STUDY MATERIAL

Name Of Teacher : Basudev Mandal

Discipline : B.SC (H)

Subject : Chemistry

Semester : IV

Course Code : CCT9

Topic : INORGANIC POLYMERS – SILICONES AND SILOXANES

ORGANIC AND INORGANIC POLYMERS

- Organic polymers are macromolecules composed of many repeating monomer units which comprises of only organic molecules (refers to carbon) .Both synthetic and natural polymers play a crucial role in everyday life.
- Inorganic polymers are polymers with a skeletal structure that does not include carbon atoms in the backbone and often highly branched and have constituents such as nitrogen,boron,silicon,sulphur phosphorous etc.
- Organic polymers are eco friendly since they are biodegradable while inorganic polymers aren’t.

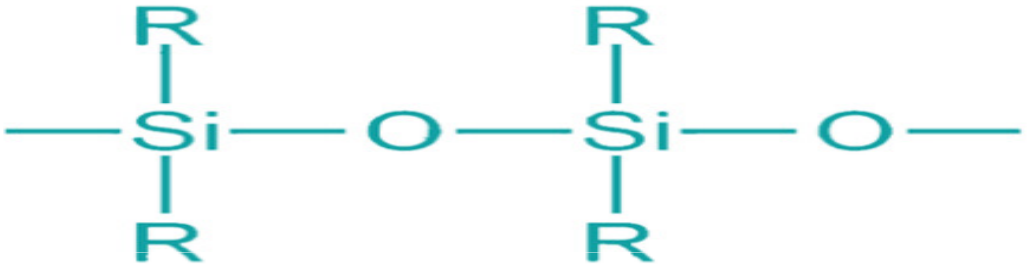
EXAMPLES OF ORGANIC AND INORGANIC POLYMERS

- Organic polymers include Polysaccharides, polypeptides, and polynucleotides are the main types of biopolymers in living cells. low density polyethylene (LDPE), high density polyethylene (HDPE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), nylon, Teflon, and thermoplastic polyurethane (TPU).
- While inorganic polymers include silicone rubber (polydimethylsiloxane),polysiloxanes,polyphosphazenes, and polysilanes.

SILICONES AND SILOXANES

- Silicones are organo silicon polymers containing -Si-O-Si- linkages (Siloxanes).
- Siloxanes are characterised by a chain of alternating silicon and oxygen atoms. A long chain of siloxane groups is called a silicone or a silicone polymer.
- The difference between silicone and siloxane is that silicone is a polymer material whereas siloxane is a functional group. Furthermore, silicone has a number of siloxane groups repeating through out the structure while the structure of siloxane is Si-O-Si bond.

STRUCTURES OF SILICONE AND SILOXANE



Silicones

Siloxane

CLASSIFICATION OF SILICONES

- Silicones are classified as cross linked silicones, cyclic silicones, linear silicones.
- Cross linked silicones are synthesized from alkyltrichlorosilane

  $R\text{-}Mg\text{-}Cl + SiCl_4 \rightarrow R\text{-}SiCl_3 + MgCl_2$

- Cyclic silicones are synthesized from dialkyldichlorosilane

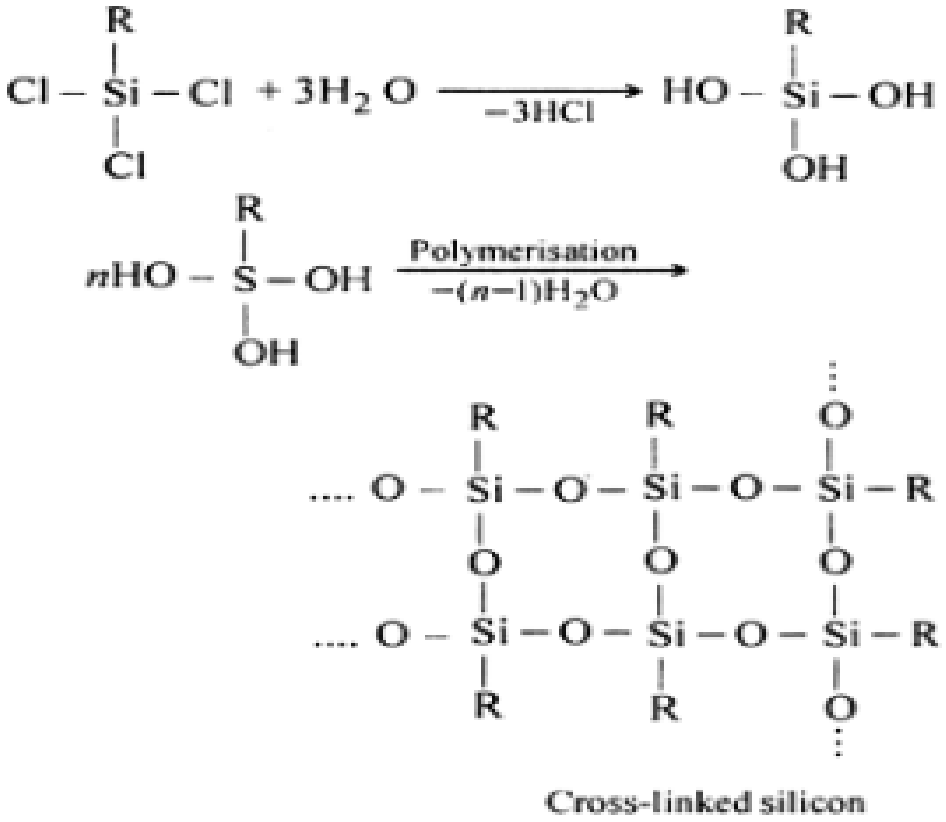
  $2R\text{-}Mg\text{-}Cl + SiCl_4 \rightarrow R_2SiCl_2 + 2MgCl_2$

- Linear silicones are synthesized from trialkylchlorosilane

  $3R\text{-}Mg\text{-}Cl + SiCl_4 \rightarrow R_3SiCl + 3MgCl_2$

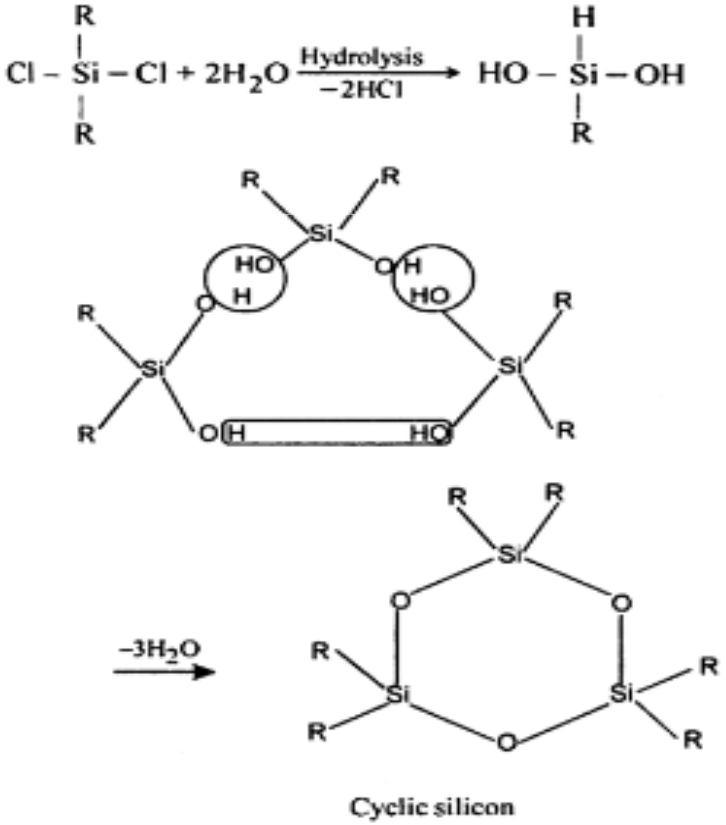
CROSS LINKED SILICONES

Hydrolysis of trichlorosilane leads to the formation of cross-linked silicones



CYCLIC SILICONES

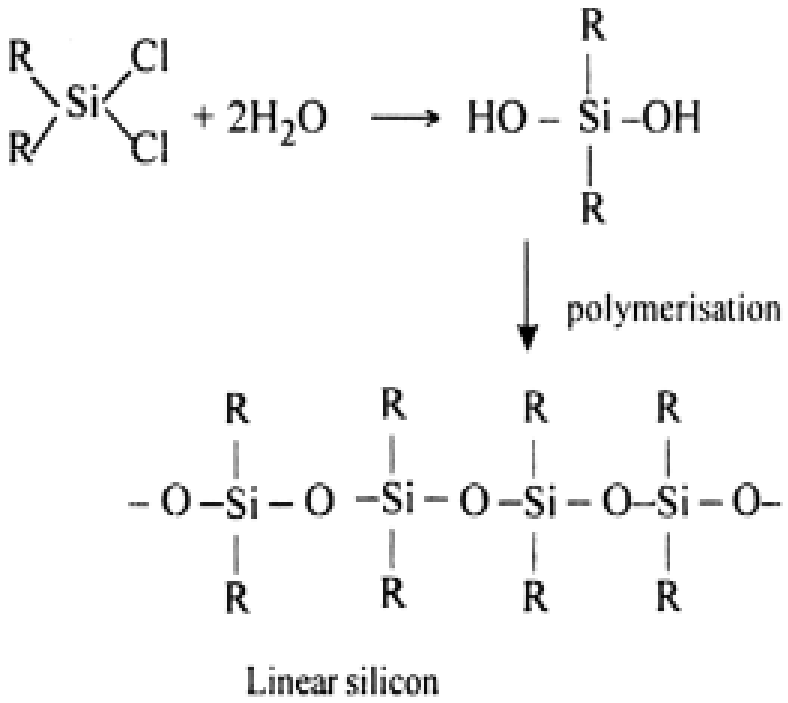
Cyclic silicones may be obtained by the hydrolysis and subsequent, condensation of R_2SiCl_2. For example,



Cyclic silicon

LINEAR SILICONES

hydrolysis of a general dialkyl dichlorosilane followed by polymerization gives a linear silicon.



Linear silicon

PROPERTIES OF SILOXANES

- Siloxanes are manmade and have many commercial and industrial applications because of their hydrophobicity, low thermal conductivity, and high flexibility and are generally used for their softening, smoothing, and moistening action.

APPLICATIONS OF SILOXANES

- Siloxanes make products like deodorants slide on more easily, and leave hair and skin more soft and silky.
- These are used in a variety of applications such as sealants, adhesives, coatings, plastics, cosmetics, medical devices, hygiene products, food contact materials, and many other industrial applications.
- Siloxanes are critical building blocks for all silicone products.

PROPERTIES OF SILICONES

- Silicone polymers or polydialkylsiloxanes are an important class of inorganic polymers that find many industrial uses. They are known for their outstanding temperature and oxidative stability, excellent low temperature flexibility,antitoxicity,water repellent and high resistance to weathering and many chemicals.

APPLICATIONS OF SILICONES

- It is their versatile quality that makes silicones an essential ingredient in products like rubbers, fluids, resins, silicone gels or silicon glue , computers and engineered spacecraft, shampoo etc.
- Silicones are not wetted and are used in making water proof cloth and paper.
- Silicones can also be consumed in renewable energy starting from wind turbines to solar panels rely on silicone technology.