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Saraquest

Exclusive Insight

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**CHEMISTRY BEHIND
GOOD FEELINGS**



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TEXTILE CHEMICAL MANUFACTURING

“Customer Delight” is the key strategy of **Sarex Chemicals** as its main motto is to provide solutions to the customers rather than selling products.

Sarex Chemicals is a bluesign® system partner. Most of the products offered by Sarex are REACH Pre-Registered and more than 100 products are GOTS certified. Moreover, Sarex also has been accredited by :

- **ISO 17025 : 2017** (NABL Certified Laboratory)
- **ISO 45001 : 2018**
- **ISO 14001 : 2015**
- **ISO 9001 : 2015**





Reactive dyes are extensively used for the coloration of cellulosic fibres because of their excellent wash fastness which arises from covalent bond formation between dye and fibre. However, upto 40% of the dyestuff may hydrolyse in the dyeing process; this hydrolysed dye has affinity for the fibre via hydrogen bonding and Vander Waals interactions, however not covalently bonded and hence exhibits poor wash fastness. Accordingly, these reactive dyeing's require a multi-step wash-off process after dyeing, involving various aqueous rinses and washings in order for the dyeing to achieve the characteristic of very high wash fastness. Wash-off and subsequent effluent treatment can account for upto 50% of the total cost of reactive dyeing and consumes significant amounts of water and energy; from a sustainable chemistry and engineering perspective, consumption of water and energy are arguably the biggest issues in textile dyeing.

The textile industry in India is a gigantic industry and is gigantically polluting. The textile industry uses copious amounts of water and chemicals. Water is used at every stage in the fabric manufacturing process to dissolve chemicals to be used and then to wash and rinse out the same chemicals from the fabric. It takes large amount of chemicals to produce fabric. The production of one T-shirt (right from cultivation to disposal) consumes approximately 4000 Litres of water and huge amount of chemicals. The chemically infused effluent saturated with dyes, defoamers, detergents, bleaches, optical brighteners, softeners, stiffeners, and many other chemicals is often released into the local river, where it enters the groundwater, drinking water and gives adverse impacts on flora, fauna and our food chain. One should note the seriousness of this and try to understand that many of these chemicals remain on the fabric that gets absorbed through human skin during usage. The use of chemicals and dyes during the manufacture of textiles generates an enormous quantity of waste as sludge, fibres, and chemically polluted waters. As a consequence of such high quantities of solid and liquid waste, textile industries are now facing major problems in environmental pollution. Textile auxiliary manufacturers and textile processors are therefore constantly on the hunt for new technologies and for products that can reduce the number of wash cycles with superior fastness results.

With this background, Sarex have launched a product **Greenkol-95** under the category of sustainable products. Greenkol-95 is green chemistry based washing off agent for reactive dyed cellulosic's. It is a biodegradable product and offers tremendous scope in application. It reduces the load of COD, BOD and TDS in the effluent. It exhibits very good fastness properties which matches the conventional chemistry. It is highly economical and cost effective thereby reducing the operating cost.

● UNIQUE FEATURES

- Product based on Green chemistry hence complies with the eco norms.

- Product is readily biodegradable hence reduced COD, BOD and TDS load in the effluent stream.
- Since it is biodegradable it complies with the stringent eco norms.
- Excellent washing off agent for medium shades.

● APPLICATION

Reactive dyeing of cotton fabric was carried out with the below given percent shade.

Recipe No.	A	B
C.I. Reactive Red 152	5%	–
C.I. Reactive Blue 21	–	4%
Urea	5%	5%
Glauber Salt	60 g/l	60 g/l
Soda ash	20 g/l	20 g/l
Caustic	5 g/l	5 g/l
Water	Balance	Balance

Dyeing is carried out at 80°C for 15 min. keeping the MLR of 1:10. After adding 20 g/l soda ash, dyeing is further continued for 45 min. at 80°C followed by drain. After giving one cold wash and neutralisation with Acetic Acid, soaping is carried out with 1.5 g/l Greenkol-95 at 95°C for 15 min. followed by cold wash and then drying.

● EVALUATION METHODS




The efficacy of the product is evaluated by performing washing fastness of the soaped fabric. The washing fastness is performed by using standard test method ISO 105 C10.

● RESULTS

Washing fastness of the soaped fabric- ISO 105 C10 - C.I. Reactive Red 152

Staining on multi-fibre strip	Samples
	Blank
	1.5 g/l Conventional
	1.5 g/l Greenkol-95

Washing fastness of the soaped fabric- ISO 105 C10 - C.I. Reactive Blue 21

Staining on multi-fibre strip	Samples
	Blank
	1.5 g/l Conventional
	1.5 g/l Greenkol-95

From the washing fastness test results, it could be seen that the performance of Greenkol-95 is slightly better than Conventional washing off agent. Conventional reactive washing off agent may exhibit good results however their contribution in reducing the carbon footprint is always a question. Looking at the current situation and the need to adapt sustainability, Greenkol-95 comes to a rescue meeting the sustainability demands.



Denim garments washing is an effective technology for changing the style, outlook, and comfortability of garments as well as creating new fashion trends. Technologists are attempting to incorporate new styles and fashion on denim fabrics using renewable washing processes to satisfy the rapid transition in existing consumer demands. Denim garments can be washed in a variety of ways after being pre-treated. Stone Wash, Acid Wash, Rinse Wash, Enzyme Wash, and Bleach Wash are some of the most widely used wash types.

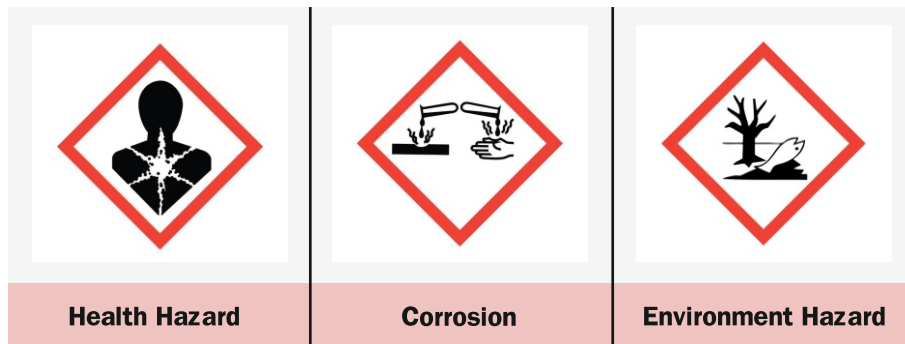
Denim Bleach or bleach wash is a process that can be used to decolorize the indigo from denim. In this process a strong oxidative bleaching agent such as sodium hypochlorite or KMnO_4 is added during the washing with or without pumice stone.

Bleaching with sodium hypochlorite is by far the most common bleaching process. This particular bleaching process is preferably used whenever a strong contrast between blue and white fibres is desired. This process is very cost-effective, however, a major disadvantage is that the AOX content, a measure of organic halogen compounds, often exceeds the permitted effluent pollution. Potassium permanganate is a very strong oxidative agent. It's a deep red-violet metallic shiny crystalline solid. It can be dissolved in water to form a dark violet solution which is well suitable to bleach denim. Potassium permanganate can be used for local bleaching by spraying application or for complete treatments in drum washing machines.

Potassium permanganate solution is sprayed on indigo denim garment to develop bright effect on sand blast area. The potassium permanganate spray appears pink on garment when it is fresh and turns to muddy brown on drying. The garment is hanged in open to dry after potassium permanganate spray and when the potassium permanganate turns its colours completely then it is considered to be ready for the next process. After reaching the desired bleaching effect, the rest of unconsumed potassium permanganate is converted into brown manganese oxide hydrate which has to be removed thoroughly.

Currently the most used neutralizing agents for potassium permanganate are hydroxylamine based sulfate products and sodium meta bisulphite. Exposure to pure sodium meta bisulphite can irritate the respiratory tract, causing asthma-like symptoms. Ingesting it may cause nausea, diarrhoea, and other gastrointestinal problems while contact with the skin can cause redness, pain, and itching. Sodium meta bisulphite can also cause permanent damage to the eyes after direct contact. Breathing Sodium Metabisulfite can irritate the nose, throat and lungs causing coughing, wheezing and/or shortness of breath. Future exposure can cause asthma attacks with shortness of breath, wheezing, cough, and/or chest tightness. Sodium Metabisulfite is a dot corrosive material.

Hydroxylamine based PP neutralizers were introduced in the garment finishing industry to replace sodium meta bisulphite which causes severe irritations to the workers however hydroxylamine based products were found to be even more hazardous and unsafe for use than sodium meta bisulphite based products. Hydroxylamine poses more dangers. It is classified as a dangerous good. With exposure to heat, hydroxylamine can explode, which causes shipping complications. In addition to causing irritation to the nose, throat and lungs, hydroxylamine is suspected of causing cancer and mutagenic effects.



To overcome the shortcomings of the current PP neutralizers, Sarex has developed a product, **Bio-PPN (Conc)**, which is a bio-based PP neutralizer product. Following mentioned are some of the key features of this product.

● **UNIQUE FEATURES**

- It is a Bio-based product and Biodegradable.
- It is Formaldehyde free and APEO free.
- Removes dirty brown stains of manganese oxide after potassium permanganate bleaching.
- Provides better contrast and brighter shades on garments.
- Requires single neutralizing step thereby minimizing water consumption and waste water load.

● **APPLICATION**





Depending upon quantity of residual chemicals at the end of Potassium permanganate treatment of garments, treat in fresh bath with:

Dosage : 2-3%
Bath pH : 4.5-5.5
Bath Temp. : 30-40°C
Time : 15-20 min.

Followed by Rinsing and Softening as usual.

Note: Concentration of Bio-PPN (Conc) may be optimized in lab before bulk trial.

● **PRODUCT PERFORMANCE DATA**

Desized Indigo Denim fabric	Sprayed with 5 g/l KMnO ₄	2% Conventional (Hydroxylamine based)	2% Bio-PPN (Conc) (Bio based)
			

From the results it could be seen that Bio-PPN (Conc) works effectively as a Potassium permanganate neutralizer and is comparable with the conventional product. Since it is bio based, it complies with the stringent eco norms. Bio-PPN (Conc) is the most ecologically advanced and sustainable neutralizing agent for potassium permanganate and chlorine that replaces the dangerous commodities of sodium metabisulfite and hydroxylamine.



Cellulose fibres and especially cotton is still the most important kind of fibre, because of its numerous advantages. One of the main disadvantage is the wrinkling after washing which is overcome by a very important and special kind of finish. Some of the words and phrases that have been used in the past includes easy care, minimum care, easy-to-iron, no-iron, wash and wear, crease-resistant, durable press, permanent press, shrink proof, wrinkle-resistant and wrinkle-free. Since the late 1980s, there has been a steady growth in demand for wrinkle-resistant, easy care 100% cotton garments. In the last few decades the interest of buyers of wrinkle-resistant apparel has forced textile finishers to use easy-care finishes. Easy-care and durable press finishes are generally applied to cellulose and cellulose blend fabrics, however other fibres can also benefit from these finishes. Durable press properties may be imparted by cross-linking hydroxyl groups in cotton's cellulose molecules with a resin molecule that has at least two appropriately spaced reactive groups, and is able to penetrate the fibre. If the fabric is cured whilst smooth and flat, it will return to that condition after washing and drying. This is because the covalent bonds created in cross-linking are not broken when the fabric is deformed, unlike the natural hydrogen bonds in cellulose, which break and then reform in the distorted position. Clearly, the covalent bond formed during cross-linking must be sufficiently hydrolytically stable to maintain the wrinkle-resistant effect through multiple washing cycles.

Easy-care finishes such as formaldehyde-based resins, N-methylol compounds, etc. are widely used finishing agents in textile finishing to obtain wrinkle-resistant cotton and cotton/polyester blends. Formaldehyde (HCHO) is a suspected carcinogen and extensive study of its toxicology has led to the establishment of regulations and to the introduction of certain limits for free formaldehyde content in textile substrates and then to the introduction of formaldehyde-free finishes. Among them, polycarboxylic acids such as 1,2,3,4-butanetetracarboxylic acids and citric acids are the most promising chemicals. Urethane pre-polymers and di-isocyanates are employed as HCHO free, durable-press finishing agents for cotton, cellulosic fibres, and their blends with polyester. To enhance the flexibility, tensile strength and whiteness of the easy-care finished textiles, novel finishing agents have been recently considered; for example, ionic crosslinking, polyamino carboxylic acids and non-ionic polyurethanes, as well as employing nano-materials as the catalyst or co-catalyst. Governmental restrictions (e.g. European community, Japan), company requirements (e.g. Levi Strauss, Marks and Spencer) and several labels (e.g. Oeko-Tex Standard 100) sets limits for free formaldehyde in textiles, which should not be more than 75 mg/kg for fabrics directly in contact with skin and 300 mg/kg for the fabrics not touched directly by skin and for fabrics used in interior decoration.

The primary effects of easy-care and durable press finishes on cellulosic fabrics are reduction in swelling and shrinkage, improved wet and dry wrinkle recovery, smoothness of appearance after drying, and retention of intentional creases and pleats. This finish provides resistance against shrinkage during washing and improved wet and dry wrinkle recovery on

cellulosic textiles. Inhibition of easy movement of the cellulose chains by cross-linking with resins / polymers is the main mechanism of a durable press (DP) finish. Fabric shrinkage of less than 5% can usually be achieved.

Mechanism of Easy-care and Durable press finishing

The prime reason for the shrinkage of cellulosic fibres is the fact that these fibres can readily absorb moisture. This absorbed moisture facilitates internal polymer chain movements in the amorphous fibre areas by lubrication. It disrupts the internal hydrogen bonding between these polymer chains. When a moisture loaded cellulosic fibre is stressed, the internal polymer chains of the amorphous areas are free to move to relieve that stress. Hydrogen bonds can reform between the polymer chains in their shifted positions. With no restoring forces available, a newly formed wrinkle or crease will remain until additional processes (ironing for example) apply adequate moisture and mechanical forces to overcome the internal forces.

Formaldehyde is a suspected carcinogen and there remains a significant world-wide concern over the health impact of formaldehyde release during the finishing process, storage and customer use, since it is a potential human carcinogen. Consequently, there is an imperative demand to develop a formaldehyde free product with similar effectiveness to DMDHEU. Keeping this in mind, Sarex has developed a product, **Saralink-FF**, a formaldehyde free, easy care and durable press finishing agent. Following mentioned are some of the key features of this product.

● **UNIQUE FEATURES**

- Formaldehyde-free crosslinking agent.
- Meets Oekotex Standard 100 requirement.
- Good DP rating and good wet and dry crease recovery angle after multiple home launderings.
- Durable to washing and dry cleaning.

● **APPLICATION**

100% Cotton shirting fabric is padded with the given recipes with 70% expression followed by drying at 110°C for 2 min. and curing at 150°C for 4 min.

Recipe No.	Recipe-1	Recipe-2
Saralink-FF	100 g/l	–
DMDHEU based Resin	–	100 g/l
MgCl ₂	20 g/l	20 g/l
Sarawet-NF (wetting agent)	1 g/l	1 g/l
Sarasoft-MRM (Conc) (Softener)	10 g/l	10 g/l
Supernol-PE (PE emulsion)	25 g/l	25 g/l
Citric acid	–	0.3 g/l

● **EVALUATION METHODS**

The finished fabrics were subjected for following testing:

- AATCC-124 : Durable press (DP) rating as per AATCC-124 and
- AATCC-66 : Crease recovery angle as per AATCC-66
- AATCC-112 : Release formaldehyde by AATCC-112 (Sealed Jar method)
- ASTM D1424 : Tear strength as per ASTM D 1424

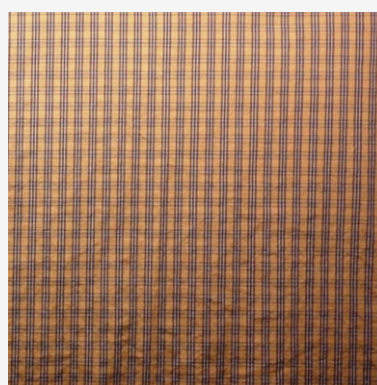
● PRODUCT PERFORMANCE DATA

Samples	DP rating	Release formaldehyde, ppm	Tear strength by ASTM D1424					Crease Recovery Angle (CRA)	
			Warp, Kgf	Weft, Kgf	Warp %	Weft %	Total %	Warp	Weft
Unfinished	2	21 ppm	1.408	1.106	-	-	-	55°	74°
100 g/l Saralink-FF	3.25	5 ppm	1.063	0.834	-25	-25	-25	76°	99°
100 g/l DMDHEU based Resin	3	62 ppm	0.513	0.343	-64	-69	-66	101°	100°

Durable Press Rating : SARALINK-FF

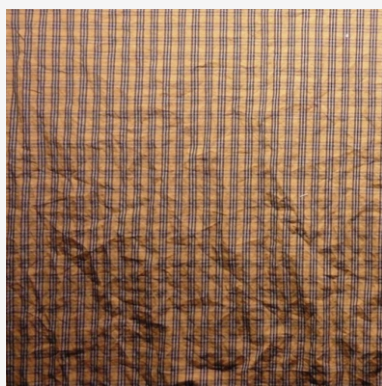


**Unfinished
Rating : 2**



**100 g/l Saralink-FF
Rating : 3.25**

Durable Press Rating : DMDHEU based Resin



**Unfinished
Rating : 2**



**100 g/l DMDHEU based Resin
Rating : 3**

From the results, it can be clearly seen that Saralink-FF performs efficiently as a formaldehyde free durable press finishing agent with the DP rating of 3+ and with good improvement in crease recovery and angle. Also the release formaldehyde content of the Saralink-FF finished fabric is within the permissible limits of brands and therefore fulfilling the company requirements.

C E R T I F I C A T I O N S



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