Silicone polymers, more properly called polysiloxanes, do not have carbon as part of the backbone structure. Although silicon is in the same group as carbon in the periodic table, it has quite different chemistry. Many silanes are known which are analogous to the hydrocarbons with Si-Si bonds. These compounds are not very stable and hence not very useful. Silicones on the other hand have an alternating -Si-O- type structure. This basic structural unit is found in many rocks and minerals in nature including common sand.

Various organic groups such as methyl or the benzene ring may be bonded to the silicon as shown below. Silicones are water repellent, heat stable, and very resistant to chemical attack. They find many uses in oils, greases, and rubberlike materials. Silicone oils are very desirable since they do not decompose at high temperature and do not become viscous. Other silicones are used in hydraulic fluids, electrical insulators and moisture proofing agent in fabrics.

The preparation of dimethyl silicon dichloride, or dimethyldichlorosilane, is the first step in the production of modern dimethylsilicone (polydimethylsiloxane) products. As explained in US Patent 2,380,995, Eugene G. Rochow describes the reaction of elemental silicon with gaseous methyl chloride within a tube furnace at 300°C.

\[
2 \text{CH}_3\text{Cl} + \text{Si} \rightarrow (\text{CH}_3)_2\text{SiCl}_2
\]

Silicones have a number of medical applications because they are chemically inert. Medical devices composed of silicone may be approved by the FDA for permanent or temporary implantation. Catheters, tubing, gastric bags, drains, and endoscopic windows are examples of consumable medical devices that are often molded from silicone. Breast implants, stents, and prostheses are examples of permanent implants often molded from silicone. Silicone rubber approved for use in FDA devices approved for permanent implantation differs from that used in medical consumables is several important ways. Implant grade silicone is of long linear chain length often exceeding one million molecular weight. Implant grade silicone rubber has had low molecular weight silicone oils, added for improved dispersion of silica fume fillers, removed thru high temperature vacuum mixing. Implant grade silicone rubber is normally cross-linked using a platinum catalyst. Silicone rubber is often used in medical devices because it can be heat sterilized. Most silicone consumables are removed from hot press molds while hot, saving expensive chilling cycles and simplifying mold design.

Silicone Rubber tubing used in medical practice can cause some problems. Gas permeability of dimethyldimethicone is
high enough to cause bubbles to form in silicone tubing often used in pumps that deliver medication to patients. Some medications are sensitive to oxygen permeate. A simple way to demonstrate this effect is to fill a section of silicone tubing with water then tie off both ends excluding any air pockets. The water filled tubing may be draped over any suitable ledge for several hours. Notice air cavities form in tube lumen.

A good deal of controversy has involved the use of silicone in polyurethane bags as breast implants. Again they were used because they were thought to be very inert and resistant to dissolving or other reactions. Reports have cited increased cancer risk and severe immune responses from possible leakage of the silicone from the implants. Some scientists dispute these findings.

Superball Demonstration

The liquids solution of sodium silicate is already in the form polymer. The silicate is alternating atoms of silicon and oxygen in long chains. When the ethanol is added, it bridges and connects the chains by cross-linking them. The analogy of a chain-link fence is a good picture of the idea of chains that are cross linked. That is what the ethanol and the silicate are doing to form this super ball.

Contributors

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