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Recently Synthesis of N-Phenylmaleimide Polymer and Application in Medical Sciences



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Suresh Kumar Meena*¹, Rakesh Meena¹

¹*Department of Chemistry Government college, Kota, Rajasthan, India.*

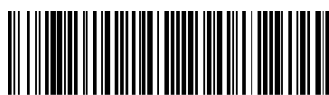
¹*SCRS Government College, Sawai Madhopur, India*

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ABSTRACT

Here we are specially focused on synthesis of N-Substituted Phenylmaleimide polymers and prepare polymer characterized different type of methods and elucidated different type of conclusions, In this article we want to knowing about the utility of the synthesis polymer in daily life and used for human being, and few parameters which are make importance of the polymers and here we discuss the type of polymers and nature of the polymers. Current passing time we are suffering from the pandemic diseased and find out the importance of polymers duration of the covid-19. Synthesis polymer and their chemical composition elucidated by ¹H-NMR, FTIR. Number average and weight average molecular mass determined by the Gel Permeation chromatography. Their Thermal stability was determined by the TGA techniques. Reaction mechanism determined by the Polydispersity index. The current research explores the various applications of synthetic polymers in the field of medicine, aerospace, defense. Applications are wide ranging with degradable polymers being used clinically as surgical sutures and implants. In order to fit functional demand, materials with desired physical, chemical, biological, biomechanical, and degradation properties must be selected.



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INTRODUCTION

Current scenario of the human being surrounded by the polymers and all things in word around the 20 to 30 percentage polymers are useful. Chemical science gives an important role as a multifunctional work. At present time utility of modern polymer chemistry accept the difficult challenges due to formation of different type of difficult product like as a polymers [1–7]. So there are many excellent block copolymers, thermal stable, polymer gels, polymer surface brushes and different fields are made the polymer utility and we know that duration of covid-19 what importance of the polymers and polymeric materials are fully described and many polymers have been made duration of the pandemic[8]. A lot of disposable mask, fluid bottles, PPE kit and many medical devices have been produced by the polymers [9]. This pandemic started from china to all word are contaminated rapidly, for this purpose each and every country invest to money for production of polymer products and utilizable N-Phenylmaleimide polymers and Japanese government raised to companies for investment for produce the polymeric materials like as mask and PPE kit and plants to manufacture to large amount of mask and medical equipments .Many Italian industries have also dedicated themselves to production of masks and other useful equipment duration of the pandemic disease [10-11]. Present work is shows that what importance of the polymers duration of this covid -19 and specially polymers made by the N-Phenylmaleimide substituted because without polymers how? You can protect yourself from this hazards virus and current scenario . At present we seen that poly(methyl methacrylate) (PMMA) is an amorphous, colorless thermoplastic possessing many excellent properties including light weight, optical clarity, good insulation, chemical resistance, scratch resistance, odorless, tasteless, and non-toxic . PMMA or plexiglass, with a monomeric structure, contains both a hydrophilic (carbonyl) and a hydrophobic (methylene) group in each unit. Polymethylmethacrylate have more utility in other fields, such as aircraft glazing, signs, lighting, dentures, food-handling equipment, contact lenses, substitute for inorganic glass, coating applications. current research paper only mentions the what utility of the synthesis polymers in daily purpose and without polymer what effect will come in our life and for past time we are suffering the pandemic disease and duration of this, only we are protected by the polymer made things like as PPE kit, Gloves, Synthetic other things.

EXPERIMENTAL

Methylacrylate (CDH) was shaken two to three times with 5% NaOH to eliminate hydroquinone inhibitor, dried over anhydrous CaCl₂ for 6 hours and distilled. The head and tail fractions were discarded. AIBN (2,2_-azobis-isobutironitrile (spectrochem.) was recrystallized twice from methanol prior to use. BPO (benzoyl peroxide CDH) was used as received. THF was purified by distillation after being refluxed for 2 h in the presence of sodium. Dioxane and DMSO were used after distillation. DMF and methanol used in the present work were of analytical grade and were used as received.

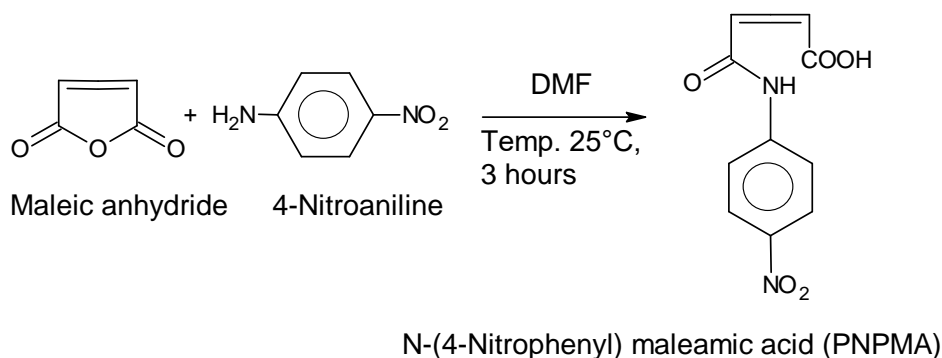
Measurements

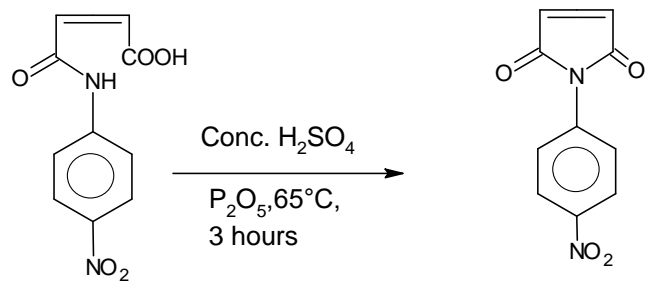
¹H-NMR spectra of monomer and polymer samples were taken in DMSO-d₆ on a Bruker DPX-200/DPX-300 spectrometer at 200/300 MHz. The internal reference used was TMS. FT-IR spectra of the monomer and polymer sample were recorded on a Shimadzu 8201 PC (4000-400 cm⁻¹) FT-IR spectrometer, using KBr pellet technique. The viscosity measurements were carried out in DMF at 30±0.2°C, using an Ubbelohde suspended level viscometer. Elemental analysis was made on Carlo Erba Model NA 500 series analyzer. The thermograms in air were obtained on a Mettler TA-3000 system, at a heating rate of 10 °C/min.

Methods

Polymers are made by the three types of methods on behalf of the chemical reactions. In this article prepared polymers by the two types of method which are used.

Condensation Methods: Substituted of N-Phenylmaleamic acid was prepared by the condensation methods and reaction are given.





N-(4-Nitrophenyl) maleimide (PNPMI)

Addition methods: Polymerization proceed via addition reaction. In this reaction at least on monomer having double bond in their structure and all the substituted N-Phenylmaleimide polymer reaction *via* free radical polymerization. Duration of the reaction there is no any side product was obtained.

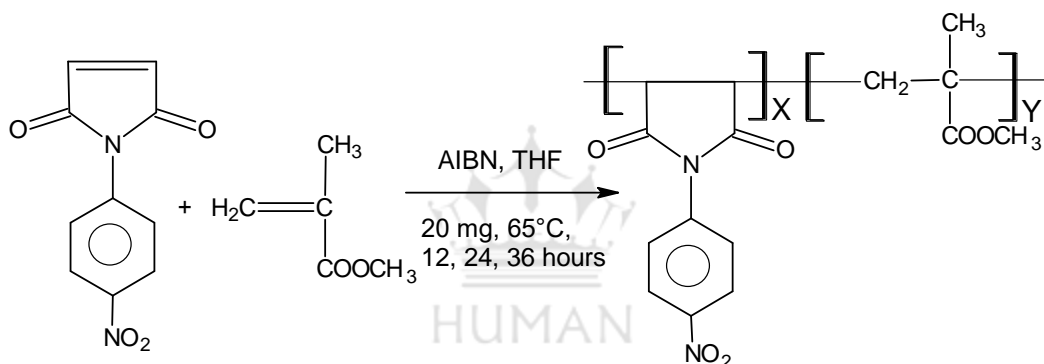


Table 1. Shows the characterization peak of FTIR and ¹H-MNR

N-Substituted phenyl maleimide polymers	FTIR Spectra for elucidate to composition
2998–2953 1715, 1731 1597, 1600, 1668, 1497, 1446 1399,1268,1150,852,751,1098, 1026, 894, 693	C–H stretch, alkene symmetric and asymmetric stretching of C=O in a five member imide ring C=C stretch, aromatic Ar-N stretch asymmetric C-O-C stretch, symmetric C-O-C stretch, monosubstituted benzene out of plane aromatic ring, C=C bend
7.28–8.08 ppm 3.60–3.72 ppm. 0.84–1.13 ppm.	five aromatic protons the 2H in –CH–CH– terminal methyl protons

Application of Polymers

Medical fields

Synthetic polymers are very important for us because many application of the synthetic polymers are make easy life, many synthetic polymers which are useful in human body for inside built-up body parts. Because they are too needed for our body like as heart valve, hernia protect mesh any drug delivery equipment are formed by the polymers and polymer applications are given in table 2.

Table 2. Shows polymers are useful in different fields in medical fields

Name of the polymer	Disease in useful
Silicon Polymer	Cardiac valve, blood filter, vessels
Polymethylmethacrylate	Contact lenses, dental restorative
Polyvinylchloride	Disposable syringes
Poly lactic acid	Dialysis medium, drug delivery, organ generations, plastic surgery
Poly glycolic acid	Surgical application suture materials, medical devices such as anastomosis

Automotive field and economically growth

At present scenario shows that polymer give an important role in growth of economic condition of any country and application of synthetic polymers are calculated. India is currently the world's third largest consumer of polymers, behind of the China and the US, with a share of 5.7% of the 2011 global total – an increase from it's 2000 portion size of 3.5%. Growth in the polymers industry kicked off in India after the country's economic liberalization in 1991(google engine).Major polymers used in light vehicles include 90 pounds of Polypropylene (PP), 58 pounds of Polyurethanes, 46 pounds of Nylon, 30 pounds of Polyvinyl Chloride (PVC), 24 pounds of Acrylonitrile-Butadiene-Styrene (ABS), 20 pounds of Polycarbonate resins and 18 pounds of Polyethylene resins. The total global consumption of lightweight materials used in transportation equipment was 42.8 million tons/\$80.5 billion in 2006 and will increase to 68.5 million tons/\$106.4 billion by 2011, at a Compound Annual Growth Rate (CAGR) of 9.9% in

tonnage terms and 5.7% in value terms between 2006 and 2011[12]. Recycling industry has witnessed tremendous growth though academic work on recycling of polymer is limited [13]. Chemical structure and density of polymer is changed. On the behalf of density there are two type of polymers one is HDPE and second is LDP polymer. Application of HDPE generally used in foam core seating systems and bumper systems in an automobile. Other than automotive HDPE is widely recycled compared to other plastic materials. Many recycled products are made like plastic lumber, highway signs, flowerpots, toys, trash cans, kitchen drain boards, detergent bottles and many other things at present time HDPE used in motor parts, aero plane parts, and mostly used in interior decorative parts and N-Phenylmaleimide polymer shows highly heat resistant polymers which are more useful for industries purpose. Low Density Polyethylene is a clear flexible plastic that is used to wrapping for bread, and it is used to make dry cleaner bags and used rain coats. LDPE is not recycled on any large scale, mainly due its softness. Other than automotive product are polypropylene, polyurethane, polyamide and PVC. In this text, the terms automotive polymers and automotive plastics are used interchangeably, as they are in everyday use. There are good reasons for the increasing use of automotive polymers. They offer enormous freedom in the design of interior and exterior parts, and they are durable, have good useful properties, and are abrasion- and vibration-resistant. Moreover, they are easier to process and offer an improved price-performance ratio. Polymers have also received a big boost from the trend to lighter weight vehicles.

Application in Agriculture Fields

India is the largest country among of the USA, China and Australia and maximum population of India live in villages so that they are totally depends on agriculture land, But growing of populations, land is not available proper portion of the population. In this condition synthetic polymer given an important play role. Many agriculture universities and their scientist giving noble ideas for agriculture crops. Today's time polyhouse is important for production of daily uses vegetables because by the poly house we are maintain the temperature and atmosphere according to crops. recently kitchen houses is demanding and they are completed by the synthetic polymers and current scenario is going on smart city project for beautification of the along the road and popular palaces which was decorated by the polymer made step wise trays in produce large amount trays and they are very useful. Durability of polymer is long life and coast

wise is cheapest. From past decades advance polymeric materials has been synthesized for agriculture and agriculture industries have generated extensively contribution and increasing the efficiency of pesticides, herbicides, and fertilizers facilitating controlled release system and there for , enabling lower dosed to be used .few polymer having superabsorbent nature and they are used as a conditioners to control the impact of drought and poly cationic polymers have been utilized for plant engineering [14].The use of plastic in agriculture is knowing to plasticulture, because of its useful in food production and plastic film have important role in the agriculture areas where is water availability is limitations.

Defense applications:

In today's time, many people have started using it a lot and today we see that the products made by polymers are used more and more in the army because the products made by them like Kelvar which is made by an important polymer. when the enemy shoots the soldier it is protected by the bullet. There are many products made by polymers which are light in weight, for this reason the soldiers Siachen, China Border Leh Ladakh Border For them, because the products made from polymers are very easily transportable. Synthetic polymers mostly used in light jet, fighter planes and ships mostly parts and interior parts of Aero plane and jets which were made by the polymers.

Corrosion protection

synthetic polymers are used for coating on the iron pipes and made water proofs because metal alloy are highly contaminated by the corrosion duration of rainy season. Underground pipe lines are coating before added inside of the land or in water drains. Surface coating which must resist both mechanical damage (scratching, impact, abrasion) and chemical attack (salts, acids and bases, solvents). Gentle and Baney report preliminary experiments using a silicate in forced silicone nano composite coating deposited to protect aluminum surfaces and electronic circuits [15].

Fire retardation

we know that polymeric materials are very highly inflammable because these are polymer having carbon compound nature in their back bones. In addition, the polymer, polymers product

show low melting point, and spreading burning droplets which serve to increase the size of the fire, and encourage it to spread. In many defense applications a fire will have disastrous results, particularly on board ships, submarines, aircraft and ground vehicles. If we are inserted in the few nano particles like as silica particles in the polymers which make it heat resistant and reported by Gilman et al [16]. The thermal properties of the polymer nano composite are improved, so that melting and dripping are delayed and the rate of burning is greatly reduced. The exact mechanisms of this are not yet entirely clear, but it appears that the presence of the (flake-like) clay nano particles reduce the diffusion of polymer decomposition volatiles (the fuel) to the burning surface, and reduce diffusion of air (the oxidant) into the polymer. One of the important roles participated by the Teflon sheet, it shows highly heat resistant and melting point.

Application in aerospace

Recently synthesis polymers have vast applications and due to some difficulties we are overcome and make more stable for this purpose many researchers and scientists trying to their best application of polymers. Polymer materials are widely used for many aerospace applications due to their many engineering designable advantages such as specific strength properties with weight saving of 20-40%, potential for rapid process cycles, ability to meet stringent dimensional stability, lower thermal expansion properties and excellent fatigue and fracture resistance over other materials like metals and ceramics [17]. Amorphous piezoelectric polymers include: poly(vinylidene chloride), copolymers of vinylidene cyanide copolymers, i.e. vinyl acetate, vinyl benzoate, and methyl methacrylate (MMA); polyacrylonitrile (PAN) [18], nitrile-substituted polyamides (APB/ODPA); even numbered polyamides (selected nylons), and aliphatic polyurethane. Semicrystalline piezoelectric polymers include: polyvinylidene fluoride (PVDF) [19]; poly(vinylidene fluoride-trifluoroethylene) and poly(tetrafluoroethylene) copolymers; liquid-crystalline polymers; polyurethane; and finally some selected biopolymers [20].

Domestic Application of Polymers

Synthetic polymers have a widely role in domestic applications. General polymer like as PVC are found in rigid and flexible forms. This property makes it useful in construction for pipe, doors and windows. It is also used in making bottles, non-food packaging, food-covering sheets. It can be made softer and more flexible by the addition of plasticizers, the most widely used being

phthalates as plasticizer. In this form, it is also used in plumbing, electrical cable insulation, imitation leather, flooring, signage, phonograph records, inflatable products, Poly(methyl methacrylate) (PMMA): Poly(methyl methacrylate) also known as acrylic, acrylic glass, PMMA is routinely prepared by using emulsion polymerization, solution polymerization, and bulk polymerization. Usually, a radical initiator is used but in case of anionic polymerization of PMMA can also be performed. This is prepared by the polymerization of the vinyl ester, methyl methacrylate using benzoyl peroxide as a free radical chain initiators Applications of Poly(methyl methacrylate): It is used in automotive lenses, reflective devices, instrument and appliance cover, optical equipment's and home furnishings. Acrylic sheeting's are used for sigs, glazing (in particular aircraft windows, furniture's, partitions Polyacrylonitrile: The addition polymerization of acrylonitrile in presence of a peroxide catalyst leads to the formation of polyacrylonitrile. It is used as a substitute for wool in making commercial fibers as orlon or acrilan. Polyacrylonitrile (PAN), also known as polyvinyl cyanide and Creslan 61, is a synthetic, semi crystalline organic polymer resin. Homopolymer of polyacrylonitrile have been used as fibers in hot gas filtration systems, ultra filtration membranes, outdoor awnings, sails for yachts, hollow fibers for reverse osmosis, fibers for textiles and fiber-reinforced concrete. Its mechanical properties derived are important in composite structures for military and commercial aircraft.

CONCLUSION

Finally, we are getting to conclusion that synthetic polymers have widely application in daily life and present scenario shows that without polymers we can't survive but we must prevent the pollutions generated by the polymers so therefore we should try to prepare eco friendly polymers and we more coincidence about the Biodegradable polymers. Many researchers and scientist they are trying to their best about the polymers. We well know about the polymers having an important play role for each and every field. In present article author have made some N-Phenylmaleimide polymers but what utility of the synthetic polymers in our life this is the only AIM for focused on the study. Recently we are observed that in many projects are used to synthetic pipe or polypipes, in this work Iron pipes are totally removed by the synthetic polymers, and use of synthetic polymers highly pollution may be will come in near future because polymer are not easily degraded.

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REFERENCES

1. H. G. Börner and H. Schlaad, "Bioinspired functional block copolymers," *Soft Matter*, vol. 3, no. 4, pp. 394–408, 2007.
2. H.-A. Klok and H. Schlaad, Eds., *Peptide Hybrid Polymers*, Advances in Polymer Science, Springer, Berlin, Germany, 2006.
3. J. C. M. Van Hest and D. A. Tirrell, "Protein-based materials, toward a new level of structural control," *Chemical Communications*, no. 19, pp. 1897–1904, 2001.
4. H.-A. Klok, "Biological-synthetic hybrid block copolymers: combining the best from two worlds," *Journal of Polymer Science, Part A: Polymer Chemistry*, vol. 43, no. 1, pp. 1–17, 2005.
5. Z. Guan, "Supramolecular design in biopolymers and biomimetic polymers for advanced mechanical properties," *Polymer International*, vol. 56, no. 4, pp. 467–473, 2007.
6. E. S. Gil and S. M. Hudson, "Stimuli-reponsive polymers and their bioconjugates," *Progress in Polymer Science*, vol. 29, no. 12, pp. 1173–1222, 2004.
View at: Publisher Site
7. I. Y. Galaev and B. Mattiasson, "'Smart' polymers and what they could do in biotechnology and medicine," *Trends in Biotechnology*, vol. 17, no. 8, pp. 335–340, 1999.
8. Mitra, K., and Wiesweg, M. (2020). *How is Polymer Demand Impacted by the COVID-19 Pandemic?*. London: IHS Markit.
9. Park, C., Kim, K., Roth, S., Beck, S., Kang, J., Tayag, M., et al. (2020). *Global Shortage of Personal Protective Equipment Amid Covid-19: Supply Chains, Bottlenecks and Policy Implications*. Available online, (accessed May 20, 2020).
10. Amendola, L., Saurini, M., Di Girolamo, F., and Arduini, F. (2020). A rapid screening method for testing the efficiency of masks in breaking down aerosols. *Microchem. J.* 157:104928. doi: 10.1016/j.microc.2020.104928
11. argaville, T., Spann, K., and Celina, M. (2020). Opinion to address the personal protective equipment shortage in the global community during the Covid-19 outbreak. *Poly. Degrad. Stab.* 176:109162. doi: 10.1016/j.polymdegradstab.2020.109162
12. Swift, K., <http://www.plastics-car.com>. <http://www.plastics-car.com/lightvehiclereport> (accessed May 30, 2012),
13. Jose, J., Jyotishkumar, P., George, S. M., "Thomas, S. Recent Developments in Polymer Recycling", Transworld Research Network: Trivandrum India, pp 187-214, 2011
14. Amanda K. Pearce, Sam J. Parkinson, Richard Napier and Rachel K. O'Reilly, Recent Trends in Advanced Polymer Materials in Agriculture Related Applications, *ACS Appl. Polym. Mater.* 2021,
15. T. E. Gentle, R. H. Baney, Materials Research Society Symp Proc 274 (1992).
16. J. W. Gilman, T. Kashiwagi, SAMPE Journal 33 (1997) 40-46.
17. J. Njuguna and K. Pielichowski The Role of Advanced Polymer Materials in Aerospace Department of Chemistry and Technology of Polymers, Cracow University of Technology, Ul. Warszawska 24, 24-155 Krakow, Poland
18. Popovic S, Tamagawa H, Taya M. Mechanical testing of hydrogels and pan gel fibres. *Smart Structures and Materials 2000: Electroactive Polymer Actuators and Devices*. 2000;3987:177-186

19. Zhang QM, Cheng ZY, Bharti V, Xu TB, Xu H, Mai T, Gross S J. Piezoelectric and electrostrictive polymeric actuator materials. *Smart Structures and Materials 2000: Electroactive Polymer Actuators and Devices*. 2000;3987:34-50
20. Mallick H, Sarkar A. An experimental investigation of electrical conductivities in biopolymers. *Indian J. Phys. Part A*. 2001;75A(1):81-85

