

The chemical and physical properties of silicones that contain organic substituents other than methyl vary according to the nature of the organic substituent. For example, substitution of some methyl groups on PDMS with polyethylene oxide chains dramatically increases the viscosity of the material because of the polarity of the polyethylene oxide. The chemical properties of the organic substituents are generally not affected by the siloxane backbone. Consequently, polydiorganosiloxanes exhibit the chemical reactivity that would be associated with the organic substituents. The two types of silicones with nonmethyl substituents that are used in topical products are discussed in Sections II.C and II.D.

B. Benefits of Silicones in Topical Products

Silicones exhibit a unique combination of properties that, to a large extent, arise from the inorganic siloxane backbone. The silicon-oxygen bonds that form this backbone are quite strong, yet they are very flexible. This results in polymers that are particularly stable and exhibit unusual surface activity because of the ability of the siloxane chain to present its pendant organic groups at interfaces (1). In PDMS, the inorganic siloxane backbone is covered by nonpolar methyl groups, leading to extremely low intermolecular forces. As a result, PDMS is a liquid over a wide range of molecular weights. In fact, PDMS will exhibit viscous flow even at molecular weights above 700,000. Low intermolecular forces are also responsible for the low surface tension of PDMS, which is in the range of 20 to 21 dyn/cm. The low surface tension and relatively high molecular weight of PDMS give rise to a number of properties that are beneficial in topical products: excellent spreading, detackification, defoaming, and water repellency. A PDMS that has been substituted with nonmethyl organic groups will provide these benefits to varying degrees, depending on the amount of substitution and the nature of the nonmethyl organic groups.

II. TYPES OF SILICONES USED IN TOPICAL PRODUCTS AND THEIR PROPERTIES

A. Linear Polydimethylsiloxanes

Ingredients that are used in topical products are often referred to by nomenclature established by the Cosmetics Toiletries, and Fragrance Association (CTFA). These CTFA names (2) have been established primarily for the purpose of ingredient labeling. The CTFA has chosen the term *dimethicone* for linear PDMS that conform to the general structure given in Figure 1. This structure is representative of the linear PDMS available from all silicone manufacturers.