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Colloidal dispersions; Properties

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Outlines

- Purification.
  - Dialysis.
- Colloids properties:
  - Kinetic.
  - Optical.

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Purification

- **Many sols contain micro-molecules in the form of true solution. which may be undesirable for any number of reasons; e.g., electrolyte impurities : cause the flocculation of the sol.**
- **To get red from these impurities, the following should be used:**

1. Dialysis
2. Electro dialysis
3. Ultrafiltration

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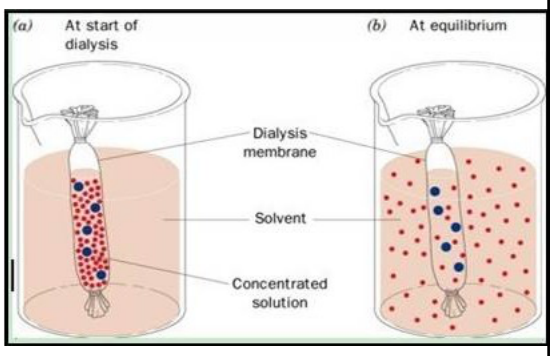
Dialysis

Depend on ***difference in size*** between colloidal particles & molecular particles (impurities).



- ***Technique;***
  use ***semi permeable membrane eg.*** nitrocellulose
- pore size of used semi permeable membrane prevent passage of colloidal particles & permit passage of small molecules & ions (impurities) **such as urea, glucose, and sodium chloride, to pass through.**

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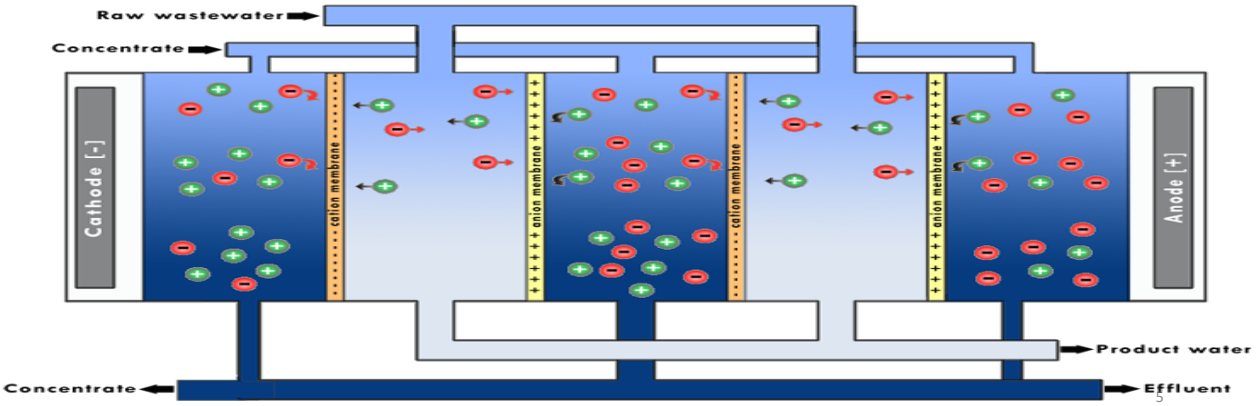
Electrical dialysis

- **An electric potential may be used to increase the rate of movement of ionic impurities through a dialyzing membrane and so provide rapid purification.**



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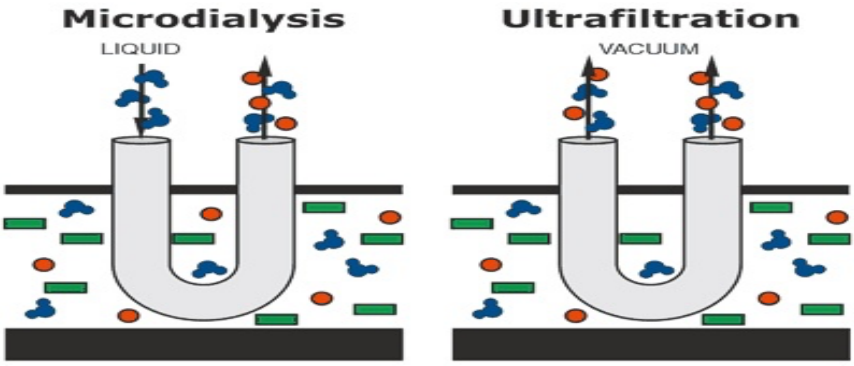
Ultra filtration

- ***Technique;***
- Apply pressure (or suction) Solvent & small particles forced across a membrane while colloidal particles are retained.



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Properties of colloids

A) Kinetic properties.

B) Optical properties.

C) Electrical properties.

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Kinetic properties

Which relate to the motion of the particles within the dispersion medium as following:

1. **Thermal motion**
   a. **Brownian motion.**
   b. **Diffusion.**
   c. **Osmotic pressure.**
2. **Gravitational movement i.e. Sedimentation.**
3. **Movement due to external force i.e. Viscosity.**

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Brownian movement

- **Definition:** colloidal particles are subjected to random collision with molecules of the dispersion medium (solvent) so each particle move in irregular and complicated zigzag pathway.
- First observed by Robert Brown (1827) with pollen grains suspended in water.
- **The velocity of particles increases with decreasing particle size and viscosity.**
- **Increasing the viscosity of dispersion medium (by glycerin) decrease then stop Brownian motion.**

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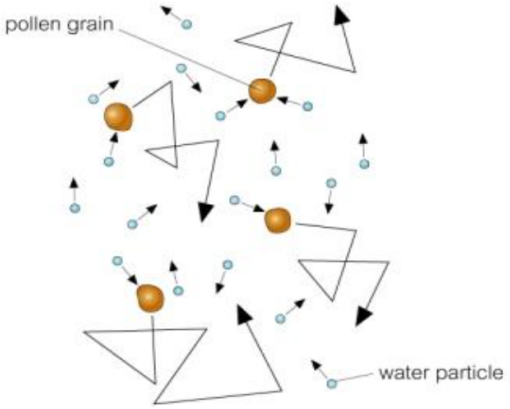

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Diffusion

- As a result of Brownian motion particles pass (diffuse) from a region of ***higher*** concentration to one with ***lower*** conc.
- Rate of diffusion is expressed by; ***Fick's first law:***

$$dm/dt = -DA\, dc/dx$$

- **Where dm is the mass of substance diffusing in time dt across an area A under the influence of a concentration gradient dC/dx.**
- **The minus sign denotes that diffusion takes place in the direction of decreasing concentration.**
- **D is the diffusion coefficient.**

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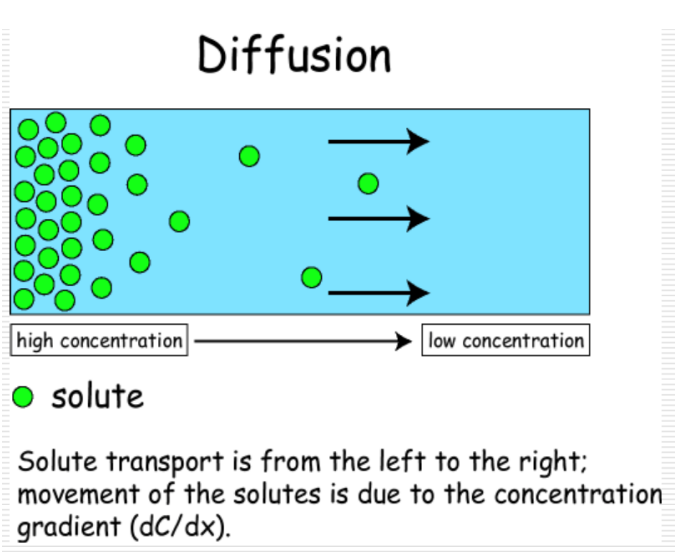

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Osmotic pressure

- **The method is based on Van's Hoff's law;**

$$P = RTC / M$$

- **From the equation;**

a) The osmotic pressure (P) depends on molar conc, of the solute (C) & on absolute temp. (T).

b) The osmotic pressure is inversely proportional tomolecular weight (M).

R= molar gas constant

- **The equation is valid for very dilute solutions in which the molecules do not interact mutually.**

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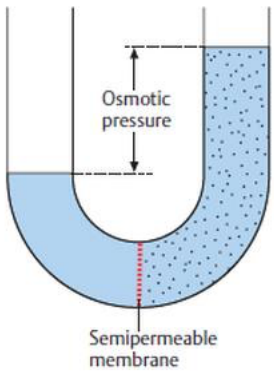

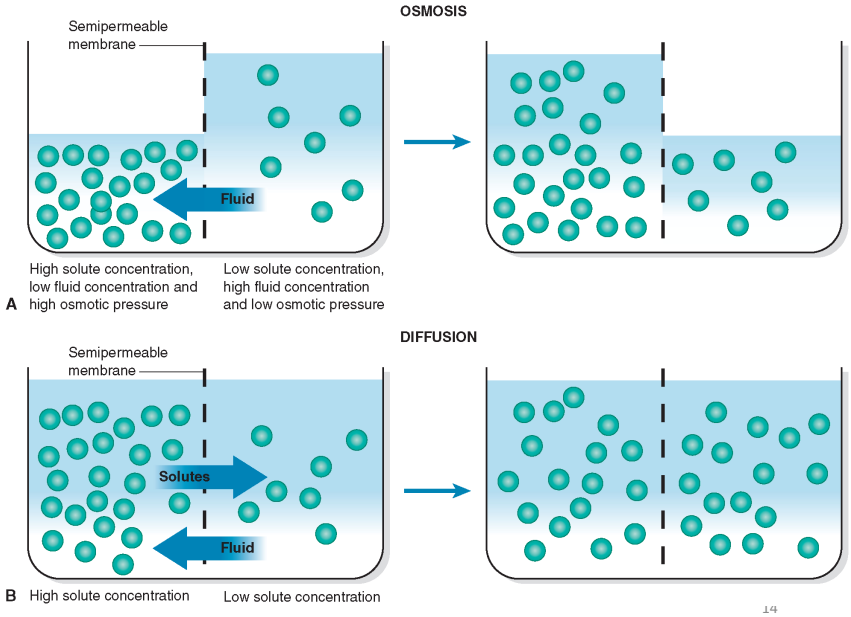

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Sedimentation

- **Stoke's law;**

$$V = 2r^2(P\text{-}Po)\ g / 9\ \eta$$

- **v: velocity of sedimentation of spherical particles. • p: density of the spherical particles.**
  • po: density of the medium.
  •η: viscosity of the medium.
- **g: acceleration due to gravity.**
  At small particle size (less than 0.5 um) Brownian motion is significant & tend to prevent sedimentation due to gravity & promote mixing in stead.
- **so, we use an ultracentrifuge which provide stronger force so promote sedimentation in a measurable manner.**

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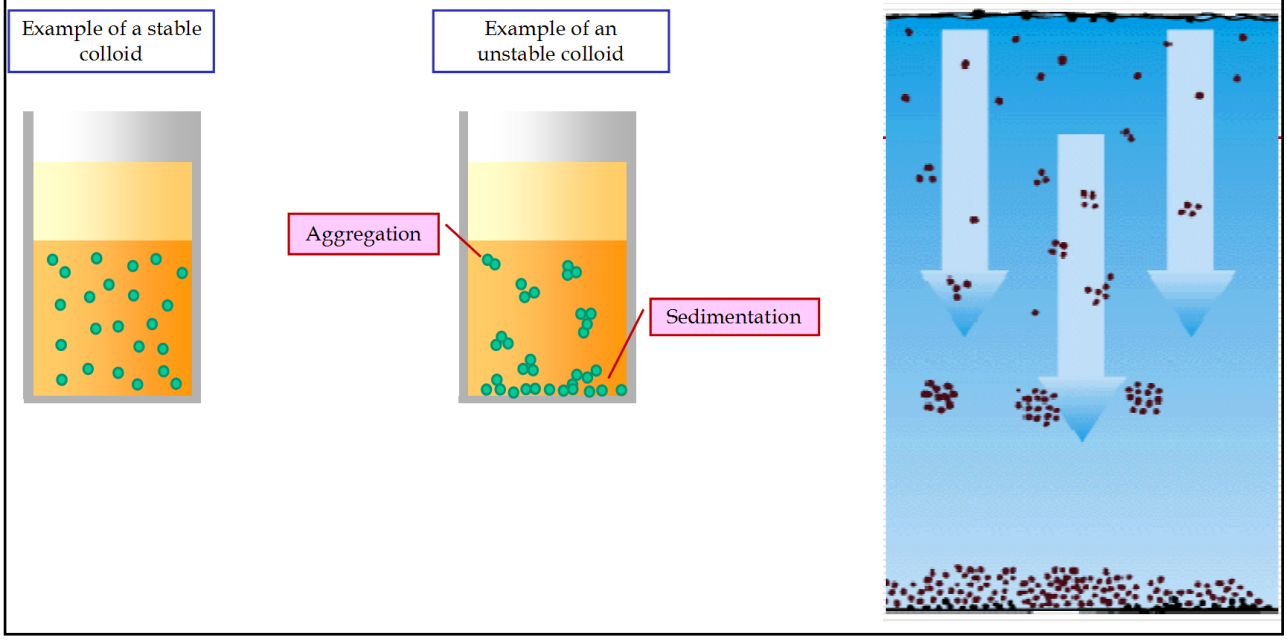

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Viscocity

- The resistance to flow of a system under an applied pressure
- Viscosity of colloid allows

  1- calculation of the molecular weight.

  2- Provide useful information about the shape of the colloidal particles.
- *Note*
- Spherocolloidal dispersions are of relatively low viscosity.
- On the other hand Linear colloidal dispersions are of high viscosity.
- If linear colloidal particles coil up into spheres, The viscosity of the system falls due to changing the shape.

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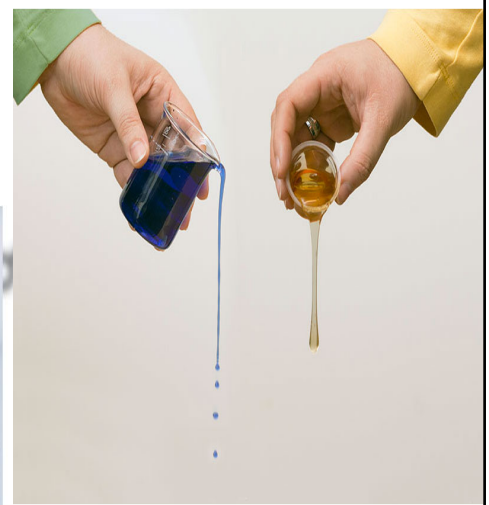

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Optical properties:

- **Light scattering (Tyndall effect).**
- **Ultra microscope.**
- **Electron microscope.**

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Light scattering (Tyndall effect)

- **True solutions do not scatter light and appear clear but colloidal dispersions contain opaque particles that do scatter light and thus appear turbid.**
- **Tyndall effect:**

when a beam of light pass through a colloidal sol, scattered light cause the sol to ***appear turbid***.

- **Importance of light scattering measurements:**

1) Estimate particle **size.**
2) Estimate particle **shape.**
3) Estimate particles **interactions.**

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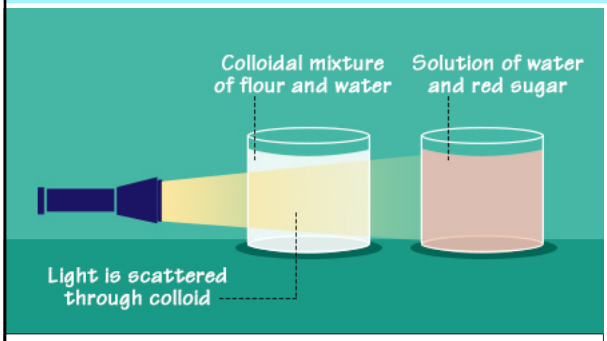

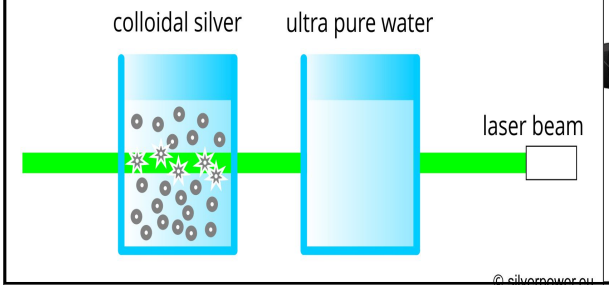

TYNDALL EFFECT

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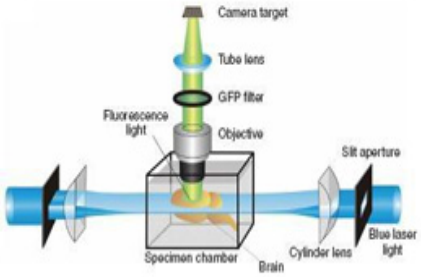
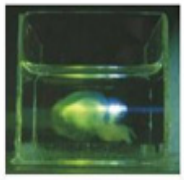
Ultra microscope

- **Particles appear as spots of light against the dark background of the microscope.**
- **Used in the technique of micro electrophoresis for measuring particle charge.**





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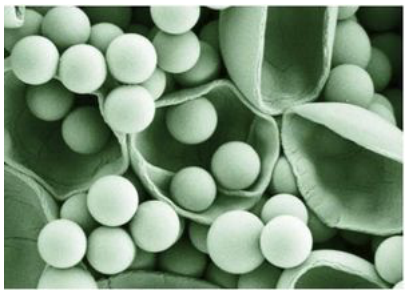
Electron microscope



- **Give actual picture of the particles (up to 5A).**
- **Used to observe the size, shape and structure of sols.**
- **High energy electron beams are used. (have greater resolving power)**
- **One disadvantage is;**
- **only dried samples can be examined. Not give information on solvation.**

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Thanks for your attention

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