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# A Review Study of Synthetic Polymers and Their Environmental Study and Nano Application

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**ABSTRACT**

In this review we are taking some importance of synthetic polymers which are more useful in daily life and used as a Nano material. Synthetic and hybrid polymers are used for multiple medical applications. A wide range of different polymers is available, which are formed in our laboratory like as N-Substituted maleimide moiety and they have further the advantage to be tunable in physical, chemical and biological properties in a wide range to match the requirements of specific applications. This review gives a brief overview about the introduction and developments of polymers in medicine in general, addressing first stable polymers. Number average and weight average are given type of polymerization reaction, Polydispersity index and PDI values give knowledge about the polymerization process and application of Nano technology of synthetic polymers giving an excellent knowledge. At present time synthetic polymers that are widely used for the design accordingly drug delivery system, tailoring formulation and therapeutic applications and developments. Still we are more requirement of the study for purpose of daily applications and we are needed to replace of the synthetic polymers by the biodegradable polymers. In this review we are focused importance of synthetic polymers as a Nano material.

## INTRODUCTION

Today's time, a lot of polymers are being manufactured, but we see that there has been a lot of difference between long ago and now, because whatever things were made in old times were made of iron, but in today's time, due to the availability of polymers, Because iron has been changed by polymers, it is widely used all fields. Hydrogels are composed of hydrophilic polymers, which are desirable materials in polymer science. They have different properties that make them potentially useful in a wide variety of applications, such as in biomedical applications, self-assembly, or catalysis [1] Hydrophilic polymers might be considered as those polymers that contain polar functional groups such as hydroxyl (-OH), carboxyl (-COOH), and amino ($-NH_2$) groups that make them soluble or swelled by water. A hydrophilic polymer that has received much attention is poly(vinyl alcohol) (PVA) because it has great promise as a biological drug-delivery matrix [2] and is nontoxic. Similarly, hydrophilic polymers can be cross-linked through chemical bonds, leading to the formation of hydrogels, which are materials that have attracted particular attention in the biomedical field [3] The research of hydrophilic polymers has been complex because the physical properties of solubility or swell ability depend on different factors, such as the type of polymer, molecular weight, the ratio of polar groups, and degree of cross-linking. High molecular weight and a high degree of cross-linking will reduce the hydrophilic of the molecule [4,5].

Hydrogels are attractive materials owing to their excellent features and properties. Besides, because of such a wide variety of response triggers, hydrogels can serve as sensors or actuators or can be utilized in controlled drug delivery systems, biosensors, tissue engineering scaffolds, and others [6] because of their biomimetic properties and multi functionalities [7].

Poly nano particles more used in environmental and agriculture areas and used in drug delivery, imaging, biosensor. PNP has small size so there for they are easily permissible by the nano size capillary or other permissible carrier materials. More application of PNP is drug safety system, releasing of drug and controlling of drug system in human body. Nano polymers having extra mechanical strength, optical and thermal properties, and conductivity, they are used in water treatment applications, sensor activity [8-14].

The aim of this review is firstly to give reader a historic prospective of nanomaterial application to biology and medicine, secondly to try to overview the most recent developments in this field, and finally to discuss the hard road to commercialization. Hybrid bionanomaterials can also be applied to build novel electronic, optoelectronics and memory devices [15,16].

**Application of Nano materials**

**Medical science**

Cancer therapy

At present time cancer is very big problems day by day cancer patients are increases due to some unwanted activities and so many different type of pesticides are available and may have possible ,they are increased the disease. Nano particle give and play an important role in your life. Without nano technology we are not overcome in medical science and today's importance is that Nano technology is wide used in cancer therapy and treatment is based on the destruction of the cancer cells by laser-generated atomic oxygen, which is cytotoxic. A greater quantity of a special dye that is used to generate the atomic oxygen is taken in by the cancer cells when compared with healthy tissue. Hence, only the cancer cells are destroyed then exposed to a laser radiation. Unfortunately, the remaining dye molecules migrate to the skin and the eyes and make the patient very sensitive to the daylight exposure. This effect can last for up to six weeks. To avoid this side effect, the hydrophobic version of the dye molecule was enclosed inside a porous nanoparticle [17]. The dye stayed trapped inside the Ormosil nanoparticle and did not spread to the other parts of the body. At the same time, its oxygen-generating ability has not been affected and the pore size of about 1 nm freely allowed for the oxygen to diffuse out.

**Application in Bar Coding**

One of the smallest and important application of nanomaterial are used in QR code this is excellent example of nanomaterial by this technique, we acknowledge about the things and all description obtained by the technique. A three-dimensional approach, based on optical "bar coding" of polymer particles in solution, is limited only by the number of unique tags one can reliably produce and detect. Single quantum dots of compound semiconductors were successfully used as a replacement of organic dyes in various bio-tagging applications [18]. This idea has been taken one step further by combining differently sized and hence having different fluorescent colours quantum dots, and combining them in polymeric microbeads [19]. A precise control of quantum dot ratios has been achieved. The selection of nanoparticles used in those experiments had 6 different colors as well as 10 intensities. It is enough to encode over 1 million combinations. The uniformity and reproducibility of beads were high letting for the bead identification accuracies of 99.99%.

**Commercial application**

Various studies have shown the beneficial effect of nano-silica as a concrete additive, such as improving hydration of cement; however, no attention has been particularly paid to the effect of nano-silica on plastic shrinkage of concrete. Du and Pang [20] found that the inclusion of nano-silica reduces drying shrinkage of mortar samples, but did not really define the difference between plastic and drying shrinkage. The research presented in this paper is therefore significant as it is perhaps the first study of its kind to delve into the effect of nano-silica on plastic shrinkage cracking as well as the combined effect when nano-silica is used in conjunction with other plastic shrinkage cracking mitigating measures. The other mitigating methods investigated are the use of a low volume of synthetic micro fibers and addition of superabsorbent polymers.

The preparation of PNPs is achieved by solvent evaporation, salting out, nanoprecipitation, desolvation, dialysis, ionic gelation, and spray drying methods [21,22]. Different types of polymers were employed for the preparation of PNPs, which includes natural polymers, for instance, gelatin, alginate, and albumin, and synthetic polymers such as random block copolymer, grafter polymer, block copolymer, and ionic polymers form PNPs .[23,24] PNPs show a wide range of applications which has been extensively employed as biomaterials in recent years because of their characteristic features. This includes biocompatibility, small size, high surface–volume ratio, and tunable surface and structure. In addition to biomaterials applications such as drug delivery, imaging, biosensors, and stimuli-responsive systems, PNPs are used in environmental and agricultural applications [25,26,27,28,29,30,31].The small size of PNPs permits penetration through capillaries, and thus, they are referred to as Nano carriers. PNPs protect the drug molecules, lead to control release, and are thus used in drug delivery and diagnostics applications. Due to their high mechanical strength, optical and thermal properties, and conductivity, PNPs are used in imaging, sensors, catalysis, and water treatment applications.

**Application in the agriculture field**

A series of vinyl monomers containing PCP via an ester linkage has been prepared [33]. These monomers have been homo- and co-polymerized with styrene and 4-vinylpridine to induce hydrophobic and hydrophilic nature to the polymers. The rates of release of PCP from the polymers have been studied at four different media (water, pH=4 pH= 10, and dioxane-water) and all at 30°C. A comparison between the rates of release from these polymers indicate that the rates increase with increasing the degree of hydrophilicity, that is, copolymer hydrolyzes faster than the homopolymer which has higher rate than the hydrophobic copolymer. Polymer herbicides containing active moieties ionically bound to ammonium salt groups have been investigated [32] to demonstrate the reactivity displayed by the polymers through changing the chemical nature of linkage bond and the chemical characteristics of the active agent structure. In addition to PCP the herbicides of general use that contain functional groups for bonding to the polymer matrix have also been used, such as 2,4-dichlorophenoxyacetic acid, 2-methyl-4-chlorophenoxyacetic acid and 2,4-dinitro-6- methyl phenol. Polymeric soil conditioners were known since the 1950s [34] These polymers were developed to improve the physical properties of soil in view of: (i) increasing their water-holding capacity, (ii) increasing water use efficiency (iii) enhancing soil permeability and infiltration rates (iv) reducing irrigation frequency (v) reducing compaction tendency (vi) stopping erosion and water run-off (vii) increasing plant performance (especially in structure -less soils in areas subject to drought). The presence of water in soil is essential to vegetation. Liquid water ensures the feeding of plants with nutritive elements, which makes it possible for the plants to obtain a better growth rate. It seems to be interesting to exploit the existing water potential by reducing the losses of water and also ensuring better living conditions for vegetation. Taking into account the water imbibing characteristics of SAP materials, the possibilities of its application in the agricultural field has increasingly been investigated to alleviate certain agricultural problems. Super absorbent polymers (SAPs) are compounds that absorb water and swell to many times their original size and weight. They are lightly cross-linked networks of hydrophilic polymer chains. The network can swell in water and hold a large amount of water while maintaining the physical dimension structure [35,36]. It was known that commercially used water-absorbent polymeric materials employed are partial neutralization products of cross-linked polyacrylic acids, partial hydrolysis products of starch– acrylonitrile copolymers and starch–acrylic acid graft copolymers. At present, the material's biodegradability is an important focus of the research in this field because of the renewed attention on environmental protection issues [37]. The half-life is in general in the range 5 - 7 years, and they degrade into ammonium, carbon dioxide and water. SAP hydrogels potentially influence soil permeability, density, structure, texture, evaporation, and infiltration rates of water through the soils. Particularly, the hydrogels reduce irrigation frequency and compaction tendency, stop erosion and water run-off, and increase the soil aeration and microbial activity [38].

**Application in aerospace**

At present time polymer have excellent role in aerospace engineering because a lot of applications are used in aerospace technology specially jet aircraft and their parts which are made by the synthetic polymers and among of the polymers resins product have more durability and light weight as compare to other metal parts. On aircraft uses, the applications includes non-load bearing structures such as flaps, cowlings, cargo pods, fan containment cases, ailerons, spoilers, rudders elevators and landing gear doors [39] Structural applications for the entire aircraft wings or fuselage are yet to be manufactured though there have been significant progress geared to this goal [40,41] A good example rotorcraft application is on the Sikorsky S92 on which more than 80% is composite materials. Most satellite and launch vehicle structures are made of sandwich cores of a honeycomb core, bonded to graphite/epoxy skin. Polymers have also been utilised extensively on spacecraft, and missiles [42] Although polymer composite materials dominate aerospace structural applications, water absorption by composite materials in-situ still remains a big challenge. Thermally stable polymeric materials are required for aerospace propulsive systems that is also applicable to skin parts for supersonic aircraft and missiles. Synthetic jet actuators for flow separation control, jet velocities of 60-100 m/s have been achieved in the laboratory and active separation control at Reynolds's number up to 40x106 has been demonstrated [43]. Other applications include engine nacelles, bearing cases, vibration dampers, elastomeric seals, thermal coupling gaskets and vibration dampers.

**Application in Automobile Industries**

Current economic and environmental concerns make the creation of more fuel-efficient vehicle a top priority in the automotive industry. Although the minimization of the mass of parts is the main reason of choosing high-performance plastic materials, the future rise of their usage will result in new applications in automobiles related to comfort, safety and possibility of parts integration. The application of high-performance plastic materials allows more freedom in design, and in many cases only these materials can allow safe geometrical or economic solutions for the construction of parts. Some other advantages of increased applications of plastic materials in transport vehicles include. Minimal corrosion, allowing for longer vehicle life, Substantial design freedom, allowing advanced creativity and innovation, Flexibility in integrating components, Safety, comfort and economy, Recyclability and it is observed that average each car having around the 150 to 300 kg polymer materials in built conditions. it makes light weight and for the purpose of light burn of the fuels and 13 types of polymers are used in single car formation. [44-48]

**Application in medical field**

Polyamide block copolymers containing soft segments for better elasticity combine the flexibility of polyurethanes with the strength of nylon and therefore became the material of choice for the balloon of catheters for angioplasty [49,50]. Polyurethanes are synthesized with multiple chemistries and properties. Polyester and polycarbonate-based polyurethanes with aromatic or aliphatic components are in medical use, where aromatic formulations have the better bio stability. Thermoplastic polyurethanes do not need plasticizers, but retain their elasticity by the mixture of hard and soft segments. The polycarbonate based polyurethanes have excellent stability against oxidation and biodegradation as PVC does, however, there are concerns about release of bisphenol A with estrogen like activity. Polyether-based polyurethanes, especially aliphatic formulations show rapid softening in the body, making them more comfortable for the patient [51]. Hemodialysis membranes are produced as bundles of hollow fibers with a blood contacting surface of 1.0–1.5 m2 . Besides the technical requirements of permeability for substances smaller than albumin and the request to prevent the passage of impurities of the dialysate into the blood, the intense blood contact poses high challenges on the blood compatibility of the membranes. Early dialysis membranes were made of cellulose, where hydroxyl groups were soon substituted by acetyl derivatives or modified with other supportive additives to prevent activation of the complement system and associated leukocyte activation and leukocyte sequestration into the lung [52-54].Synthetic membranes mainly are composed of a hydrophobic base material and hydrophilic components; the co-precipitation membranes of poly aryl sulfones, polysulfone (PSf) or PES and polyvinylpyrrolidone (PVP) are most prominent. But also multiple other membrane materials are used, such as polyamide (PA), polycarbonate (PC), and polyacrylonitrile (PAN), PMMA, polyester polymer alloy (PEPA), ethylene vinyl alcohol copolymer (EVAL), and molecular-thin nanoporous silicon membranes [55,58].The hydrophilic component PVP or poly(ethylene glycol) (PEG) in the membrane is pore-forming agent and also improves antifouling properties and blood compatibility. Wound dressings are a very wide field for polymers in temporary, mainly external contact with the body. Wound healing is a complex biological process, involving inflammation, clearing of cell debris, cell migration, proliferation and differentiation, and remodeling which may be disturbed at different steps in the case of delayed wound healing of chronic wounds. Advanced active polymer wound dressings have been developed with release or adsorption properties to support physiological processes or remove detrimental influences. They are also more comfortable for the patient than traditional gauze dressings [59-61]. Mechanical protection and a barrier function are achieved with minimized adherence to the wound avoiding traumatization during movements or removal. The dressing has to provide permeability for oxygen and water vapor for a proper ambient of wound healing without bacterial super infection. Hemostatic properties are preferred for the wound dressings, especially in the case of hemorrhagic traumatization.

## CONCLUSION

In this review, we are concluding that synthetic polymers and their application in daily life, they are made easy life to each other's. They are used as a Nano material in human body and they are given key play role in drug delivery systems and many natural polymers are being used from the ancestor time which was the period our garments and other clothes were made by the juts. It is observed that biodegradable polymer-based nanoparticles have widely used in medical field. They can target infected areas, organs, tumor sites, and tissues in the body. Biodegradable and biocompatible polymers are appropriate materials for the development of novel drug delivery systems. Biocompatibility, mechanical properties, and low cytotoxic effects of these polymers make them an appropriate choice for drug delivery systems. It is the need of time to manipulate the system, which reduces the toxic effects of drugs on healthy organs or body parts. Recent technological breakthroughs in drug discovery and development have resulted in novel therapeutics for targeted prevention and individualized therapies potentially leading to ultimate improvement of the life quality of patients treated. These innovations have been accomplished by increasing interest (and consequently investments) in the research field by pharmaceutical companies. In fact, drug delivery technologies have become one of the major players in biopharmaceutical industry. Recently we need to more investigation of nano natural polymer for requirement for diagnosis of cancer cells because cancer cell is fast growing and how we can easily trapped growing cells this is the major challenge for us.

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