Lab. 2: Properties of colloids

1- Heterogeneity:

A colloidal solution is heterogeneous system consisting of the two phases of the dispersed phase (colloidal particles of a solid) and the aqueous dispersion medium. Often a colloidal sol appears to be homogeneous as the particles are small in size and not visible to the naked eye. However, this is disproved when it is viewed under electron microscope.

2- Filterability:

Colloidal particles do not pass through ultra filter papers, animal and vegetable membranes. The large pore size of ordinary filter paper enables colloidal particles to pass through.

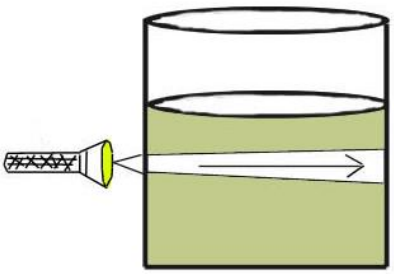
3- Mechanical Properties (Brownian movement)

When colloidal solutions have been observed through ultra microscope, the colloidal particles are seen in constant and rapid zigzag motion called Brownian movement. Sir Robert Brown first observed the phenomenon in 1827. Suspensions and true solutions do not exhibit Brownian movement.

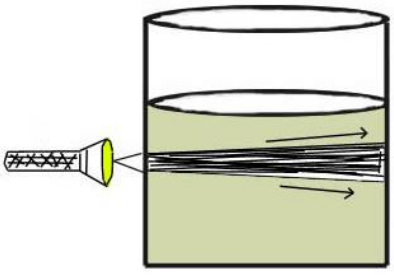
4- Optical Properties (Tyndall Effect)

When a strong beam of light is passed through a colloidal solution, the path of the light becomes visible when viewed from a direction at right angle to that of the incident light. This occurs because the colloidal particles absorb light energy and then scatter it in all directions. The phenomenon of scattering of light by sol particles to form illuminated beam or cone is called Tyndall effect or Tyndall beam or Tyndall cone.

Tyndall effect is not shown by true solutions because the ions or solute molecules are of such minute sizes that they cannot reflect light. The Tyndall effect can therefore be used to distinguish between a true solution and a colloidal solution. The hazy illumination of the light beams from the headlights of a car on a dusty road is a familiar example of Tyndall effect. Blue color of sky and seawater, twinkling of stars and visibility of tails of comets are also due to scattering of light of Tyndall effect.



true solution



Colloidal solution

5- Electrical Properties (Electrophoresis)

Colloidal particles of a sol either carry positive or negative charge. Sols in, which the colloidal particles carry positive charge are called positive sols. When colloidal particles carry negative charge, the sols are called negative sols. The existence of charge on the colloidal particles can be demonstrated by a phenomenon called electrophoresis where the colloidal particles, when placed in an electric field, move towards either cathode or anode depending upon the charge on them. Sols of basic dyestuffs, ferric hydroxide, aluminum hydroxide etc., are some common examples of positive sols. Colloidal solutions of gums, starch, soap solution, metals (Ag, Cu, Au, Pt etc.), metal sulphides, and some acid dyestuffs are the examples of negative sols.

Exp: We can able to determine electric charge type which is bearing on stain particle or colloidal solution by using filter paper **Ash less**. This paper empty from any charges or the charge of it equal to zero. If we moist it by water it get OH- or get negative charges because the force of negative charge greater than force of positive charge H+. So the OH- remains on the paper and the H+ direct to solvent.

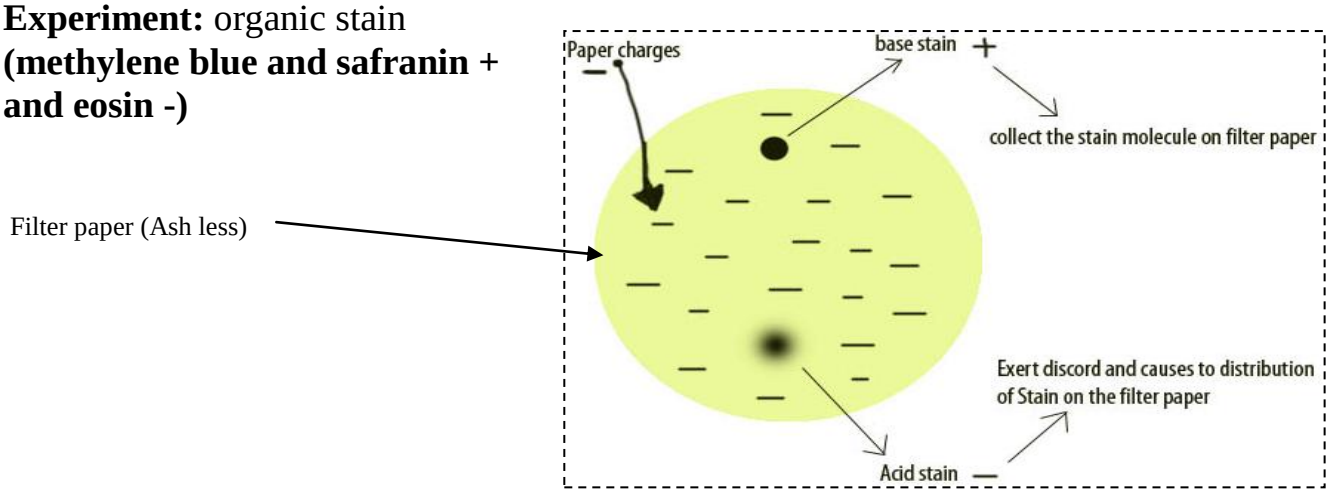
$$H_2O \rightleftharpoons H^+ + OH^-$$

The cellulose matter when moist with water it is get negative charges because the OH- collecting on surface of cellulose particle

Q: How we can determine the type charge of an acid or base charges by using this paper which bearing negative charge?

Answer: if the charges of particle or stain are base (+) with negative (-) of paper it is causes to collecting stain molecule in the ash less paper, while if it is acidic stain (-) causes to distribution of stain on paper.

Experiment: organic stain **(methylene blue and safranin + and eosin -)**



6- Viscosity:

The viscosity of a fluid is its resistance to flow. Glycerin has viscosity more than the water viscosity; the viscosity will increase by increasing concentration. Temperature affects on viscosity, increasing temperature causing decreasing the viscosity.

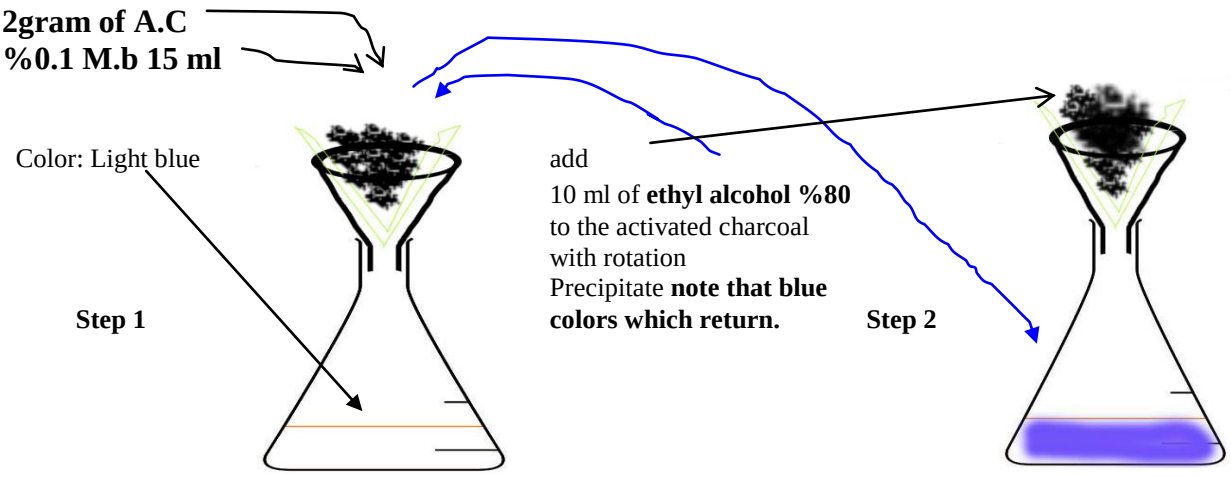
Exp: Fill a (pipette) 50 $(cm)^3$ clean and dry with pure water, carry it vertically, and let water flow out from it and count the time needed to empty it. Then repeat the process with other liquid (more concentration) like gelatin (2%), blue stain and starch. Notice how the time will be longer because of the higher concentration.

7- Adsorption:

It's the interface between two non-mixed liquid or liquid and gas or liquid and solid or solid and gas, its called separation surface. The particles tendency to collect on the separation surface called (adsorption), and it happens due to:

1- Surface tension between two materials.
2- Surface area of the particles.
(Colloidal particles has good adsorption capability because of the high surface area of the particles).

Exp: add activated charcoal to the low concentration of methylene blue stain then filtrate the mixture. We will see a transparent liquid or light blue because the particles of blue methylene attract with the charcoal more than the water.
And if we add Ethyl alcohol to the charcoal in the filtering membrane, the color will return blue because the alcohol attracts blue methylene more than the charcoal.

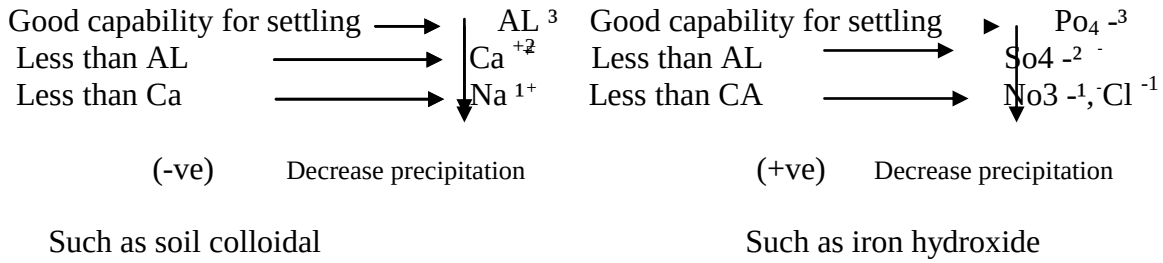


8- Stable nature:

Colloidal solutions are quite stable. The colloidal particles do not settle at the bottom under the influence of gravity. This is because of the constant motion of colloidal particles.

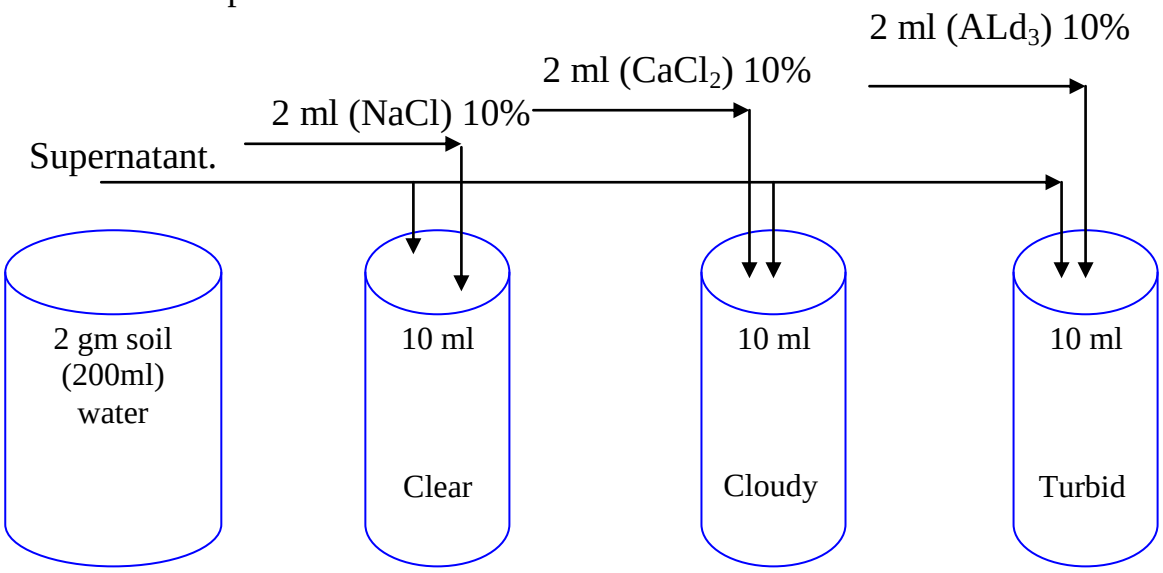
(A) Settling of colloidal (precipitation) (lyophobic or hydrophobic):

As we know the colloidal particles which lyophobic or lyophilic dose not settles by gravity, they will still distributed in the solution. The stability of lyophobic colloidal due to the presence of similar electric charge carried by particles. We can make settling lyophobic colloidal solution by adding solution containing different charges and the added solution must be diluted electrolyte solution. As the number of ions increase, the capability of settling will increase.



Exp:

1: take (2 gm) of soft soil and dissolve it in (200 ml) D.W.
2: left the mixture for (20 minute) without moving for settling.
3: take the supernatant.



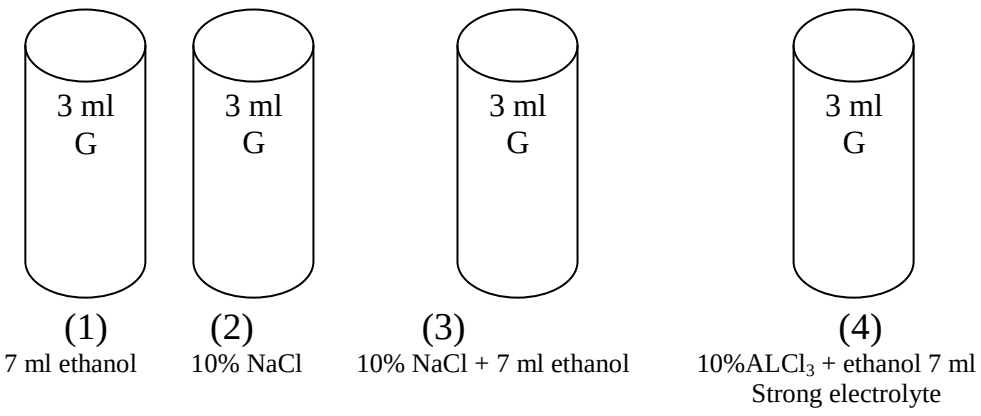
Determine in which of the three bottles the settling will be faster? and why?

B: **Settling of colloidal solution (Lyophilic or hydrophilic):**

This type is more stability from the last one. The stability of lyophilic colloidal due to the presence of similar electric charge carried by particles and the particles are surrounded by water cover. We can settle this type of solution by:

1: Remove the water cover by (alcohol, hydrate agent).
2: Remove or equalize the charge by adding dilute electrolyte solution.
3: Remove the water cover and the charge together by adding strong electrolyte solution

Exp: 3 gm gelatin + 50 ml D.W.



After good mixing and left to settling:

1- The settling did not happen because of the water cover was remove and the charges don’t remove.

2- The settling did not happen because of the water cover was not remove and the charges remove.

3-The settling happened because of removing of the charges and the water cover.