Sarex

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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**

SARAFLAM-**DUR**

SARAFLAM-DUR
Durable Flame Retardant
For Cellulosic's

In the 21st century, innovative fashion and technology have introduced smart and integrated wearable textiles that have multi-dimensional values in various sectors viz., sports, fashion, defense, healthcare & safety, industrial etc. They are not just alternatives to natural or synthetic fibres, but also provide superior functionality in broad and emerging sectors of the textile industry in comparison to normal ones. Flame retardant finish, one of the most appropriate functional properties of smart textiles, provides textiles with high-performance characteristics. Consequently, the field of flame retardancy has witnessed rigorous development in the area of new technologies, products and materials to meet the challenges and needs of the current era.

Human safety has become of paramount importance with the industrialization of the world, so a massive portion of industrial textile has been involved in developing protective clothing. Flame retardant fabric is an important protective clothing. Flame retardancy is an important characteristic of textile materials in order to protect consumers from unsafe apparels. Textile substrates, omnipresent in our day-to-day life are made-up of natural and synthetic polymeric units. These materials are being used in the formation of value added home appliances viz., apparel and typical indoor products which exhibit high flammability and combustibility. Flame retardant fabrics are usually used in industrial worker wears, uniforms for firefighters, military pilots suit, war-combat dress, tent fabric, parachute fabric, professional motor racing apparel etc. A flame retardant fabric protects the wearer against fires, and electrical arcs etc. Flame retardant clothing requirements range from situations where the wearer may be subject to moderate heat occasionally during his/her working period to protecting the wearer from severe heat to direct flame. Flame retardant finishes provide a protective effect to textile substrates against fire, which is the need of firefighters and emergency personnel.

Flame retardants (FR) are chemicals which are added to combustible materials such as textiles and plastics to render them resistant to fire. Flame retardants are the key components in reducing the devastating impact of fires on people, property and the environment.They are designed to minimize the risk of fire in case of contact with a small heat source such as cigarette, candle or an electrical fault. They are added to or treat potentially flammable materials, including textiles and plastics. If the material is ignited, the flame retardant will slow down the combustion and prevent fire from spreading to other items. They act by interfering at particular stages of burning viz., by acting on the polymer at the heating, decomposition or ignition stage or by acting on the flame spread. Flame retardants act both; by preventing the initial start of a fire or by impeding ignition and by delaying the spread of the fire. Flame retardants are thus necessary to ensure the fire safety of a wide range of materials including plastics, foam and fibre insulation materials, foams in furniture, floor coverings, upholstery and drapery, mattresses, wood products, and natural and man-made textiles.In this modern era, the presence

with flammable materials in our homes (curtains, carpets, decorations, plastics etc.), a typical room in a house can reach 600°C in 3 minutes. The flame retardant materials in consumer goods and furnishing help us to avoid the fires. Sometimes it adds few life-saving minutes to escape from danger. Flame retardants fabrics save lives and protect property by helping to prevent fires from starting and spreading.

Several types of compounds and polymers are used as FR for textile materials, including inorganic acids, acid salts and hydrates, organo phosphorous and organo bromine compounds, antimony salts/halogen systems etc. However the flame retardants are primarily classified as Durable and Non durable. Some chemical flame retardants may be non-durable and washed away after single laundering while some may be durable even after more than 50 laundering cycles.The most successful durable flame retardants for cellulose are based on phosphorus and nitrogen-containing chemical systems that can react with the fibre to form cross-linked structures on the fibre. One of the key ingredients of these finishes is Tetrakis (hydroxymethyl) phosphonium chloride (THPC) derivative. Non-durable flame retardants for cellulosic fibres are generally water soluble inorganic salts that are easily removed by water, rain or perspiration as they provide only temporary protection and therefore periodic reprocessing becomes necessary to maintain the flame retardant effect. Commercially important products are di-ammonium phosphate, ammonium sulfamate and ammonium bromide.

Since the Covid-19 pandemic hit the country,the rising prices of raw material including phosphonates have taken a toll on the textile industry. From engineering to textiles, manufacturing units across India are facing the brunt of a steep increase in raw material prices. Air and sea freight cost has also escalated manifolds because of this disruption. The shipping industry is experiencing a tight capacity market, which means there is strong freight demand, but a low supply of drivers and carriers. Ocean freight charges are soaring worldwide. The rates of raw material are constantly fluctuating which is creating big hurdle for exporters in quoting cost of the materials to buyer. The industry which is already under tremendous pressure due to Covid-19, cannot afford to ask buyers for an increased price as they will swiftly move towards other manufacturing destinations who can offer same products at lesser price. Under such circumstances, Sarex is offering a viable alternative **Saraflam-DUR** which is a Durable flame retardant for cellulosic's. Saraflam-DUR meets the demand of commercially successful flame retardant of meeting flammability requirement, having little or no adverse effect on textile physical properties, retaining the textile aesthetics and being durable to repeated home launderings.

UNIQUE FEATURES

- Saraflam-DUR is an organo phosphorous durable flame retardant for 100% cellulosic fibres such as cotton and re-generated cellulosic fibres like viscose, modal, tencel.
- It chemically reacts with these fibres thereby imparting durable flame retardancy which can withstand several home launderings and dry cleanings.
- It prevents flame propagation in presence of fire. It is recommended for home textiles, industrial textiles and apparels. The product has passed the NFPA-701, BS 3119, BS 5852 regulation tests.

APPLICATION PROCESS

100% Cotton fabrics were padded with the given recipe with 70% expression and dried at 105°C for 2 min and followed by curing at 165°C for 3 min. After finishing, the fabrics were washed with 20 g/l soda ash at 40°C for 20 min followed by cold wash and drying at room temperature.

Saraflam-DUR	: 400 - 600 g/l	Pick-up	: 70 - 80% (2 dip - 2 nip)
Saraprint AC	: 70 - 100 g/l	Drying	: 100 - 110°C
Phosphoric acid (80%)	: 20 - 25 g/l	Curing	: 150°C, 5 min.
Sarawet NF	: 2 - 5 g/l		
Saralube-2975	: 20 - 40 g/l		

SARAFLAM-**DUR**

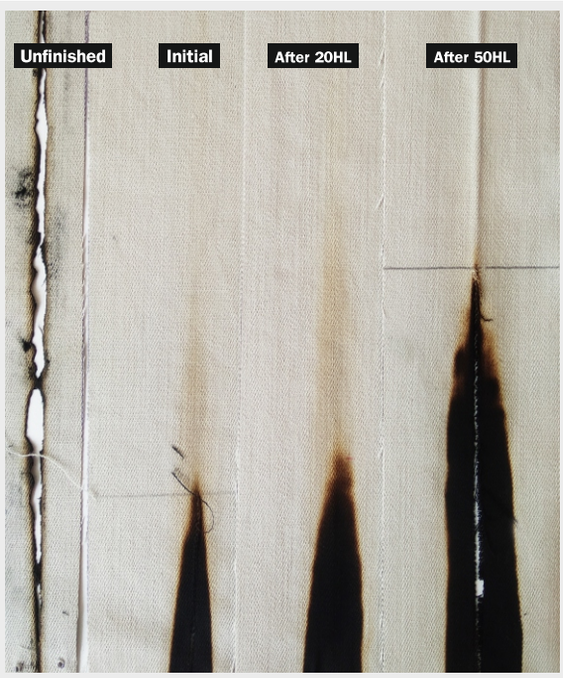
TEST METHODS

Finished fabrics were washed for 50 HL as per AATCC-135 & AATCC-61 2A (accelerated washing) where one wash is equal to five washes. The finished fabrics were evaluated for flame retardancy as per Vertical ASTM D 6413 test, an industry benchmark for flame retardancy. The Char length and After glow time were recorded.

RESULTS & DISCUSSION

Table - 1: Flame retardancy effect of Saraflam-DUR on 100% Cellulosic fabric (Cotton Bottom Weight)

Efficiency Of Saraflam-DUR on 100% Cotton fabric



Substrate : Cotton Bottom Weight Fabric
Dosage : 400 gpl
% Add on : 11.24%

	Char length, cm	After glow time, sec.
Initial	6.6	0
5 HL	5.3	0
10 HL	8.9	0
20 HL	7.7	0
50 HL	13.5	5 - 6

HL: Home Laundering

From the table it could be seen that 100% Cotton fabric treated 400 gpl Saraflam-DUR shows excellent flame retardancy with minimum char length and with “0” after glow time which indicates that Saraflam-DUR does not allow the flame to propagate after the ignition source is removed. Saraflam-DUR enhances the dehydration and char formation in the condensed phase and suppressing the formation of combustible volatiles in the thermal degradation process. Since Saraflam-DUR is a phosphorous based flame retardant, it is particularly efficient in catalyzing cellulose dehydration. Saraflam-DUR is equally effective after 50 Home launderings which can be seen from the results of char length and after glow time.

CONCLUSION

Cotton is one of the most widely used fibres in number of fields including military textiles and home furnishings, so developing a cost-effective durable flame retardant for cotton is of utmost importance. The Sarex flame retardant, Saraflam-DUR meets the demand of commercially successful flame retardant of meeting flammability requirement, having little or no adverse effect on textile physical properties, retaining the textile aesthetics and being durable to repeated home launderings.

BIOPOL-PLUS **(CONC)**

BIOPOL-PLUS (CONC)
Multi component Enzyme For Bio-polishing

In the recent years, enzymes have found a variety of uses in textile applications. Popular uses are stone washing of denims and surface modification of cellulosic fabrics to improve their appearance and handle. In case of denims, one can get stone wash effect without using pumice stones by using enzymes. Surface cleaning of cellulosic can be achieved with cellulase enzyme. Another advantage of using enzymes is that, these are environmental friendly, as they are readily biodegradable. Besides, they will not leave chemical residue on the processed materials and the colour changes on the dyed goods are very less.

Cellulase is the most popular and versatile enzyme used in textile wet processing for bio-preparation, bio-polishing and softening of cellulosic fibres. The process of treating the fabric with cellulases is termed as bio-polishing. Bio-polishing is an environmentally friendly process which uses enzyme to extend the lifetime of the fabric. It is a process in which the cellulase enzyme acts on the surface of the cellulosic materials. The cellulase enzyme remove the protruding fibres from the fabric surface leaving the fabric surface clean. Bio-polishing enhances the fabric quality by decreasing the pilling tendency and fuzziness of (cellulose) knitted fabrics possibly due to the fact that there is fewer protruding fibre ends from the yarns on the fabric surface.

Objective of Bio-polishing in Textile

- To remove protruding fibres, hairiness, fluffs and pills.
- To soften the fabric hand and improved handle.
- To achieve clean and smooth surface
- To improve material texture relaxation and increased flexibility.

The process employs the same cellulase action i.e. cleavage 1-4 β glucosidic linkage of cellobiose chain to remove fine surface fibrils and micro fibrils from cellulose. The presence of fibrils on the fabric surface may result in the pill formation and a faded or dull appearance due to an apparent loss of colour and increased diffuse reflection of white light on fabric surface which ultimately reduces the value of final articles. The hydrolysis action of the cellulase enzyme weakens the protruding fibres to the extent that a small physical abrasion force is sufficient to break and remove them. The enzymatic removal of fibrils results in softer and cleaner articles which are free from surface hairiness and neps with much improved handle and flexibility and which retain the original colour of the fabric. The fabric surface becomes smoother and more lustrous. Again, bio-polishing is a sustainable process as enzymes are sustainable alternative to the use of harsh chemicals in industry and

BIOPOL-PLUS **(CONC)**

reduce energy and water consumption, as well as chemical waste production during manufacturing processes.

Cellulases are high molecular colloidal protein bio-catalyst in metabolite form. Enzymes or cellulases have a protein like structure with primary, secondary, tertiary and quaternary structures and that are susceptible to degradation due to temperature, ionizing radiation, light, acids, alkali, and biological effect factors. They are usually classified by the pH range in which they are more effective acid cellulase, neutral cellulase and alkaline cellulase.

Sarex have an enzyme **Biopol-PLUS (Conc)**, a neutral cellulase multi component enzyme which is effective for bio-polishing and peroxide killing in one stage operation. Biopol-PLUS (Conc) can be used for cellulosic fabric and its blends. Biopol-PLUS (Conc) does not show strength loss or shade changes. Since it is a neutral cellulase enzyme, it will ensure a higher degree of whiteness than expected acid cellulases for full white fabric. It can be used in soft flow machine and garment dyeing machine.

MECHANISM OF BIO-POLISHING WITH BIOPOL-PLUS (CONC)

When cotton fabric is treated with Biopol-PLUS (Conc), under optimum condition, the cellulase enzyme hydrolyze the cellulose by reaching to the 1,4-B-glucoside bond of the cellulosic molecule. Cellulases enzymes are large molecular complex and can't penetrate into the interior of fabric, hence enzyme action takes place preferentially on the surface. As a result of which the fabric surface becomes smooth with the loss of surface fibres and the hand becomes soft. Though the effects of cellulase hydrolysis remain as the surface phenomena, changes in many physical aspects as well as mechanical properties of fabrics take place during the processing. Improvement in the handle value is obtained on account of the changes that take place during the reaction. An important aspect of cellulase for textile application is their relatively slow kinetics which allows the modification of cellulosic fibres in a controlled manner without excessive damage.

Bio polishing with Biopol-PLUS (Conc) can be carried out at any stage of wet processing but most conveniently performed after bleaching. In addition, this is a permanent process and it keeps the fabric in good condition after repeated washing; consequently, products become more attractive to the customer and fetch better prices. Bio-polishing of cotton fabric can also be carried out either before or after the dyeing process. The effect of cellulase treatment on color yield of cotton is of great importance to the dyers in both cases.

UNIQUE FEATURES

- Multi component enzyme which enables bio-polishing and peroxide killing in the same bath (after bleaching).
- Controlled action - No shade change in dyed material or strength loss.
- Applied at wide pH range.
- Saving in water, time and energy hence economical.
- Retain brightness of full whites.
- Eliminates residual peroxide.
- No shade changes during dyeing.
- Stable to anionic auxiliaries and salt (sodium sulphate, sodium chloride). Can be used during dyeing.

BIOPOL-PLUS **(CONC)**

APPLICATION PROCESS

Bio-polishing Process in Textile:
There are two process of Bio-polishing:

Process Sequence	
Conventional Process	**Biopol-PLUS (Conc) Process**
Pre-treatment : 110°C, 30 min. 0.8 gpl Wetting Agent 1.0 gpl Lubricating agent 0.5 gpl Stabilizer 3.0 gpl Caustic 3.0 gpl H_2O_2 ↓ **Neutralisation : Room Temp., 10-15 min.** 1.0 gpl Acetic Acid 0.75 gpl Core Alkali Neutralizer ↓ **Peroxide Killing : Room Temp., 10-15 min.** 0.5 gpl Peroxide killer ↓ **Bio-polishing** 1.5% Bio-polishing enzyme, 55°C, 30 min. Raise the temperature to 80-85°C and run for 10 min. ↓ Dyeing	**Pre-treatment at 110°C at 30 min.** 0.8 gpl Wetting Agent 1.0 gpl Lubricating agent 0.5 gpl Stabilizer 3.0 gpl Caustic 3.0 gpl H_2O_2 ↓ **Neutralisation : Room Temp., 10-15 min.** 1.0 gpl Acetic Acid 0.75 gpl Core Alkali Neutralizer ↓ **Peroxide Killing & Bio-polishing** Check the bath pH 6-6.5 Add 1% Biopol-PLUS (Conc), 55°C, 30 min. Raise the temperature to 80-85°C and run for 10 min. ↓ Dyeing

RECOMMENDED APPLICATION PROCESS

Equipment	: Jet dyeing machine or Garment dyeing machine
Biopol-PLUS (Conc)	: 0.6 - 0.8% (depending on requirement)
pH	: 5.0 - 6.5% (depending on requirement)
Temperature	: 45 - 60°C
Treatment time	: 60 - 75 min.

Check residual peroxide after 15-20 min. and ensure it is absent and then follow dyeing as per customer's dyeing procedure. During exhaustion of dye, bio-polishing will also be simultaneously taking place. To prevent any damage of the fabric after the finishing operation, it is very essential that the reaction be terminated at the end of treatment by enzyme inactivation. If the enzyme is not inactivated entirely, the fibres may get damaged and even extreme cases total destruction of the material may result. The enzyme inactivation is therefore of great importance from the technical point of view. There are two distinct process of termination of enzyme:

- By adding alkali in the bath which will inactivate the enzyme and also promote dye fixing.
- By increasing the temperature to 80°C for 10 min.

CONCLUSION

Biopol-PLUS (Conc), being an enzyme is a sustainable alternative to the harsh toxic chemicals in the textile industry. There is a wide range of applications and a multitude of prospects for the use of enzymes in textile processing, leading to a positive impact on the environment.

CHELATIN-**SA**

CHELATIN-SA
Sugar Acrylate
Sequestering Agent

A sequestering agent is an organic compound capable of linking metal ions or molecules together to form complex ring-like structures known as chelates. Sequestering agents are used to link undesirable metal ions together to form a stable structure that does not readily decompose. This limits the metal ions ability to react with other ions, clays or polymers. Sequestering agents are commonly used for water treatment purposes to reduce water hardness. They combine with calcium, magnesium and other heavy metal ions in hard water to form molecules in which the ions are held so securely (sequestered) that they can no longer react.

The purity of water supply is considered as an important issue in dye house. The presence of metal ions in water can adversely affect a number of wet processing operations. For example, Magnesium (Mg^{2+}) or Calcium (Ca^{2+}) ions in hard water can form insoluble complexes with soaps, and if these complexes are deposited on textile substrates, they will create difficulties in subsequent dyeing processes. The presence of metals ions (calcium and magnesium) and other heavy metals have a significant effect on the degree of success which is achieved in the sequence of preparation, dyeing and washing-off during the processing of cotton and its blends. Potential problems include physical and chemical damage (including pin holes) in the cotton during preparation, reduced depth of shade, dulling of colours, un-level dyeing, poor colour reproducibility and reduced fastness properties during dyeing. These can give rise to customer complaints and a reduction in the level of right-first-time (RFT) production obtained with an increase in cost for reprocessing resulting in loss of economy, loss of productivity, revenue and profitability. Potential sources of metallic impurities in wet processing are water quality, impurities in cotton, reactive dyes, chemicals and textile substrate. The most undesirable impurities in fibre, common salt, glauber salt, caustic soda and soda ash are the divalent and trivalent cations viz., Ca^{2+}, Mg^{2+}, Cu^{2+}, Fe^{3+} etc. These ions increase the hardness of process bath and generate metal oxides in the bath. Calcium and Magnesium ions present in the hard water reacts with natural soaps generated during the alkaline scouring to form waxy substance on the textile material which creates patchy dyeing and discoloration of the fibre. This waxy substance also deposits on the machinery surface. This is termed as Lime soap deposits. Calcium and Magnesium ions also reduce the solubility of anionic dyes causing reactive dyes to aggregate or even precipitate onto the fibre. Aggregated and certainly precipitated dyes cannot migrate or diffuse and usually remain on the fibre surface as particulate deposits. This causes lower colour yield, un-level dyeing, spots and stains which are difficult to remove, change of shade and even contamination of machines. Pthalocyanine turquoise dyes and triphendioxazine blues and some reactive orange dyes are particularly susceptible in this respect. Sequestering agent used in dyeing should be of different strength than those used for scouring and bleaching. This is because some dyestuff chromophore has metal component in it and powerful sequestering agent if is used, may attack the metal component in the dyestuff chromophore.

CHELATIN-**SA**

The presence of transition metal ions such as iron (Fe^{2+}) and copper (Cu^{2+}) can catalyze the decomposition of hydrogen peroxide in bleaching processes and if these ions are already adsorbed into the substrate, then localized accelerated attack may occur. Cotton fibre/fabric also contains varying quantities of metal traces (iron, copper) which mainly comes from fertilizers and insecticides. Also, the iron content of caustic soda may exceed to 100 mg/lit. There are many routes through which the metal traces enters in the wet processing operation. The ferric oxide with cellulose creates small pinhole on the fibres and also damages the machinery by scale formation in the nozzles and base. Fabrics comprising pinholes results into poor mechanical properties and are rejected as waste and are the cause of major concern to textile processing organizations.

Hard water build-up in Pipes and Nozzles

To overcome these deleterious effects in the scouring and bleaching bath, adequate amount of sequestering agent must be used. Sequestering agents are compounds that are able to form soluble complexes with metal ions. The soluble complex formed with the metal ions does not interfere with the process (such as bleaching or dyeing) and is washed out at the end of the operation with the exhaust liquors. Sequestering agents have structures that enable them to form closed rings with polyvalent metal ions by sharing of a lone pair of electrons with them. In this way they 'lock up' the metal ions and prevent them from any further reaction. A sequestering agent surrounds the molecule or atom and holds it "in seclusion." In this process, the sequestering agent hides the molecule or atom and prevents it from entering into chemical reactions. There are several classes of sequestering agents however the choice of sequestering agent depends to a great extent upon the conditions under which it is applied.

In this article, properties and performance of a sugar acrylate based sequestering agent will be discussed. Since the raw material prices have increased by multi fold in last few months, Sarex has come up with a solution, offering **Chelatin-SA** which is a chelating agent based on sugar acrylate. Sugar acrylates have sequestering values as high as amino polycarboxylates or the phosphonates. They are biodegradable, effective components in cellulosic fabric pretreatment during desizing, scouring, bleaching and mercerizing.

UNIQUE FEATURES

- Chelatin-SA is a biodegradable multi functional auxiliary based on Sugar acrylate.
- It is stable over wide range of pH from 2-12.
- Exhibits chelating efficiency for calcium and iron even at pH values of 9-11, hence suitable for scouring, bleaching and as a dyebath conditioner.
- It has excellent demineralizing property and thus it can be used in scouring process to remove impurities.
- It leads to water saving as demineralizing and bleaching can be carried out in same bath.
- Scouring can be carried using only Chelatin-SA and wetting agent at 95°C for dark shades.
- Caustic dosage in bleaching can be reduced by 1-15% leading to lower TDS.
- Does not have any adverse effect on the metal-containing dyestuffs and are non-foaming.

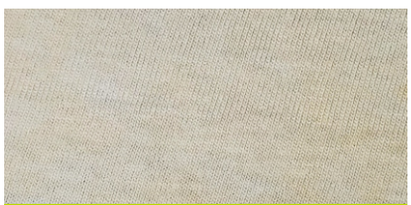
CHELATIN-**SA**

EXPERIMENTAL

Experiment to study the efficacy of Chelatin-SA

- **To sequester Ferric ion present in water**
- **Beaker A :** Take 500ppm Ferric ion solution + 1% Celldet-R (nonionic detergent)
  Beaker B : Take 500ppm Ferric ion solution + 1% Celldet-R (nonionic detergent) + 3g/l Chelatin-SA

RFD fabric is soaked in Beaker A and Beaker B., half squeezed and kept in polyethylene bag overnight.



Fabric soaked in beaker without Chelatin-SA shows Iron stains on the fabric (Blank)

Fabric soaked in beaker containing Chelatin-SA shows very less Iron stains as compared to Blank

Chelatin-SA effectively chelates Ferric ion present in the water and does not allow it to deposit on the fabric.

To sequester Ferric ion present on the fabric

Fabric with Iron stains is subjected to bleaching using

- **Beaker A :** 2g/l Caustic + 2g/l Hydrogen Peroxide
- **Beaker B :** 2g/l Caustic + 2g/l Hydrogen Peroxide+ 3g/l Chelatin-SA

2g/l Caustic + 2g/l Hydrogen Peroxide

2g/l Caustic + 2g/l Hydrogen Peroxide + 3g/l Chelatin-SA

Fabric bleached in presence of Chelatin-SA shows better stain removal as compared to Caustic and Hydrogen peroxide alone.

Recommended Application Process:

In combined scouring and bleaching of cotton and blends by batch process:

Chelatin-SA	: 0.4 - 0.5%
Celldet-R	: 0.35 - 0.5%
Caustic Flakes	: 1.25 - 1.5%
Peroxide (50%)	: 2.0 - 2.5%

Dyeing:

Exhaust Application	: 0.5 - 1 g/L Chelatin-SA
Continuous Application	: 3.0 - 5.0 g/L Chelatin-SA

Treat at 98°C for 45 min. or 110°C for 20-25 min.

RESULTS

Ion sequestering efficiencies of various Sequestering Agents:

	Ca chelation value (mg CaCO3/gm at pH 12)	Fe chelation value (mg of Fe/gm of sample at pH 11.5-12)
Chelatin-SA	140 - 180	200 - 240

CONCLUSION

Chelatin-SA, a sugar acrylate based sequestering agent, exhibits very good chelating efficiency and is ideally recommended in desizing, scouring, bleaching and as dye bath conditioner during cellulose dyeing.

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

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