

# Macromolecules

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## **Polymer:**

It is a high molecular weight compound, which is formed by connecting the same or different atoms more or less regularly with chemical bonds.

## **Monomer:**

It is a large number of simple repeating units that form polymers. Materials such as cellulose, starch, gelatin, natural rubber are also known as natural polymers and are made up of simple, repeated units.

## **Macromolecule:**

High molecular weight compounds in the complex structure described above are generally termed as macromolecules.

Upon contact of the polymers with the liquids, dissolution or gel formation is observed.

When a polymer is placed in the solvent, small solvent molecules are diffused into the polymer and the polymer is swollen.

## Natural macromolecules

- Acacia gum
- Tragacanth
- Gelatine
- Alginic acid
- Starch
- Agar
- Pectin

# Gelatin (gelatinum)

## Used as:

*coating agent,  
film former,  
gelling agent,  
suspending agent,  
tablet binder,  
Ovule base  
Capsule material  
viscosity increasing*

- ❑ It is mixture of purified protein fractions of animal collagen.
- ❑ consist of amino acids joined together by amide linkages to form linear polymers.

Gelatin may be two types,

### Type A gelatin :

- is obtained by digestion with dilute acids from the pig's pound.
- partial acid hydrolysis
- The isoelectric point is pH 3.8-6.

### Type B gelatin:

- Raw ossein or leather is obtained by neutralizing  $\text{CaOH}_3$
- partial alkaline hydrolysis
- The isoelectric point is pH 5-7.4.

## **Alginic acid Sodium alginate**

- ❑ It is extracted from brown sea algae (Laminaria sp.)
- ❑ Its structure consist of mannuronic and gluronic acid polymers.

**Orally,**

- Tablet /capsule binder or disintegration agent
- Hydrophilic matrix material in controlled release
- Antiacid (Ex. gaviscon)

**Topically,**

- Suspending agent and/or thickening agent in creams pastes and gels
- Stabilization agent in O/W emulsions

## **Starch** *(amylum)*

- ❑ It is obtained from corn, wheat, potatoes and rice.
- ❑ The structure contains amylose (soluble) and amylopectin (insoluble, swollen) polysaccharides.
- ❑ White powder. Insoluble in cold water, swell in hot water (~ 70 ° C), partially soluble at 100 ° C.
- ❑ It is used in tablets, capsules, cachets and in topical dosage forms,
- ❑ Emollient in egzema (glycerine ointment)
- ❑ Used in iodine toxicity, diarrhea therapy (as rice musilage)

## **Semi synthetic Macromolecules**

### **Cellulose types**

- **Microcrystal cellulose (Avicel)**
- **Carboxymethyl cellulose**
- **Methyl cellulose**
- **Ethyl cellulose**
- **Hydroxy propyl cellulose**
- **Hydroxy propyl methyl cellulose**
- **Sodium carboxy methyl cellulose**

**Cellulose is handled from the cell walls of plants**



## **Methyl cellulose** *(methocel)*

- ❑ Obtained from cellulose by methylation in alkaline medium.
- ❑ It's white powder.
- ❑ It swells in cold water and forms a colloidal dispersion. Insoluble in hot water and alcohol.
- ❑ It has bulk laxative therapeutic effect .
- ❑ It is used in tablets as binder/coating agent/disintegrant
- ❑ In oral liquids, suspensions, creams and gels.
- ❑ In ophthalmic preparations.
  
- ❑ Types:
  - A4MP    4000 mPa.s
  - A15-LV    15mPa.s
  - A15CP    1500mPa.s
  - A4CP    400mPa.s

# Hydroxy propyl methyl cellulose (HPMC)

- ❑ It is obtained by reaction with NaOH solution.
- ❑ Odorless, tasteless, creamy white colored fibrous or granular powder.
- ❑ It is soluble in cold water and gives a viscous colloidal solution.
- ❑ Different types of viscosities are found (100 - 100000 mPa.s).
- ❑ It is used in tablets, topical formulations and in eye drops

Ex. Tears Naturale Free / Alcon

**In tablets,**

- **it is used as binder and film coater**
- **used to prepare a matrix tablet to provide sustained/prolonged release.**

**In topical formulations,**

- **Stabilizer**
  - **suspending agent,**
  - **viscosity enhancer,**
  - **emulsion agent.**
- **Partly used as ophthalmic. Because it gives a clearer solution than MC, it enters the eye drop and artificial tear composition (0.5-1%).**

## **Synthetic macromolecules**

- **Polyvinyl alcohol**
- **Polyvinyl pyrrolidone**
- **Carbopol**
- **Poloxamer**

**Carbopol  
(carbomer)**

➤ **Acrylic acid polymers**

- ❑ **White, acidic, fluffy, hygroscopic dust.**
- ❑ **High MW**
- ❑ **Crosslinked polymers,**
- ❑ **It is bioadhesive and can be used tablets as binder,**
- ❑ **In topical formulations as emulsifier, suspension agent or gelling agent.**
- ❑ **Can be used as controlled release agent**

**Carbomer / Carbopol 934**

**Carbomer / Carbopol 934P**

**Carbomer / Carbopol 940**

**Carbomer / Carbopol 941**

**Carbomer / Carbopol 1342**

## **Polyvinyl alcohol (PVA)**

- ❑ obtained by hydrolysis in alcohol and mineral acid or alkali catalysis in methyl acetate.
- ❑ It is used in topical, ophthalmic dosage forms (artificial tears) and contact lens solutions and oral dosage forms.

**MW:      \*200000 (high viscosity),  
             \*130000 (medium viscosity),  
             \*30000 (low viscosity)**

- stabilization agent in emulsions
- used in artificial tear and contact lens solutions
- microspheres,
- coating agent, lubricant in oral dosage forms
- patch backing material in transdermal therapeutic systems

# Polyvinyl pyrrolidone (PVP)

*(collidon, povidone)*

- ❑ It is a creamy or white colored, odorless, hygroscopic powder.
- ❑ Soluble in water and alcohols.
- ❑ It can be used as
  - carrier for drugs (10-25 %),
  - dispersing agent (up to 5%),
  - eye drops (2-10 %),
  - suspension agent (max 5%),
  - tablet binder/diluent or coating agent (0.5-5%)

Can be defined with “K” value due to MW and viscosity characteristics

**K12      MW 2500;      1.3-2.3 mPa.s**

**K17      MW 10000;      1.5-3.5 mPa.s**

**K30      MW 50000;      5.5-8.5 mPa.s**

**K90      MW 1000000;      300-700 mPa.s**