Sarex

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Saraquest

Exclusive Insight

Chemistry behind good feelings

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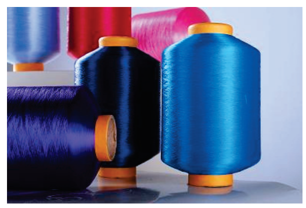
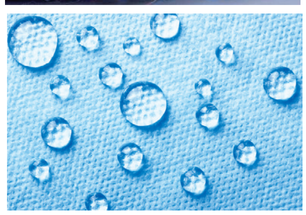
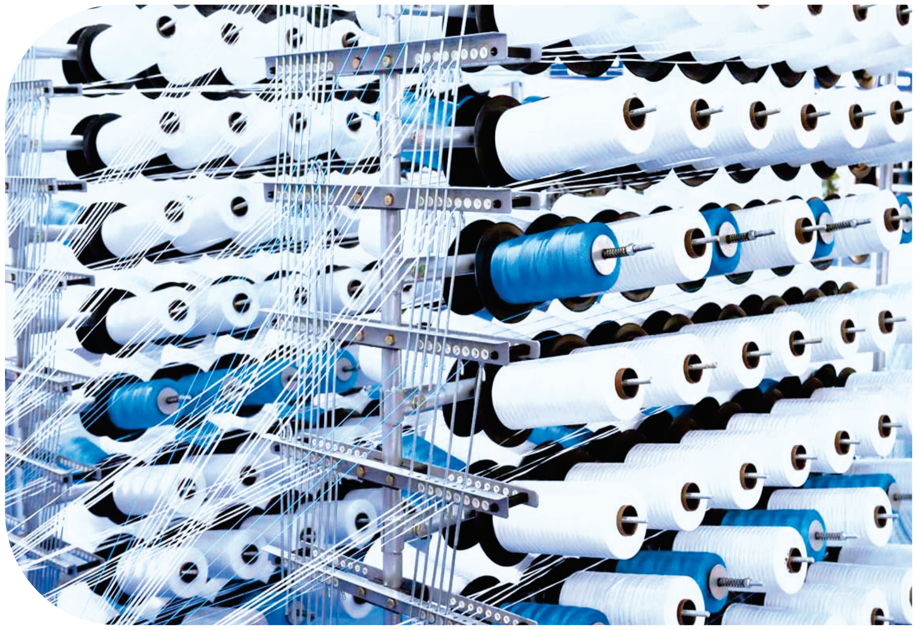




Levelling cum Dispersing Agent for Polyester Dyeing



Saragen-DLN

Before the First World War, almost all dyes were applied from aqueous dyebath to substrates such as cotton, wool, silk and other natural fibres. However, the introduction of a man-made fibre, cellulose acetate, with its inherent hydrophobic nature, created a situation where very few of the available dyes had affinity for the new fibre . Disperse dye were invented to dye the first hydrophobic fibre. The development of disperse dyes for dyeing secondary cellulose acetate fibres in the early 1920s was a major technological breakthrough although their major use today is for the coloration of the most important group of synthetic fibres, polyesters .

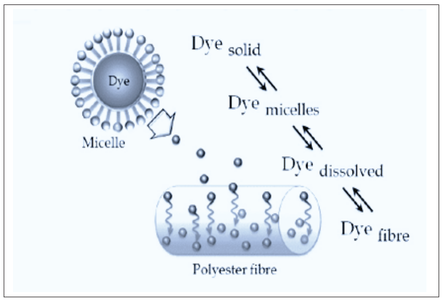
Disperse dyes have extremely low water solubility and to be applied from this aquous medium they must be (i) dispersed in water using a dispersing agent and (ii) milled to a very low particle size (1-3 microns). These non ionic hydrophobic dyes then can be used on acetate, triacetate, polyester fibres and their mechanism of fixation involves solid-solid solution formation. A fine dispersion is essential for rapid dyeing and avoids deposition of larger dye particles on the substrate.

Dispersing Agent

Disperse dyes are substantially water-insoluble dyes which have substantivity for one or more hydrophobic fibres and are usually applied as a fine aqueous dispersion. These dyes are milled or grounded with a dispersing agent (e.g. polymeric forms of sodium dinapthylmethane sulphonates) to a fine dispersion (0.5-2micro m) so that they can be supplied as grains, powders or liquid dispersions. Dispersions stability is of prime importance in exhaust dyeing since failure of the dispersion will result in agglomeration and possibly precipitation of the dye which in turn will result in unlevel dyeing and dye gets deposited in machine. The property to dispersion failure is greatest in the case of HT dyeing hence additional dispersing agents are added to the dyebath which prevents agglomeration and crystallization of the dye and maintains dispersion stability.

Basic principle

The inclusion of dispersing agent in the dyebath is a crucial factor in the application of disperses dyes. Once such a compound is added to water, its dual character results in the formation of micelle above critical, but low, concentration. The hydrophobic tails of the dispersing agent molecules are inside the micelle which, as a consequence, is able to solubilise the disperse dye molecules, so conferring a higher apparent solubility on the dye. The dye transfer to the fibre from the micelles. As micelles empty their dye, they re-form and dissolve more dye from the solid particles.



Anionic products such as sulphonic acid salts of naphthalene/formaldehyde condensates and lignin sulphonates are used widely as dispersing agents. The hydrophobic group of the dispersant is adsorbed onto the surfaces of disperse dye particles. The sulphonate groups are solvated by the water with the formation of electrical double layer. Mutual repulsion of the negatively charged dye particles inhibits breakdown of the dispersion.

Levelling agents

Dyeing is a critical operation and to produce fabrics with uniform and consistent shades is always a big challenge for the dye house. Even a modern process house equipped with the latest machinery and systems, face the problem of shade variation in the same lot or in between different lots of the same fabric due to innumerable variables such as fibre substrates, machinery, dyes, auxiliaries, procedures and the skill of the work force. Selection of dyes and chemicals is as important as machinery used in dyeing.

The levelling characteristics of a dye while dyeing a substrate is generally governed by

- The exhaustion behavior during initial period of dyeing and
- Migration of dye.

A dye depending on its chemical structure transfers very slowly in the fibre, tends to dye the fibre uniformly whereas the dyes which go rapidly into the fibre are more likely to dye unevenly. If A dye has good migration properties, the unevenness caused during initial phase gets levelled out rapidly under dyeing conditions and a level dyeing is obtained. In other words, the levelling capacity of a dye is its ability to even out variations by the dye distribution in the substrate. In actual practice, the requirements of dyes with matching compatibility, penetration properties and adequate automation with minimum supervision cannot be met by all the processing units and hence a range of levelling agents for different dye-fibre systems have been developed by the textile auxiliary manufacturers to meet the quality requirement.

The primary objectives of using levelling agent in polyester dyeing:

- To obtain level shades.
- To obtain uniform depth and tone of the shade.
- To achieve optimum colour value.

The levelling capacity depends very much on the characteristics of the substrate and dye. The levelness increases with the increase in temperature, time of dyeing, type and quantity of levelling agent. The selection of levelling agent will depend on the fibre substrate, class of dyes, type of equipment and the conditions of dyeing used.

Although the dispersing agents are known to improve certain extent levelling of disperse dyes on polyester fibres, under HT dyeing conditions, during exhaust dyeing usually expedite by the addition of specific levelling agents, which can be non-ionic or anionic surfactants or an anionic/non-ionic surfactant blend.

Dyeing levelness depends on the rate at which the dye is taken up by the fiber and the extent of migration at the maximum dyeing temperature. Hence, there are two fundamental mechanisms that can contribute to a level dyeing ;

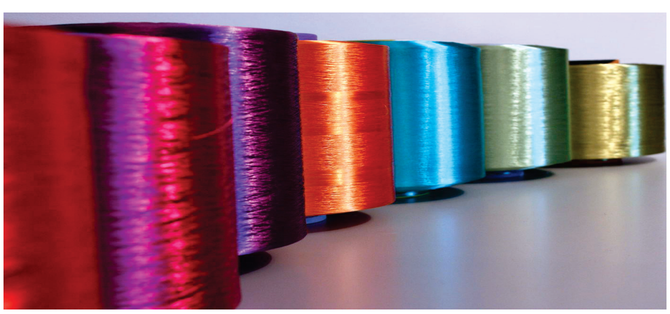
(I) Control of rate of exhaustion of the dye so that it is taken evenly and slowly.

(ii) Migration of the dye after initial uneven sorption on the fiber.

Many nonionic agents appear to act by reducing the rate of the dye exhaustion, with little effect on migration properties. However, non ionic levelling agents can have adverse effects on dispersion stability. These compounds increase the solubility of the dye thereby lowering the initial strike rate and overall rate of dye uptake which can also cause a retarding effect that result in a loss of colour yield. The solubility of these products decreases with increasing temperature; the temperature at which they become insoluble is known as the cloud point. If the cloud point of an added nonionic agent is below the dyebath temperature the dye dispersion breaks down resulting into the formation of precipitation and aggregation and ultimately resulting in a sticky colored deposit on the substrate being dyed.

Careful consideration must be given to the type and amount of non-ionic levelling agent used owing to the often marked retarding effect exerted by these compounds on dye uptake. Anionic levelling agents, typically polycondensate dispersing agents, exhibit little if any retarding effect on dye uptake but can induce dye migration and functions by increasing the solubility of the dye hence retarding dye uptake.

In complex formation the principle of levelling is usually the same, irrespective of whether non ionic or ionic agents are used, although the mode of complex formation is



different. As the temperature of the dye bath increases, the complex gradually breaks down, progressively releasing dye for more gradual sorption by the fiber.

Based on above concept, **Sarex** has developed innovative levelling cum dispersing agent **Saragen DLN** for polyester dyeing. **Saragen-DLN** is recommended to control the rate of dye uptake under adverse conditions of dyeing to obtain level and uniform dyeing.

Key Feature of Saragen DLN

- Saragen-DLN can work as dispersing and levelling agent.
- Saragen-DLN effectively ensures gradual exhaustion of dyebaths.
- Saragen-DLN does not affect shade .
- It improves migration of disperse dyes so level dyeing can be achieved.

Application:
In Exhaust dyeing of polyester tops, yarn, fibre & fabrics set the bath with

0.5 - 1.0 g/l Saragen-DLN

Circulate at 60^{0}C for 5-10 min., add dyestuff dispersion. Adjust pH to 4.5 - 5.5. Start Dyeing.

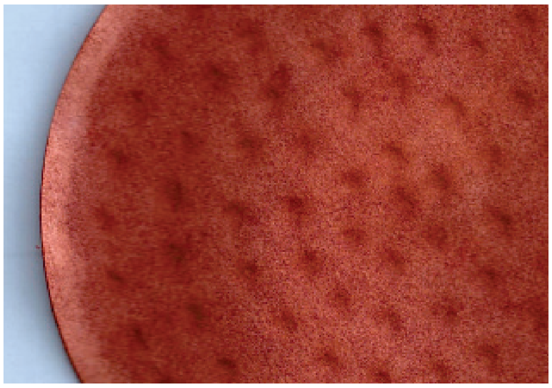
For correction of faulty dyeing
0.5 - 1.0 g/l Saragen-DLN

Adjust pH to 4.5 - 5.5
Treat at 130 ^{0}C for 40-60 min.

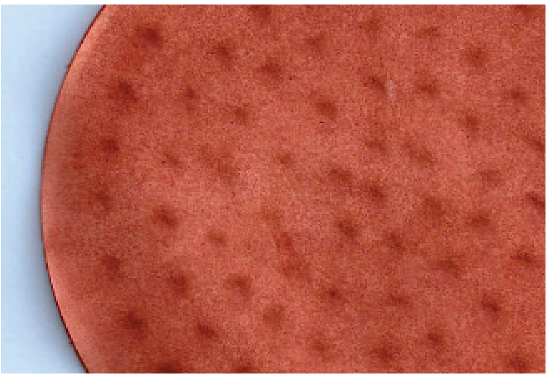
PERFORMANCE OF SARAGEN-DLN

a) Dispersion Behavior of Saragen-DLN

2 gm Disperse brown 3RD is added to hard water (250 ppm CaCl2) at 50^{0}C. Temperature raised to 70^{0}C under constant stirring and filtered under vacuum using whatmann filter paper no 2 and 4.



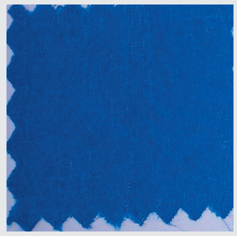
Without Saragen-DLN



With 1 g/l Saragen-DLN

b) Migration Behavior of Saragen-DLN

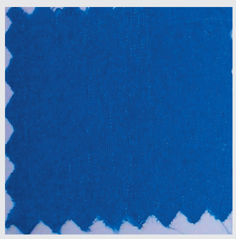
1g Blue SR dyed (2% shade) PES fabric is Attached with equal weight of undyed polyester fabric and treated with and without levelling agent at 130 °C /30min. The depth difference between dyed and undyed fabrics are compared



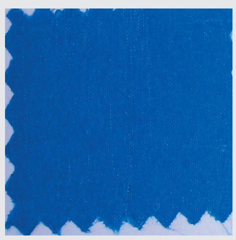
Original Dyed fabric

Migration of Dye on Undyed Fabric

Dyed Fabric	Undyed Fabric



Without Saragen-DLN



With 1 g/l Saragen-DLN

Result:
1 g/l Saragen-DLN shows 36%migration of dyes on undyed fabric from dyed fabric which indicates Saragen -DLN has good migration property.

Water & Oil Repellent for Synthetic Fabric

Newguard-AC

Fluor chemical finishes (also termed fluorocarbon finishes) were first applied to textiles in the 1960s and their growth, particularly during the 1990s, has been greatly stimulated by the consumer demands for easy-care properties such as water and oil repellency, stain repellency, and soil and stain-release properties. Unlike silicone and wax based finishes, which confer water repellency but not oil repellency on textile fibre and fabric surfaces, fluorochemical finishes can combine outstanding water repellency with oil repellency. This provides a level of protection to textile fibre surfaces against both aqueous and oily liquids, which confers upon fluorochemical-treated textiles both stain and soil repellent properties.

Fluorochemicals (fluorocarbons) are a class of synthetically produced organic chemicals that contain a perfluoroalkyl residue in which all the hydrogen atoms have been replaced by fluorine. Fluorochemicals exhibit outstanding chemical and thermal stability, low reactivity through their incompatibility with water and oil, and considerable reduction in surface tension. It is this latter property which is of particular importance in the context of water- and oil-repellency, while their chemical and thermal stability contribute towards the durability of the surface finish to fabric care treatments such as laundering, dry cleaning and tumble-drying.

Mechanism of water and oil repellent

Before going into the processing, it is important to understand the mechanism of water and oil repellency. Let us consider a liquid put on a solid:

Fig. 1

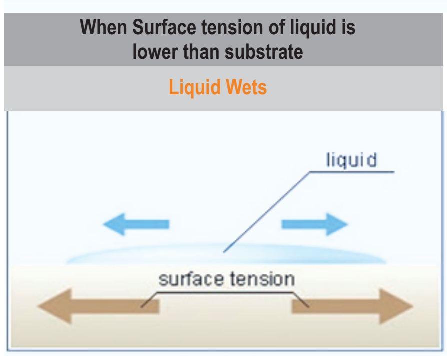


Fig. 2

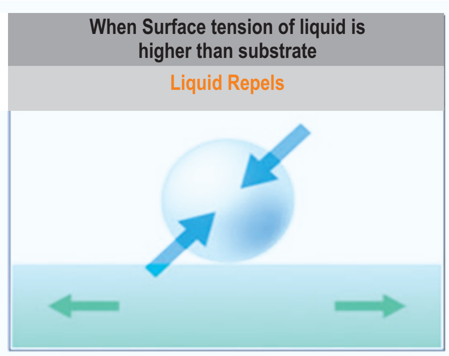


Fig. 3

In the above case the dimensions of surface tensions determine whether the liquid will or will not wet the solid.

If the critical surface tension of solid is greater than or equal to the surface tension of liquid, the liquid will wet the fabric. (Fig.2)

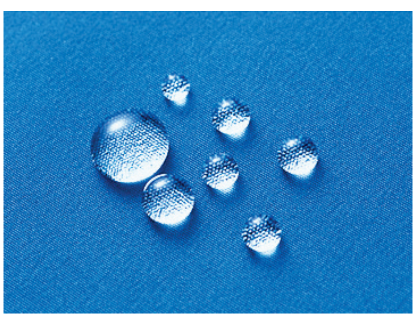
If the critical surface tension of the solid is less than surface tension of the liquid, the fabric will repel the liquid. (Fig.3) (In case of solids 'Critical surface tension' is used instead of 'surface tension')
Thus water repellency can be obtained in case the critical surface tension of solid is smaller than surface tension of liquid.

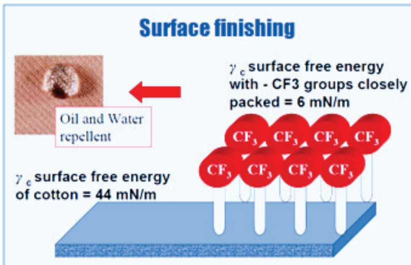
Finishing fabrics with paraffin wax, silicones or fluorochemicals results in significant lowering of the surface tension of the treated substrate such that they are able to repel water . However with the first two products oil repellency was not achieved. Since the surface tension of Fluorocarbon water repellent agent is extremely small of (10 dynes/cm) high levels of both water as well as oil repellency could be achieved. The addition of crosslinking agents along with the fluorocarbon improved the durability of water and oil repellency.

Fluorochemical structure in relation to performance

The chemical structure of a fluorochemical is based upon a polyacrylate/polyurethane backbone .The perfluorinated side-chains of the polyacrylate are oriented away from the fibre surface towards the air and hence the $–CF_3$ terminal groups form a low-energy repellent surface. For physical reasons the optimum orientation only takes place if the length of the perfluorinated side-chain is at least seven atoms. This maximizes the $–CF_3$ group density projecting away from the fibre surface.

The effect of the fluorochemical chain length upon the critical surface tension (γC) is illustrated in Fig. 4. It can be clearly seen that the critical surface tension decreases fairly rapidly as the chain length (*n*) increases from 1 to 8, after which little further decrease in critical surface tension is noted.





As the critical surface tension of the fluorochemical film on the fibre surface is decreased, the water and oil repellency rise, reaching their maximum protective value around a chain length of *n* = 9.

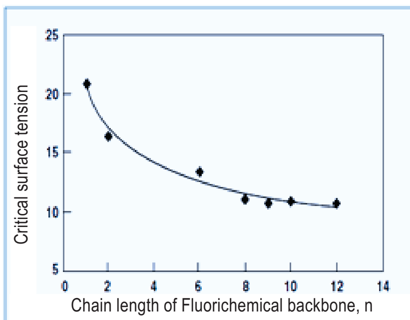


Fig. 4

This improvement in repellency performance is illustrated in Table 1 in which the oil-repellency (as measured according to AATCC Test Method 118) rises from 0 with a $–CF_3$ perfluorinated chain length from CF_3 to C_9F_{19} (that is, $–(CF_2)_8–CF_3$) gradually enhances the oil-repellency and, to a lesser extent, the water-repellency.

Application of Fluorocarbon finishes

In accordance with good practice in water & oil finishing, fabrics should be clean and free from other processing agents. Problems can arise from the following:

- Silicone-containing defoamers must be avoided because they normally impair the oil repellency performance;
- A typical fabric pH of 5–7 is desirable – any residual alkali may destabilise the fluorochemical dispersion and/or may impair the curing of applied cross linking agents;
- Presence of residual surfactants, which exert a rewetting action, can increase the interfacial tension and also decrease both the rating of the hydrophobic properties and the bath stability;

Perfluorinated groups	Measurements of oil-repellency (AATCC-118)	Spray Rating AATCC-22
$-Cf_3$	0	50
$-CF_2-CF_3$	3-4	70
$-(CF_2)_2-CF_3$	6-7	70
$-(CF_2)_4-CF_3$	7-8	70
$-(CF_2)_6-CF_3$	7-8	90
$-(CF_2)_8-CF_3$	8	100

Table 1 - Effect of fluorocarbon Chian on Oil & Water Repellency

We at **Sarex** developed is a non-flammable durable fluorocarbon **Newgurad-AC** for all types of substrate specially for acrylics and synthetic fabrics.

Newguard-AC
imparts very high oil repellency along with water repellency. It does not lead to harsh feel.

Key feature of Newguard-AC

- Newguard-AC imparts highly durable water & oil repellent finishes on textile.
- Suitable for acrylics and synthetic fabrics.
- It does not impair the hand feel and shade of fabric.
- Newguard-AC can be applied by padding and coating technique.
- Newguard-AC does not show roller build up property.

Application :

New guard-AC : 12-40 g/l
IPA : 5 g/l
Acetic Acid : 1 g/l

pH 4-4.5 ,
Padding Expression : 65-70 %
Drying : 100-120 ^{0}C
Curing : 170 ^{0}C

RESULTS:

Recipe	**Spray Rating**		**Oil Ratiing**	
	Initial	**After 10 Wash**	**Initial**	**After 10 Wash**
100 % Acrylic				
30 g/l Newguard-AC + 5 g/l IPA + 1g/l Acetic acid	100	80	6	5
100 % Polyester				
30 g/l Newguard-AC + 5 g/l IPA + 1g/l Acetic acid	100	100	5	4
Polyester / Viscose & Polyester / Cotton Blend				
30 g/l Newguard-AC + 5 g/l IPA + 1g/l Acetic acid	90	80	5	4

Note
Application concentration will vary from substrate and preliminary trials are recommended to determine optimum results levels however recipe given in table should provide a suitable starting point.

Test Method - Water Repellency : AATCC 22 & M&S P23
Oil Repellency : AATCC 118 & M&S C 50

The relative advantages and disadvantages of water-repellent finishes based upon paraffin waxes, silicones and fluorochemicals are compared in Table 2.

	Advantages	**Disadvantages**
Parafin Waxes	Good water Repellency Resistant to water pressure Low price	Little breathability No oil-repellency Not durable
Silicones	Good Water-repellency Water-vapour-permeable Soft Handle Good price/performance ratio	No oil Repellency No soil-repellency
Fluorocarbons	Good oil and water-repellency Resistant to washing and dry-cleaning Soil-repellency Good price/ performance ratio	High price

Hydrophillic Silicone Softener

Xtrasoft-832

Softeners have gained great importance in textile finishing industry. No textile leaves the production house without being treated with a softener. The softeners main purpose is to improve the aesthetic properties of textiles. Growth of silicones particularly in textiles has been enormous over the last few decades as it imparts the desired handle.

Functional textiles have to meet ever increasing consumer demands. A good towel should be both wonderfully soft and hydrophilic. The same applies to sports clothing textiles: the wearer expects a soft hand combined with optimal moisture management. Only textiles boasting both properties can satisfy today's increased demands for wearing comfort and end user requirements. Nowadays, no consumer will wear a garment which doesn't feel good because it scratches or rubs, even if it offers perfect moisture control.

Silicones have been responsible for giving super softness to fabrics over the years, and the quest to produce optimum handle for apparel fabrics with suitable comfort properties has presented a challenge. The chemistry of silicones for textile treatment is vast and the commonly used silicones in textiles are amino, amido, organo and epoxy functionalities. Depending upon the functionality in the polymer chain, they offer a wide range of properties, such as durable softness, sewability, lubricity, elasticity, hydrophobicity, hydrophilicity, wrinkle and stretch recovery.

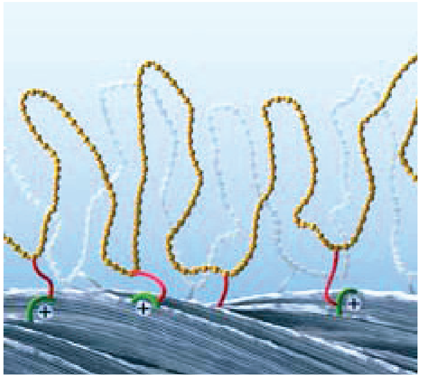
The addition of **Polydimethyl Siloxane (PDMS)** to fabric softener formulations dramatically improves the water absorbency of softened cotton fabric. This effect is true for ester – quat based softeners. The diverse property of the silicone can be changed by changing the R (reactive) group in the structure.

Amino modified silicones are used in textile industry as amino groups provide better affinity to textile fibers and for further reactivity, the end group of amino is modified by hydroxyl, methoxy or ethoxy group.
Amino silicones first have to be emulsified before they can be used in water-based textile finishing processes.

Amido silicones are highly effective softening agents imparting ease of ironing, water absorbency and low yellowing. They are more substantive to fabrics than poly dimethyl siloxanes.

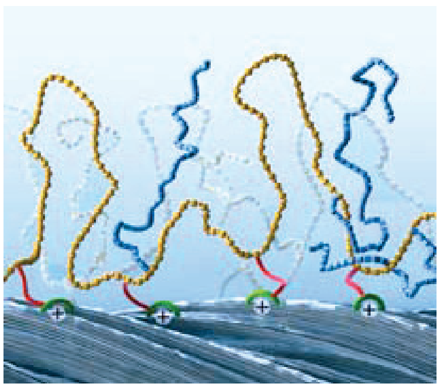
The trend in modern textile finishing is definitely towards softness and hydrophilicity. The silicone softeners typically impart an excellent soft hand with hydrophilicity.

Based on the above principle, **Sarex** has developed innovative hydrophilic softener, **Xtrasoft-832**, which imparts excellent inner and outer surface smoothness on the fabric.



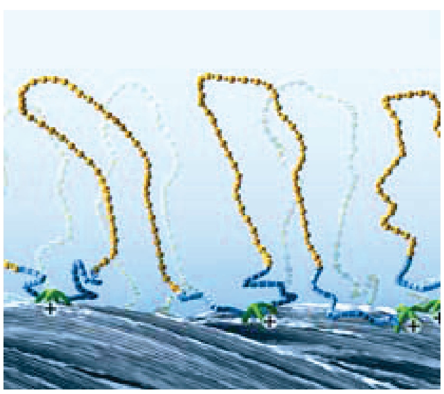
The silicone chains (yellow) completely shield the fiber surface. The anchoring groups (green) are attached to a spacer (red) > softness

SOFTNESS



The silicone chains (yellow) are supplemented by polyglycol side chains (blue), which form a hydrophilic layer on the fiber surface > hydrophilicity

HYDROPHILICITY



Hydrophilic polyglycol chains (blue) are attached via anchoring groups (green) directly to the fiber surface > hydrophilicity and softness

SOFTNESS
+
HYDROPHILICITY

Silicone chains in **Xtrasoft-832** possess silicone copolymer which firmly get anchored and gets distributed on entire fabric surface. Also, the polymer molecule is built-up in such a way that the hydrophilic chains end-up on the fibre surface. Thus silicone polymer forms hydrophilic layer directly on the fibre surface without diminishing the mobility of silicone chains and the softness of fabric. Moisture can be transported unhindered from the silicone finished fabric.

Key features of Xtrasoft-832

- Imparts inner softness and surface smoothness for all types of fabric
- Shear stable and hence suitable for jets, soft flow machines and garment washing machines
- Suitable for exhaust application as well as pad application.

Application:

Exhaust application

2-4% o.w.f. Xtrasoft-832
pH: 5.0 – 6.0. Temp. 35 - 40°C,
Treatment time: 20-30 mins.

Pad application

20-40 g/l Xtrasoft-832
pH: 5.0 – 6.0. Pick up: 65 – 70%,
Dry : 140-160°C

Sarex

Sarex Chemicals

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