RESEARCH OF THE POLYMERIZATION PROCESS OF POLYMERS

Tojiboyev Begijon Mamitjonovich
Docent of Andijan machine-building institute
tel: +99(894) 685 84 52

Makhammadjanov Khusanboy Alisher o'g'li
Base doctoral student of Andijan machine-building institute
E-mail: Xusan7797@mail.ru, tel: +99(894) 433 77 97

Valiyev Durbek Khayotbek o'g'li
Student of Andijan machine-building institute
tel: +99(890) 545 89 89

Naturally occurring polymers—those derived from plants and animals—have been used for many centuries; these materials include wood, rubber, cotton, wool, leather, and silk. Other natural polymers, such as proteins, enzymes, starches, and cellulose, are important in biological and physiological processes in plants and animals. Modern scientific research tools have made possible the determination of the molecular structures of this group of materials and the development of numerous polymers that are synthesized from small organic molecules. Many of our useful plastics, rubbers, and fiber materials are synthetic polymers. In fact, since the conclusion of World War II, the field of materials has been virtually revolutionized by the advent of synthetic polymers. The synthetics can be produced inexpensively, and their properties may be managed to the degree that many are superior to their natural counterparts. In some applications, metal and wood parts have been replaced by plastics, which have satisfactory properties and can be produced at a lower cost This type of polymerization involves the presence of two or three unsaturated molecules, especially carbon-carbon.

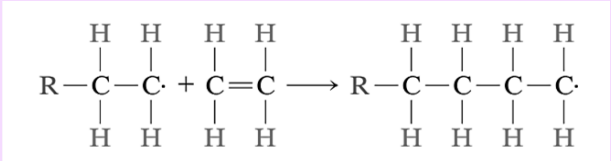
In these reactions, monomers combine with each other without destroying any atoms, where polymer types synthesized by breaking or opening the ring can be obtained without eliminating small molecules. From a kinetic point of view, this polymerization can be thought of as a three-step reaction: initiation, multiplication, and termination.

First, the beginning of the reaction takes place, in which heating is applied to the molecule that is considered to be the initiator (denoted by R) to form the following two types of roots:

$$R_2 \rightarrow 2R$$

If polyethylene production is given as an example, then the next step is dispersion, where the reactive radical applied to the ethylene molecule is formed and a new radical type is formed as follows:

$$R\square + CH_2 = CH_2 \rightarrow R - CH_2 - CH_2\square$$



This new radical is then combined with another ethylene molecule, and this process continues in sequence, resulting in the fusion of two long-chain radicals to form polyethylene, and the reaction ends. [1]

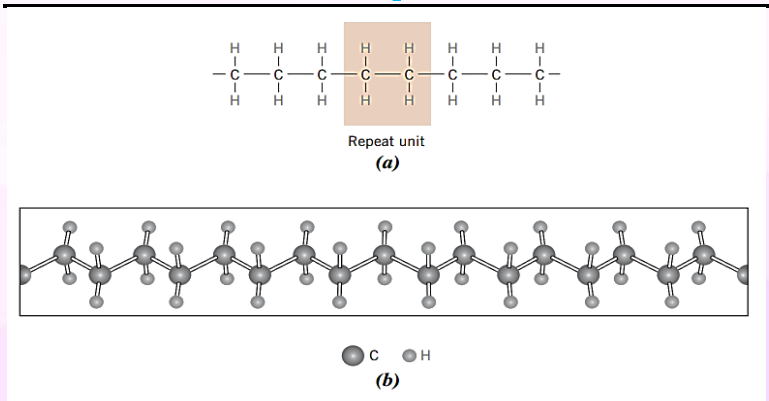


Figure 1. For polyethylene, (*a*) a schematic representation of repeat unit and chain structures, and (*b*) a perspective of the molecule, indicating the zigzag backbone structure.

In the case of polymerization by condensation reactions, in addition to the destruction of a small molecule, usually water, a combination of two different monomers usually occurs.
Similarly, the polymers formed as a result of these reactions often have heteroatoms, such as oxygen or nitrogen, as part of their spinal cord. In addition, in a repeating unit that represents the basis of its chain, it does not have all the atoms in the monomer that can be broken down. [2]
On the other hand, there are recently developed methods, including plasma polymerization, the properties of which do not fully correspond to any of the previously described types of polymerization. Thus, synthetic-derived polymerization reactions can occur in the absence or presence of both addition and condensation catalyst types.
In addition to the methods used to synthesize these synthetic polymers, there is biological synthesis, which has been described as the field of study responsible for the investigation of biopolymers into three main categories: polynucleotides, polypeptides, and polysaccharides. In living organisms, synthesis can occur naturally through processes involving the presence of catalysts such as the polymerase enzyme in the production of polymers such as deoxyribonucleic acid (DNA). In other cases, most of the enzymes used in biochemical polymerization are amino acid-based polymers and proteins that are required for most biological processes. In addition to the biopolymers obtained by these methods, there are also commercially important ones, such as vulcanized rubber, which is produced by heating naturally occurring rubber in the presence of sulfur. [3]
Thus, the methods used to synthesize polymers by chemically modifying naturally occurring polymers include termination, cross-linking, and oxidation.
Types of polymers can be classified according to their various properties; for example, they are divided into thermoplastics, thermosets, or elastomers according to their physical response to heating. In addition, depending on the type of monomers formed, they can be homopolymers or copolymers. [4]
Similarly, natural or synthetic polymers can be obtained depending on their origin; or organic or inorganic depending on the chemical composition.

- Its most striking feature is the repetitive nature of the monomers that form the basis of its structure.
- Its electrical properties vary depending on the purpose.
- They have mechanical properties such as flexibility or resistance to gravity, which determines their macroscopic behavior.
- Some polymers have important optical properties.
- The microstructure they have directly affects their other properties.
- The chemical properties of polymers are determined by the attractive interactions between the chains that make them up.
- Its transport properties are relative to the speed of intermolecular motion.
- The behavior of its aggregation states depends on its morphology.

Among the many polymers are:
Polystyrene - Used in all types of containers, as well as in containers used as heat insulators (for cooling water or storing ice) and even in toys.
Polytetrafluoroethylene, better known as Teflon, is used as an electrical insulator, as well as in the manufacture of rollers and in the coating of kitchen utensils.
Polyvinylchloride - This polymer used in the manufacture of wall ducts, tiles, toys and pipes is commercially known as PVC. [5]

List Of Used Literature:

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4. Gustavo Mendes and Bruno Lago "Strength of materials". New York 2009.
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