



## Consumer Solutions

# Polydimethylsiloxane Networks: Silanol-terminated Polydimethylsiloxanes

**XIAMETER™**

Polydimethylsiloxane (PDMS) polymers offer a unique combination of properties such as:

- Extremely low  $T_g$
- Release action
- High temperature and oxidation resistance
- Chemical resistance
- Vapor permeability and hydrophobicity

There are many applications in which these properties are desirable, but to take full advantage of them, these polymers need to be cross-linked into a network.

The condensation of silanol groups to form siloxane bonds is one of the most important classes of reactions used to cross-link siloxanes in commercial applications. In practice, the systems are derived from the use of silanol-terminated PDMS.

A typical system contains silanol-terminated PDMS, a cross-linker and a catalyst. Reinforcing fillers and other additives may be added depending on the application. Upon cure, these systems can yield lightly cross-linked silicone films capable of dissipating normal and shearing stresses at high temperatures (as in release coating applications), as well as tough and flexible silicone elastomers with excellent retention of their elastic properties over a wide temperature range.

In general, high-molecular-weight silanol-terminated PDMS will yield elastomers with higher strength than low-molecular-weight polymers. As expected, the incorporation of reinforcing fillers such as fumed silica (up to 40 wt %) onto surface areas at 150 to 300 m<sup>2</sup>/g will improve the mechanical properties of the elastomers and affect the flow properties of the system.

Introduction of a trifunctional molecule to the system will produce a three dimensional network. Tri- and tetrafunctional cross-linkers, such as trialkoxysilanes ( $R'Si(OR')_3$ ), enable moisture-cure capability upon exposure to air. The alkoxy functionality is hydrolyzed to form silanol and the corresponding alcohol. The silanol can then condense with the PDMS SiOH-terminated polymer and produce a cross-linked network.

Suitable catalysts for a two-part system using this chemistry are tin carboxylates. One part would typically contain the silanol-terminated PDMS and the other the cross-linker and catalyst. Both parts are mixed at the application stage.

A one-part system can be produced by reaction of an SiOH-terminated PDMS with an excess of a trialkoxysilane (e.g.  $MeSi(OMe)_3$ ) to produce a PDMS polymer with hydrolyzable end-groups of the form  $SiMe(OR)_2$ . This polymer, in combination with an organotitanate catalyst, can produce a stable one-part formulation that will cross-link when exposed to moisture after application and without its packaging.

### For further reference:

Jerschow, P. 2001, 'Silicone Elastomers', Rapra Review Reports, vol. 12, no. 5.

Clarson, S. J. & Semlyen, J. A. (eds) 1993, *Siloxane Polymers*, P T R Prentice Hall, New Jersey.

Noll, W. 1968, *Chemistry and Technology of Silicones*, Academic Press, Orlando.

## Product Information

A complete list of fluids are available at [consumer.dow.com](http://consumer.dow.com).

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Form No. 95-704-01 A