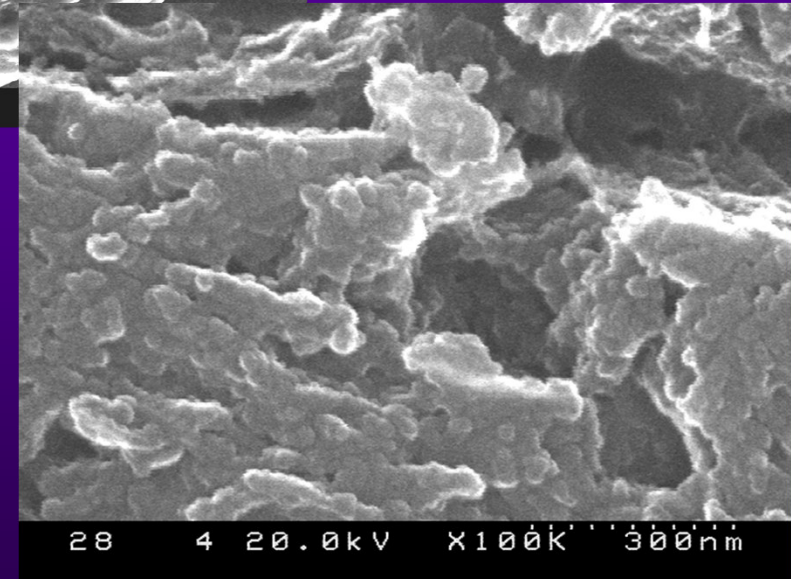
Fluid coke-derived Activated Carbon



Before activation
(SSA $\sim 8 \text{ m}^2/\text{g}$)

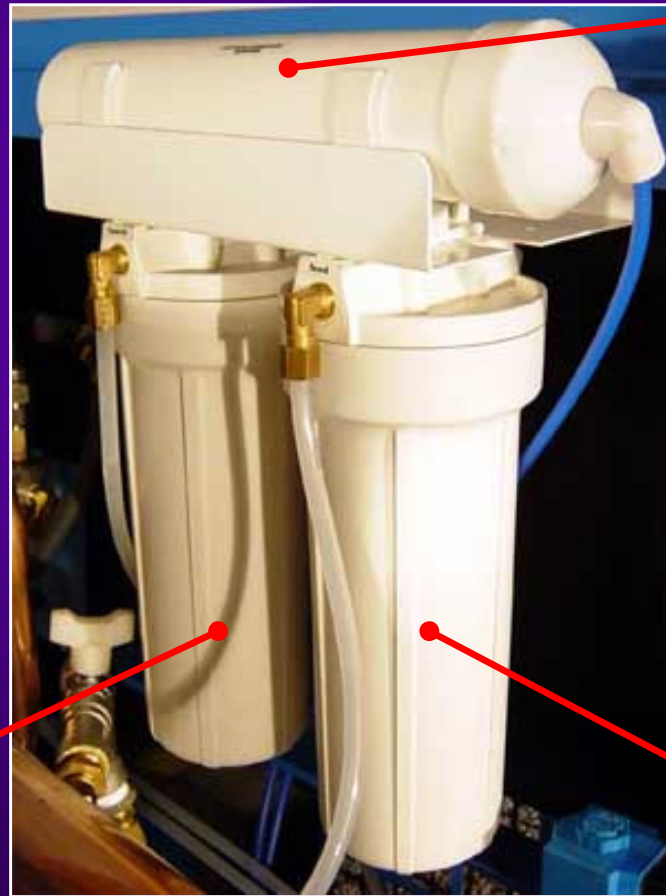


After activation
(SSA $\sim 2500 \text{ m}^2/\text{g}$)





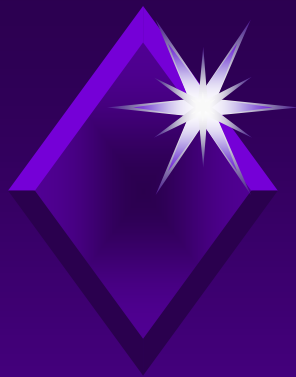
Water Purification System



Reverse Osmosis
Membrane Cartridge

Activated Carbon
Post-Filter

Activated Carbon
Pre-Filter



Electro dialysis

□ Electro chemical method

With passing from membrane

An electrical field,

anion→anod

cation→catod

Cell divided with membranes

✓ 40-50% soluble inorganic compounds

M1

M2

Slide 26

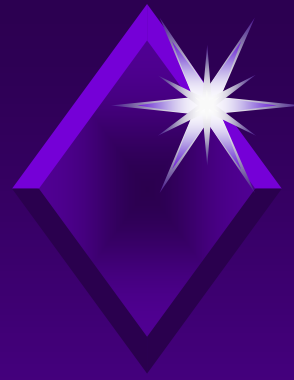
- M1** passing anion
Maria, 5/11/2009
- M2** passing cation
Maria, 5/11/2009

Other methods:

- UV-ray
- Lava filter

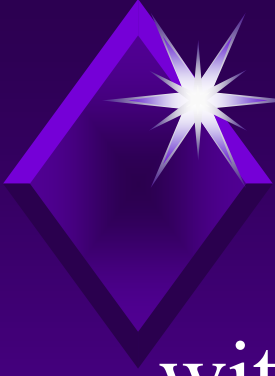


**Devices for
producing water
with micro-
clusters**



Oxy-Plus Water Treatment Devices

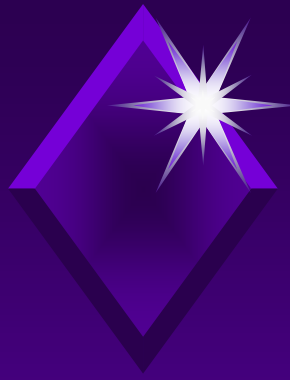




Disinfection

with aggressive chemicals like chlorine or ozone (UV-ray, H_2O_2) is normally the last step in purifying drinking water. Water is disinfected to destroy any pathogens which passed through the filters

Removing harmful microbes, water preserving,
killing pathogens (passed from filter)



Usages

❑ In Pharmaceutics

➤ As a deliver & solvent

In chemical tests (distillate water)

Laboratory

❖ Quality norm of Purified water by:
ACS, ASTM, NCCLS, USP,

❑ Other use:

Deionized water: acidic battery of cars, cooling systems,
vapor irons, H_2 preparation, machine washing, Maple
syrops preparing, air plane engines



Storage:

Water from rivers may also be stored in bankside reservoirs for periods between a few days and many months to allow natural biological purification to take place. This is especially important if treatment is by slow sand filters.

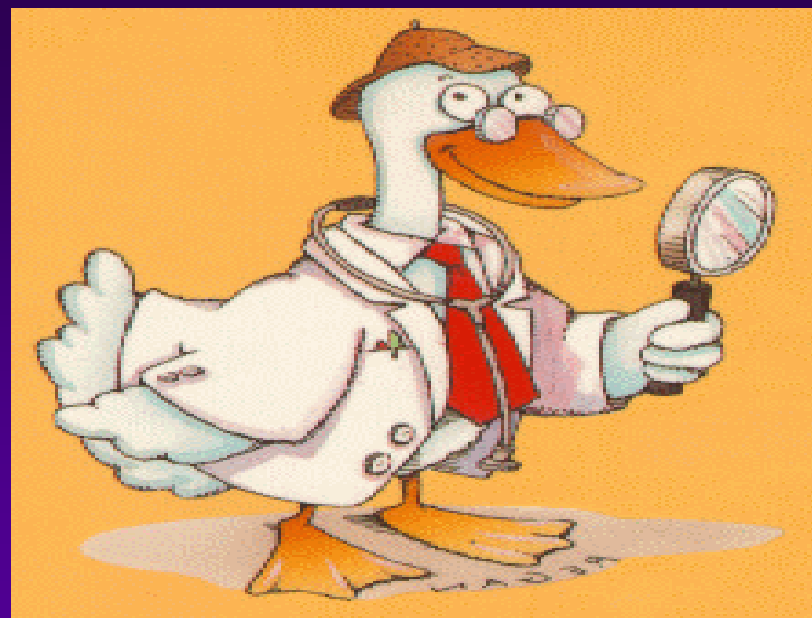
The filtered water is then treated to remove or inactivate remaining potentially harmful microscopic organisms including viruses and bacteria.

This removal step comprises part of a multistep process of disinfection which is completed by chemical and/or ultraviolet light treatment which damages and makes non-infectious any remaining viable harmful microbes.

For waters that are particularly difficult to treat such as from catchments with intensive agriculture, extra physical, chemical and biological treatment steps may be necessary.



Any question?



Thank you!

