

BPHARM_BP801T_UNIT1_POLYMERS

POLYMERS IN DRUG DELIVERY

Polymers are macromolecules having very large chains, contain a variety of functional groups, can be blended with other low- and high-molecular-weight materials, and can be tailored for any applications. Polymers play a vital role in the progression of drug delivery technology by offering repeated dosage, release of hydrophilic and hydrophobic drugs, in a synchronized manner and constant release of formulations over extended periods. They are also increasingly used as taste-masking agent, stabilizer, and protective agent in oral drug delivery. Polymers enable hydrophobic drug administration if formulated as micelles, favourably alter bio distribution, if formulated into dense nanoparticles, make drugs available in response to stimuli, prolong drug availability if medicines are formulated as hydrogels or microparticles and transport a drug to its usually inaccessible site of action if formulated as gene medicines.

CLASSIFICATION OF POLYMERS:- BASED ON SOURCE:-

1. **Natural:-** Albumin, Alginate, Chitosan, Collagen, Dextran and Gelatin,
2. **Semi-Synthetic:-** Hydroxy Propyl Cellulose (HPC), Hydroxy Propyl Methyl Cellulose (HPMC) and Methyl Cellulose (MC),
3. **Synthetic:-** Polyethylene, Polyglycolic acid, Polyhydroxy Butyrate, Polylactic acid and Polypropylene,

TECHNIQUES FOR THE CHARACTERIZATION OF POLYMERS

I. CHROMATOGRAPHIC TECHNIQUES

1. Gas Chromatography
2. Liquid Chromatography
3. Gel Permeation Chromatography

II. THERMAL ANALYSIS

1. Differential Scanning Calorimetry (DSC)
2. Thermogravimetric Analysis (TGA)
3. Thermomechanical Analysis (TMA)
4. Dynamic Mechanical Thermal Analysis (DMTA)

III. MICROSCOPY FOR POLYMER CHARACTERIZATION

IV. ELEMENTAL AND STRUCTURAL CHARACTERIZATION TESTS

1. Atomic Absorption Spectroscopy
2. Established Methods by ¹H NMR
3. Fourier Transform Infrared (FTIR)
4. Inductively Coupled Plasma Atomic Emission Spectroscopy
5. Ion Chromatography (IC)
6. Ion Selective Electrodes (ISE)
7. Mass Spectrometry (MS and GC/MS)
8. Neutron Activation Analysis
9. Nuclear Magnetic Resonance Spectrometer
10. Potentiometric Titrations
11. Ultraviolet, Visible, and Infrared Spectrometry (UV, Vis, IR)
12. X-Ray Fluorescence Spectrometry

V. RHEOMETRY

1. Rheometrics System
2. Capillary Rheometry
3. Torque Rheometry

VI. CHEMICAL ANALYSIS OF POLYMERS

1. Comminution, Separation, and Identification
2. Stabilizer Identification
3. Polymer Identification .

POLYMERS IN PHARMACEUTICAL AND BIOMEDICAL APPLICATIONS

Applications of polymers for controlled drug delivery:-

Biodegradable systems, electric current responsive drug release, matrix systems, matrix systems, ocusert system, osmotically controlled drug delivery, pH responsive drug release, polymer-drug conjugates, reservoir designed transdermal patches, reservoir systems, stimulus responsive drug release, swelling controlled release systems, temperature responsive drug release, the progestasert system ,ultrasound responsive drug release

Cellulose-Based Polymers

1. Carboxymethyl cellulose :- super disintegrant, emulsion stabilizer
2. Cellulose acetate :- phthalate enteric coating
3. Ethyl cellulose :- insoluble but dispersible in water, aqueous coating system for
4. Hydroxyethyl and hydroxypropyl celluloses
5. Hydroxypropyl methyl cellulose :- binder for tablet matrix and tablet coating, gelatin alternative as capsule material
6. Soluble in water and in alcohol, tablet coating sustained release applications

Water-Soluble Synthetic Polymers

1. Poly (acrylic acid) Cosmetic, pharmaceuticals, immobilization of cationic drugs, base for Carbopol polymers
2. Poly (ethylene glycol) plasticizer, base for suppositories
3. Poly (ethylene oxide) Coagulant, flocculent, very high molecular-weight up to a few millions, swelling agent
4. Poly (isopropyl acrylamide) and poly (cyclopropyl methacrylamide)· Thermogelling acrylamide derivatives, its balance of hydrogen bonding, and hydrophobic association changes with temperature
5. Poly (vinyl alcohol) Water-soluble packaging, tablet binder, tablet coating
6. Poly (vinyl pyrrolidone) Used to make iodine complex, plasma replacement, tablet granulation
7. Polyacrylamide Gel electrophoresis to separate proteins based on their molecular weights, coagulant, absorbent

Water-Insoluble Biodegradable Polymers

1. (Lactide-co-glycolide) polymers Microparticle–nanoparticle for protein delivery

Hydrocolloids

1. Alginic acid :- oral and topical pharmaceutical products; thickening and suspending agent in a variety of pastes, creams, and gels, as well as a stabilizing agent for oil-in-water emulsions; binder and disintegrant
2. Carrageenan :- modified release, viscosifier
3. Chitosan :- cosmetics and controlled drug delivery applications, mucoadhesive dosage forms, rapid release dosage forms
4. Hyaluronic acid :- Reduction of scar tissue, cosmetics
5. Pectinic acid :- Drug delivery

Starch-Based Polymers

1. Sodium starch glycolate :- Super disintegrant for tablets and capsules in oral delivery
2. Starch glidant :- diluents in tablets and capsules, a disintegrant in tablets and capsules, a tablet binder

Plastics and Rubbers

1. 2-Ethylhexyl acrylate and butyl acrylate copolymer
2. Acrylic acid and butyl acrylate copolymer
3. Poly (hydroxyethyl methacrylate) Soft contact lenses
4. Poly (methyl methacrylate) Hard contact lenses
5. Poly (vinyl acetate) Binder for chewing gum
6. Poly (vinyl chloride) Blood bag, hoses, and tubing
7. Polycarbonate Case for biomedical and pharmaceutical products
8. Polychloroprene Septum for injection, plungers for syringes, and valve components
9. Polycyanoacrylate Biodegradable tissue adhesives in surgery, a drug carrier in nano- and microparticles
10. Polyethylene Transdermal patch backing for drug in adhesive design, wrap, packaging, containers
11. Polyisobutylene Pressure sensitive adhesives for transdermal delivery
12. Polypropylene Tight packaging, heat shrinkable films, containers
13. Polystyrene Petri dishes and containers for cell culture

14. Silicones Pacifier, therapeutic devices, implants, medical grade adhesive for transdermal delivery transdermal patches
15. Ethylene vinyl acetate and polyethylene terephthalate
16. Ethylene vinyl acetate and polyethylene Transdermal patch backing (heat sealable, occlusive, translucent)
17. High cohesive strength pressure– sensitive adhesive for transdermal patches
18. Low Tg pressure–sensitive adhesive for transdermal patches
19. Polyethylene and polyethylene terephthalate Transdermal patch backing (when ethylene vinyl acetate copolymer is incompatible with the drug)
20. Polyurethane Transdermal patch backing (soft, comfortable, moderate moisture transmission), blood pump, artificial heart, and vascular grafts, foam in biomedical and industrial products
21. Transdermal patch backing (occlusive, heat sealable, translucent)
22. Vinyl acetate and methyl acrylate copolymer

References:

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