Americos Industries Mind

AIm

AMERICOS INDUSTRIES INC.

Concept Driven Chemicals

Silicones

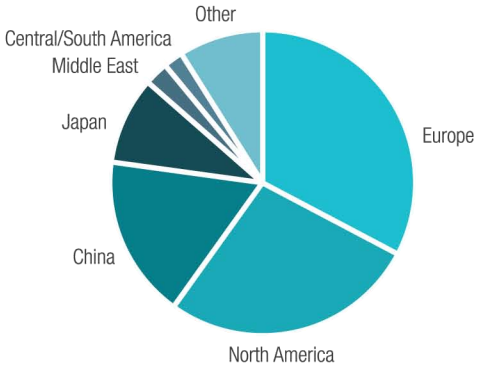
VOL 2, ISSUE 2, 2009

Contents

I have the pleasure to present our third issue of "AIM." Our first two issues, one on Denim and one on Enzymes, were well received. This is our special issue on Silicones.

Silicones and siloxanes are versatile materials consisting of an alternating silicon-oxygen backbone, typically with aliphatic or aromatic side groups. Other pendant side chains, such as hydrogen, hydroxyl, amino or epoxy groups, may also be used. Silicones can be classified as fluids, elastomers or resins, depending on their molecular weight, the extent of cross-linking and the type and number of organic groups attached to the silicon atoms.

WORLD CONSUMPTION OF SILICONES (YEAR 2006):



In 2007, the global silicone/silane market was valued at approximately US $10.3 billion, a significant increase from 2002's US $7.3 billion. Over the next three years, global consumption is expected to grow at an average rate of 5% per annum, with the most rapid growth expected in Asian countries. According to the US Geological Survey, the applications of silicon in which silicone is a major part has seen enormous growth, from 7,230 to 227,000 metric tons in the US alone over the last three decades.

The other major applications of silicon as a mineral commodity in particular industrial sectors (such as steel, cast irons, superalloys, and other alloys), in which silicone does not play a major part, have decreased from 303,439 to 132,080 metric tons.

Another statistical report estimates global silicone consumption as 875,000 metric tons. Europe, North America and China consume the most silicone products.

The world's largest silicone producers vary significantly in their market share and in the degree to which they may be back-integrated into raw materials. Countries like India, China, Argentina, Chile, Brazil, USA, Canada, Western and Central European countries, and other Asian countries trade in silicones.

As an example, India exports silicone products such as dimethyl poly-siloxane fluids, activated fluids, amino silicone fluids, epoxy-functional fluids, carboxyl-functional fluids, methyl hydrogen silicone fluids, silicone surfactants, and co-polymers of amino and glycols throughout the world for diverse markets, including the aerospace, automotive, construction, electrical, electronics, medical materials, performance chemicals and coatings, personal care and textile industries.

In the textile industry, for example, silicones are used as antifoaming agents, lubricants, softeners, wetting agents and water repellents

Americos is one of the leading manufacturers of softeners, both silicone-based and non-silicone-based, which, along with other special properties, act to soften textile substrates like cotton, polyester, silk, and wool. Americos products are special in that they not only enhance fundamental properties but also add special value and multifunctional properties. For example, Americos' recent silicone nanoemulsion, produced with the state-of-the-art technologies, offers unique softness because of the enhanced penetrability of nanoemulsion droplets.

Americos uses these kinds of R&D efforts to meet the increasing demands of both domestic and worldwide customers. Its automated high-capacity production plants help Americos supply hundreds of metric tons of silicones per annum to many countries, including India.

The purpose of this newsletter is to present Americos' contribution to silicone finishing, the spectrum of Americos' innovative products, and relevant diverse subjects.

I hope you will find this special issue of "AIM" enlightening and useful.

With warm regards,

Ashok Khanna
Managing Director

Century-wise Developments: Silicon to Silicones

OLDEN TIMES

In the Stone Age, quartz and silica - based stones were fashioned into tools to aid survival. The ancient Romans started turning sand into glass and from thereon the technological evolution was continual.

19th CENTURY

Pioneering chemists discovered how to gain silicon from sand. Silicon is the origin for silicones.

- 1823 J.J. Von Berzellus isolated silicon in elemental form.

- 1854 H.E. Saint-Claire Deville synthesized pure silicon.

20th CENTURY

Commercialization of silicones.

- 1930's J.F. Hyde carried out the first successful research leading to commercial production of silicones.

- 1940's F.S. Kipping was the pioneer to achieve extensive synthesis of silicone compounds and coined the name 'silicones.'

- R. Mueller and E.G. Rochow develop independently of each other a direct method for synthesizing silicones on an industrial scale.

- A combination of history, engineering,

accident and entrepreneurship produced one of the most successful toys of the 20th century – Silly Putty

- 1960's S. Silver invents pressure sensitive adhesives (PSA). They are designed to allow the surface on which they are coated to stick to other materials when a little pressure is applied and to peel away cleanly without tearing. The most familiar example of a PSA application is the Post-it Notes, which were invented by Art Fry in 1973.

- The first footprint that Neil Armstrong left on moon was made with a silicone rubber boot sole. Moreover, new silicone materials are used in the lunar and command modules were critical to the crew's support systems and safety.

- 1980's Silicones played a major role in the advancements in telecommunications, information technology, and all other related fields that rely on the microchip.

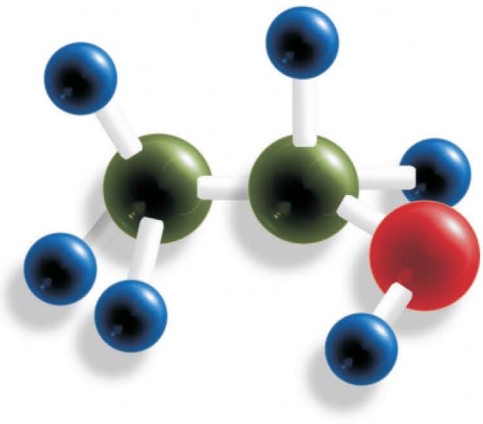
3rd MILLENIUM AND 21st CENTURY

- Current discoveries in photonic science where photons (light) are used for very fast information delivery through internet and other digital communication applications have accelerated the use of optical fiber for data transmission.

- Silicone in Life Science. Merging the various disciplines of biotechnology and silicone science opens a world of opportunity for innovations in areas such as:

  - Bio-based sensors
  - Cleaning products
  - Personal and health care
  - Fabric care
  - Optical switches

- Plasma science. Plasma is the matter of which stars are made. Plasmas are extremely energetic gas molecules and atoms moving rapidly. As these atoms or molecules collide, they form a mixture that is capable of both breaking and making chemical bonds, and it can be used to change the properties of any surface with which it comes into contact. The combination of plasma and silicones make it possible to produce polymeric thin films with a thickness of less than one-tenth of a human hair. These films make it possible to make better solar energy devices, integrated circuits, faster microprocessors, with enhanced reliability.



Appreciating Silicones

Silicones are a class of synthetic compounds in which carbon and silicone are combined with oxygen. They have found wide ranging uses in industry. Silicones are inert compounds having a variety of properties, forms and uses. The physical forms range from oils and greases, solids, water-thin liquids and semi-viscous pastes. They have revolutionized the performance of thousands of products which have enhanced the quality by way of comfort and safety. The major scientific progress took place in the 19th and early 20th Century. Commercial development began in the 1940s.

Silicones are polymers noted for their ability to function in conditions that would literally destroy conventional material. They have unique properties that can bond, seal, lubricate, defoam, release and encapsulate. They can even waterproof, insulate and coat. They won't crumble or dry out, harden, rot, crack peel or become brittle with age.

FOLLOWING ARE THE VARIOUS PROPERTIES OF SILICONES:

- Thermal/oxidative stability
- The ability to repel water and form water tight seals
- Excellent resistance to oxygen, ozone and sunlight
- Flexibility
- Good electrical insulation
- Non-stick
- Low chemical reactivity
- Low toxicity
- High gas permeability
- Low surface tension (spreadability)
- Low fire hazard
- High compressibility
- Low viscosity change with temperature
- Low temperature flowability

SILICONES, IN THEIR MANY FORMS, ARE USED IN THE FOLLOWING SECTORS:

Aquarium and Oven Joints

Manufacturers of aquariums have used silicone sealant from its inception in order to join glass plates. Glass joints made with silicone sealant can withstand hundreds of metric tons of presure. Silicone rubber does not melt at oven temperatures. It is used to seal oven doors.

Automotive Vehicles

In automobiles, silicone grease is typically used as a lubricant for brake components since it is stable at high temperatures, is not water-soluble and is far less likely than other lubricants to foul.

Automotive spark plug wires are often insulated by multiple layers of silicone to prevent sparks from jumping to adjacent wires, causing misfires.

Cookware

Silicone finds applications in the cookware industry, particularly kitchen utensils.

Dry Cleaning

Liquid silicone can be used as a dry cleaning solvent.

Additionally, liquid silicone is chemically inert, meaning it does not react with fabrics or dyes during the cleaning process. This reduces the amount of fading and shrinking that most dry-cleaned garments experience.

Electronics

Electronic components are sometimes protected by enclosing them in silicone to increase stability against mechanical and electrical shock, radiation and vibration. Silicones are used when durability and high performance are demanded of components under hard conditions, as in space (satellite technology). Silicones play an important role in computer technology, telecommunications and all other related fields which rely on microchips.

The combination of plasma and silicones make it possible to produce polymeric thin films with a thickness of less than one-tenth of a human hair. These films make it possible to make faster microprocessors, better solar energy devices, and IC chips with enhanced reliability.

Firestops

Silicone foams have been used in North American buildings in an attempt to fire stop openings within fire-resistance-rated wall and floor assemblies to prevent the spread of flames and smoke from one room to another.

When properly installed, silicone-foam fire stops can be fabricated for building code compliance. Advantages include flexibility and high dielectric strength.

Lubricants

Silicone greases are used for many purposes, such as bicycle chains. A dry-set lubricant is delivered with a solvent carrier to penetrate the chain. The solvent evaporates, leaving a clear film that lubricates but does not attract dirt and grit as much as a traditional "wet" lubricant.

> Silicone eye protection

Appreciating Silicones

Medical and Surgical Products
Silicone, in the gel form, is used in bandages and dressings, in artificial human parts including breast implants, heart valves and a variety of other medical and surgical uses.

Mold Making
Two-part silicone systems are used to create rubber molds which can be used for production casting of resins, foams, rubber and low-temp alloys.

Personal Care
Silicones are used in hair conditioning products. Silicones are also used in some personal lubricants. Menstrual cups are often made of silicone for its durability and reusability.

Plumbing and Building Construction
The strength and reliability of silicone rubber is widely acknowledged in the construction industry. Silicone water repellents keep brick and concrete walls dry in the rain and are used as waterproof sealants for bathroom and kitchen tiling.

In plumbing, silicone grease is typically applied to O-rings in faucets and valves. Whilst the film is extant, it prevents lime from sticking to the brass work.

Space Technology
The imprint that Neil Armstrong left on soil of the moon was made with silicone rubber boot sole. Novel silicone materials were used in the lunar and command modules for the safety and support of the crew.

Textiles
Silicones have revolutionized the textile and garment industries. They provide added protection and functional properties that may not exist in fabrics. They give soft feel property to woven, non-woven and knit fabrics. Silicone coated fabrics are used to make variety of clothes and industrial textiles.

Toys
Silicone balls have become a juggler's favorite due to the high bounce back.
One of the most successful toys of the 20th Century is Silly Putty.

In conclusion, we can say that, silicones are very versatile and highly useful as consumer products.

> Silly Putty (toy)

> Silicone protection case

> Silicone kitchen utensils

> Silicone safety rubber boots

> Silicone breasts implant

Silicone Finishing Softer than a Soft Touch

ABSTRACT

Growth of silicones particularly in textiles has been enormous over the last few decades as it imparts particular hand along with flexibility, drapability, compressibility and elastic recovery to the textile fabrics. Softening and water-repellency are almost synonymous with silicone finishing in textiles.

Advancement in science and technology has thoroughly engineered the basic structure of silicones to have series of functionally modified silicones which include the family of amino, carboxy and epoxy modified silicones. This paper reviews the fundamental aspects of silicone finishing in terms of structure property relationships. It also highlights on silicones for multifunctional finishing, micro/macro/nano finishing and water repellent finishing.

INTRODUCTION

Keeping the colors, design and price of a garment or fabric aside, what ultimately a customer generally considers to choose a particular textile product in a retail shop is the handle and appearance of a garment. Practically everyone who examines a textile automatically touches it with their fingers to get a feel of the hand. Hence, almost all apparel and home furnishing textiles are treated with softeners. Only a few specialty fabrics do not receive a softener finish, consequently, it is easier to state which fabrics are not softened. These include wall coverings, carpeting and most industrial textiles. Therefore, softening of textiles becomes an important finishing process of many after treatment processes in a textile chemical processing industry. The hand of a fabric is a subjective sensation felt by the skin when a fabric is touched with the finger tips and gently pressed. The perceived softness of a fabric is the combination of several measurable physical phenomena such as elasticity, compressibility and smoothness. Almost all the natural fibres, by providence arrangement, have some percentage of wax which makes the fibre naturally soft, the classical example is cotton, the most widely used fibre. However, the presence of wax both on the surface and on the bulk of a fibre makes it resistant for wetting.

Unfortunately, the lack of water absorbency makes the fibres unsuitable for dyeing and printing which are the primary objectives of a textile processing unit. Therefore, in order to make the fibre suitable for dyeing, various preparatory processes such as desizing, scouring, bleaching, etc. are carried out, which actually remove the natural softening agents to make the fibres more absorbent. Therefore, generally after dyeing and printing the fabrics become harsh and stiff. Finishing with softeners can overcome this deficiency and even improve on the original suppleness. The softening treatments impart soft handle (supple, pliant, sleek and fluffy), smoothness and enhance flexibility, drape and pliability. Other properties improved by softeners include the feeling of added fullness, antistatic properties and sewability.

With chemical softeners, textiles can achieve an agreeable, soft hand and some smoothness. However, the disadvantages sometimes seen with chemical softeners include reduced crockfastness, yellowing of white goods, changes in hue of dyed goods and fabric structure slippage. Most softeners consist of molecules with both a hydrophobic and a hydrophilic part. Therefore, they can be classified as surfactants (surface active agents) and are to be found concentrated at the fibre surfaces. Most softeners have low water solubility. Therefore, softening products are usually sold as oil in water emulsions containing 20–30% solids. The softener molecules typically contain a long alkyl group, sometimes branched, of more than 16 and upto 22 carbon atoms, but most have 18 corresponding to the stearyl residue. Exceptions to this molecular structure are the special categories of silicones, paraffins and polyethylene softeners. About one-third of the softeners used in the textile industry are silicone based as it imparts excellent soft hand combined with various other properties such as water repellency, superior smoothness, greasy feel, excellent body, improved crease resistance, etc. The silicones were actually first utilized by the textile industry primarily as lubricants in fibre and fabric manufacture. Silicone softeners are also applied with permanent press finishes to improve garment wear life and permanent press finish durability. It can also be used with other finishing agents for multifunctional finishes, for example, it can be used in resin finishing of textiles to have a soft wrinkle resistant fabric. Recently, by Americos Industries, silicone softeners are also formulated with special polymers to impart a unique leather soft finish. This article, therefore, discusses the fundamental principles behind silicone finishing, various developments in silicones and their corresponding textile applications. This paper includes the contribution from Americos in the field of silicone finishing of textiles.

Silicone Finishing: Softer than a Soft Touch

SILICONES

In the science of silicone finishing, a fundamental difference between silicon and silicone should be noted, in that silicon is an atom that lies below carbon atom in the periodic table, while the term silicone refers to artificial polymers based on a framework of altering silicon and oxygen (siloxane bonds). The electronic configuration of silicon is $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^2$. The larger atomic radius of silicon atom makes the silicon-silicon single bond much less energetic due to which the silanes (Si_nH_{2n+1}) are much less stable than alkanes. The opposite, however, is true of silicon-oxygen bonds that are more energetic (about 22 kcal/mole) than the carbon oxygen bonds. Polysiloxanes, therefore, have recurring Si-O linkages in the backbones.

WHY NOT SILANES BUT POLYSILOXANES?

Generally, the silicone treatment of textile consists of treating them with silicone polymer emulsions but not with the silane monomers which may also impart the softness and water repellent characteristics. The reason being is that the silane monomers, during treatment, liberate hazardous chemicals, for instance treatment of textiles with chloromethylsilanes liberates hydrochloric acid. Attempts have been made to improve the treatment of textiles with silane monomers, using of ammonia to absorb the hydrochloric acid in the case of chloromethylsilanes. The attempts which have been patented are replacement of chlorine with acetoxy, alkoxy, amino, or isocyanate groups. However, none of these has resulted in a practical process. Therefore, silanes are not used as such for textile finishing but are converted to polysiloxanes, which can be applied to textiles as solutions in organic solvents or as aqueous emulsions.

POLYSILOXANES

The chemistry and technology of polysiloxanes have been the interest of many researchers and manufacturers as it finds very wide applications. The silicones used for textile applications are polymers with a –O–Si–O– backbone. According to proper chemical nomenclature, these polymers are polysiloxanes (Fig. 1).

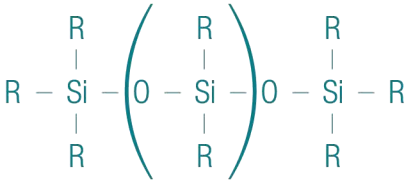


Figure 1 Polysiloxane

Engineering of silicone and oxygen of siloxane bonds (Fig. 1) with organic substitutes results in various kinds of silicone polymers. Accordingly, the substituents R can be a hydrogen, hydroxyl, alkyl, aryl, or alkoxyl group. The substituents in the polymer chain can be all of the same kind or can be different. However, for textile applications, R is usually either methyl or hydrogen groups and are the most important of the organic substituents used in commercial silicones, the vast majorities of which are polydimethylsiloxanes (PDMS). Polysiloxane is a mixture of inorganic and organic substances. Because of their "inorganic-organic" structure and the flexibility of the siloxane bonds, silicones have the following unique properties:

- Thermal/oxidative stability
- Low temperature flowability
- Low viscosity change with temperature
- High compressibility
- Low surface tension (spreadability)
- Low fire hazard

They also have good electrical insulating (dielectric properties) characteristics and water repellency (hydrophobicity) which are maintained over a wide range of temperatures. As a result of having combined unique properties, these semi-inorganic materials i.e. polysiloxanes become industrially important and find applications in many diverse markets, such as aerospace, automotive, construction, electrical, electronics, medical materials, performance chemicals and coatings, personal care and textiles. Fluids and greases, emulsions, rubber products and resins are some of the materials based on silicone technology.

TEXTILE APPLICATIONS

Silicones have broad utility in textile processing and finishing; most of the products for this industry are based on PDMS technology. The applications for silicones vary widely and include antifoam for fabric and carpet dyeing, print paste softeners, fabric finishes and coatings. In fabric processing, silicone antifoams are often used to maximize the efficiency of the scouring baths, washing/dyeing and bleaching options. They serve as fibre lubricants for spinning, winding and slashing. Various types of silicones are commonly used as softeners, wetting agents and water repellents. In sewing operations, silicone thread lubricants are essential to meet the demands of industrial high-speed sewing machinery. Silicones also have many uses in nonwoven applications, such as binders, additives for wet-laid processes.

Some silicones are supplied as neat fluids, while others are in the form of emulsions or room temperature curing elastomers. PDMS is extremely versatile, and can be modified to formulate a wide range of products with tailored

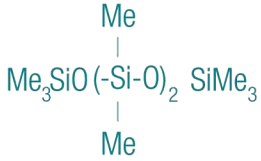
Silicone Finishing: Softer than a Soft Touch

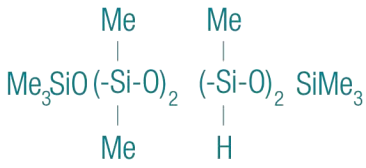
hydrophobicity and durability, used to modify the feel and appearance of fabrics, or to improve processing.

TYPE: DURABLE/NONDURABLE REACTIVITY

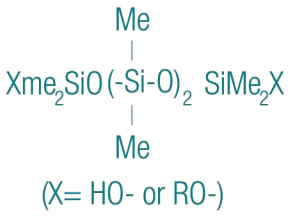
Aminosilicones are for durable finish. Polydimethylsiloxane is a non-durable finish. Polydimethylsiloxane with its terminal reactive hydroxyl groups is a conventional, may be semi-durable finish. Polymethylhydrogensiloxanes acts as a reactive as well as cross-linking agent and hence, is responsible for producing durable finish with the blend of polydimethylsiloxane. Aminofunctional silicones and other organo-functional silicones contain groups such as amino, substituted amino, epoxide, or alcohol groups attached to the polymer backbone. Therefore, they offer durable, soft and lively hand and a slight increase in wrinkle recovery and flat appearance. The presence of silane coupling also plays a major role in enhancing the durability.

Silicone softeners include both polydimethylsiloxane polymers as well as a wide range of organo-modified polydimethylsiloxanes. Performance enhancing additives and finishes based on PDMS technology can be nonreactive (Fig. 2a), conventionally reactive (Fig. 2b) or the organofunctional materials (Fig. 2c). With these silicones, one of the advantage to the processors is that the ability to derive more than one benefit from a single product.

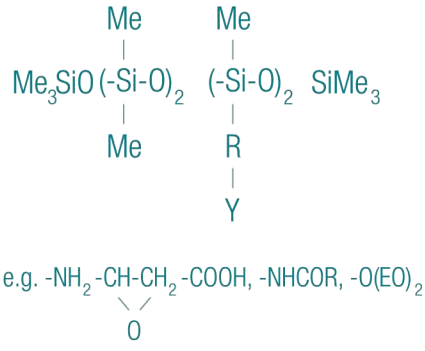




(a)



(b)



(c)

Figure 2 Example of
a) nonreactive silicone polymer
b) conventionally reactive silicone polymer
c) organofunctional reactive silicone polymer

Organo-modified polydimethylsiloxanes, particularly epoxy modified, were found to offer a significant improvement over conventional unreactive silicones.

The improvement was in terms of both a greater degree of softening and good durability of polymers to laundering. Amino-functional polydimethylsiloxanes softeners were found to have the same advantages as reactive silicones.

Two additional benefits were found with aminofunctional silicone softeners. Knit fabrics became more elastic, with better stretch recovery. The softener also additionally delivered antistatic benefits and wrinkling resistance. These two benefits and the fact that the amino functional silicone are readily adsorbed from dilute solutions onto cotton fabrics in conjunction with traditional cationic softeners lead to their use in rinse cycle softeners in the middle to late 1980s. One of the features shared by many silicone materials is effectiveness at very low concentrations. Very small amounts (0.1 to 1.0% by weight) are usually required to achieve the desired properties, which can improve the cost efficiency of textile operations and help ensure a minimum of environmental impact. Therefore, in spite of high cost, amine silicones did bring a consumer-perceptible new dimension to rinse cycle fabric softeners.

The reactivity of polydimethylsiloxanes can be increased by mixing with polymethylhydrogensiloxanes. The Si–H bond is hydrolyzed to –Si–OH, which can condense with another Si–OH group or a –Si–H group and forms cross links. However, hydrolysis produces hydrogen, which may create a fire hazard and a storage problem. The Si–H bond hydrolyzes rapidly in an alkaline or strongly acidic medium but can be stabilized with certain organic additives in an aqueous medium buffered at pH 3-4. Oxidation of –Si–H groups by atmospheric oxygen or oxidizing agents can produce –Si–OH groups, which can also contribute to eventual cross-linking of the finish on the fabric.

Silicone Finishing: Softer than a Soft Touch

Polymethylhydrogensiloxanes produce a hard brittle film on fibres and the finish has a harsh handle. They are, therefore, not used alone, but in admixture with polydimethylsiloxanes, which act as plasticizers and improve the handle of the finished fabric. However polymethylhydrogen siloxanes can produce a highly water-repellent finish with a soft handle when cross-linked on cotton in the presence of organic peroxides.

The water repellency of "silicones" on synthetic fabrics, especially those made of filament fibres, is fairly resistant to laundering and dry-cleaning with pure solvents. The loss of water repellency during dry cleaning is caused mainly by adsorption of hydrophilic substances, such as detergents, and to a lesser extent by dissolution of the silicone finish in the solvent. The durability of silicone finishes on cellulosic fabric is impaired by swelling of cotton fibres during laundering. The expansion of the fibres ruptures the silicone film essential for water repellency. Since the repellent polysiloxane film does not melt and flow, the cracks in the ruptured film cannot be sealed and the initial repellency restored by heating. Although attempts have been made to form a covalent bond between the polysiloxane and cellulose fibres, the –Si–O–CELL bond is yet not stable to hydrolysis.

Apart from the type of reactive groups, the viscosity and the adsorption mechanism of the softener, as well as treatment conditions such as curing temperature, are crucial factors affecting the performance properties of the treated fabrics.

METHOD OF PREPARATION OF SILICONES

The hydrophobicity of silicones was discovered at General Electric by Patnode, who observed that paper treated with chloromethylsilanes become water repellent when exposed to moist air. Preparations of such substituted chlorosilanes $R_n - SiCl_{4-n}$ where R is usually a methyl or phenyl group and n = 0, 1, 2, or 3 is the first step in the manufacture of silicones. There are two methods available for the preparation of chlorosilanes.

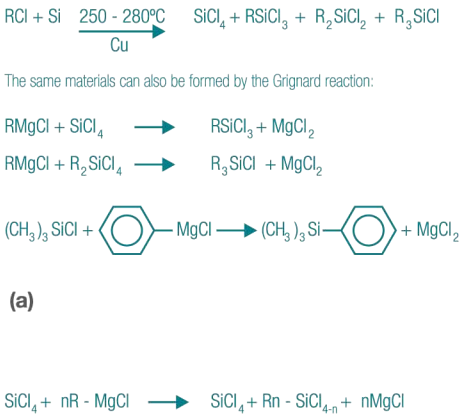


Figure 3 Preparation of chlorosilanes
a) first method
b) second method

In the first, direct process, the starting materials can be prepared through hydrolyses of alkyl or arylsilicone halides. Organosilicone halides, in turn, are made commercially by heating alkyl or aryl halides with silicone at 250° to 289°C (Fig.3a). Copper catalyzes this reaction. The second method is the Grignard method (Fig. 3b) in which a given chlorosilanes or a mixture is reacted with methyl or phenyl magnesium halide to yield the desired more highly alkylated or arylated chlorosilanes. Neither of the above methods of synthesis yields any given chlorosilanes free from the other members of its series. For example chloromethylsilanes are hydrolyzed by water to silanols (Fig. 4), which condense spontaneously to siloxanes. Chlorotrimethylsilane yields hexamethyldisiloxane.

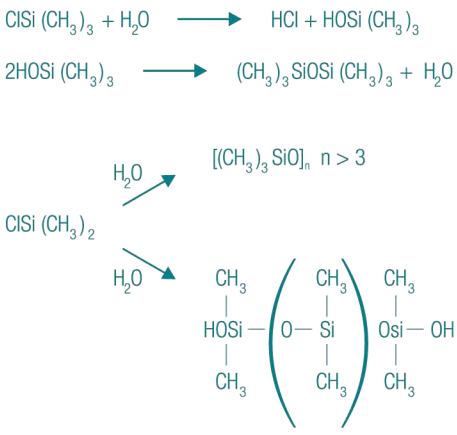


Figure 4 Hydrolyses of chloromethylsilanes

Dichlorodimethylsilane yields, depending on reaction conditions, 20-50% cyclic siloxanes and 80-50% linear polydimethylsiloxanes.

Trichloromethylsilane yields cross-linked polymethylsiloxanes. Condensation reactions can occur between –SiOH and –SiH groups, if present, and between two –SiOH groups. In the presence of peroxides or upon irradiation, two – $SiCH_3$ groups can also undergo a condensation reaction. The hydrolysis and condensation reactions of chloromethylsilanes or chlorohydrogensilanes are, therefore, more complex than those shown above and hence, the separation of the reaction products requires highly efficient fractional distillation columns – a difficult processing step in the manufacture of silicone.

continuation on page 23-26

Product Portfolio

CLASS	PRODUCT	APPLICATION	BENEFITS	TYPE OF FEEL
Cationic Softeners	**Americos Catasoft 1550 NY**	**Application conditions** pH: 5–8 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Easily soluble in cold water • On synthetics, it provides silk-like handle • Does not affect dye fastness • Non-irritant on skin • Suitable for cheese dyeing process • Low yellowing	Supple
	Americos Catasoft All 786 Flakes	**Dilution Method** 1:10, 1:5 & 1:4 **Application conditions** pH: 5–8 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Easily soluble in warm water • On synthetics, it provides silk-like feel • Does not affect dye fastness • Non-irritant on skin • Suitable for cheese dyeing process • Low yellowing	Supple
	Americos Catasoft ASE 170 Flakes	**Dilution Method** 1:10, 1:5 & 1:4 **Application conditions** pH: 4.8 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Easily soluble in cold water • No yellowing on heating • On synthetics, it provides silk-like handle • Does not affect dye fastness • Non-irritant on human skin • Suitable for cheese dyeing process	Supple
	Americos Neutrasoft NCM	**Application conditions** pH: 5–8 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Can be applied in both exhaust and padding processes • Compatible with silicone and cationic products used in finishing formulation • Does not affect dye fastness • Non-irritant on skin • Suitable for cheese dyeing process • No yellowing	Bulky & Waxy

Product Portfolio

CLASS	PRODUCT	APPLICATION	BENEFITS	TYPE OF FEEL
Weak Cationic Softener	**Americos AC - 1000**	**Application conditions** pH: 7 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts excellent feel only using 2–4% (wof) for all kinds of textiles, especially polyester and its blends after re-dyeing or dark color dyeing • Imparts good feel and elasticity like wool for acrylic and its blends • Imparts good antistatic effect to all kinds of textiles • Does not affect dye fastness and color yield • No yellowing problem on white fabrics	Extremely Supple & Soft
Non-ionic Softeners	**Americos Neutrasoft NMC**	**Application conditions** pH: 7 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Can be applied in both exhaust and padding processes • Compatible with silicone and cationic products used in finish formulation • Does not affect dye fastness • Non-irritant on skin • No yellowing	Bulky & Waxy
	Americos Neutrasoft DN	**Application conditions** pH: 8.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Easily dispersed in hot water (80°C) and forms very stable emulsion • Can be used with anionic or cationic softener or other finishing agent • Exerts no bad influence on colored or white fabrics • Imparts smooth and soft feel to all fabrics • Shows better softening effect in comparison with other types of non-ionic softeners • No yellowing	Bulky & Waxy

Product Portfolio

CLASS	PRODUCT	APPLICATION	BENEFITS	TYPE OF FEEL
Anti-Ozone Softeners	**Americos Anti-Ozone**	**Application conditions** pH: 7.5–9.0 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Primarily designed to improve ozone fastness • Produces soft and full feel • Exhibits no tendency for sublimation • Does not affect shade or fastness properties of dyed fabrics • Does not affect the whiteness of fabrics • Minimizes needle breakage and optimizes machine efficiency	Soft
	Americos Ozosoft ZE	**Application conditions** pH: 6–7 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Improves ozone fastness • Improves sewing and napping performance • Imparts a soft hand to the treated fabric • Can be applied by exhaust and padding process • Produces a soft and full handle • Exhibits no tendency for sublimation • Does not affect the shade or fastness properties of dyed textiles • Does not affect the whiteness of textiles • Minimizes needle breakage and optimizes machine efficiency	Soft
Silicone Softeners	**Americos Nanosoft 1140**	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts durable soft feel to textiles • Imparts superior smooth fee to textiles • Increases crease recovery • Increases shade depth and shine when used on dyed textiles	Surface & Inner softness

Product Portfolio

CLASS	PRODUCT	APPLICATION	BENEFITS	TYPE OF FEEL
Silicone Softeners	**Americos Nanosoft 1160**	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts bulky touch to textiles • Imparts smooth feel to textiles • Imparts crease recovery • Increases shade depth and shine when used on dyed textiles • Imparts depth to color • Low yellowing	Supple
	Americos Nanosoft 2000	**Application conditions** pH: 5–5.5 Temperature: 45° – 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts soft touch to textiles • Imparts smooth feel to textiles • Imparts crease recovery • Highly concentrated • Imparts depth to color • Low yellowing	Supple
	Americos Nanosoft 950	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20-30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts smooth feel to textiles • Imparts crease recovery property • Increases shade depth and shine when used on dyed textiles • Low yellowing	Inner Softness
	Americos Elastomer 1140	**Application conditions** pH:5–5.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts excellent surface smoothness to textiles • Imparts crease recovery • Increases shade depth and shine when used on dyed textiles	Excellent surface smoothness with bulkiness

Product Portfolio

CLASS	PRODUCT	APPLICATION	BENEFITS	TYPE OF FEEL
Silicone Softeners	**Americos Nanosoft SM 702**	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Highly concentrated • Imparts excellent softness and bulky & bouncy finish to the garments and fabrics • Helps to retain back staining when applied on denim	Surface Softness
	Americos Nanosoft ASAM	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts excellent softness and bulky bouncy finish to garments and fabrics • Imparts smooth feel to textiles • Enhances crease recovery angle significantly • Increases shade depth and brightness when used on dyed textiles • Provides excellent result to white fabrics • Helps to retain back staining when applied on denim	Bulky and bouncy surface and inner softness
	Americos Nanosoft Fight 112	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts smooth feel to textiles • Imparts crease recovery • Increases shade depth and shine when used on dyed textiles • Low yellowing	Inner Softness
	Americos Nanosoft 36G	**Application conditions** pH: 5–5.5 Temperature: 45° – 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts durable soft feel to textiles • Imparts superior smooth feel to textiles • Increases crease recovery • Increases shade depth and shine when used on dyed textiles • Low yellowing	Surface & Inner softness

Product Portfolio

CLASS	PRODUCT	APPLICATION	BENEFITS	TYPE OF FEEL
Silicone Softeners	**Americos Nanosoft 59G**	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20-30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts leather like bulky and soft hand with low-yellowing character • Does not modify typical fabric properties and hence, it can be used on knitted fabrics as well • Increases the tear strength of fabric substantially	Powerful soft hand feel; excellent surface softness
	Americos Nanosoft 3G	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20-30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts durable soft feel to textiles • Imparts superior smooth feel to textiles • Increases crease recovery • Increases shade depth and shine when used on dyed textiles	Surface & Inner softness
	Americos Nanosoft 2060	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20-30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts soft feel to textiles • Imparts smooth feel to textiles • Imparts crease recovery • Imparts depth to color • Low yellowing	Supple
	Americos Nanosoft 1130	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20-30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts durable soft feel to textiles • Imparts superior smooth feel to textiles • Increases crease recovery • Increases shade depth and shine when used on dyed textiles • Low yellowing	Surface & Inner softness

Product Portfolio

CLASS	PRODUCT	APPLICATION	BENEFITS	TYPE OF FEEL
Silicone Softeners	**Americos Nanosoft 1180**	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts smooth feel to textiles • Imparts crease recovery • Increases shade depth and shine when used on dyed textiles • Imparts depth to color • Low yellowing	Smoothness, and supple feel
	Americos Nanosoft 950l	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts smooth feel to textiles • Imparts crease recovery • Increases shade depth and brilliance when used on dyed textiles • Low yellowing	Inner softness
	Americos Nanosoft AM	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts excellent softness to textiles • Imparts smooth feel to textiles • Enhances crease recovery angle significantly • Increases shade depth and brightness when used on dyed textiles	Surface smoothness and bouncy
	Americos Greasysoft 780	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts durable soft feel to textiles • Imparts superior smooth feel to textiles • Increases crease recovery • Increases shade depth and shine when used on dyed textiles • Low yellowing	Surface & Inner softness

Product Portfolio

CLASS	PRODUCT	APPLICATION	BENEFITS	TYPE OF FEEL
Silicone Softeners	**Americos LX 30**	**Application conditions** pH: 5–5.5 Temperature: 45°– 50°C Time: 20-30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts excellent surface smoothness to textiles • Imparts crease recovery property • Increases shade depth and shine when used on dyed textiles	Excellent surface smoothness with bulkiness
	Americos FX 30	**Application conditions** pH: 4.5 Temperature: 45°– 50°C Time: 20-30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Non-yellowing and effective softener for white fabrics • Endows excellent soft touch and elasticity to various kinds of textiles and their blends • Excellent to washing and solvent fastness • On cotton knits, it gives excellent luster and drape and stretching properties • Has excellent elasticity and prevents crease and filling, and also improves sewability • In case of durable press finishing of cotton knit or woven, it improves tearing strength and endows soft elasticity	Smooth
Silicone Softeners with Organic Polymer Resin	**Americos Leathersoft 750**	**Application conditions** pH: 5-7 Temperature: 45°– 50°C Time: 20-30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts leather like bulk and soft hand with non-yellowing character • Compatible with silicone and cationic products used in finishing formulation • Does not influence dye fastness • Does not modify typical fabric properties and hence, it can be used on knitted fabrics as well • Increases tear strength of the fabric substantially • Highly effective, even if used alone • Effectively used on dyed garments • Provides excellent surface smoothness	Bouncy, bulky surface and Inner softness

Product Portfolio

CLASS	PRODUCT	APPLICATION	BENEFITS	TYPE OF FEEL
Silicone Softeners with Organic Polymer Resin	**Americos Rabroxil 5011**	**Application conditions** pH: 5-7 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts leather like bulky and soft hand with non-yellowing character • Compatible with silicone and cationic products used in finishing formulation • Does not influence dye fastness • Does not modify typical fabric properties and hence, it can be used on knitted fabrics as well • Increases tear strength of the fabric substantially • Highly effective, even if used alone • Highly effective when used on dyed garments • Provides excellent surface smoothness	Bouncy and bulky surface and inner softness
Hydrophilic Silicone Softener	**Americos SF -1402**	**Application conditions** pH: 5.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• Imparts typical silicone silky velvety hand • Increases moisture transport in textiles and absorbs moisture quickly • Helps cotton towels remain absorbent after finishing • Especially advantageous when finishing polyester fabric	Supple
Urethane Resin	**Americos Urethane Resin**	**Application conditions** pH: 9.5 Temperature: 45°– 50°C Time: 20–30 minutes **Suitable M/c** Wash wheel, Jigger, Padding machine	• A unique product that imparts a special elastic effect on the treated textiles • Improves the softness and smoothness significantly • Enhances other handle related properties such as crease recovery, drape etc. • Increases the depth of shade • Imparts shine • Imparts depth to color on cotton textiles	Supple

Silicone Chart

AMERICOS SILICONE SPECIFICATIONS

SILICONE SOFTENERS	LIMP	BOUNCE	SURFACE SOFTNESS	INNER SOFTNESS	SMOOTHNESS	YELLOWNESS
Americos NanoSoft 1140	★★★★★	★★★	★★★★★	★★★★★	★★★★★	★★
Americos Nanosoft 1160	★★★★★		★★★★½	★★★★½	★★★★½	★★½
Americos Nanosoft 950	★★★	★★★	★★★½	★★★½	★★★★	★½
Americos Nanosoft 950i	★★★★	★★★½	★★★★	★★★½	★★★★½	★½
Americos E 1140	★★★	★★★	★★★★	★★★★	★★★★	★
Americos FX30	★★½	★★★½	★★★★	★★★½	★★★★	
Americos ASAM	★★	★★★★★	★★★★★	★★★★★	★★★★★	
Americos AMK	★★½	★★★★½	★★★★½	★★★★½	★★★★½	
Americos Flight 112	★★★★½	★★★★★	★★★★★	★★★★★	★★★★★	★½
Americos Nanosoft 36G	★★★★★	★★★★½	★★★★★	★★★★★	★★★★★	★½
Americos Nanosoft 2000	★★★½	★★★★★	★★★★★	★★★★★	★★★★★	★
Americos Nanosoft 2060	★★½	★★★★	★★★★	★★★★	★★★★	
Americos Nanosoft 1130	★★★★½	★★½	★★★★	★★★★	★★★★	★
Americos Nanosoft 1180	★★★★½	★★★	★★★★	★★★★★	★★★★½	★★
Americos AM	★★★	★★★★★	★★★★½	★★★★½	★★★★★	★★½
Americos 606V	★★★★½	★★★	★★★★½	★★★★½	★★★★½	★½
Americos Nanosoft 59G	★★★★★	★★½	★★★★★	★★★½	★★★★½	★
Americos DK750	★★	★★	★★★½	★★★★½	★★★★	★
Americos LX30	★★½	★★★½	★★★	★★★½	★★★★	★

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Do you find the newsletter:

◯ Difficult to read	◯ Easy to read
◯ Uninteresting	◯ Interesting
◯ Not relevant	◯ Relevant
◯ Not worthwhile	◯ Worthwhile

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Quiz

1. Where was the first MBA programme in the world introduced and in which year?

2. Which is the world's first dotcom domain name and in which year it was registered?

3. Who invented the just-add-hot water "instant" coffee and in which year?

4. Who invented the mobile phone?

5. Who invented the e-mail and in which year?

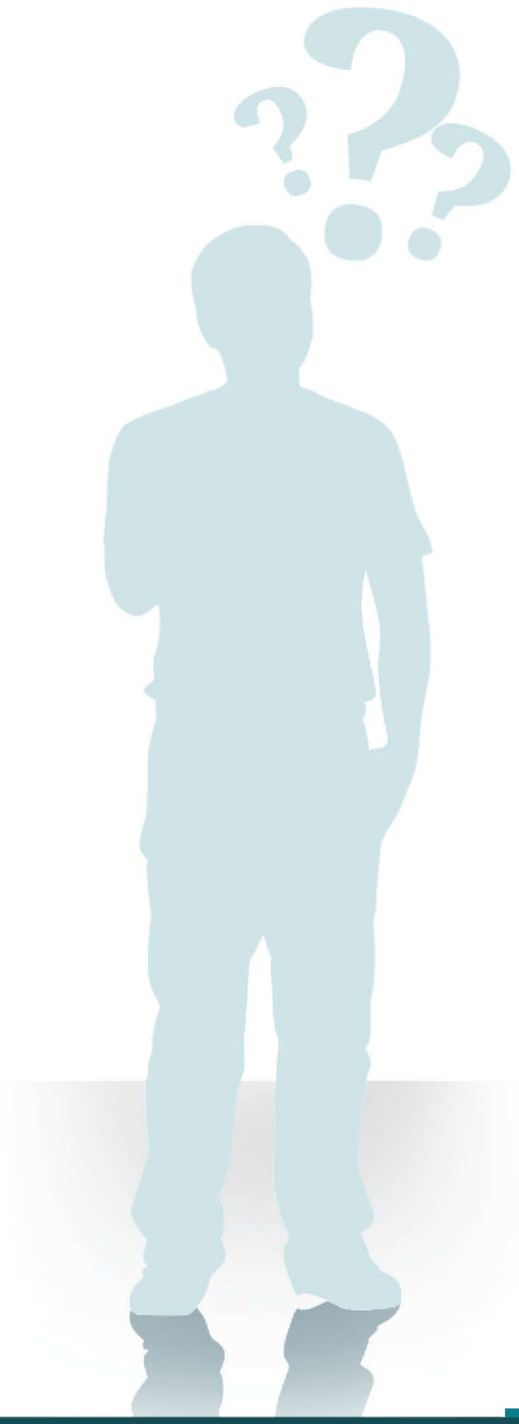
6. Who is considered as the "Father of the Internet"?

7. Who is the pioneer of the concept of SEZ?

8. Whose slogan is "One World, One Dream"?

9. Which is the only ship-scrapping yard in India?

10. What is known as rock cotton?



Answers.
1. Harvard Business School, in 1908. 2. Symbolics.com. It was registered in 1985.
3. Nestle, in 1938. 4. Martin Cooper of Motorola. 5. Ray Tomlinson, in 1971.
6. Vinton G. Cerf. 7. China. 8. Beijing Olympics. 9. Alang (Gujarat). 10. Asbestos.

Silicone Finishing: Softer than a Soft Touch

The polymerized silicones are prepared by hydrolyzing a known mixture of pure substituted chlorosilanes with water, washing the hydrolysate free from hydrochloric acid and further polymerizing the neutral hydrolysate to yield the desired product. The silicone fluids are prepared from mono – and difunctional chlorosilanes so as to get end-blocked linear polymers.

SILICONE FOR SOFTENING

As the uniqueness of silicone finishing has been established in the previous sections, this section expands further on silicones as softeners. As the soft touch, supple feel and appearance, etc. are of significantly important for a customer, softening of textiles has become an important finishing operation. Silicone emulsions, especially, are capable of bestowing significant benefits in this regard. Therefore, silicone softeners are becoming extremely important because of their very good softness and greater wash permanence compared to other softeners. The mechanism of softening by silicone treatment is due to flexible film formation. The reduced energy required for bond rotation makes the siloxane backbone more flexible. Therefore, polysiloxanes form a flexible film on fibres and yarns and hence, reduces the inter-fibre and inter-yarn friction. Thus, the silicone finishing of textile produce an exceptional soft handle combined with other properties such as superior smoothness, greasy feel, excellent body, improved crease resistance, etc.

The silicone molecules can produce a wide range of hand variations, from dry to oily to resilient, and are also used for such purposes. The extent of the effect depends on the degree to which the molecules are cross linked. The responsibility from the finisher side is to select the appropriate silicone softener from the vast range available in the textile auxiliaries sector. Silicones particularly as softener are expected to confer the following:

- Soft supple hand
- Improved sewability
- Improved tear strength
- Improved crocking fastness
- Outstanding hydrophobic or hydrophilic properties
- Higher crease recovery angle
- Improved wash permanence
- Very good anti-pilling properties
- Antistatic properties
- High effectiveness and process stability

Silicone softeners include both polydimethylsiloxane polymers as well as a wide range of organo-modified polydimethylsiloxanes.

Polydimethylsiloxanes, polymethylhydrogen-siloxanes or blend of these two fluids are generally used as softeners. Silicone softeners are also applied with permanent press finishes to improve garment wear life and permanent press finish durability. Organo-modified polydimethylsiloxanes, particularly epoxy modified, were found to offer a significant improvement over conventional unreactive silicones. The improvement was in terms of both a greater degree of softening and good durability of polymers to laundering conventional unreactive silicones. The improvement was in terms of both a greater degree of softening and good durability of polymers to laundering.

Of the silicone softeners available, perhaps the most common in current industrial usage and likely to be the best is the aminofunctional silicone softeners (Fig. 5). These materials offer a range of handles depending on the relative size of x and the ratio of x:y. They may be supplied as surfactant-stabilized emulsions in water, either mechanical or microemulsions. Mechanical emulsions contain large droplets which tend to coalesce on the fabric, giving surface effects. The microemulsions, of much smaller droplet size, will tend to migrate into the yarn and give an overall softness to the whole structure. The aminosilicones may give a relatively dry handle where the x:y ratio is high, and a typically greasy handle where the x:y ratio is low.

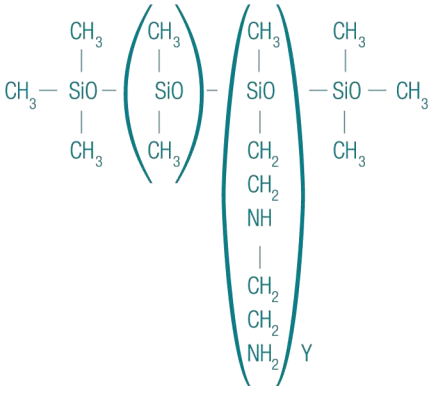


Figure 5 Aminofunctional softener

Aminofunctional silicone fluids are much more effective at imparting hand properties than either methyl oils or silicones with carboxyl or epoxy functions. This exceptional property stems from the fact that the partly protonated amino groups of the softener molecule interact with the negatively charged cotton fibres. Hence, the amino functional silicones are readily adsorbed from dilute solutions onto cotton fabrics in conjunction with traditional cationic organic softeners lead to their use in rinse cycle softeners. Two additional benefits were found with aminofunctional silicone softeners. Knit fabrics became more elastic, with better stretch recovery. The softener also additionally delivered

Silicone Finishing: Softer than a Soft Touch

antistatic benefits and wrinkling resistance. All these fabric property improvements exhibited durability to repeated launderings. In addition the ability to blend these aminofunctional silicones with organic softeners and retain performance properties allow the creation of softener blends with optimum cost – performance parameters. Thus, a polyester cotton blend fabric showed improvement in durable press rating, wrinkle recovery and tear strength even when half the amino functional silicone softener was replaced by an organic softener, which, however, caused a loss in stretch/ recovery performance of cotton knit fabric after five washes.

Microemulsions are generally aminosilicones. Epoxy silicones can also be used as microemulsions but softness is not as good as amino-microsilicone emulsions. Microsilicone emulsions give a permanent feel to the fabric with a high degree of softness. Amino functional silicones have shown good softening ability. Increased tear strength, greater abrasion resistance and improved wrinkle recovery are seen on polyester/cotton blends and 100% cotton woven fabrics treated with aminofunctional silicones along with a durable press resin.

SILICONES FOR MULTIFUNCTIONAL FINISH

Since the curing conditions of the polysiloxanes are similar to durable press cross-linking treatments with methylol compounds, polysiloxanes can be applied with a durable press finish. The durable press resins enhance the durability of the “silicone” finish. Wrinkle free finishes are renowned for the substantial quantities of glyoxal crosslinker and catalysts employed. Since the finishing process occurs in an acid milieu, silicone softeners are expected to be stable in saline solution and acids, and to be resistant to shear. Not many silicone softeners on the market can meet these demands.

Americos is one of the leading manufacturers of softeners both silicones based and non-silicones based for various textile substrates to impart soft handle along with various other special properties. Particularly, Americos silicone softeners are engineered to impart multifunctional properties. For example, **Americos FX-30** is silicone based softener specially engineered with polyurethane (PU) polymers for white fabrics. It imparts excellent and durable softness to the fabric along with a special supple feel due to the presence of PU polymers. In addition, it also enhances the whiteness of the treated fabric. Americos also has commercialized a range of multifunctional silicone softeners such as **Americos Rubrisoft FL, Americos Leather Soft 750** and **Americos Rabroxil 5011** which are produced using unique silicone polymers and combination of special polymers. **Americos Rubrisoft FL** gives acme bouncy effect commonly understood as stretch or rubbery effect. The finish is durable and it improves wrinkle recovery property of fabric significantly along with softening. Similarly, **Americos Leather Soft 750** and **Americos Rabroxil 5011** impart a bulky, soft hand and non yellowing leather like effect. They also provide protection against harmful UV-B rays. Further, they increase the tear strength significantly and improve crease recovery property.

MICRO/MACRO/NANO EMULSIONS

There are vast differences between the conventional microemulsions that made history in the textiles industry around 20 years ago, and the quite recent generation of macroemulsions. The primary difference is the particle size of the silicones. These may be up to 80 nm in microemulsions, whereas they are at least 120 nm in macroemulsions.

Microemulsions are generally easier to make, but they also have their disadvantages. Adding more of them produces only a very limited increase in their softening effect. As more is added, the resultant higher proportion of emulsifier leads to hand saturation and may even cause it to deteriorate. With macroemulsions, however, this effect – if it occurs at all – only becomes noticeable at much higher application rates. Unlike microemulsions, macroemulsions provide more resilience, smoothness and a fuller hand. However, its mechanical application properties depend crucially on the quality of the macroemulsions. Poorly emulsified emulsions bring more disadvantages than advantages. To optimize the desired parameters, such as particle size distribution, homogeneity and shear stability, the right processing technology is needed.

With the help of extreme shear technology, Americos emerges out with silicone nanoemulsions which have their unique penetrability in the fabric and fibre structure. Thus, it results in excellent softening properties. The schematic diagram shown in Figure 6 depicts the penetration of silicone nanoemulsion droplets inside the structure of cotton. The cotton fibre is made of fibrillar structure and hence, it has porous structure. The droplet size of nanoemulsion is so small that it can penetrate the micro and nanostructures very well compared to the droplets of microemulsions. Therefore, using Americos nanoemulsions, it is possible to obtain special softening effect.

Silicone Finishing: Softer than a Soft Touch

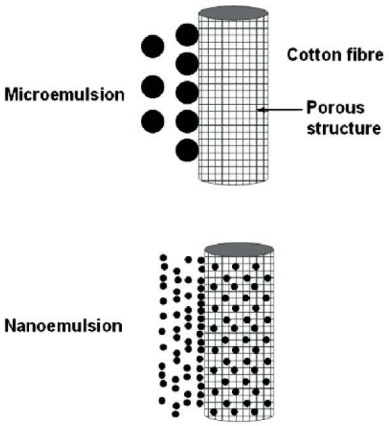


Figure 6 Schematic representation of diffusion of micro and nano silicone emulsion droplets in cotton fibre

Americos Nanosoft 1140, Americos Nanosoft 1180, Americos Nanosoft 950 and **Americos Nanosoft 2000** are the various silicone nanoemulsions currently Americos sells in the market for various textiles. These silicone nanoemulsions impart durable softness, crease resistance, oily and greasy soft hand, suppleness and limpness, excellent body, superior smoothness, and surface levelness.

SILICONE FINISHING AND WATER REPELLENCY

In addition to imparting soft feeling, silicone finishing, in general, imparts water repellent property to the textiles. Such water repellency property is provided by methyl group which are oriented and attached to the fibre surface by silicone links. The silicones are mostly built up of polymethylhydrogen siloxane and polydimethyl siloxane. The first one is reactive and is generally used as water-repellent mostly along with the second one. The problem with the reactive low molecular weight polysiloxanes is that they are liable to undergo further polymerization by lengthening of the –Si-O- chain and also by cross-linking of adjacent –Si-O- chains. This is undesirable in textile application and is prevented by previously replacing the end hydrogen atoms by more inert substituents like methyl groups.

Advantages of silicone water repellents include a high degree of water repellency at relatively low (0.5 – 1% owf) concentrations, very soft fabric hand, improved sewability and shape retention, and improved appearance and feel of pile fabrics. Some modified silicone repellents can be exhaust applied (to pressure-sensitive fabrics). However, some of the limitations with the silicone repellents are increased pilling and seam slippage, reduced repellency if excessive amounts are applied (for example silicone double layer with polar outside, Fig. 7), only moderate durability to laundering (through hydrolysis of siloxane and rupture of the film by strong cellulose fibre swelling) and dry cleaning (adsorption of surfactants), and no oil and soil repellency. The silicone finish may enhance the attraction of hydrophobic dirt.

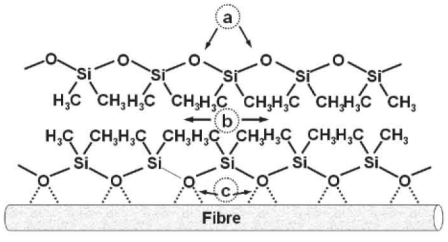


Figure 7 Silicone double layers on fibre,
a) Polar surface,
b) Hydrophobic attraction of the methyl groups,
c) Hydrogen bonds to polar fibre surface

However, while silicone finishing is considered only for enhancing the fabric handle, the hydrophobic property imparted as a result of silicone finishing becomes a problem rather than to be an advantage. Attempts have been thus made to enhance the hydrophilicity of the silicone treated fabrics. Okada et al. have grafted acrylamide over the silicone treated surface in order to render it a hydrophilic property. The authors have first treated with corona discharge in air to introduce peroxides onto the surface. These peroxides were further used to graft the acrylamide. Likewise there are many attempts made to enhance the hydrophilicity of the silicone treated textiles. However, Americos with its special R&D efforts have discovered special silicone softeners which not only enhance fabric handle properties but also preserve the hydrophilicity. Americos SF 1402 and Amerisoft Sil HL-40 AS are the two special hydrophilic silicone softeners that are currently in the market. They impart very good hydrophilicity, durable softness and excellent shear stability. They are also compatible with cationic and nonionic softeners and are stable with resin applications.

SILICONES CONTAINING AMIDE GROUPS: NON-YELLOWING

One limitation with the aminofunctional silicone is that the amino group which is responsible for many unique properties also results in a propensity to yellowing, particularly during curing or drying, and the likelihood of yellowing increases with increasing amino content. Therefore, silicones containing not an amino group but an amide group (Figure 8) were developed. The benefits of these softeners are that they are essentially non-yellowing, and that the handle is very dry when compared to even the low-amine aminosilicones.

Silicone Finishing: Softer than a Soft Touch

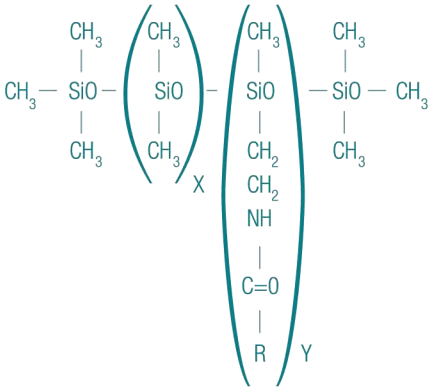


Figure 8 Silicone softener containing amide group

When low-yellowing silicone softeners are needed, amino fluids with low amine number are generally preferred. They tend to be used for white goods and pale shades. The higher the amine number of the aminoethyl-aminopropyl fluid, the more yellowing can be expected. One corollary of this is that the hand becomes softer. Americos Silsoft 1140 and Americos Silkytop are some of the prominent silicone softeners of which Americos Silkytop is a blend of cationic and silicone softener. It has especially non-yellowing character and it can be used for cotton, polyester and their blends. It imparts cotton garment excellent supple, soft and brilliant look. It does not affect dye fastness rather it increases the shade depth.

CONCLUSION

Silicone finishing is becoming increasingly important in textiles as it imparts a very unique soft handle with supple, pliant, sleek and fluffy effect. It also enhances smoothness, flexibility, drape and pliability of the fabric greatly. Manipulation of the basic silicone chemistry has resulted in multifunctional finishes that not only impart the unique soft hand of silicone but also the other essential properties such as crease resistance, wrinkle resistance, leather soft effect, durability, etc. Silicone nanoemulsions, as it shows improved penetrability into the textile structures produces favorable unusual soft hand and other properties that are obtained with micro and macro emulsions. Americos has particularly shown its excellence in producing the silicone nanoemulsions and special silicone softeners for multifunctional finishes with its state-of-the-art manufacturing technology.

FAQs

WHO INVENTED SILICONES?

In the 19th century pioneering chemists discovered how to gain silicon from sand. Silicon is the basis for silicones. Between 1904 and 1940 Professor F S Kipping was the first to achieve extensive synthesis of silicone compounds and coined the name 'silicone' in recognition of similarities with the chemistry of carbon. His work was built on by James Franklin Hyde, who achieved the essential chemical synthesis that opened the way to commercial use of silicones.

WHAT ARE SILICONES?

Silicones are high performance polymers that can take a variety of physical forms, ranging from solids to water-thin liquids and semi-viscous pastes, greases and oils. They are noted for their ability to function in conditions that would literally destroy conventional material.

Silicones display a host of unique properties that can lubricate, seal, bond, release, defoam and encapsulate. They can even insulate, waterproof and coat. They conduct electricity. They won't crack, peel, dry out, crumble or harden, rot or become brittle with age.

> Sand: silicon origin

> Liquid silicon

WHAT ARE SILANES?

Silanes are a group of speciality products, based on silicon and closely related to silicones. Like silicones, silanes have a wide range of applications in products essential to contemporary living.

WHAT IS THE DIFFERENCE BETWEEN SILICON AND SILICONE?

Silicon is the chemical element that is the basis for most inorganic substances. It is present in enormous quantities and indeed makes up 26% of the Earth's crust. However, under natural conditions it very rarely occurs on its own but combined with oxygen - for which it has a strong affinity. The most visible form of silicon compounds are quartz and silica or common sand.

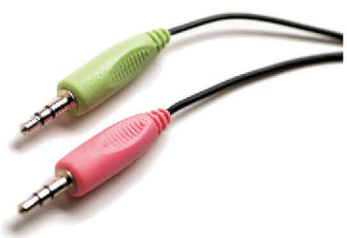
Silicones are obtained by structurally modifying silicon through the addition of carbon molecules. In this way, silicones are metalloids.

ARE SILICONES RELEVANT TO SUSTAINABLE GROWTH?

Silicones play an extremely important role in sustainable growth because their pivotal role is enhancing performance. Silicones are specialty products that give important characteristics to other materials. For example, to make them stay flexible or rigid, last longer, spread better, withstand extremes of temperature or electricity etc. These are qualities that reduce resource consumption while making life more interesting, safer, and more comfortable.

WHERE ARE SILANES USED?

Silanes are essential raw materials in the electronics and telecommunications industries where they are used to produce optical fibres and silicon wafers and chips. Some of their many other uses include silanes, paints, pigments, wires and cables, textiles, and adhesion promoters in glues.



Americos Industries Mind

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