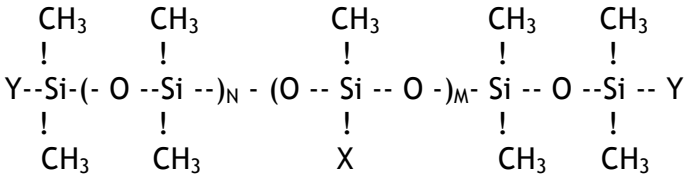
Technical Tuesdays

REF:TT/Nov.09/WK3

Classical Silicone Softeners

A. Aminopolysiloxane

First generation silicones were not successful as fabric softeners due to lack of affinity and hence exhaustion towards the cotton goods. Cotton fabrics are slightly anionic in nature after pretreatment and dyeing. To get exhausted on an anionic surface, a slightly cationic substance would do better than anionic or nonionic softeners. Hence, to provide a slight tinge of cationic charge, chemists had to introduce amine groups in the side chain of silicone molecules. At the same time, the nonionic nature of the silicone is not lost as the charges are prevalent only at a pH of 4.5-7.0 in an aqueous medium. The structure of aminopolysiloxane is depicted below:



Y = CH_3, (Non-reactive) (or) OH, OCH_3, OC_2H_5 (Reactive)

X = $(CH_2)_3NH(CH_2)_2NH_2$ (Diamine) (or) $(CH_2)_3NH$ (Monoamine)

The terminal groups decide the reactivity of the system. Groups like OH, OCH3, OC2H5 are capable of reacting further. Diamines offer superior handle, better durability and anchorage compared to its other counterpart but fail in meeting visual effects as they leave a yellowish tinge on the finished fabrics. Monoamines offer moderate-good handle and is less yellowing compared to di-amines. Molecular weight of the polymers combined with amine value and reactivity decides the kind of hand modification onto the fabric surface. The exhausted silicone polymers are forced to expose their lengthy chains along the direction of the fibers due to anchoring of amine groups perpendicular to the plane of the fabric surface. In a non-amine modified fluid, this kind of directional orientation is not possible and hence those polymers cannot compete with amine modified fluids in offering superior handle to the fabric structure.

Another interesting fact is that, during emulsification, a part of the silicone fluid itself can be transformed into a surfactant system by adding suitable amine neutralizing agents to ensure that the internal phase, silicone polymers, are of micrometer in size, as the emulsion is suitably called micro emulsions. The significance of the size is that it is small enough to travel through the fibre-fibre or yarn-yarn distance and reach out every part of the fibre, modifying the entire nature of the fabric to soft and limpy by loosening the rigidity of the network to some extend.

Major disadvantage associated with amine-modified fluids is its yellowing tendency. This is mostly due to the vulnerability of the amine groups to atmospheric oxygen. Amines are attacked by oxygen and modified into nitro groups, leading to azo groups formation, which is strong chromophore for yellow and brownish range of visible light.

----------NH2 ---------- > ----------NO2

Aminopolymer Nitropolymer

A strange and interesting fact is that the yellowed emulsion does not necessarily make a fabric yellow, as exhaustion of nitro - and azo- groups are very less leading to reduction in softness rather than yellowness. However, once a high amine fluid is exhausted onto the fabric surface, it makes it yellow during shelf life slowly. So it is always essential that the amine value is optimised between handle requirements and its side effect Yellowness or shade changes. Besides, viscosity of the polymers also play a major role in offering softness and, in fact, for each and every chain length there is an optimum range of amine value for better exhaustion and hence effective performance.