# PHB

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| **Course Name** | **: D. Pharm** |
| **Year** | **: First Year** |
| **Subject Name** | **: Pharmaceutics** |
| **Topic Name** | **: Gels** |

Ch – 13.7

# Gels

Gels are 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. The word ‘‘gel’’ is derived from ‘‘gelatin,’’ and both ‘‘gel’’ and ‘‘jelly’’.

## Characteristics of Gels

- **Swelling:** Gels can swell, absorbing liquid with an increase in volume.
- **Syneresis:** Many gel systems undergo contraction upon standing.
- **Ageing:** Colloidal systems usually exhibit slow spontaneous aggregation. This process is referred to as ageing.
- **Structure:** The rigidity of a gel arises from the presence of a network formed by the interlinking of particles of the gelling agents. It determines the structure of gels.

## Properties of Gel

1. The topical gel must not be sticky.
2. The ophthalmic gel must be sterile.
3. It should have suitable anti-microbial agent.
4. Ideally, the gelling agent must be inert, safe and cannot react with other formulation constituents.
5. Each component is continuous throughout the system.
6. The gelling agent should produce a sensible solid-like nature at the time of storage which is easily broken when exposed to shear forces produced by squeezing the tube, trembling the bottle or at the time of topical application.

## Classification of Gels:

Gels can be classified based on colloidal phases, nature of solvent used, physical nature and rheological properties, etc.

### A. Based on colloidal phases

They are classified into:

**a. Inorganic** (Two phase system)

**b. Organic** (Single phase system)

### B. Based on nature of solvent

**a. Hydrogels (Water based): E.g.:** Carpooler and poloxamer gel.

**b. Organogels (With a non-aqueous solvent)**

**c. Xerogels: E.g.:** Tragacanth ribbons, gelatin sheets and acacia tears.

**C. Based on rheological properties**

Usually gels exhibit non-Newtonian flow properties. They are classified into:

**a. Plastic gels: E.g.:** Flocculated suspensions of Aluminum hydroxide.

**b. Pseudo plastic gels: E.g.:** Liquid dispersion of tragacanth.

**c. Thixotropic gels: E.g.:** Agar

**D. Based on physical nature**

**a. Elastic gels: E.g.:** Alginate and Carbopol

**b. Rigid gels: E.g.:** In silica gel

## Preparation of Gels:

Gels are normally in the industrial scale prepared under room temperature. However, few of polymers need special treatment before processing. Gels can be prepared by following methods:

**1.** Thermal changes method

**2.** Flocculation method

**3.** Chemical reaction method

**1. Thermal changes**

Solvated polymers (lipophilic colloids) when subjected to thermal changes causes gelatin. If the temperature is reduced, the degree of hydration is decreased and gelation takes place. (Cooling of a concentrated hot solution will produce a gel).

**E.g.:** Gelatin, oleate, guar gummed, cellulose derivatives, etc.

**2. Flocculation**

Here gelation is produced by adding just sufficient quantity of salt to precipitate to produce age state, but inadequate to bring about complete precipitation.

**E.g.:** Solution of ethyl cellulose.

**3. Chemical reaction**

In this method gel is produced by chemical interaction between the solute and solvent.

**E.g.:** Aluminium hydroxide gel.

## Formulation Considerations for Pharmaceutical Gels

**1. The choice of vehicle/solvent**

Normally purified water is used as a solvent. To enhance the solubility of the therapeutic agent in the dosage form.

E.g., Alcohol, glycerol, PEG 400, etc.

**2. Inclusion of buffers**

Buffers may be involved in aqueous and hydroalcoholic-based gels to control the pH of the formulation.

**E.g.:** Phosphate, citrate, etc.

**3. Preservatives**

Certain preservatives cooperate with the hydrophilic polymers used to prepare gels.

**E.g.:** Parabens, phenolics, etc.

**4. Antioxidants**

It may be involved in the formulation to improve the chemical stability of therapeutic agents that are prone to oxidative degradation. **E.g.:** Sodium metabisulphite.

**5. Flavors/Sweetening agents**

Flavors and sweetening agents are only incorporated in gels that are designed for administration into the oral cavity.

**Sweeteners: E.g.:** Sucrose, glycerol, sorbitol, saccharin sodium etc.

**Flavors: E.g.:** Butterscotch, vanilla, cherry, mint, anise, raspberry.

## Uses of Gels

**1.** As delivery systems for orally administered drugs.

**2.** For topical drugs applied directly to the skin, mucous membrane or the eye.

**3.** In cosmetics like shampoos, fragrance products, dentifrices and skin and hair care preparations.

**4.** Lubricant for catheters

**5.** NaCl gel for electrocardiography

**6.** Sodium fluoride & Phosphoric acid gel for dental care prophylactic.

## Evaluation Parameters of the Formulated Gels

**1. Measurement of pH**

The pH was determined by using a digital pH meter.

**2. Drug content**

Drug content was calculated by using the equation, which was got by linear regression analysis of calibration curve.

**3. Viscosity study**

It is carried out by using Brookfield viscometer.

**4. Spreadability**

It indicates the extent of the area to which gel readily spreads on application to the skin or affected part.

**5. Extrudability study**

The formulations are fill in the collapsible tubes, after it was set in the container. Extrudability is determine in terms of weight in gm required to extrude a 0.5 cm ribbon of gel in 10 second.

**6. Skin irritation study**

For skin irritation study, by using animal study.