Sarex

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Saraquest

Exclusive Insight

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Chemistry Behind Good Feelings

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Yuvi-cell - UV Protective Finish

Protection of skin against the action of solar radiation is relatively a new buzz in textile finishing. Textiles are second skin to humans which are wore to safeguard the skin from external agencies like wind, water, sunlight etc. Since all the textile substrates do not guarantee adequate protection, special finishes are required to enhance their properties. Ultraviolet radiations constitute a very low fraction in the solar spectrum but influence all living organisms and their metabolisms. These radiations can cause a range of effects from simple tanning to highly malignant skin cancers, if unprotected. UV protection textiles include technical textiles, various apparels, accessories, such as hats, shoes, and shade structures such as umbrellas.

Ever increasing demand in the marketplace for lightweight apparel that offers protection to human skin is increasing. Looking beyond the physical appearance and feel of the fabric, today's end user is demanding for various functionality in a garment or a textile material. Due to this, clothing manufacturers are also focusing their attention in imparting performance and functional finishes to the fabric which meets the requirement of the customer. These finishes help in enhancing the performance of the wearer. One such finish is UV protective finish which helps in protecting the skin from the harmful radiations emitted from the sun. Garment construction can also help to increase the protection from radiations by choosing suitable fibre and construction but that is not enough, so a chemical treatment is required to enhance the UV protection of fabrics.

Ozone layer in the atmosphere blocks the UV radiations emitted from the sun acting as a shield that prevents these radiations from falling on the earth's surface. But, due to the emission of greenhouse gases which has led to the depletion of ozone layer, allows these harmful radiations to fall on the earth's surface. Ultraviolet radiations accelerate the physical and chemical deterioration processes of the polymeric substances such as fading of colorants, yellowing of cellulosic's, photo-oxidation of polyolefin's, embrittlement of coatings etc. Photo-degradation is observed in almost every plastic material upon prolonged exposure to sunlight, thereby restricting their application for outdoor use. The degradation can be minimized by using UV stabilizers, which dissipate the energy acquired from these ultraviolet radiations in the harmless manner thus protecting the material and getting themselves destroyed in the process.

Clothing made from woven fabrics can provide convenient personal protection, however not all fabrics offer sufficient UV protection. Deep dyed fabrics show excellent protection from UV radiation. Sun protection involves a combination of sun avoidance and the use of protective garments and accessories. Reducing the exposure time to sunlight, using sunscreens and protective clothes are the three ways of protection against the deleterious effects of UV radiation.

UV radiation degrades the textile materials due to excitations in some parts of the polymer molecule. Much depends on the type of fibre and its chemical structure.

Due to large surface area available, textile fabrics are more susceptible to attack by UV radiation. Natural fibres viz., cotton, silk, and wool have lower degree of Ultraviolet Protection Factor (UPF) absorption than synthetic fibres. Cotton fabric in grey state provides a higher UPF because of natural pigments, pectins and waxes. Dyed cotton fabrics exhibit higher UPF and undyed bleached cotton yields very poor UPF. UV radiation attacks polyamides the most by photo oxidation. The fabric looses its strength and its crystalline structure. Polyester too gets affected by UV radiation to the tune of 45-50% after 30 days of exposure. Polyester fibres absorb more in the UVA and UVB regions than aliphatic polyamide fibres. Bleached silk and bleached Poly Acrylonitrile show very low UPF of 9.4 and 3.9 respectively. UV protective finish are very integral for outdoor wear, active wear, parasols, beachwear, work wear etc.

Work Wear

Parasols

Active wear

Beach wear

Solution from Sarex:

Understanding the requirement of today's generation and the exigency for protection against harmful UV radiations to the end users, Sarex has developed an Ultraviolet protecting agent **Yuvi-Cell** for cellulosic substrates which give very good Sun Protection Factor (SPF). Cellulosic substrates treated with Yuvi-Cell exhibits excellent ultraviolet absorbing properties which are also durable to home launderings. It can be applied on dyed fabrics with minimum shade change.

Application of Yuvi-Cell on various cotton substrates:

Various quality of cotton fabrics were taken and padded with 70gpl Yuvi-Cell, adjusting the pick-up to 65-70% and maintaining the bath pH in the range from 5.0-6.0. These fabrics were further dried at 130-160°C.

Ultraviolet protecting factor testing:

The UPF values of the unfinished and finished fabrics were measured using a Shimadzu UV-2600 series in the range of 280 to 400 nm, Model UV- 2600 (A11665101436). The UPF values of each fabric were determined from the total spectral transmittance based on AS/NZS 4399:1996 method. UPF was calculated using mean percentage transmission in the UVA region (315 to 400 nm) and mean percentage transmission in the UVB region (280 to 315 nm). The fabric is rated according to UPF. UPF is like SPF, except UPF rates protection against both UVA and UVB. Technical textile with a UPF of 50, allows only 1/50th of the UV radiation falling on the surface of the substrate to pass through it. In other words, it blocks 98% of the UV radiation. Sun protection clothing is an easy and steadfast form of UV protection and so is becoming more and more fashionable.

Table 1: Grades and classification of UPF

UPF Rating	Protection Category	UV radiation Blocked
UPF 15 – 24	Good	93.3 – 95.9%
UPF 25 – 39	Very Good	96.0 – 97.4%
UPF 40 – 50+	Excellent	97.5 – 98+%

Results and Discussion:

Results in Table 2 show that the fabrics treated with Yuvi-Cell shows excellent UPF than the unfinished fabrics. This is due to strong absorption and blocking of UV rays in the near UV region. Organic products like benzotriazole, hydro benzophenone and phenyl triazine are primarily used for coating and padding processes in order to achieve broad protection against UV rays. The UV protection offered by a textile material is a synergistic influence of chemical characteristics, physico-chemical type of fibre, presence of UV absorbers, construction of fabric, thickness, porosity, extension of the fabric, moisture content of the fabrics, colour and the finishing given to the fabric.

Table 2: UPF rating of various finished and unfinished cotton fabrics

Sr. No.	Colour	Finished	UVA (315-400nm)	UVB (290-315nm)	UPF (290-400nm)
1	White	Unfinished	25.17	18.69	4.97
		Yuvi-Cell (70gpl)	5.02	2.05	48.71
2	Maroon	Unfinished	5.56	4.38	22.01
		Yuvi-Cell (70gpl)	1.75	1.12	87.61
3	Purple	Unfinished	6.22	2.94	28.78
		Yuvi-Cell (70gpl)	1.41	0.92	107.17
4	Blue	Unfinished	11.43	10.25	9.53
		Yuvi-Cell (70gpl)	2.99	2.09	51.26
5	Yellow	Unfinished	3.15	1.98	19.25
		Yuvi-Cell (70gpl)	2.26	1.61	59.28
6	Striped Shirting	Unfinished	12.28	8.36	11.56
		Yuvi-Cell (70gpl)	4.09	3.13	30.21

Fabric finished with Yuvi-Cell showed durability upto 15 Home Launderings.

To cope up with the current scenario and meet the requirement of the customers, which are ever increasing, such kind of finish can be very important. Today, human beings are more aware and concerned about health and the purpose of clothing has changed from basic need to enhance the performance. Recreational exposure accounts for most of the significant UV Radiation exposures of the population, and occupational exposure is also significant. This necessitates the development of stronger UV absorbers and thus Sarex has developed a UV protective agent i.e. Yuvi-Cell which can protect the wearer from the harmful UV radiations and also increase the life of the clothing.

Reduclear-NS - Reduction Clearing Agent with No Smell

Last few decades have seen significant growth in consumption of synthetic fibres globally. Consumers highly prefer characteristics such as durability, better stain resistance, softness, and elasticity in their fibre uses. Manufacturers ability to provide all such properties at lower costs is one of the key driving factors for the growth of the global synthetic fibre market. In addition, changing fashion trends are also expected to have perceptible effects on the global synthetic fibre market.

Among the synthetic fibres, polyester is the most important and widely used due to its high strength, dimensional stability, abrasion resistance, resiliency, as well as suitability for blending with natural fibres. According to Zion Research, the Polyester market was valued at USD 73.5 Billion in 2014 and should be worth USD 115.0 Billion by 2020. Polyester has also high chemical resistance, moth proofness and excellent Wash & Wear and permanent press characteristics. These unique properties make it the largest trade fibre in the synthetic fibre world. Polyester fabric when blended with cotton and wool, gives high quality fabric.

Dyeing of polyester is difficult due to the following factors:

1. High crystalinity
2. Hydrophobicity
3. Absence of chemically active group

Disperse dyes are the most important class of dye used in dyeing of polyester fibres and provide a wide range of hues with good build-up and fastness properties. Disperse dyes are non ionic in nature with low aqueous solubility at dyeing temperature. These dyes are applied in the form of an aqueous dispersion.

Different methods of Polyester dyeing are as below:

1. Carrier dyeing
2. High temperature high pressure dyeing
3. Thermo-fixation dyeing
4. Solvent dyeing system

Irrespective of method of dyeing of polyester with disperse dyes, unfixed disperse dyes remains on to the fibre surfaces after dyeing, which will considerably reduce wash fastness, sublimation fastness, dry cleaning fastness as well as dulling of the fabric shades. In order to remove unfixed disperse dye, conventional reduction clearing is carried out with caustic and hydrose (Sodium dithionite) at 70°C for 10-20 min. The treatment with caustic and hydrose is often sufficient to clear the fibre surfaces but the ease of removal varies from chromophore to chromophore of the dyestuff used in study .

Sodium dithionite has setback due to generation of sulphites and sulphates. High concentrations of sulphate increases TDS in effluent. It causes corrosion of the drainage system and has obnoxious odour.

In order to overcome these disadvantages of reduction clearing by caustic hydrosulphite, Sarex has developed a concentrated reduction clearing agent **Reduclear-NS** which works under acidic pH and is free from unpleasant smell or odour.

Unique features:

- Reduclear-NS is available in powder form with no odour.
- Works under acidic pH hence alkalifying the bath and fresh post-cleaning treatment is not require.
- Dyeing followed by reduction clearing in the same bath is possible.
- Saves time, energy, and water.
- Elimination of subsequent neutralisation helps in reduction of TDS in effluent.

Experimental

Disperse Dye	% Shade	
	Recipe-1: Navy Blue shade	Recipe-2: Maroon shade
C.I. Disperse Red 165	0.4 %	2.90 %
C.I. Disperse Orange 30	0.8 %	1.1 %
C.I. Disperse Blue 79:1	3.6 %	0.26 %

Dyeing of polyester was carried out with Recipe-1 and Recipe-2 by maintaining the dye bath pH of 4.0-4.5 at 130°C for 45 min. After the completion of dyeing, Reduction clearing (RC) was carried out by conventional method i.e. with 2g/l Caustic + 2g/l Hydrose and with 0.75g/l of Reduclear-NS.

Process flow diagram of dyeing of polyester followed by reduction clearing

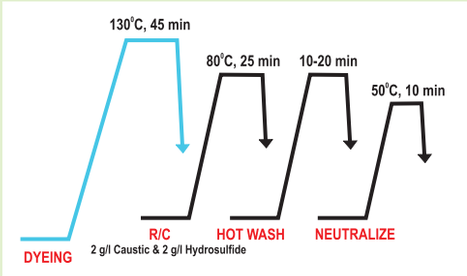
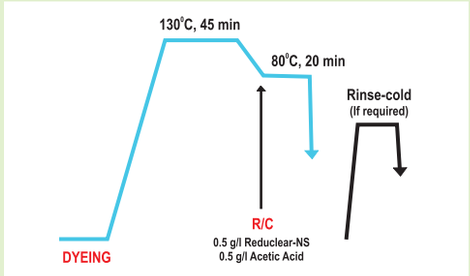
Conventional system	Reduclear-NS
RC with 2g/l Caustic + 2g/l Hydrose	RC with Reduclear-NS
	

Table 1: Colour strength and shade change values of maroon and navy dyed fabric

Fabrics	Colourant strength (%)	dE	Da	Db
Maroon shade				
Conventional (2g/l Caustic + 2g/l Hydrose)	100	–	–	–
0.75g/l Reduclear-NS	102	0.691	0.570	0.376
Navy blue shade				
Conventional (2g/l Caustic + 2g/l Hydrose)	100	–	–	–
0.75g/l Reduclear-NS	102	0.605	0.466	0.385

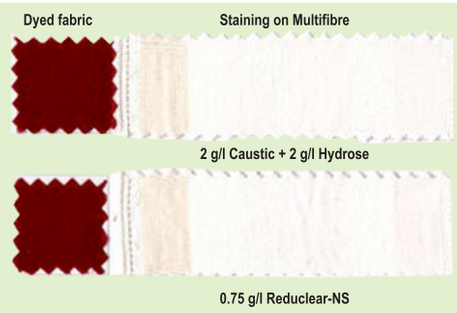
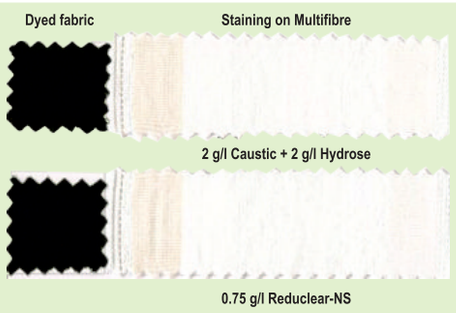
Table 2: Grey scale rating for colour staining

Fabrics	Wool	Acrylic	Polyester	Nylon	Cotton	Acetate
Maroon shade						
Conventional (2g/l Caustic + 2g/l Hydrose)	4	4 - 5	4 - 5	4	4 - 5	4 - 5
0.75g/l Reduclear-NS	4	4 - 5	4 - 5	4 - 5	4 - 5	4 - 5
Navy blue shade						
Conventional (2g/l Caustic + 2g/l Hydrose)	4	4 - 5	4 - 5	4 - 5	4 - 5	4 - 5
0.75g/l Reduclear-NS	4	4 - 5	4 - 5	4 - 5	4 - 5	4 - 5

Both the reduction cleared fabrics were subjected for fastness studies.

The washing fastness was performed by ISO 105 C06-C2S.

Table 3: Washing fastness - ISO 105 C06-C2S

Maroon shade	Navy blue shade
	

Nylolevel-606 (Conc) - Nylon Leveling Agents (Migration)

Polyamides refer to various natural (polypeptides) and synthetic materials containing free amino groups. Examples of polyamides include nylons, wool, and silk. Nylon fibre is commonly dyed with acid dyes which are anionic in character, including premetallized acid dyes, in a batch process referred to as exhaust dyeing. For example, nylon fibre which has been made into fabric may be dyed in a jet-dyeing machine, whereby a continuous loop of the fabric is circulated throughout the dye bath by impinging the dye bath liquor against the fabric in a venturi nozzle. Care must be taken during the dyeing process to obtain a uniform distribution of dye on the fabric, referred to as leveling.

Since acid dyes are negatively charged, the dyes are attracted to positive dye sites appearing in the targeted substrate. In general, acid dyes have a high affinity for protonated polyamide materials, meaning that the dyes have a strong tendency to quickly bind to the polymer. Unfortunately, however, once in contact with the cationic polymer surface, acid dyes have a tendency to poorly diffuse into the polyamide. In such cases leveling agents which works on migration principle works effectively.

Leveling agents or assistants are generally surface-active textile dyeing auxiliaries which have the task of (i) thoroughly wetting the fibre/ fibre blend to be dyed (ii) promoting penetration of the fibres and (iii) preventing too rapid uptake of the dyes, which can lead to unlevelness (spottiness) during the dyeing operation. Suitable leveling assistants include oleyl sulphonates, fatty alcohol sulphonates, fatty acid condensation products, alkyl and alkyl aryl poly glycol ethers and surface-active chemicals in general.

Unlevelness is caused by:

- High and varying affinity of the dye on the fibre.
- High and varying affinity of the fibre for the dye.
- Uneven distribution of the dye solution on the fabric / fibre.
- Temperature differences on the fabric or fibre.

Insufficient levelness can be prevented by means of suitable dyeing techniques and by means of leveling assistants.

Leveling assistants reduce mainly the rate of dyeing, increase the rate of dye migration within the fabric and improve the compatibility of the dyes.

Leveling assistants can exert two or more of the above mentioned effects at the same time. Leveling assistants can be divided into two groups, those which have an affinity for the fibre and those which have an affinity for the dye. Leveling assistants with an affinity for dyes form an addition compound with the dye whose stability is concentration dependent and normally decreases with increasing temperature.

The dye distribution equilibrium between the dye in solution and the dye in the fibre is therefore shifted to the dye in solution. The increased dye concentration in the dye solution makes it possible for regions of the fabric which were dyed in a non-level manner to level out as a result of dye migration.

Effective leveling assistants have an affinity for the dye that is sufficient to reduce the absorption rate or to speed the migration rate. Differences in the absorption behaviour of different dyes can likewise be levelled, so that the dyes in a dye mixture can go on at a uniform rate. Assistants with an affinity for dyes can also be used to level previously dyed materials. Assistants with an affinity for fibres go onto the fibre in competition with the dye. This competition reaction reduces the absorption rate and promotes the migration rate.

Important dye-affinity leveling agents for polyamides are nonionic surfactants, cationic compounds or ethoxylated compounds. Important fibre-affinity leveling agents for polyamides are cationic compounds.

In every dye house, levelness of the dyeing is a major criteria, since unleveled goods are usually not saleable, causing loss to the manufacturer.

Migration of applied dyes in a uniform manner throughout the dyed goods is called leveling and it may be a property of the dye or it may require some chemical assistance. Understanding the need, Sarex has developed a product **Nylolevel-606 (Conc)**, an excellent leveling agent for polyamide fabrics which works on dye migration principle.

Unique features:

- Leveling agent for polyamide fabrics.
- Excellent migration imparting level dyeing.
- Corrections of faulty dyeing.

Application:

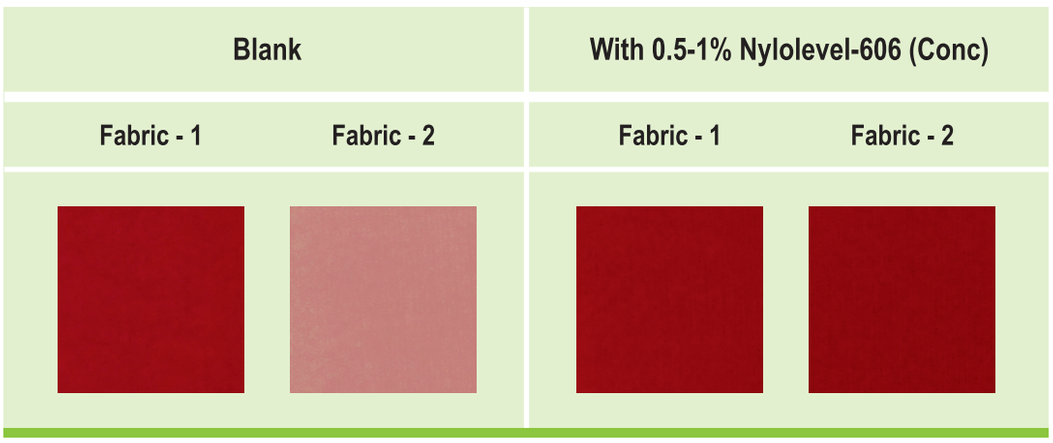
Exhaust:

Recommended dosage during dyeing of polyamide fabrics with Acid dyes.

Nylolevel-606 (Conc) : 0.5-1 %

Migration study:

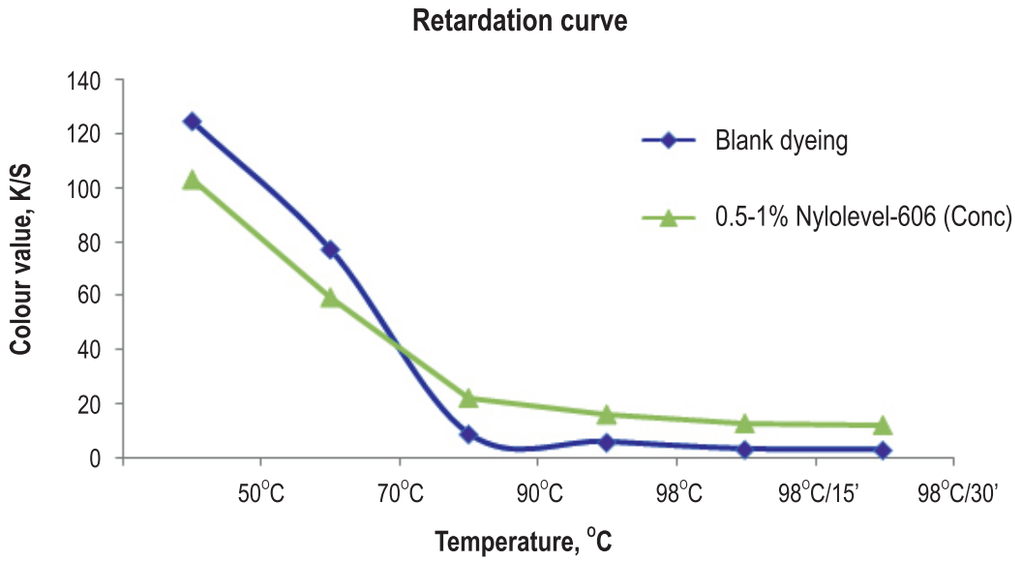
The efficiency of the product is evaluated by migration study. Polyamide fabric was initially dyed with 3.5% C.I. Acid Red 1. Dyed (Fabric-1) and Undyed (Fabric-2) polyamide fabrics were treated together with 0.5-1% Nylolevel-606 (Conc) at 98°C for 30 min. and the amount of dye migrated on the undyed fabric was evaluated. More the migration of dye on Fabric-2, better is the leveling property.



The above figure show excellent migration of dye on the fabric resulting into level dyeing.

Retardation study:

Dyeing of polyamide was carried out with 2% C.I. Acid Blue 83 at various temperatures i.e. 50°C, 70°C, 90°C, 98°C, 98°C, 15 min and 98°C, 30min. The quantity of dye remaining in the dyebath i.e. retardation property was evaluated by performing second dyeing in the exhausted bath at 130°C for 30-45 min.



From the graph (Retardation curve) it could be seen; In blank dyeing, maximum amount of dye has been rushed onto the fabric as it reaches near to the dyeing temperature i.e. 90°C. This rushing of dye causes unlevel and patchy dyeing. Addition of Nylolevel-606 (Conc) in the dye bath show clear retardation of the dye at this temperature which in turn results into level and uniform dyeing.

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