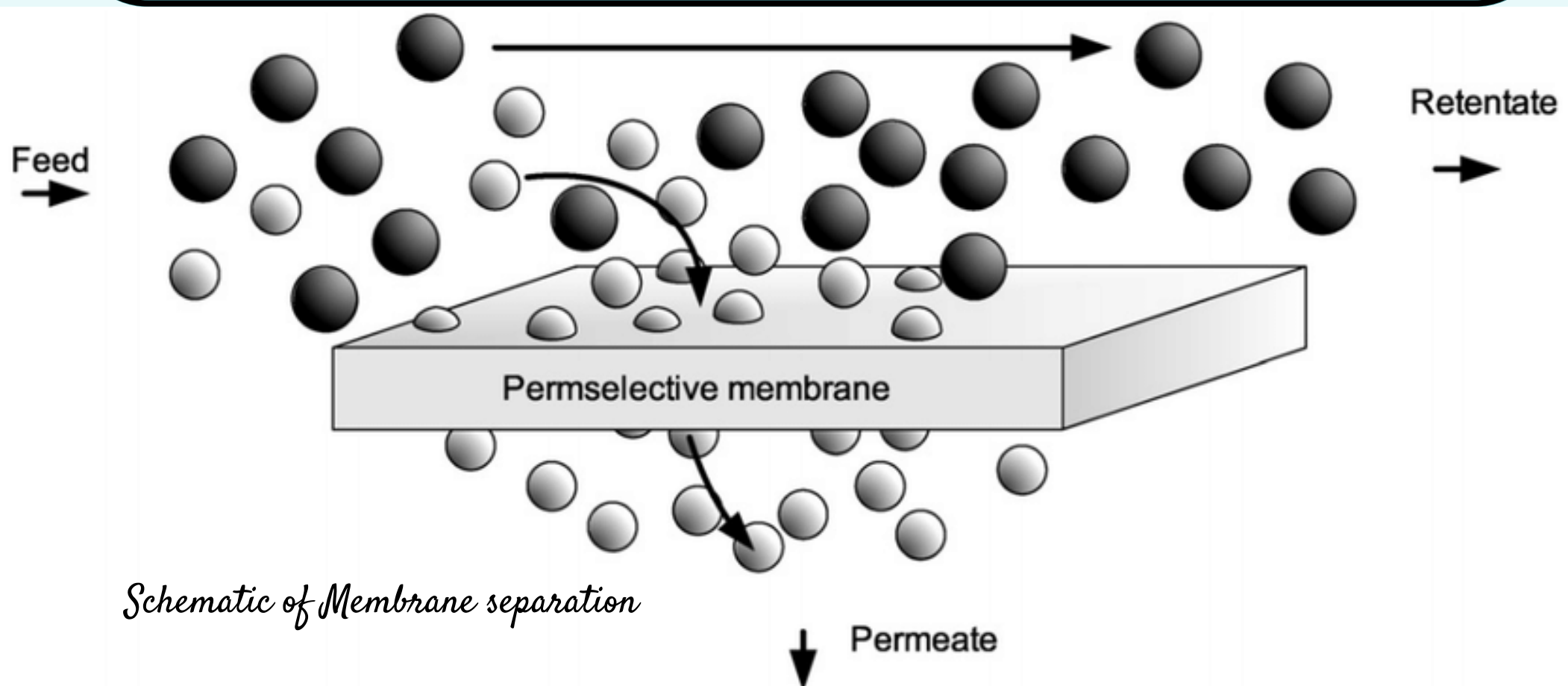


MEMBRANE SEPARATION PROCESSES

- The driving force of the separation process is differences in concentration or pressure between the two sides of the membrane.

Membrane separation process is a process where a membrane is used to separate the components in a solution by rejecting unwanted substances and allowing the others to pass through the membrane.



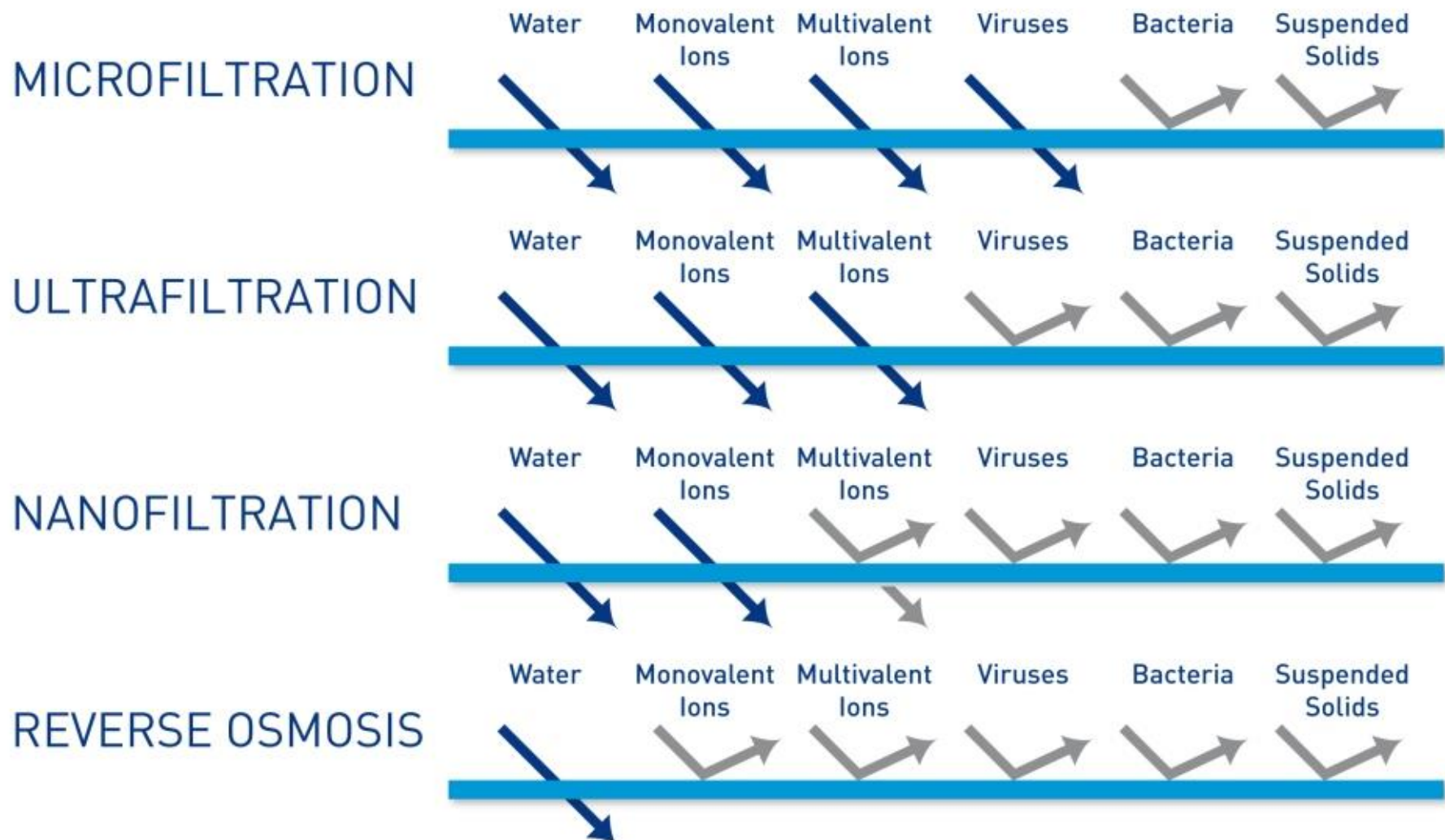
- Membranes are semi-permeable barriers, used to separate two phases (**permeate and retentate**) on the basis of particle size, electric charge.

Membrane Separation Methods



- **Reverse osmosis (RO)** : Concentration of solution by removal of water.
- **Nanofiltration (NF)** : Concentration of organic components by removal of part of monovalent ions like sodium and chlorine (partial demineralization).
- **Ultrafiltration (UF)** : Concentration of large and macromolecules.
- **Microfiltration (MF)** : Removal of bacteria, separation of macromolecules.

Types of Membrane and technologies



Reverse Osmosis:

- Driven by a pressure gradient, in which the membrane separates the solvent (generally water) from other components of a solution.
- **Applicable for** water purification, recovery of sugar from candy, recovery of oil-seed protein, and concentration of dilute solution (fruit and vegetable juices, milk).

Particle size range: $5 \times 10^{-3} \mu\text{m}$ to $10^{-4} \mu\text{m}$



Ultrafiltration:

- In ultrafiltration technique, Suspended solids and solutes of high molecular weight are retained, while water and low molecular weight solutes pass through the membrane.
- **Applicable in** dairy industry mainly for two purposes i.e production of protein concentrates from whey and cheese from milk.

Particle size range: $0.15\ \mu\text{m}$ to $5 \times 10^{-2}\ \mu\text{m}$



Nanofiltration:

- The nano filtration technique is mainly used for the removal of two valued ions and the larger mono-valued ions such as heavy metals.
- **Applicable for** pre-concentration of thin juices in the production of sugar from sugarcane and beet, desalting of lactose, production of protein concentrates, the demineralization and de-acidification of whey obtained from ultrafiltration.

Particle size range: $5 \times 10^{-2} \mu\text{m}$ to $5 \times 10^{-3} \mu\text{m}$



Microfiltration

- Microfiltration (MF) is a pressure-driven separation process, which is widely used in concentrating, purifying or separating macromolecules, colloids and suspended particles from solution.
- **Applicable for** clarification of beer and wine i.e. for removal of yeasts, microorganisms, pretreatment of cheese whey, removal of oil droplets and fat globules, wastewater treatment.

Particle size range: 0.15 μm to 0.15 μm



Advantages



- **Able to recover minor but valuable components from a main stream without substantial energy costs.**
- **Very simple flowsheet.**
- **Extremely high selectivities.**
- **Potentially better for the environment.**



Disadvantages



- Cannot be easily staged compared to processes such as distillation.
- Can have chemical incompatibilities with process solutions.
- Temperature limitation.
- Can be saddled with major problems of fouling of the membranes.



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