Review Article:

Comparison of three types of polymers Delrin , Polyester and Nylon

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Abstract:

This article discusses three types of manufactured polymers: Delrin, nylon, and polyester. Polymers are the product of various forms of raw plastics found in nature, whereas plastics are the names given to chemically human-made polymers. Polymer substances consist of a single unit called a monomer, which binds to millions of other similar molecules to form long chains. The length of these chains, the number of branches, and how closely they relate to each other determine the physical properties of the final plastic Polymers and their privileged position in chemistry due to their chemical and physical properties. The strength of the polymer depends on the number of monomers along the chain, side groups, cross-links and branches. If the polymers consist of only one type of monomer, it is called a homopolymer, and if there is more than one monomer in the polymer series, it is called a copolymer. Increasing the length of the chain polymers leads to a high degree of colour acceptance, describing the existence of polymers with different colours. Many chemical names of polymers were used, such as plastics, and became familiar to consumers.

key words: Nylon, Polyester, Delrin, polymers.

المقال العلمي : مقارنة بين ثلاث أنواع من البولمرات ديلرين و نايلون

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الخلاصة :

في هذه المقاله سنتحدث عن ثلاثة أنواع من البوليمرات المصنعة هي دلرين والنايلون والبوليستر .البوليمرات هي في الواقع اسم منتج البلاستيك الخام الموجود في الطبيعة بأشكال مختلفة للبلاستيك هو الاسم الذي يطلق على المواد الكيميائية المصنوعة من البوليمرات بواسطة الإنسان .بالنسبة للبوليمرات ، تتكون هذه المواد من وحدة واحدة تسمى المونومر ، والتي ترتبط بملايين الجزيئات الأخرى المماثلة لتشكيل سلاسل طويلة .يحدد طول هذه السلاسل وعدد الفروع فيها ومدى ارتباطها ببعضها البعض الخصائص الفيزيائية للبلاستيك النهائي تتمتع البوليمرات بمكانة مميزة في الكيمياء بسبب خصائصها .تعتمد قوة البوليمر على عدد المونومرات ، أي على طول السلسلة والمجموعات الجانبية والروابط المتقاطعة والفروع .إذا كانت البوليمرات تتكون من نوع واحد فقط من المونومر ، فإنها تسمى بوليمر متجانس ، وإذا كان هناك أكثر من مونومر واحد في سلسلة البوليمر ، فإنه يسمى بوليمر مشترك .من خلال زيادة طول سلسلة البوليمرات لديها درجة عالية من قبول اللون ، وهذا هو السبب في أنها يمكن العثور عليها بألوان مختلفة أصبحت العديد من الأسماء الكيميائية للبوليمرات المستخدمة كبلاستيك مألوفة للمستهلكين.

الكلمات المفتاحية : نايلون ، بوليستر ، ديلرين ، بوليمرات.

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Introduction:

Polymers are used in many different products, including building materials like coatings and home appliances. Tires, cans, textile fibres, medical and surgical supplies, health items, packaging materials, glues, sponge brushes, electronic and electrical equipment, car parts, toys, cosmetics, and much more. Polymers we see in our daily life are either natural or manufactured. Most of what we see of polymers are industrial and produced from petroleum and natural gas. What distinguishes polymers is the multiplicity of their specifications and properties, either solid or soft, rubber, transparent, opaque, insulating or sometimes transmitting, resistant to ambient conditions and lightweight. Since their molecules are constructed in the shape of chains which are linked in various ways to create products with different specifications, its structure is crucial to its products' diversity [1].

History of Polymers:

The history of synthetic plastics dates back almost a century, and there is no doubt that the widespread use of plastics, or what are known as polymers, has markedly advanced modern chemical science and set it apart from previous eras in human history. Polymer science is particularly noteworthy because, until after 1920 AD, the composition of these giant molecules—known as polymers—was unknown. Since ancient times, polymers were identified as rubber derived from plants formerly referred to as crying trees. The building blocks of significant industrial products are polymers. In addition to social causes, their rapid growth in production is a result of the need to replace traditional materials. J. J. Berzelius, a Swedish chemist, used the term "polymer." For instance, he believed that benzene (C6H6) was a polymer of ethyne (C2H2). Later on, a minor change was made to this definition. [2] Polymer science is a fairly young field of study that works with materials that are widely used in modern life, such as rubbers, plastics, adhesives, coatings, sealants, and synthetic and natural fibres. One of the most influential concepts of the 20th century is the idea of polymers. It was first proposed in the 1920s amidst protracted debate, and the 1953 Nobel Prize winner H. Staudinger is strongly linked to its adoption. It is possible to list many of the instances of synthetic polymers; some commonplace, such as nylons or polyesters, and others less well-known, such as those utilized in organ medical applications, biodegradable sutures, polyester, nylon, and Delrin, among others. [3]

Polyesters

Ellis discovered unsaturated polyesters (UPES) in 1933, and they went on sale in 1942. Those polycondensation products are called alkyds; their name seems to have come from the combination of the words alcohol (alk) and acid (yd); their main application is as coatings. Phthalic anhydride and glycerol are components of the same family that are used in glycerophthalic (Glyptal) coatings [4]. Polyesters are made of both manufactured materials like polybutyrate and naturally occurring substances like those found in insects and plants. The majority of synthetic polyesters are not biodegradable. However, certain synthetic and natural polyesters are. Clothes made of synthetic polyesters are widely utilized. Occasionally, natural and polyester fibres are spun together to create a textile with mixed qualities. Blends of polyester and cotton could be robust, resistant to rips and wrinkles, and less likely to shrink [5]. Among the first liquid crystal polymers to be employed in industry were polyesters. Their mechanical qualities and heat resistance make them useful. Those characteristics are also crucial for their use as an abradable seal in jet engines. [6] Natural polyesters include the cutin found in plant cuticles, which is made up of derivatives of omega hydroxy acids joined by ester bonds for forming polyester polymers with varying sizes[7]. Bees belonging to the genus Colletes are known as "polyester bees" [8] because they secrete a polyester coating similar to cellophane for their underground brood cells. Polyester synthesis is often accomplished using a polycondensation process. The general formula for a diol and diacid reaction is:

$(n+1)\ R(OH)_2 + n\ R'(COOH)_2 \rightarrow HO[ROOCR'COO]nROH + 2n\ H_2O$.

Biodegradation and environmental concerns

Polyester plastic reinforced with fibreglass, poly (methyl methacrylate), and polyester-polyurethane have been used to construct the Futuro houses. It was discovered that cyanobacteria and archaea were degrading one house. [9, 10]

2-Nylon

A family of synthetic polymers known as nylon has amide backbones that are typically used to link aliphatic or semi-aromatic groups. Nylons are silky and colourless or white [11, 12]; some even resemble silk [13]. Because they are thermoplastic, they may be melted and formed into a variety of

shapes and fibres [14–16]. Blending nylons with a wide range of additives can change their characteristics. DuPont researchers started working on cellulose-based fibres, which eventually led to the creation of rayon, a synthetic fibre. DuPont's research and marketing of nylon benefited greatly from its experience with rayon [17]. Over the course of eleven years, DuPont invented nylon, which was the first synthetic thermoplastic polymer to be successfully sold on the market [18]. Wallace Hume Carothers created nylon 66, the first nylon, on February 28, 1935, at DuPont's research laboratory at the DuPont Experimental Station. [19,20]

PA 6 or Nylon 6: $[NH-(CH_2)_5-CO]n$ made from ε-caprolactam.

PA or Nylon 610: $[NH-(CH_2)_6-NH-CO-(CH_2)_8-CO]n$ made from hexamethylenediamine and adipic acid

PA 6/66: $[NH-(CH_2)_6-NH-CO-(CH_2)_4-CO]n-[NH-(CH_2)_5-CO]m$ made from caprolactam, hexamethylenediamine and adipic acid

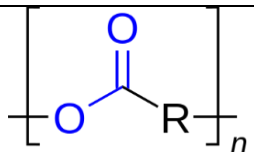
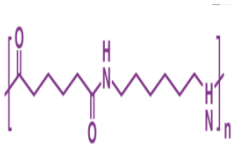
Biodegradation and environmental concerns of Nylon

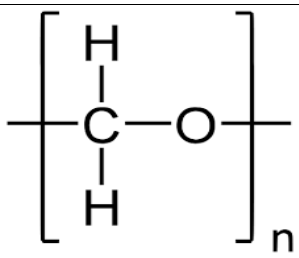
The low level of toxicity present in all side products and raw materials throughout processing and production.

3- Delrin

German chemist Hermann Staudinger, winner of the 1953 Chemistry Nobel Prize, made the discovery of polyoxymethylene [21]. DuPont finished building a facility in Parkersburg, West Virginia, in 1960 to manufacture Delrin, its own brand of acetal resin. [22].

Table (1) : Physical and Chemical Properties for polymers

Polymer	repeat unit	functional group	properties of natural Polyester	properties of synthetic Polyester	Name
Polyester	Ester functional group		-plant-derived fibers. When set to ignite, they could melt and are less fire-resistant.	Have high water, wind, and environmental resistance	polyethylene terephthalate (PET)(23)
1- PA or Nylon 6 2- Nylon 610 3- Nylon 6/66	ε-caprolactam hexamethylenediamine and adipic acid caprolactam, hexamethylenediamine and adipic acid;		not absorbent due to crystallinity, Excellent for Abrasion resistance:, the Good Dimensional stability:Have Excellent Resiliency and Hand feel: Soft and smooth	Lustrous Elastic Very strong Damage resistant to oil and many chemicals Resilient Does not absorb water	polymerization. (24)

Delrin POM (acetal)	Oxymethylene		Good strength retention at high temperatures: flexural modulus is 180,000 and tensile strength is 2,000 psi at 200° F.	has great resistance to organic solvents, However, environments involving strong acids, bases or oxidizing agents are not suitable for this material., Delrin is ideal for underground applications since it is impervious to insects, fungi, and rodents.	Polyoxymethylene (25)

Conclusion

Originally created to be a chemist's domain, polymers are currently closely linked to engineering as well, being used in product design, manufacture, and testing, as well as fibres, plastics, and elastomers. The polymer business has shown over the past few decades that rapidly developing and introducing enhanced and new products is an increasingly vital requirement. Plastics have led the way in the development of this family of engineering materials throughout the past century, with fibres and elastomers following closely behind. The significance of nylon and polyethene terephthalate is due to a number of factors. PTA or DMT and MEG are reasonably simply accessible raw materials. The synthesis process is a simple chemical reaction that is widely understood and characterized. Hexamethylenediamine is used to make the most popular nylon polymers; this compound has one more CH2 group than cadaverine. Delrin POM is a hard plastic that is about as robust as it gets. Glass-fiber reinforcement is a common application for epoxy, yet POM will not adhere to it. Thus, it is not a viable alternative.

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