1. **Surface water:**

i) Sand Filtration –

- They are usually used to separate small amounts (<10 ppm or <10 g/m^3) of fine solids (<100 µm) from aqueous solutions.
- It is necessary to pre-treat the effluent flowing into a sand bed to ensure that the particulate solids can be captured by adopting the following mechanisms:
    - Coagulation.
    - Flocculation.
- As water passes through the *Schmutzdecke layer formed on the top of sand beds*, particles of foreign matter are trapped and dissolved organic material is adsorbed and metabolized by the bacteria, fungi and protozoa. The water produced from a well-managed sand filter can be of exceptionally good quality with 80-90% bacterial reduction.

Demerits:

- Generally ineffective against taste and odour problems.
- Produces large volumes of sludge for disposal.
- Skilled supervision is essential.
- Cost of maintenance is higher.
- Inadequate filter maintenance has been the cause of occasional drinking water contamination.

ii) Micro Filtration –

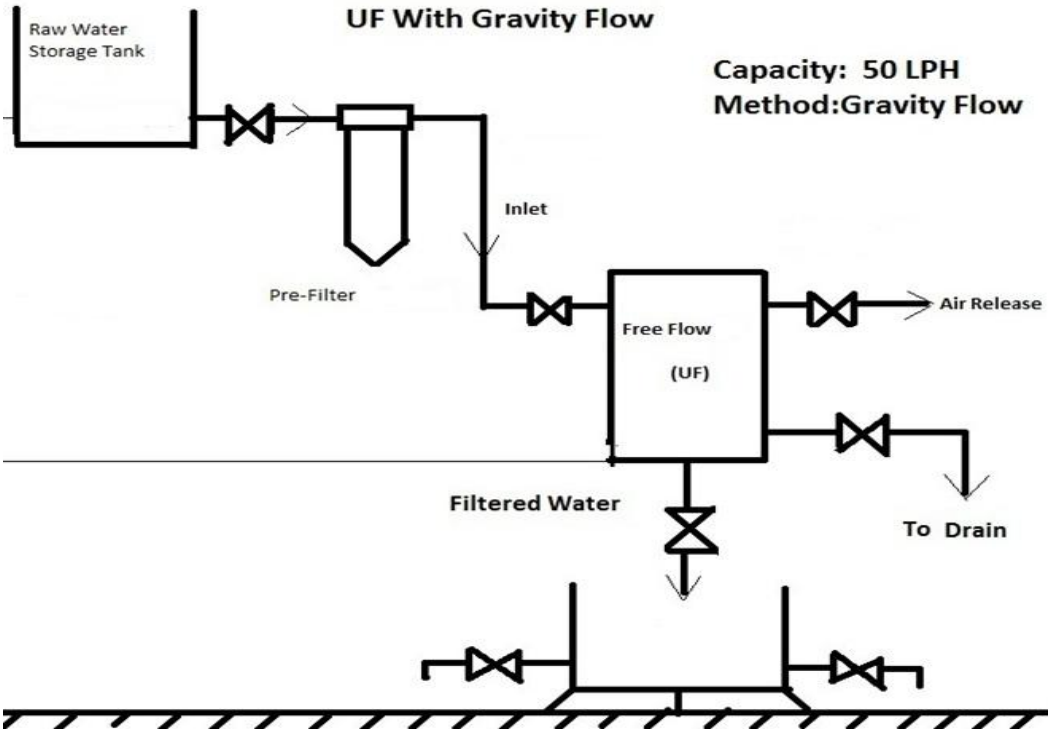
- Microfiltration usually serves as a pre-treatment for other separation processes such as ultra filtration, and a post-treatment for granular media filtration (sand filtration).
- The typical particle size used for microfiltration ranges from about 0.1 to 10 µm.
- The filters used in the microfiltration process are specially designed to prevent particles such as, sediment, algae, protozoa or large bacteria from passing through a specially designed filter.
- Ineffective in treating microscopic, atomic or ionic materials such as as Sodium (Na+) or Chloride (Cl-) ions, dissolved or natural organic matter, and small colloids and viruses.

iii) Ultra Filtration –

- The pores of ultra filtration membranes can remove particles of 0.001 – 0.1 µm from fluids.
- They have been used to either replace existing secondary (coagulation, flocculation, sedimentation) and tertiary filtration (sand filtration and chlorination) systems employed in water treatment plants.

- UF processes are preferred for the following reasons:
    - No chemicals required for pre-treatment.
    - Constant product quality regardless of feed quality
    - Compact plant size
    - Capable of exceeding regulatory standards of water quality, achieving 90-100% pathogen removal

a. Gravity Filtration –



2. Ground water:

a) With Chemical contamination:

i) RO –

- It is the process by which water molecules are forced through a 0.0001 micron semi-permeable membrane by water pressure.

Suitable When:

- Ground Water is Quality affected.
- Other purification methods are not viable.
- No surface water source is available nearby.

Advantages:

- Removes very small particles and less than 0.001 Microns like Fluoride, Salinity, TDS, etc.,
- Removes even bacteria.
- Improves taste, decreases odour and colour.
- No Post-disinfection required.

Limitations:

- Costs are high.

- Nearly 50% - 60% of the raw water is wasted as reject leading to further depletion of water sources.
- Reject water or sludge further leaches into and contaminates surface and ground water sources.
- The water is demineralised as sodium, calcium, magnesium, and iron are removed.
- Due to removal of natural minerals, there are health risks like gastrointestinal problems, bone density issues, joint conditions, and cardiovascular disease.

ii) **Electrolytic Defluoridation Plants** –

- Removal of fluoride by active species of hydroxide of aluminium produced by passing DC power through aluminium electrode.
- Process is effective to remove excess fluoride.
- Simple to fabricate, easy to operate with minimum maintenance
- Suitable for treatment of raw water with fluoride concentration upto 10 mg/L.
- Quantity of sludge produced is much less (60-70%) than conventional treatment methods.
- Simultaneous reduction in bacterial contamination in treated water
- Treatment cost is less than RO plants.

iii) **Terafil technology** –

- Used for removal of sediments, suspended particles, iron and certain microorganisms in drinking water.
- Terrafil is a burnt red clay porous media produced from mixture of red clay (silt clay), river sand and wood saw dust, without using chemicals.
- About 99% of turbidity, 90-95% of micro-organisms, 80-95% of soluble iron, colours etc., are effectively removed from the raw water during filtration process through the Terafil.
- Low in capital cost and maintenance costs.
- Does not require skilled professional.

Treatment Technique	Particle size in µm	Turbidity Removal	Bacterial contamination	Chemicals Impurities removed
Sand Filtration with Pre-treatment	<100 µm	90%	85-90% Bacteria removed. Virus cannot be removed.	Cannot alter the chemical composition of raw water. Not suitable for water with chemical contamination.
Micro Filtration	0.1 to 10	100%	100% Bacteria removed. Virus cannot be removed.	Cannot alter the chemical composition of raw water. Not suitable for water with chemical contamination.
Ultra Filtration	0.001 – 0.1	100%	100% Bacteria and Virus removed.	Cannot alter the chemical composition of raw water. Not suitable for water with chemical contamination.
RO	0.0001- 0.001	100%	100% Bacteria and Virus removed.	90-95% of TDS (Salt, fluoride, lead, manganese, arsenic, iron, and calcium etc.,) will be rejected.
Electrolytic Defluoridation Plants	Suitable with fluoride concentration up to 10mg/l	99%	90-99% Bacteria removed. Virus cannot be removed.	Reduction in Hardness and nitrate along with Fluoride is possible.
Terrafil Technology	90-95% of soluble iron removal is possible.	99%	90-95% Bacteria removed. Virus cannot be removed.	Iron removal only.