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AN OVERVIEW OF INTERPENETRATING POLYMER NETWORK

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ABSTRACT

Inter penetrating networks (IPNs) are composites of at least two polymers in which at least one network is synthesized or cross-linked in the presence of the other. Formulations based on micro-spheres provide liquid pa optimum control of kinetics of drug release from the dosage form. The procedure for the synthesis of IPNs-Simultaneous synthetic method and Sequential synthetic method. For improving the delivery of therapeutic materials like films, hydrogels, tablets, capsules, microspheres, sheets, sponges.

Keywords: - IPN, Method, Formulation, Bicalutamide, etc.



INTRODUCTION

Interpenetrating polymer network is defined as any material which contains two or more polymers in the network form. IPN is obtained when at least one of the polymers is synthesized or cross-linked in the immediate presence of the other polymer without any covalent bond between them [1]

The following conditions of polymer which are necessary in the composition of Interpenetrating polymer network the conditions are as follows. [1]

- 1) At least two polymers must be synthesized and cross linked in the presence of the other.
- 2) Both polymers have similar kinetics.
- 3) Polymers are not dramatically phase separated.

Double network gels are also obtained from interpenetrating polymer network in which the properties of two networks can be done in contrast such as, rigidity, molecular weight, network density etc.

Interpenetrating polymer network formulation is one of the important/successful methods for developing a product with better physio- mechanical properties than the normal poly blends. There are so many ways to making of IPN. IPN found also in form of latex which is known as interpenetrating electromagnetic network (IEN).

The term sustained release indicates an initial release of drug sufficient to provide a minimum effective concentration immediately after administration and then gradual release over an extended period of time. Sustained release dosage forms are designed to increase the therapeutic activity of a drug in order to achieve a prolonged duration of action with the benefit of safe and effective concentration in plasma. [4]

Interpenetrating networks (IPNs) are composites of at least two polymers in which at least one network is synthesized or cross-linked in the presence of the other. IPN are also known as entanglements of polymer networks that are ideally held together only by permanent topological interactions. It can insure a slow release of drug from a polymeric matrix for a prolonged period of time. This fits the criteria of sustained release dosage forms. [4]

Formulations based on micro-spheres provide liquid pa optimum control of kinetics of drug release from the dosage form. Controlled release (Sigma, preparations are preferred as this produce maximum therapeutic effect with a minimal risk of adverse effects. [2]

The androgen receptor (AR) has essential anabolic and reproductive roles in men and women additionally; androgen receptor signaling plays a crucial function in tumorigenesis and metastasis of different cancer types, including prostate cancer, bladder, kidney, lung, breast,

and liver cancer. AR is a member of the nuclear receptor family and consists of three main functional domain a variable N-terminal domain, a highly conserved testosterone and dihydrotestosterone (DHT) to the LBD induces AR conformational changes then translocation into the nucleus to interact with DNA and modulate prostate-specific antigen (PSA) levels. AR antagonists (antiandrogens) inhibit these processes and used for the treatment of advanced prostate cancer (PC). A variety of nonsteroidal antiandrogens (NSAA) are approved for the treatment of prostate Cancer. The first generation NSAAS include flutamide, hydroxyflutamide, and bicalutamide, however these antiandrogens eventually fail to inhibit the AR upon long-term treatment, switching from being AR antagonists to AR agonists with development of castration-resistant prostate cancer (CRPC), an aggressive form of the disease with poor prognosis. Similarly, resistance to the more recent second-generation antiandrogens (enzalutamide, apalutamide) is developing in PC patients via the upregulation of AR expression 1:1 More recently, darolutamide (ODM-201) has been recently approved and clinically used in patients with nonmetastatic CRIC New AR antagonists are continuously needed to improve the efficacy of the Clinically used compounds.[3]

Methods for IPN preparation:

The technique for the synthesis of IPNs may be divided in to two classes: [1]

1. Simultaneous artificial technique:

In simultaneous synthetic technique, each monomer is combined collectively to shape polymer community simultaneously via one-of-a-kind re movement routes.

2. Sequential synthetic approach:

In sequential synthetic technique, distinctive community reactions are managed sequentially by way of including exclusive monomers. Now a day, basically industrial substances are organized by means of sequential IPNs, due to their flexibility and smooth to system capacity.

Whilst IPNs are used for coating motive, they cannot be prepared by way of the sequential or simultaneous interpenetrating polymerization due to the presence of risky monomer. For this motive, they may be organized from preforming prepolymers which incorporate complementary purposeful organizations that growth their miscibility. In IPNs, cross linking of mutual chain entanglement produces finer dispersion of one polymer into the alternative.

Formulation:

Now a days, there are numerous techniques which can be getting used for enhancing the transport of therapeutic substances like films, hydrogels, tablets, drugs, microspheres, sheets,

sponges, matrix, transdermal patches, nanoparticles and so forth. some of the essential IPN based drug delivery systems are mentioned here.[1]

- **Films:**

IPN primarily based films are used as piezodialysis membrane which can be non-mosaic membrane. The essential application of IPN transport device is the uralkyd/poly (glycidylmethacrylate) based totally film which indicates higher mechanical and tensile energy. Biodegradable collagen films or matrices have served as scaffolds for the survival of transfected fibroblasts.

IPN based films which might be prepared via the combination of collagen and alcohol, move-connected with glutaraldehyde vapor indicates depot components for recombinant human growth hormones. In lots of animal models, after implantation of transfected cells, a long-time expression of the foreign gene has no longer been done. Suh et al., studied the graft copolymerization of type I atelocollagen onto the floor of polyurethane (PU) films handled with ozone was per formed. It has been found that they might decorate an attachment and proliferation of fibroblasts and growth of cells.

- **Hydrogels:**

To determine capability in a drug transport device, hydrogel formulations have been prepared through the mixture of polymers. Hydrogels are the 3-dimensional polymeric network which are chemically cross-linked and have the ability to maintain the water in its structure because of the presence of hydrophilic functional organizations.

- **Microspheres:**

Microspheres are one of the classes of most up to date IPN based drug transport system. Microspheres are loose flowing powder, which might be solid commonly small round debris made of natural or artificial polymers and preferably having a particles size variety from 1-1000 um in diameter. Microspheres are the service-related transport system having a center which includes drug and outer layer of polymer as coating material. IPN microspheres are the flexible carrier for controlled release of the drug and additionally for the focused-on software due to the fact they encapsulate an extensive variety of drugs, improved bio availability, bio compatibility. Affected patient compliance and sustained release characteristics.

- **Sheet:**

Sheeting is one of the new techniques of manufacturing IPN based totally drug transport system. Those are especially used in numerous forms of wound dressings and scar control merchandise. An IPN composed of polymeric material like polyol (allyl carbonate) e.g.,

nouryset two hundred epoxy resin is evolved by 70-95 components by weight of polyol (allyl carbon ate) with the aid of radical initiation and polymerizing partly or simultaneously is an epoxy resin forming aggregate composed of 10-90 weight % of aliphatic or cycloaliphatic epoxide and 90-10 weight % of polyol/anhydride adduct.

- **Sponges:**

IPN based totally sponges are also used as drug delivery gadget. They were especially utilized in wound dressings and hemostyptics and beneficial inside the remedy of excessive burns. The benefits of collagen are:

- a) Their potential to without problems absorbs massive portions of tissue exudates and offer easy adherence to the wet –wound bed with renovation of wet weather.
- b) Its safety in opposition to mechanical harm and secondary bacterial contamination.

- **Pills:**

IPN primarily based pills are one of the important approach for transport of drug. IPN capsules also are used as drug transport structures for sustain release of drug. Interpenetrating polymer networks (IPNS) hydrogel tablets includes polyacrylamide and polyvinyl alcohol for sustained drug release. Supra colloidal IPN strengthened pills the use of mi cron-sized colloidosomes of poly (methyl methacrylate-co-divinyl benzene) micro gels have been used as scaffold through radical polymerization of the interior segment to supply hollow supra-colloidal structures with raspberry core-shell morphology.

- **Capsules:**

IPN based capsules are one of the important routes for delivery of drug. Mostly IPN capsules are used as drug delivery systems for sustain release of drug. Interpenetrating polymer networks (IPNS) hydrogel capsules include polyacrylamide and polyvinyl alcohol for sustained drug release. Supra colloidal IPN support capsules using micron-sized colloidosomes of poly (methyl methacrylate-co-divinyl benzene) micro gels were used as scaffold via radical polymerization of the interior phase to produce hollow supra-colloidal structures with a raspberry core-shell morphology.

Application [5]

1. IPN system allows in growing within the mechanical power, segment balance and biological acceptability of the very last product.
2. IPN is likewise useful in generating the synergistic impact from the issue polymer.
3. Because of the infinite 0-viscosity of the gel, phase separation among element polymers is not viable.

4. Because of everlasting interlocking of the network section, thermodynamic incompatibility may be made to conquer because the reacting components are combined very well at the time of synthesis.
5. IPN additionally effective to increase the controlled releases system for handing over the drug.
6. Whilst the blends are subjected to pressure, they preserve the section separate.
7. IPN was utilized in automobile components, damping materials, scientific gadgets, molding compounds, and in engineering plastics.
8. even as many advantages come from the improved mechanical properties of the IPN substances, other characteristics such as resistance to solvents swelling also can make IPNs a material of advertisements interest.
9. Greater current applications and areas of research for IPNs consist of makes use of inside the drug delivery systems, strength garage substances and tissue engineering.
10. offers the todays and relevant applications of IPN within the subject of pharmaceutical and organic sciences.
11. Realizes the ability of the IPNs within the movement of pharmaceutical sciences in regions including most cancers treatment and tissue engineering.

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