Sarex

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Saraquest

Exclusive Insight

Care for nature

Enzymes: *For today and tomorrow*

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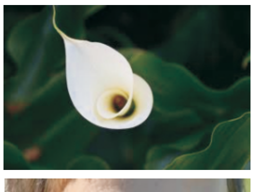

Cationizing Agent for Pigment Dyeing: Catfix 511

Generally, cotton fabrics are most commonly dyed with reactive dyes. Bright colors in wide shade range, good all-round fastness properties and ease of application are some of the reasons for the popularity of reactive dyes. Despite their several advantages, reactive dyes still suffer from a limitation of hydrolysed dye formation during dyeing, which must be removed by a subsequent thorough wash-off treatment. A significant proportion of the total cost of reactive dyeing is attributed to washing-off stages and the treatment of the resulting effluents.

Pigments have been used for textile printing for many decades. One of the advantages of pigment coloration is that the subsequent washing-off can be avoided. Another possible advantage in dyeing with pigments is that some finishes may also be combined with the dyeing process.

Pigments and dyes both come under the classification of word colorant meaning, a substance used for coloring. Further a colorant can be elaborated as any chemical that is colored or can become colored in a particular environment/under certain condition and can be applied/used to impart the property of color to an item .

Pigments are colorant composed of particles that are in soluble in the application medium. They have no substantively for the material on which they are applied. Since the particles are too large to penetrate in to the substrate, the pigments are therefore easily removed unless fixed with adhesive.

Pigment dyeing like pigment printing is a phenomenon in which insoluble Coloring matter called pigment, having no affinity with the substrate is applied on to fabric.

The color is being fixed are being attached to the fabric by virtue of binding agents. The role binders hence becomes extremely important since the pigments some what sandwiched between the substrate and final layer of binder.

They exist in the form of finely ground molecules, milled for garment purpose in to a paste. When anionic dispersing agents are added a slightly negative charge is present, thus the foundation for pigment dyeing is born. When a positively charged cationic pre-treat is added to the fiber, a magnetic bond is formed. The process is completed when a cationic agent is added to lock the pigment into place. In pigment dyeing no actual reaction takes place between the dye and the fabric

Coloration of cotton cellulose with pigment emulsion has always played a key role in determining the aesthetic appeal and acceptability of the products made from them. Generally pigments are anionic in nature when dispersed in water and have no affinity towards cellulosic fibre. The presence of cationic charges on or in the fibre causes pigments to be strongly attracted to the fibre and to be held much more tightly on the fibre. Higher doses than the optimum level reduce the pigment build up ability and level dyeing property.

Above modifying agents act as a physical barrier for the pigment molecule to attach on to the fibre surface, resulting loss in depth of shade. Excessive build up of polymer on the interior surface of the machine can also occur which cannot be removed easily and will give patchy dyeing/dye spot etc.

There are two fundamentally different types of cationic pre-treatments in use.

The first type are cationic polymers that form a layer of cationic charges when applied to fiber surfaces (See Figure a).The second category of cationic pretreatments involves reactants that modify the fiber by forming covalent bonds with the cellulosic fibre (See Figure b).

Fig (a) Cationizing agent forms a layer of cationic charges on to fiber surfaces.

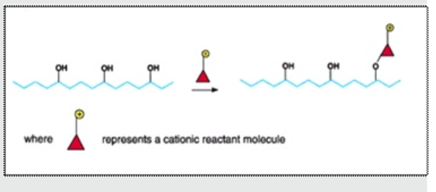

Fig (b) Cationizing agent modify the fiber by forming covalent bonds with the cellulosic fibre.

The presence of cationic charges on or in the fibre causes anionic materials such as direct and fiber reactive dyes to be strongly attracted to the fibre and to be held much more tightly than without the cationic charges.

Key Features of Cationizing Agent For Pigment Dyeing Process: Catfix 511

- Imparts good washing and rubbing fastness to pigment Dyeing Processes.
- Retains original tone of Dyeing Processes.
- Releases no formaldehyde.
- No adverse effect on Sea Water and Perspiration fastness of pigments dyeing processes.
- Does not impair light fastness properties of the pigment Dyeing Process.

The pigment dyeing process is generally a three step process such as:

1.Cationisation of the Fabric on of the Fabric

Pigment dyeing is an electrical process whereby the goods to be dyed are given an electrical charge opposite that of the pigment. When the pigment is added to the bath, the opposite electrical charges attract each other, much like the north and the south poles of two magnets. Because of the electrical nature of the process.

2.Pigment Exhaustion on the Fabric

The pigments are first mixed with water and a dispersing agent that imparts an anionic charge to the pigments. This solution is added gradually to the dyeing machine. The temperature of the bath is slowly increased and the machine is held at the dyeing temperature f or up to 20 minutes. The fabric is held at an elevated temperature to increase the adsorption of the pigments.

3.Binder Application

A binder used in the exhaust pigment dyeing procedure for fixing pigment colors. Binders are commonly acrylic polymers with nonionic and cationic nature. It improves crock and wash fastness. After the pigment is exhausted , the binder is feed into the dyeing machine and exhausted onto the fabric over a period of time. Acetic acid is added to the bath, which facilitates binder polymerization, then the fabric is rinsed.

Strictly speaking, pigment dyeing is not actually dyeing at all, since it only coats the outside of the material, rather than fully penetrating it like a dye would. There are both advantages and disadvantages to pigment dyeing, as is the case with any type of coloring technique.

Garment dyeing with Pigments

Exhaust Method
⇩
Garment loading
⇩
Cationization
⇩
Rinsing
⇩
Pigment exhaustion
⇩
Binder exhaustion
⇩
Extraction
⇩
Tumble drying

Advantage of Pigment Dyeing

- Applicable to wide range of textiles and wide gamut of colours available
- Process of pigment dyeing is relatively cheap.
- The process chemicals are less toxic, environmentally friendly and least polluting
- The colours fades with the repeated use just like denims

Limitations of Pigment dyeing

- Colour fading could be a problem if not desired and can only be kept intact with further chemical treatments.
- The abrasion resistance and hand could be unsatisfactory depending upon the pigment, binder and softener used.
- The dark and deep shades are better produced with other dyestuffs rather than pigments.
- Poor build-up in dyeing in

comparison with reactive dyes, poor rubbing fastness properties, loss in fabric tear strength and deterioration of fabric handle.

Recommendations

The recommended piece of equipment for this process is generally a rotary drum machine capable of being programmed with a variable drum speed during the dyeing cycle. However, other types of equipment, such as paddle machines, are also utilized in pigment garment dyeing.

The cationic fixative is exhausted onto the garment first and acts as the link between the fabric and the pigment. Once this bath has been dropped and the garment rinsed, the pigment is applied. It is important to keep the liquor-to-fabric ratio high (20:1) and the initial bath temperature low (80°F/27°C) to gain uniform exhaustion of the pigment onto the garment. A long rate of rise (2°F(1°C) per minute), when increasing the temperature of the bath, will also aid uniform exhaustion of the pigment.

Once the pigment dyeing is completed and after rinsing off any excess color, a low temperature or air-curable binder, usually an acrylic-based product, must be applied to the garments to improve the fastness to rubbing or crocking. It is preferable, where possible, to use a cationic rather than a nonionic binder since the cationic binder can be exhausted onto the fabric.

Because reproducibility from one dye lot to the next may be difficult, it is important to carefully select the garment components, dyestuffs, and chemicals to be used and to monitor the dyeing process. Only with precise process control is it possible to reproduce colors between dye lots within currently accepted tolerances.

PIGMENT GARMENT DYEING: TWO BATH/THREE STEP METHOD

Rotary Drum Machine, Liquor Ratio 20:1

1. Load machine, set bath @ 80°F (27°C).
2. Adjust pH to 4.7 with acetic acid.
3. Run 5 minutes.
4. Add binder.
5. Heat to 120°F (50°C).
6. Run 10 minutes.
7. Add cationic pretreatment over 10 minutes.
8. Heat to 140°F (60°C) @ 3°F (1.5°C) per minute.
9. Run 10 minutes.
10. Drop.
11. Fill @ 80°F (27°C) and rinse 3 minutes.
12. Drop.
13. Fill and set bath @ 80°F (27°C).
14. Add diluted pigments over 15 minutes and run 10 minutes.
15. Heat bath to 140°F (60°C) @ 2°F (1°C) per minute.
16. Run 10-20 minutes (check exhaustion).
17. Drop.
18. Fill at 80°F (27°C), rinse 3 minutes, and drop. Repeat.
19. Fill and rinse 5 minutes with softener.
20. Drop, extract, and tumble dry.

Enzymes: For today and tomorrow

In the entire world a growing awareness about the damage caused to the environment by the indiscriminate use of chemicals, some of which are very toxic and carcinogenic. The textile industry is one of the most pollution creating industry in terms of high solid waste, high Biochemical Oxygen demand (BOD)/ Chemical Oxygen Demand (COD) in waste water, hazardous chemicals and dyes etc. The most problematic is textile wet processing, in terms of vast quantity of water and good number of chemicals which are used in wet processing, and on completion of the process. residual dyes and chemicals together with water are discharged as effluents.

A suitable textile processing method that delivers not only use of eco friendly products but also do not hamper the surrounding atmosphere and environment by way of polluting the air and water, due to emissions and effluent water discharges. The textile industry is considered as the most ecologically harmful industry in the world. Many chemical processes used in textile industries have inherent drawbacks from a commercial and environmental point of view. High temperatures needed to drive reactions lead to high energy costs and may require large volumes of cooling water downstream. Harsh and hazardous processes involving high temperatures, acidity, or alkalinity need high capital investment, and specially designed equipment and control systems. Unwanted by-products may prove difficult or costly to dispose of. High chemicals and energy consumption as well as harmful by-products have a negative impact on the environment.

Therefore, in order to adopt an eco-friendly textile process, the key areas of textile wet processing like pretreatments, dyeing, printing, finishing etc. the process should create minimum pollution load with a simultaneous minimum consumption of resources like water, power etc. and do not utilize any harmful/ hazardous/ carcinogenic chemicals.

Alternate to hazardous chemicals are enzymes which are a class of proteins that function as biocatalysts which are biodegradable, very specific in action and are used in small quantities. They work by lowering the activation energy of the reaction making it much faster. Enzymes replace harsh chemical processes, catalyzing the reactions mostly at mild conditions of temperature and pressure.

- Proteineous polymers
- Made up of 200-250 amino acids
- Produced by living organisms – i.e. plant, fungi or bacteria
- Act as organic Bio-Catalysts
- Work in aqueous medium, hence hazardous organic solvents not required (Green Chemistry)

How Enzyme Works ?

- Speeds up a reaction without being changed; lowers the activation energy;
- Physically promotes a reaction

by serving as a physical site upon which one or more

- Reactant molecules can be positioned, but it does not become a part of the product (catalyst)

E + S ---ES ---- E + P

Enzyme + substrate Enzyme = substrate complex

Enzyme + product

Enzyme Reaction

- Transfer of enzyme molecules from aqueous phase to fibre surface
- Adsorption of enzyme molecules onto the substrate surface
- Catalysis of surface hydrolytic reactions by a specific enzyme
- Transfer of the hydrolytic reaction product to the aqueous phase
- Substrate binds to a specific site called the active site
- Forms the enzyme substrate complex
- Can join substrates together or break substrates to form products and release enzyme

TYPES OF ENZYMES AND THEIR ORIGIN

BACTERIAL ORIGIN

Amylase -Bacillus subtilis, licheniformis, tearothermophilus, Amylase Bacillus cereus
Catalase-Micrococcus lysodeicticusProteaseBacillus coagulans
Xylose - Isomerasestreptomyces aebus

FUNGAL ORIGIN

Amylase - Aspergillus niger, oryzae, rhizopus oryzae
Cellulase - Aspergillus niger, oryzae, pencillium funiculosum, rhizopus, trichoderma longibrachiatum
Protease - Aspergillus niger, oryzae
Pectinase - Aspergillus niger, oryzae, pencillium funiculosum, trichoderma longibrachiatum
Catalase - Aspergillus niger

ENZYME APPLICATIONS IN TEXTILE PREPARATORY PROCESS

In a number of cases, some or all of these drawbacks regarding effluent can be virtually eliminated by using enzymes.

Industrial enzymes originate from biological systems; they contribute to sustainable development through being isolated from microorganisms which are fermented using primarily renewable resources.

In addition, as only small amounts of enzymes are needed in order to carry out chemical reactions even on an industrial scale, both solid and liquid enzyme preparations take up very little storage space. Mild operating conditions enable uncomplicated and widely available equipment to be used, and enzyme reactions are generally easily controlled. Enzymes also reduce the impact of manufacturing on the environment by reducing the consumption of chemicals, water and energy, and the subsequent generation of waste. The current application in the textile industry involves following enzymes;

Application of Enzymes in textile industry

S.No.	Enzyme Name	Substrate Attacked	Textile Application
1.	Amylase	Starch	Starch desizing
2.	Cellulase	cellulose	1.Biopolishing. 2. Carbonization of wool
3.	Pectinase	pectin	Bio-Scouring replacing caustic
4.	Catalase	peroxides	Residual peroxide decomposition after bleaching.
5.	Protease	Protein molecules or peptide bonds	1. Bio scouring (Replaces caustic) 2. Degumming of silk
6.	Lipase	Fats and oils	Bio-Scouring
7.	Glucose Oxidase	Colouring matter	In situ generation of H_2O_2 and Bio Bleaching of cotton
8.	Laccase	Colour chromophore and pigment	1.Bio-bleaching of lignin containing fibres like Kenaf and jute 2. Bio-bleaching of indigo in denims for various effects

ENZYMATIC DESIZING

Prior to weaving of yarn into fabric, the warp yarns are coated with a sizing agent to lubricate and protect the yarn from abrasion during weaving. Historically, sizing agent used for cotton fabrics is starch because of its excellent film forming capacity, availability, and relatively low cost. From woven fabric the applied sizing agent and the natural non-cellulosic materials must be removed. Amylase enzymes for the removal of starch size is one of the oldest method of enzyme applications. Amylase hydrolyses starch molecules to tri, di and monosaccharides.

Bio scouring:

Before cotton yarn or fabric can be dyed, it goes through a number of processes in a

Classification of enzymes

Class of Enzyme	Enzyme	Enzyme Reaction
Oxido-reductases	Catalases Glucose oxidases Laccases	Oxidation reactions involve the transfer of electrons from one molecule to another. In biological systems removal of hydrogen from the substrate. Typical enzymes in this class are called dehydrogenases.
Transferases	Fructosyl transferases Glucosyl transferases	This class of enzymes catalyzes the transfer of groups of atoms from one molecule to another. Aminotransferases or ansaminases promote the transfer of an amino group from an amino acid to an alpha-oxoacid.
Hydrolases	Amylases, Cellulases Lipases, Mannanases Pectinases, Phytases Proteases, Pullulanases Xylanases	Hydrolases catalyze hydrolysis, the cleavage of substrates by water. The reactions include the cleavage of peptide bonds in proteins, glycosidic bonds in carbohydrates, and ester bonds in lipids. In general, larger molecules are broken down to smaller fragments by hydrolases.
Lyases	Pectate lyases Alpha-acetolactate decarboxylases	Lyases catalyze the addition of groups to double bonds or the formation of double bonds through the removal of groups.
Isomerases	Glucose isomerases	Isomerases catalyze the transfer of groups from one position to another in the same molecule. In other words, these enzymes change the structure of a substrate by rearranging its atoms.
Ligases		Ligases join molecules together with covalent bonds. These enzymes participate in biosynthetic reactions where new groups of bonds are formed. Such reactions require the input of energy in the form of co-factors such as ATP

textile mill. One of the important step is scouring for complete or partial removal of fats, waxes, pectins, hemicelluloses, and mineral salts, as well as impurities such as machinery and size lubricants. Scouring gives a fabric with a high and even wettability that can be bleached and dyed successfully. Today, highly alkaline chemical such as sodium hydroxide is used for scouring. These chemicals not only remove the impurities but also attack the cellulose, leading to a reduction in strength and loss of weight of the fabric. Furthermore, the resulting effluent has a high COD (chemical oxygen demand), BOD (biological oxygen demand), TDS (total dissolved solid) and salt content.

Disadvantages of alkali scouring:

1) Damage to fibre.

2) Requirement of large quantity of water.

3) Load on effluent.

Enzymatic Scouring

Alternative and mutually related processes introduced within the last decade, is Bio-Scouring and Bio-Preparation, are based on enzymatic hydrolysis of pectin substrates in cotton. They have a number of potential advantages over the traditional processes. Such as water consumption is reduced by 25% or more, lower strength and weight loss, soft feel as compared to alkali scouring.

Enzymes used for Bioscouring:

Pectinase – (Pectins removal)

Bioscouring with pectinases

Pectinase enzyme is effective and environmentally friendly for scouring. Pectinase enzyme hydrolyses pectinous material and releases fats and waxes which are embedded in the pectin. Fats and waxes gets emulsified with wetting agent. Research has shown that pectin acts like glue between the fiber core and the waxes, but can be destroyed by an alkaline pectinase. It breaks down the pectin in the cotton and thus assists in the removal of waxes, oils and other impurities and has no negative effect on the strength properties of cotton textiles or yarn. The optimum Temperature is 50-65^{0}C and pH between 7.5-9.0.

Bioscouring with Cellulase

It is believed that pectinase along with cellulase gives better scouring performance than pectinase alone. Pectinase can destroy the cuticle structure by digesting the inner layers of pectins in the cuticle of cotton. On the other hand, cellulase can destroy the cuticle structure by digesting the primary wall cellulose which is under the cuticle of cotton. Thus cellulase breaks the linkage from the cellulose side, and the pectinase from the cuticle side. The result of the synergy is obviously a more effective scouring in terms of both speed and evenness of treatment.

Studies have been undertaken into the application of cellulases, pectinases, and proteases for bioscouring. Of the enzymes investigated, pectinases have found to be the most suitable as they are capable of removing impurities from raw cotton substrate without damaging the properties of the substrate.

Bio bleaching

The purpose of cotton bleaching is to decolourize natural pigments and to confer a pure white appearance to the fabrics.. The most common industrial bleaching agent is hydrogen peroxide, which is usually applied at alkaline pH and boiling temperatures. However, radical reactions of hydrogen peroxide with the fibre can lead to a decrease in the degree of polymerization of cellulosic fibre which causes damage to fabric.. Furthermore, a large amount of water is needed to remove hydrogen peroxide, alkali from the fabrics before it to be dyed. Therefore, replacement of hydrogen peroxide by an enzymatic bleaching system would not only lead to better product quality due to less fibre damage but also to substantial savings on washing water needed for the removal of hydrogen peroxide.

Chlorine and oxygen containing oxidizing agents are used during conventional bleaching process of cellulosic fibres. When a higher whiteness is needed, it is necessary to perform multiple oxidizing treatments. Rapid bleaching with laccase–hydrogen peroxide enhances the whiteness of cotton fabrics and significantly reduces the amount of hydrogen peroxide required during subsequent chemical bleaching processes.

Bleach-cleanp

After completion of bleaching process the bleached liquor was drained and then the fabric was rinsed with water a number of times to remove the H_2O_2 from the bleached fabric. Alternatively, a mild reducing agent can be used to neutralize the bleach. In either case, large amount of water is required for rinsing, which result in discharge of a large volume of wastewater.

Removal of peroxide is very essential after bleaching of fabric which goes for dyeing.Traces peroxide present in a fabric leads degradation of reactive dyes. Reduces colour value. Use of catalase enzyme as bleach clean up made it possible to reduce the temperature and volume of the second wash from 80-95^{0}C to 30-40^{0}C, resulting in a 9-14% saving of energy, a 17-18% saving of water and an overall cost saving of 9%. This is very significant in the highly competitive textile industry. The enzymatic process results in reduced water consumption and reduced energy consumption as compared to traditional method of peroxide removal.
Limitations are imposed by the low temperature and alkali stability of the enzyme.Catalases from Bacillus SF showed high stabilities at 60 °C and pH 9 Degradation of hydrogen peroxide with an immobilized catalase from Bacillus SF enabled the reuse of the water for the dyeing process. This enzyme can be added directly to bleaching Bath. Peroxidase can also be used as bleach clean up agent.

Combined Scouring and Bleaching using Enzyme:
Two enzymes, Amyloglucosidase and Glucose Oxidase can be used for scouring and bleaching process as single bath two step process.

Step1. Scouring using Amyloglucosidase:
Amyloglucosidase also known as glucoamylase, is also an exo-enzyme which hydrolyses starch. It removes glucose residues in a stepwise manner from the non-reducing end of the starch polymer, hydrolysing a-1,4 and a-1,6 bonds, although at slower rate with the latter bond configuration. The optimum pH level of these enzymes is 4.0-4.5. Commercial glucoamylases are generally produced from strains of Aspergillus nige

Step 2 – Bleaching using Glucose Oxidase:
The Glucose Oxidase enzyme has to be added in the scoured (Amyloglucosidase) bath. In the presence of molecular oxygen, glucose is oxidised by the enzyme glucose oxidase to gluconic acid and hydrogen peroxide:

$$\beta\text{-}D\text{-}Glucose + O_2 \xrightarrow[(GOD)]{Glucose\ Oxidase} D\text{-}Gluconic\ Acid + H_2O_2$$

D- Gluconic acid is act as a sequestering agent during bleaching. To produce enough amount of hydrogen peroxide in the bleaching bath more amount of Amyloglucosidase has to be added in the scouring bath, there by enough glucose can be produced to obtain atleast 250 mg per litre.

Rapid Enzymatic Single bath treatment
A single bath combined process, in which various enzymes, namely, amylase, pectinase, and catalase were employed. This new process was named as the "Rapid Enzymatic Single-bath Treatment" (REST), since it was completed almost in half of the conventional dyeing time, and all of the stages, namely, desizing, scouring, bleaching and dyeing were carried out in a single bath without replacing the process water with fresh water until the end of the dyeing. In the REST process, the untreated, starch-sized fabric was first desized by amylase enzyme, and this was followed by a pectinase treatment in the same bath. The fabric was then bleached by hydrogen peroxide in the same bath, and after the hydrogen peroxide bleaching; the catalase enzyme was added to the bath to remove residual peroxide before reactive dyeing. Without carrying out intermediate washings/rinsing between these processes, the reactive dyeing was carried out in a conventional way in the same bath, and finally, the fabric was taken from the bath and washed out. The colour yield was compared with the dyeings which were carried out conventionally in separate baths. Finally, the REST has many benefits in terms of water saving, reduced process time and energy consumptions compared to the conventional method.

Biopolishing:
Cellulases are derived from both fungal and bacterial sources. They find extensive application on cellulosic materials. Cellulases used in bio-finishing of cellulosic fabrics are derived from more than ten different fungal species which vary in their component composition, application pH and special effects produced. Cellulases derived from the fungus, Trichoderma reesei is widely used in textile finishing since it gives higher yield in industrial production. In addition to cellulases originating from the above fungus, those originating from Humicola insolens can also degrade cotton cellulose efficiently and they find extensive application in biostoning of denim fabric.

Enzymes or cellulases has 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. Cellulases are capable of breaking the 1,4-B-glucoside bond of cellulose randomly. When cotton fabric is treated with a cellulase solution under optimum condition: Cellulase hydrolyse cellulose by reaching to the 1, 4-B-glucoside bond of the cellulose molecule.

Cellulase enzyme hydrolyses protruded fabric which reports in smooth and soft fabric surface. There is also loss in strength proportional to the amount of weight reduction.

There are mainly three types of cellulases:
1) Acid stable (more effective in pH range of 4.5 - 5)
2) Effective at pH 5-7
3) Alkaline stable.

Action of Cellulases:
The mechanism of cellulase action on cellulose as follows: (i) the endoglucanases degrades cellulose by selectively cleaving through the amorphous sites and breaking long polymer chains into shorter chains, (ii) cellobiohydrolases degrades cellulose sequentially from the ends of glucose chains, thus producing cellobiose as the major product and it plays a mediator role in degrading cellulose, and (iii) B-glucosidases complete the hydrolysis reaction by converting cellobiose into glucose.

Enzyme Inactivation:
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 then at the end of the reaction fibres 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:
1. Rise in temperature
2. Increases in pH.

Since enzymes are true catalysts and are not consumed during the chemical reaction, the hydrolysis reaction will continue until either the reaction conditions change or the cellulose is physically removed from the reaction mixture. Mechanical agitation is important in order for the hydrolysis reaction to proceed efficiently. Recent work has demonstrated that the kinetics of the reaction is controlled by mass transfer effects. The adsorption-desorption mechanism of enzyme action depends on agitation to remove hydrolysis by-products and expose new fibre areas to attack.. Recent developments in enzyme manufacturing have led to commercial products that contain a preponderance of one cellulase component. These 'Mono-component' enzymes are produced from modified Humicola strains and are primarily endo-glucanases active at pH 5 – 7.

Advantages Bio-polishing with enzyme
- Hairiness, fluffs and pills are removed.
- Material sticking (the burr effect) is prevented.
- Improved handle.
- Surface smoothness and a clear surface.
- Decrease in pilling of natural regenerated fibres and their blend.
- Stone wash effect without pumice stone and dyestuff destroying chemicals.
- Poor quality, uneven, napped, knoppy material surface (ie) typical second quality goods are converted into elegant, lustrous, soft, top quality with a fine, high quality surface appearance.
- Improve colour uniformity.:

Bio-polishing of non-denim fabrics

Most of the natural materials used in fabric manufacturing contained cellulosic fibers, such as cotton, linen, ramie, viscose and lyocell, which had a tendency for 'fuzz' formation (short fibres protruding from the surface) as well as 'pilling' (fluffy/loosened fuzz attached to the surface). These phenomena were considered as negative features of cellulosic fabrics. Hence, the prevention or permanent removal of fuzz formation and pilling was necessary to increase the commercial value of cellulosic fabrics. This was accomplished using cellulases in a process called 'bio-polishing'. During this process, the cellulases act on small fibre ends that protrude from the fabric surface, where the mechanical action removes these fibres and polishes the fabrics.

Enzymes for denim finishing

Today use of cellulases to accelerate the abrasion by loosening the indigo dye on the denim. Since a small dose of enzyme can replace several kilograms of stones, the use of fewer stones results in less damage to garments, less worn out of machines, and less pumice dust in the working environment. The need for the removal of dust and small stones from the finished garment is also reduced.

Productivity can furthermore be increased through laundry machines containing fewer stones and more garments. There is also no sediment in the wastewater, which can otherwise block drains. Denim garments are dyed with indigo, a dye that penetrates only the surface of the yarn, leaving the center light in colour. The cellulose molecule binds to an exposed fibril (bundles of fibrils make up a fiber) on the surface of the yarn and hydrolyses it, but leaving the interior part of the cotton fiber intact.

When the cellulases partly hydrolyse the surface of the fiber, the blue indigo is released, aided by mechanical action, from the surface and light areas become visible, as desired. Both neutral cellulases acting at pH 6–7 and acid cellulases acting at pH 4–5 are used for the abrasion of denim.

The denim industry is driven by fashion trends. Bleaching or fading of the blue indigo colour can also be obtained by use of another enzyme product based on a laccase enzyme. This system bleaches indigo, creating a faded look. This bleaching effect was previously only obtainable using harsh chlorine-based bleach. The combination of new looks, lower costs, shorter treatment times, and less solid waste has made abrasion and bleaching with enzymes the most widely used fading processes today.

Hydrophilization of Synthetic Fibre

Synthetic fibres share common disadvantages, such as high hydrophobicity and crystallinity, which affect not only wearing comfort (making these fibres less suitable to be in contact with human skin), but also processing of fibres, impeding the application of finishing compounds and colouring agents. Lipases and esterases are mainly used for biomodification of PET. Enzymatic hydrolysis of PET fibres with different lipases increased hydrophilicity as lipase has an ability to hydrolse ester linkage.

Decolourization of dyes

Laccases are developed for the decolourization of textile effluents. Due to their ability to degrade dyes of diverse structures, including synthetic dyes, laccases are an environmentally friendly tool to treat dye wastewater

Products from Sarex

Product Name	Application	Key Feature
Desize GC	Desizing	• High temperature stable, bacterial Alpha-amylase based desizing agent specially recommended for desizing of starch and starch based sizes • Alkali stable up to pH 10 • Can be used by exhaust as well as padding method • More Productivity as shorter batching time
Sarazyme BS	Bio scouring	• For scouring of cotton fibre, cotton yarn, cotton knits and cotton terry towels. • Works at milder condition than conventional alkaline scouring • Scouring/bleaching or combined scouring/dyeing can be possible thereby low BOD, COD and TDS of effluent • Soft Feel
Biofeel PST	Bio polishing	• It is a highly active economical acid cellulase enzyme • Removal of protruding fibers on the surface of fabric / knits • Prevents fabric from Pilling after many wash cycles • Peroxide elimination and bio-polishing can be carried out without draining the bath
Biopol N	Bio polishing	• It is neutral enzyme • For bio polishing of cellulosic and cellulosic blends. • Minimum strength loss of fabric • Can be applied during dyeing or after dyeing for bio polishing of woven, knit, fabrics & terry towels • Can be applied at acetic to neutral pH
Biopol COMBI	Peroxide Killer cum Bio polishing	• Innovative multi component enzyme which is effective for Peroxide killing and bio-polishing can be carried out after bleaching in the same bath • It does not show strength loss or shade change. • Economical Process.
Peroxy ALK	Peroxide Killer	• Enzyme based peroxide scavenger product to eliminate residual peroxide at the end of bleaching • Product of unique formulation focusing on cost, and time saving. • Problems associated with pre-treatment residues interfering in dyeing are minimised • It is stable upto 70^0C
Saroxy K MOD	Peroxide Killer	• Enzyme based peroxide scavenger product to eliminate residual peroxide at the end of bleaching • Combined peroxide scavenging and dyeing in same bath can be carried out thereby saving time, water and effluent. • It can be work at wider rage of i.e. pH 5 to 9

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