

Gels and Magmas

They are defined as semisolid systems consisting of dispersions made up of either small inorganic particles or large organic molecules enclosing and interpenetrated by a liquid.

They are also defined as semi-rigid systems in which the movement of the dispersing medium is restricted by an interlacing three dimensional network of particles or solvated macromolecules of the dispersed phase.

Gels may be

- Clear as water or,
- Turbid because of that ingredients may not be molecularly dispersed or they may form aggregates which disperse light.

Terminology related to gels:

- *Imbibition*: is the taking up of a certain amount of liquid without a measurable increase in volume.
- *Swelling*: is the taking up of a liquid by a gel with an increase in volume, only liquids that solvate a gel can cause swelling.
- *Synersis*: occurs when the interaction between particles of the dispersed phase becomes so great that on standing, the dispersion medium is squeezed out in droplets and the gel shrinks, it depends on the conc. of gelling agent.
- *Aging*: is the slow spontaneous aggregation which results in formation of denser network of gelling agent.

Separation of solvent phase occur because of the elastic contraction of polymeric molecules, in the swelling process during gel formation the macromolecules become stretched and the elastic forces increase as a swelling proceeds. At equilibrium the restoring force of the macromolecules is balanced by the swelling forces determined by osmotic pressure, if the osmotic pressure decreases as on cooling, water may be squeezed out of the gel.

Classification and types of gels:

We have two classification, the first one:

- Single phase gel: gels in which macromolecules are distributed so that no apparent boundaries exist between them, it also called organic gels e.g carbopol, tragacanth.
- Two phase gel: gels consist of floccules of small, distinct particles, and frequently called a *magma* gels or inorganic gels e.g Aluminium hydroxide gel , bentonite magma.

Another classification is based on the type of continuous phase:

- Hydrogels : includes ingredients that are dispersible as colloids or soluble in water they include organic hydrogels, natural and synthetic gums and inorganic hydrogels.
- Organogels include hydroxylcarbons, animal and vegetable fats, and hydrophilic organogels.
- Xerogels: gels in which vehicle has been removed leaving a polymer network.

Consideration of pharmaceutical gels:

1. Choice of vehicles.
2. Inclusion of buffers.
3. Preservatives.
4. Antioxidants.
5. Flavoring and coloring agents.

Gelling agents: these are substances which when added to an aqueous mixture leads to increase its viscosity without modifying its other properties. They are of 3 types:

- Natural polymers e.g proteins and polysaccharides.
- Semisynthetic polymers e.g cellulose derivatives.
- Synthetic polymers.

Methods of preparation: We have 3 methods:

- a. Fusion method.
- b. Cold method.
- c. Dispersion method.

Fusion method: in this method various waxy materials employed as gelling agents, drug was added when waxy materials melted by fusion, stirred slowly until uniform gel formed.

Cold method: water was cooled to 4-10°C and placed in the mixing container. Gelling agent was slowly added and agitated until solution is complete, maintain temperature below 10°C. drug was added in solution form slowly with gentle mixing.

Dispersion method: gelling agent was dispersed in water with stirring at 1200 rpm for 30 min. Drug was dissolved in non aqueous solvent with preservative, this solution was added in above gel with continuous stirring.

Processing parameters:

1. Processing temperature.
2. pH of the dispersion.
3. Duration of swelling.

For instance, hot water is preferred for gelatin and polyvinylalcohol and cold water is preferred for methyl cellulose dispersions.

A swelling duration of about 24-48 hr generally helps in obtaining homogeneous gels, natural gums need about 24 hr and cellulose polymers require about 48 hr for complete hydration.

Examples of gelling agents include acacia, alginic acid, bentonite, carbomer, CMC sodium, polyvinlalcohol, xanthan gum, tragacanth, sodium alginate....etc.

Colloidal dispersion

Dispersion of a solid substance in a liquid, solid or gaseous medium is termed dispersion. To be more descriptive a prefix such as hydro for water (hydrosol) or alc for alcohol (alcosol) may be used to indicate the dispersion medium.

The term aerosol used to indicate a dispersion of a solid or a liquid in a gaseous phase.

Differences between colloidal dispersion and true solutions are:

- ✓ The larger particle size of the dispersed phase of the colloidal dispersion than true solution.
- ✓ True solutions do not scatter light and therefore appear clear but colloidal dispersion contain opaque particles which scatter light so appear turbid.

We have three types of colloidal dispersion:

1. Lyophilic: are large organic molecules capable of being solvated or associated with the molecules of the dispersion medium.
 2. Lyophobic: means solvent hating, that is mean that the degree of interaction is small between the disperse phase and the dispersion medium. Lyophilic colloids are easier to prepare and have greater stability.
 3. Amphiphilic colloid or association is formed by grouping or association of molecules that exhibit both lyophilic and lyophobic properties, they form dispersions in both aqueous and non aqueous media.
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- Natural colloids: they are self-dispersing substances that is mean they readily dispersed upon the addition of the dispersion medium such as acacia.

- Artificial colloids: substances that require special means for prompt dispersion like fine pulverization of coarse particles to colloidal size by a colloid mill or a micropulverizer.