Synthetic rubber

A **synthetic rubber** is any artificial elastomer. They are polymers synthesized from petroleum byproducts. About 32-million metric tons of rubbers are produced annually in the United States, and of that amount two thirds are synthetic. Global revenues generated with synthetic rubbers are likely to rise to approximately US$56 billion in 2020. Synthetic rubber, just like natural rubber, has many uses in the automotive industry for tires, door and window profiles, seals such as O-rings and gaskets, hoses, belts, matting, and flooring. They offer a different range of physical and chemical properties, so can improve the reliability of a given product or application. Synthetic rubbers are superior to natural rubbers in two major respects, thermal stability and resistance to oils and related compounds.They are more resistant to oxidizing agents for example, such as oxygen and ozone which can reduce the life of products like tires. Synthetic rubber production begins with the refining of oil, coal or other hydrocarbons. During the refining process, naphtha is produced. It is made by the polymerization of isoprene (2 methyl-1, 3-butadiene) which has a chemical formula $(C_5H_8)_n$ and it is known as cis- 1, 4- polyisoprene.The naphtha is collected and can then be combined with natural gas to produce monomers such as styrene and isoprene, which are necessary for the production of synthetic rubber Among the most important synthetic rubbers are butadiene rubber, styrene-butadiene rubber, neoprene, the polysulfide rubbers (thiokols), butyl rubber, and the silicones.

Natural Vs Synthetic Rubber

Natural rubber, coming from latex of Hevea brasiliensis, is mainly poly-cis-isoprene.

Synthetic rubber, like other polymers, is made from various petroleum-based monomers. The most prevalent synthetic rubber is styrene-butadiene rubbers (SBR) derived from the copolymerization of styrene and 1,3-butadiene. Other synthetic rubbers include:

polyisoprene, prepared by polymerization of synthetic isoprene

chloroprene , prepared by polymerization of 2-chlorobutadiene

nitrile rubber made from cyanobutadiene or 2-propenenitrile and butadiene

Many variations of these can be prepared with mixtures of monomers and with various catalysts that allow for control of stereochemistry.

Some synthetic rubbers are less sensitive to ozone cracking than NR. Natural rubber is sensitive owing to the double bonds in its chain structure, but some synthetic rubbers do not possess these bonds so are more resistant to ozone cracking. Examples include Viton rubber, EPDM and butyl rubber. Polyisobutylene or butyl rubber is commonly used in tyre inner tubes or linings owing to its resistance to diffusion of air through the lining. It is sidewalls to minimize energy losses and hence heat build-up. Indeed, it is so resilient that it is used in super balls. An elastomer widely used for external sheet such as roof coverings is Hypalon or chlorosulphonated polyethylene. A new class of synthetic rubber is the thermoplastic elastomers which can be moulded easily unlike conventional NR vulcanized rubber. Their structure is stabilized by cross-linking by crystallites in the case of polyurethanes or by amorphous domains in the case of SBS block copolymers.

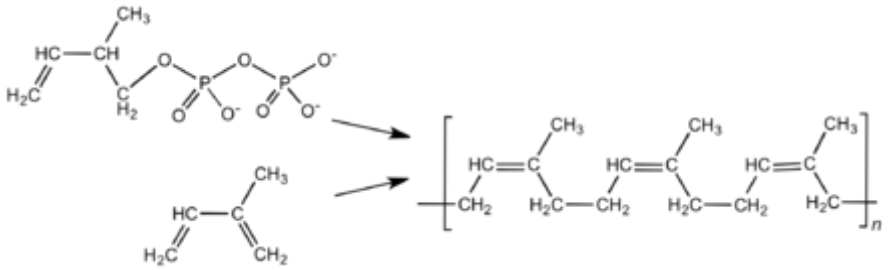

Figure: Chemical structure of cis-polyisoprene, the main constituent of natural rubber.
Synthetic cis-polyisoprene and natural cis-polyisoprene are derived from different precursors by different chemical pathways.

Silicone Rubber

Silicone rubber is also a synthetic elastomer composed of silicone polymers. Silicone rubbers are widely used in industry, and there are multiple formulations. Silicone rubbers are often one- or two-part polymers, and may contain fillers to improve properties or reduce cost. Silicone rubber is generally non-reactive, stable, and resistant to extreme environments and temperatures.