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AN OVERVIEW ON PHARMACEUTICAL POLYMERS ANALYSIS

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ABSTRACT :

Pharmaceutical polymers play a vital and crucial role in conventional and novel drug delivery pharmaceutical formulations. They can be used as Binding agent, suspending agent, emulsifying agent, coating agent and as packaging materials. When pharmaceutical polymers, used in controlled conditions results in sustained, extended, modified, controlled, and targeted drug delivery. This review article mainly focuses on a overview of polymers which includes polymer composition , classification, pharmaceutical polymer analysis and their applications.

KEYWORDS:

Polymers, pharmaceutical applications, pharmaceutical polymer analysis, targeted drug delivery.

INTRODUCTION:

The word "Polymer" is a Greek word where "Poly" means many and "Meros" means parts.A Polymer in general terms can be defined as a class of natural or synthetic substance which comprises of very large molecules called macromolecules, which in turn are multiples of many subunits known as monomers.Synthetic and natural-based polymers due to their huge advantages, managed to quickly find their way into the pharmaceutical industries and their application is growing in rapid pace.

Classification of polymers:

Polymers can be classified in many ways on various criteria, but mainly they are classified into7 types :

1. **BASED ON THE ORIGIN:**

i) Natural Polymers
*Protein-based*Polysaccharides

ii) Synthetic Polymers

*Biodegradable	*Polyesters
*Polyanhydrides	*Polyamides
*Phosphorus-based	
*non-biodegradable	
*Cellulose derivatives	*Silicones
*Acrylic polymers	

iii) Semi-synthetic Polymer

1. **BASED ON BACKBONE:**

i) Polymers with carbon chain backbone
ii) Polymers with hetero chain backbone

2. **BASED ON THE PRESENCE OF CARBON:**

i)Organic Polymers
ii)Inorganic Polymers

3. **BASED ON THE TYPES OF MONOMERS:**

i)Homopolymers
ii)Copolymers

4. **BASED ON POLYMERISATION PROCESS:**
i)Addition polymers
ii)Condensation polymers

5. **BASED ON THE LINE STRUCTURE:**

i)Linear Polymer

ii) Branched Polymer

iii) Cross-linked Polymer

6. **BASED ON THERMAL RESPONSE:**

i)Thermoplastic polymers
ii) Thermosetting polymers

Characteristics of Ideal Polymer:

1. Should be inert.
2. Should be compatible with the surrounding environment.
3. Should be non-toxic substance.
4. Should be easy to administer.
5. Should be easy to formulate.
6. Should be economic to fabricate.
7. Should have a good mechanical strength.

Use of polymers in conventional dosage forms:

1. Tablets
2. Capsules
3. Film coatings of solid dosage forms
4. Dispersion systems
5. Gels
6. Transdermal drug delivery systems (patches)

*****Tablets: used as a binder and disintegrator.

***** Capsules: used as a plasticizer.

*****Repository patches: used to make patches.

Use of polymers in controlled drug dosage forms:

1.reservoir systems

2. Ocuser System

3. Matrix systems

4. Release systems that regulate swelling

5. Biodegradable systems

6. Osmotically controlled drug delivery

7. Introduction: Principles of Controlled Drug Delivery

8. Reservoir Designed Depot patches

9. Matrix systems

10. Stimulus-responsive release of drugs

11. Ultrasound-sensitive drug release

12. Temperature sensitive drug release

ANALYTICAL METHODS FOR CHARACTERIZING PHARMACEUTICAL POLYMERS:

Polymer analysis is used to identify basic chemical and structural polymer information such as molecular weight, molecular weight distribution and branching information etc. Below are some of the analytical techniques used to characterizepolymers.

CHROMATOGRAPHIC METHODS FOR POLYMER ANALYSIS:

Chromatography is a technique used to separate mixtures and isolate individual compounds. It is one of the most widely used techniques for polymer analysis. Some of them are:

1. Gas Chromatography – Flame Ionization (GC-FID),
2. Gas Chromatography-Mass Spectrometry (GC-MS) and
3. Reversed Phase High Performance Liquid Chromatography (RP HPLC).

More recently, an advanced instrument for molecular weight chromatography analysis has been developed and the technique is called high temperature gel permeation chromatography (HTGPC). It is particularly used for analysing polyolefin materials such as polypropylene and polyethylene. It provides insight into molecular weight, which in turn provides important data on structural and mechanical properties.

THERMAL METHODS FOR POLYMER ANALYSIS:

The temperature factor can have a major influence on the behaviour and function of polymers. This makes these techniques an important step in product research and development. Generally, techniques such as

1. differential scanning calorimetry (DSC) and
2. thermogravimetric analysis (TGA)

they are used to measure the physical properties.These include high-performance thermoplastics, composites and resins for industrial applications. Thermal analysis makes it possible to develop a deep understanding of polymer properties. These insights can be used to accelerate product development, maintain quality control and support decision-making processes.

SPECTROSCOPIC METHODS OF POLYMER ANALYSIS:

Spectroscopy is the study of how a matter absorbs and emits light. This technique has become an important tool for polymer analysis. Spectroscopic techniques are used to characterize the structure of polymers and observe physical and chemical changes when exposed to different environmental conditions. The main techniques used are IR, Raman and NMR spectroscopy, and most of this course will cover these important analytical techniques. Absorption is a quantized inelastic phenomenon in which energy from EM radiation is transferred to a material.

THERMAL AND MECHANICAL TESTS:

Thermal analysis is used to describe solid state transitions in polymers and plays an important role in understanding the mechanical properties and processing of plastics. Measuring the glass transition and crystal transitions using typical analytical techniques is discussed. Polymer systems are dominated by kinetics and this is highlighted by the use of dynamic mechanical and thermal analysis techniques to describe mechanical absorption phenomena associated with the glass transition and other mechanical transitions.

DIFFRACTION AND SCATTERING:

In addition to inelastic absorption phenomena, an elastic interaction between EM radiation and a material is possible, leading to diffraction and scattering phenomena. The small crystallite size and dominance of crystal orientation in processed plastics lead to several unique analytical approaches when analysing X-ray diffraction data in these materials. The focus of this course is on the tools used in diffraction that are specific to polymeric materials. Small-angle X-ray scattering is a crucial technique for describing polymeric materials because small-angle diffraction is associated with the colloidal to nanoscale scale of a typical polymer chain. Colloidal deposition is also associated with polymer crystallites (lamellae) and block copolymer structures separated by microphases. Additionally, light scattering is widely used in polymer science to describe disordered structures at the micro- meter scale, as well as a primary technique for determining molecular weight from dilute solutions.

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