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REVIEW ON CELLULOSE DERIVATIVES

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ABSTRACT

Cellulose derivatives are most commonly used to modify the release of drugs in tablet and capsule formulations for the purpose of tablet binding, thickening, film formation, water retention, adhesion, and as suspending and emulsifying agents. Annual cellulose synthesis by plants is close to 10^{12} tons. Plants contain approximately 33% cellulose whereas wood contains around 50 % and cotton contains 90%. This fact was the starting point of our research into understanding, designing, synthesising and finding new alternative applications for this well-known but underused biomaterial.

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INTRODUCTION

Cellulose Introduction –

Cellulose is a complex carbohydrate, or polysaccharide consisting of 3000 or more glucose units.

Cellulose + $H3O^+$ + heat → over 1000 glucose molecules.

Cellulose is a substance found in the cell walls of plants. Although cellulose is not a component of the human body, it is nevertheless the most abundant organic macromolecule on Earth. The scientific community first observed cellulose in 1833 when it was studied in plant cell walls. The chemical structure of cellulose resembles that of starch, but unlike starch, cellulose is extremely rigid . This rigidity imparts great strength to the plant body and protection to the interiors of plant cells.

The most abundant organic compounds on earth.

The basic structure component of plants cell walls

33% Vegetable

90% Cotton

50% Wood

WHAT ARE CELLULOSE DERIVATIVES

- ✖ Pharmaceutically used cellulose derivatives obtained by either mechanical or chemical processing or both.
- ✖ The hydroxyl groups of cellulose can be partially or fully reacted with various reagent to afford derivatives with useful properties.
- ✖ Pure cellulose additional treatment by HCL produced various cellulose derivatives.

Classification of Cellulose

- ✖ Based on solubility:-

Water soluble:-
hydroxypropylmethylcellulose
hydroxyethylcellulose
hydroxypropylcellulose

Water insoluble:-
ethyl cellulose
cellulose acetate phthalate
HPMC phthalate

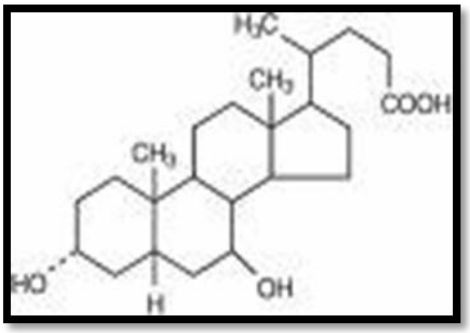
✖Based on chemical nature:-

cellulose ester:-
cellulose acetate
cellulose triacetate
cellulose propionate
cellulose nitrate (nitrocellulose)

cellulose ether:-
methyl cellulose
ethyl cellulose
HPC,HPMC
carboxy methyl cellulose

CELLULOSE DERIVATIVES

Microcrystalline cellulose

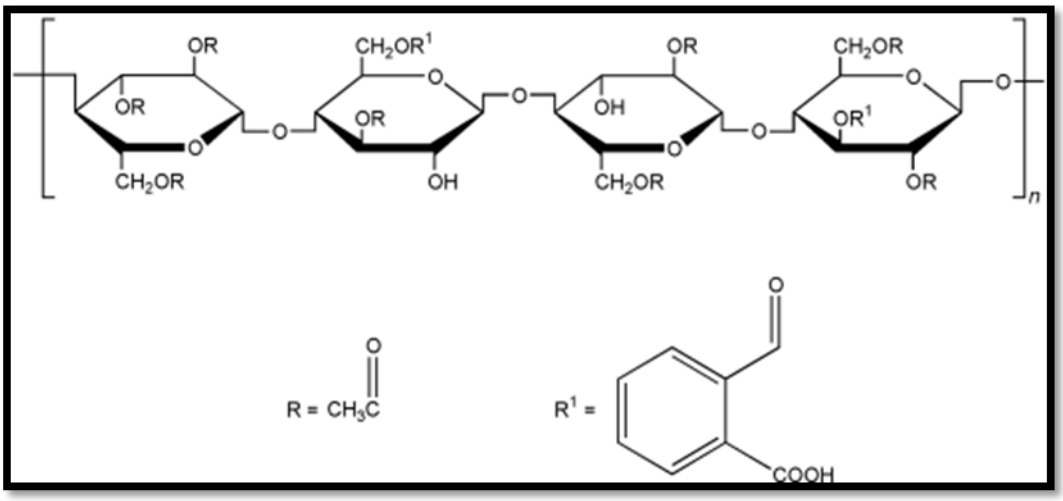


Synonyms: Celex , cellulose gel , fibrocel.
Empirical Formula : $(C_6H_{10}O_5)_{n\ n=220}$
Molecular Weight : 36000
Function Category : Adsorbent, Suspending agent, table diluent
Application in Pharmaceutical Formulation:
→Binder (20-90%) → Disintigrant (5-15%)
→ Antiadherent (5-20%) → Lubricant
→Diluent (20-90%)

Description:White,Odorless, Tasteless,Crystalline power
Typical properties
Density(bulk):0.337g/cm^3
Density(tapped):0.478g/cm^3
Density(true):1.512-1.668g/cm^3
Flow ability: 1.41 g/s
Melting point: 260-270^{0}c
Moisture content: < then 5 % w/w
Solubility: Slightly soluble in NAOH

Precaution:
Irritant to eye so recommended eye protection.
Incompatibilities : With strong oxidizing agents.

Cellulose Acetate phthalate

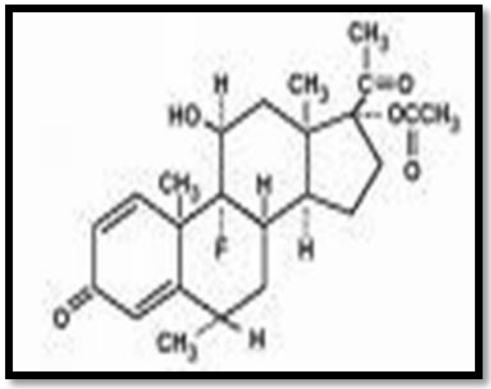


Synonyms: cellacephate
Function Category : coating agent
Application in Pharmaceutical Formulation:
→used in enteric film coating material (0.5-9%)
→matrix binder for tablets and capsules

Description:
Hygroscopic, White to off White ,Free-flowing powder
Typical properties
Density(bulk): 0.260 g/cm^3
Density(tapped): 0.266 g/cm^3
Melting point: 192^{0}C
Moisture content: 2.2%
Solubility: <10%w/w

Incompatibilities : With ferrous sulfate , $Fecl_2$,$Cacl_2$, $Hgcl_2$, lead acetate , strong oxidizing agent.
Precaution:
Irritant to eye should be handled in a well ventilated environment.

Cellulose Acetate

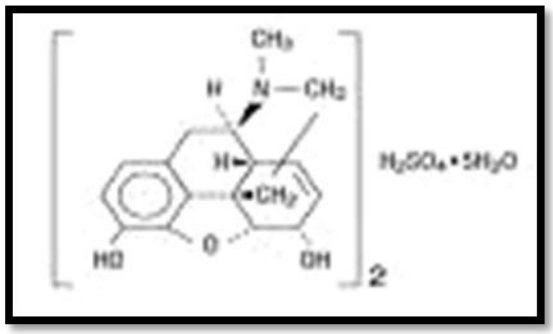


Synonyms: Acetyl cellulose
Empirical Formula:$(C_6H_{12}O_7)_n$
Molecular Weight: 38000
Function Category : Extended release agent,Diluent
Application in Pharmaceutical Formulation:
→used in sustain release & taste masking
→used in transdermal drug delivery

Description:
Free flowing pellets, tasteless, slightly odour of acetic acid
Typical properties
Density:1.3 g/cm^3
Melting point: 230-300^{0}c
Glass transition temperature: 170-190^{0}c
Solubility: soluble in acetone-water, dichloromethane-ethanol
Viscosity: 10-230 mPa s
Incompatibilities : With strongly acidic or alkaline substance

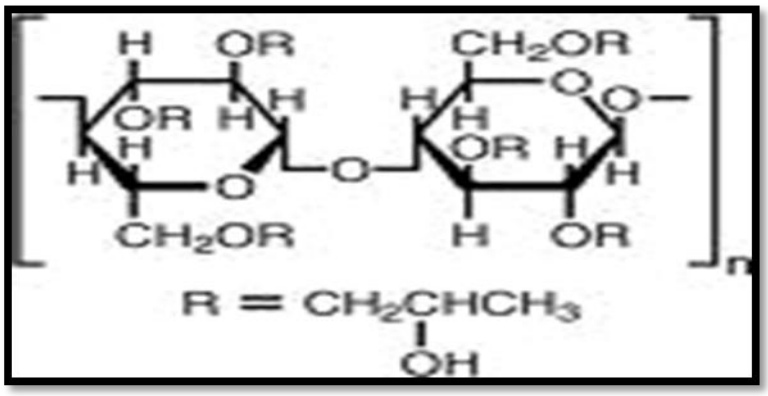
Precaution:
Cellulose acetate irritant to eye so eye protection should be worm

Hydroxy ethyl cellulose



Synonyms: cellulose hydroxy ethyl ether
Molecular Weight: 38000
Function Category : Suspending agent, Binder
Coating agent, Thickening agent
Application in Pharmaceutical Formulation:
→Opthalmic & Topical formulation
→ Cosmetic preparation
Description:
Hygroscopy powder, odourless, tasteless, cream to white colour
Typical properties
Density(bulk):0.35-0.61g/cm^3
Melting point: 135-140^{0}c(softens)
205^{0}C(Decompose)
Moisture content: < then 5 % w/w
Solubility: soluble in Hot & Cold water
Insoluble in ethanol, ether, toluene
Viscosity: 2-20000 mPa s
cello size (2-3000)
Natrosol (>3000)
Incompatibilities : With fluorescent dyes , quaternary disinfectant.
Precaution:
Irritant to eye so recommended eye protection.

Hydroxy propyl cellulose

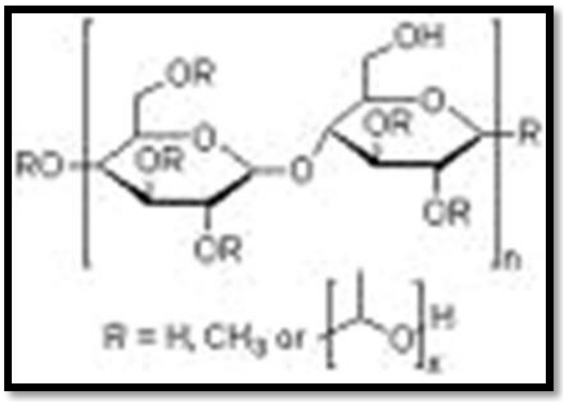


Synonyms: Hyprolose
Molecular Weight: 50000-125000
Function Category : Suspending agent, Binder, Coating agent, Emulsifying agent
Application in Pharmaceutical Formulation:
→ Oral & Topical formulation
→ binder in tableting process (2-6% w/w)
→ extended drug release(15-35% w/w)

Description:
odourless, tasteless, white to slightly yellow colour.
Typical properties
Density(bulk): 0.5 g/cm^3
Melting point: 130^{0}c(softens)
260-275^{0}cDecompose)
Moisture content: 4 % w/w(at 50%relativehumidity)
12%w/w(at 84% relative humidity)
Solubility: soluble 1 in 10 part dichloromethane
1 in 2.5 part ethanol
1in 2 part methanol
Viscosity: 75-3000 mPa s
Incompatibilities : With phenol derivatives such as
methylparaben , propylparaben.

Precaution:
Irritant to eye so recommended eye protection.

Hydroxy propyl methyl cellulose

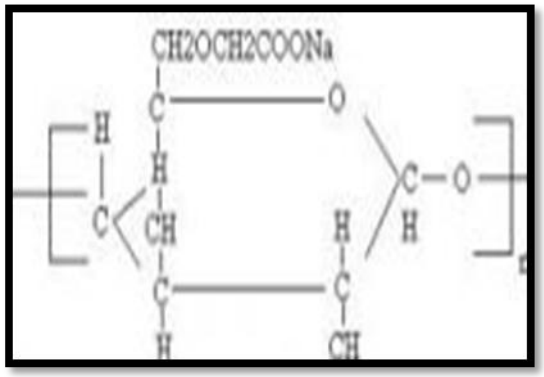


Synonyms: Hypromellose
Empirical Formula : $C_{56}H_{108}O_{30}$
Molecular Weight : 10000-1500000
Function Category : Coating agent, Suspending, agent, tablet binder
Application in Pharmaceutical Formulation:
→Binder (2-5%w/w)
→Thickening agent(0.45-1%w/w)
→Emulsifier, Suspending agent
→Plastic bandage
Description: White, Odorless, Tasteless
Typical properties
Density(bulk):0.341 g/cm^3
Density(tapped):0.557g/cm^3
Density(true):1.326g/cm^3
Melting point: 190-200^{0}c
Moisture content: depend on initial moistur content, temperature, relative humidity.
Solubility: soluble in cold water And insolubal in chloroform, ethenol, ethers.
Incompatibilities : With oxidizing agents , metallic, salts or ionic organics.
Precaution: Irritent to eye so recommended eye protection.

Powder cellulose
Synonyms: Arbocel
Empirical Formula: $(C_6H_{10}O_5)_{n\ n=500}$
Molecular Weight : 243000
Function Category : Suspending agent, tablet diluents, disintigrant
Application in Pharmaceutical Formulation:
→Binder (5-25%w/w)
→Disintigrant (5-15-1%w/w)
→Glident(1-2%)
→Plastic bandag

Description: White, Odorless, Tasteless
Typical properties
Density(bulk):0.139-0.391 g/cm^3
Density(tapped):0.210-0-481 g/cm^3
Density(true):1.5 g/cm^3
Moisture content: < then 5 % w/w
Solubility: Slightly soluble 5% in NAOH
Incompatibilities : With strong oxidizing agent.
Precaution: Irritent to eye so recommended eye protection.

Carboxyl methyl cellulose



Synonyms: carmellose
Chemical formula: $C_8H_{16}NaO_8$
Molecular formula: 90000-700000

Properties:

→ Water soluble
→Stable at pH 5-10, best at 7-9 pH
→At pH 3 CMC is insoluble
→ Fine Film Forming Properties
→ Resistance to oil Greases & Solvents

Methyl cellulose

- ✖ Synonyms:- Methocel, methyl ether
- ✖ Contain 27.5 to 31.5%of methoxy groups.
- ✖ Description :- White,powder or granules.
- ✖ Solubility:- insoluble in ether,alcohol and chloroform but soluble in glacial acetic acid and in mix. of equal parts of alcohol and chloroform.
- ✖ Uses:- dispersing thickening emilsifying and coating agent.

Ethyl cellulose

- ✖ Synonyms:- Aquacoat,ethocel,surelease.
- ✖ Description :- tasteless, free flowing.
- ✖ Solubility:- insoluble in glycerin, propylene glycol, and water. soluble in chloroform, ethanol.
- ✖ Uses:- Micro encapsulation (10-20%)

Sustained release tablet coating (3-20%)
Tablet coating (1-3%)

Advantages

- ❖ Improve stability of drug.
- ❖ Good Lubrication
- ❖ Good binding properties
- ❖ Rapid disintigration
- ❖ Good flowing properties
- ❖ Reduced friability & weight loss
- ❖ Excellent compression & hardness

Uses of Cellulose

Cellulose has many uses such as the following.

- ➢ Anticake agents
- ➢ Emulsifier
- ➢ Stabiliser
- ➢ Dispersing agent
- ➢ Thickener
- ➢ Gelling agent
- ❖ Most important use is of holding on to water

CONCLUSION

Cellulose and Cellulose derivatives are carbohydrate polymeric system is applicable for pharmaceutical as well as industrial purpose.

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