SI, VMQ, PVMQ, FVMQ (Silicone elastomer)

General information

Overview

Silicon-oxygen backbone elastomers with excellent high and low temperature properties.

Strengths

SI-VMQ: Outstanding stability of rubber properties over a wide temperature range, -50 to 200 °C (-58 to 390 °F), including high temperature performance and low temperature flexibility. Good chemical resistance, weatherability, ozone/oxidation, excellent electrical performance, sealing capability, good adhesion to metal. Excellent compression set resistance. Lowest density of the high-temperature elastomers.
SI-PVMQ: Low temperature flexibility to -90 °C (-130 °F), high temperature stability, good chemical resistance, weatherability, ozone/oxidation, electrical performance, sealing capability, and damping in some formulations.
SI-FVMQ: Similar mechanical and physical properties to standard silicone rubber, but improved resistance to fuels and mineral oils. Combines the solvent, fuel, and oil reistance of the flurocarbons with the temperature stability of the silicones. High temperature stability, low temperature flexibility, chemical resistance, weatherability, ozone/oxidation, electrical performance, sealing capability.

Limitations

SI-VMQ: Relatively expensive. Low room temperature strength, low oil resistance. Can react with silica fillers causing it to become difficult to mold or extrude - therefore shelf life of some grades is only 1-3 weeks. Can undergo hydrolysis at high temperatures in a confined space, causing softening.
SI-PVMQ: Low strength, poor oil resistance.
SI-FVMQ: Low strength and high cost.

Designation

Silicone elastomer / Polydimethylsiloxane / Vinyl methyl silicone (VMQ / SI)
Heat cured Phenyl silicone elastomer / Phenyl vinyl methyl silicone (PVMQ / SI)
Heat cured Fluorosilicone elastomer / Trifluoropropyl vinyl methyl silicone (FVMQ / SI / FSi) : heat cured

Tradenames

SI-VMQ: Silastic, Elastosil-R, Baysilone, GE LIM, Shincor LIM, Rhodorsil HCR, Tufel, Silopren, Mmentive LSR, ShinEtso LIMS, Baysilone, Dow Corning, GE LIM, Shincor LIM, Stycast (formerly Eccosil)
SI-PVMQ: Silastic, Elastosil-R, Baysilone, GE LIM, Shincor LIM, Rhodorsil HCR, Tufel
SI-FVMQ: Silastic, Elastosil-R, Baysilone, GE LIM, Shincor LIM, Rhodorsil HCR, Tufel

Typical uses

SI-VMQ: Automotive: seals, hose, spark-plug boots, gaskets, mounts, cable sheathing. Electrical/electronic: computer key pads, insulators, surge arresters. Food contact: Gaskets for Pressure Cookers, Heat resistant kitchen mats. Medical: seals, syringe plungers, breast nipple protectors, structural implants, catheters, sterilization mats, O-Rings for dialyzers, baby bottle parts. Sports: swimming goggles and caps. Other: molds.
Used extensively as electrical insulation on naval craft as it is not destroyed in a fire, producing a protective layer of silica.
SI-PVMQ: Similar to regular silicone but where extra lower temperature and higher damping is required.
SI-FVMQ: Similar to regular silicone but where oil and fuel resistance is required.

Composition overview

Compositional summary

SI-VMQ: Polymer of dimethyl silicone, formula -(OSi(CH3)2)-, with some methyl groups substituted by vinyl groups as cure sites (cross-linking sites), formula -(OSiCH3CH=CH2)-. Can be compounded with 5-30% fumed silica (SiO2) with 100-325 m2/g surface area. Can contain organic peroxide or platinum (addition) heat cure system for LIM (liquid injection molding) or HTV (high temperature vulcanization).
May be filled with a thermally conductive, electrically insulative ceramic or mineral, and undergo two-part room temperature vilcanization (RTV) to obtain thermally conductive grades.
SI-PVMQ: Polymer of dimethyl silicone, formula -(OSi(CH3)2)-, with some methyl groups substituted by phenyl groups, formula -(OSiCH3C6H5)-, and some by vinyl groups as cure sites (cross-linking sites), formula -(OSiCH3CH=CH2)-. Typically compounded with 10-30% fumed silica (SiO2) with 100-325 m2/g surface area. Contains organic peroxide or platinum (addition) heat cure system for LIM (liquid injection molding) or HTV (high temperature vulcanization).
SI-FVMQ: Polymer of dimethyl silicone, formula -(OSi(CH3)2)-, with some methyl groups substituted by gamma-trifluoropropyl groups, formula -(OSiCH3C2H4CF3)-, and some by vinyl groups as cure sites (cross-linking sites), formula -(OSiCH3CH=CH2)-. Typically compounded with 10-30% fumed silica (SiO2) with 100-325 m2/g surface area. Contains organic peroxide or platinum (addition) heat cure system for LIM (liquid injection molding) or HTV (high temperature vulcanization).

Material family	Elastomer (thermoset, rubber)

Base material	SI-VMQ(hc) (Silicone rubber, vinyl methyl type, heat cured)

Processing properties

First commercial production	1943

Forming

Compression, injection, and transfer molding, extrusion, calendering, and casting. Heat curing: LIM (liquid injection molding) or HTV (high temperature vulcanizing). LIM provides lower cost parts than conventional injection molding. One- or two-part room temperature vulcanizing (RTV). Dispersion processing.

Geo-economic data for principal component

Annual world production	9.84e4	ton/yr

Notes

Warning

Can evolve carbon monoxide upon burning.