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Dear Friends,

The Textile Industry has strategic importance to India as it is the 2nd largest employer in the country, next only to agriculture, India being the world’s 2nd largest nation with over 1 billion people, after food clothing is most important.

The Textile Industry has been modernising in India and composite mills are becoming the norm once again. The whole industry is quite old and has witnessed many changes. At the same time, Indian entrepreneurship can fully take advantage of a good technical post and emerge as a number one supplier for high quality fabrics and garments, with China being the “mass-producer” for textile goods.

There is a very big opportunity for the Indian Textile Industry in this segment.

In the last few decades we have witnessed the perils of pollution caused by irresponsible use of carcinogenic chemicals, dyes and non-ecofriendly auxiliaries! In several places, where textile processing is a major industry, wastage is highly polluted. We today cannot drink even a drop of water in any river near Tirupur in South India or near Fial and Balobi in Punjab! It met various textile and garment producers in Ludhiana, I warned them that this should not happen in a state like Punjab!

Gurudev Pragas Sri Sri Ravi Shankar has always told us to take responsibility and solve problems. There are two major challenges going forward - Quality and Environment Protection. We at ADVANCED ENZYMES have accepted this challenge and responded with several ECO-SAFE solutions. In order to help the textile and garment industry, we have expanded our service team as well as our Research & Development Labs to solve this problem right from the ‘molecular’ level. Over and above this, we have set up a separate blending facility at Shatapur near Mumbai to help us quickly service customer needs.

This issue of Enzyme World is a showcase of our commitment. This is the beginning. In the near future, my team is committed to offering better products that will not only improve the Quality of the textile goods by several notches, but also improve Cost Efficiencies significantly!

I welcome each and every technocrat to this mission to help enlarge the scope and area of the challenge.

Jai Gurudev,
C L Rathi,
Managing Director
Enzymes have found wide application in the textile industry, replacing harsh and hazardous chemicals in various processes. They go a long way in improving production methods and fabric finishing by reducing effluent processing costs.

One of the oldest applications in this industry is the use of Amylases to remove starch size. The warp (longitudinal) threads of fabric are often coated in starch in order to prevent them breaking during weaving. Scouring is the process of purifying fabric of the native cellulase fibres from impurities such as waxes, waxes, hemicelluloses and mineral salts. Research has shown that pectin acts like glue between the fibre cores and the waxes, but can be destroyed by an Alkaline Pectinase. An increase in 'stiffness' can thus be obtained.

Cellulases have become the tool for fabric finishing. Their success started in denim finishing when it was discovered that cellulases could provide the 'luminous' stone washed look, traditionally achieved through the abrasive action of pumice stones. Cellulases are also used to prevent bleeding and expensive shrinking and prevent yarn breakage of cotton fabric, a process that is called 'Scouring. In addition, a soft hand finish is achieved.

Creating an aged look on denim. The fashion of the time, white flare was an increased emphasis on 'aging' to 'overdye'. Today processes upscale and different types of processed denim are the main type of processed denim is now finished in a way that is more desirable to denim fabric finishing chemicals. Cellulases are used for degreasing residual hydrogen peroxide after the bleaching of cotton. Hydrogen peroxide has to be removed before dying. Proteases are used for wool treatment and the degumming of raw silk.

Furthermore, Advance Enzymes is developing various enzymes and enzyme based solutions, replacing conventional age-old enzymes and hazardous chemicals. Thus, reducing processing time, minimising processing cost and the use of water. Enzymes for applications like washing, dye wash off, bleaching any sort of dye etc., are in the advanced stage of development. If enzymes can do such wonders, let us first understand WHAT ARE ENZYMES? AND WHY WE NEED THEM?

WHAT ARE ENZYMES?
Enzymes are protein-like substances that are capable of long chain of amino acids held together by peptide bonds. They are present in all living cells, where they perform a vital function by catalyzing (mainly involved) biochemical reactions, nutrients are converted into energy and health requirements. Furthermore, enzymes, like other proteins, are involved in the breakdown of food in the digestive system. Some of the food fermentation enzymes are distributed in the digestive tract of many plants, fungi, and bacteria. When broken down into simple sugars, Enzymes (mainly saccharifomes) are capable of performing these tasks. Because of these properties, enzymes are used in the food industry. They break down the proteins and other food molecules into simpler substances and make them more digestible.

ENZYME PROPERTIES
1. Enzymes are specific
   Contrary to inorganic catalysts such as acids, bases, metals and inorganic oxides, enzymes are very specific. In other words, each enzyme can break down or synthesise one particular compound. In some cases, they limit their action to specific bonds in the compound with which they react. Most proteases, for instance, can breakdown several types of protein, but in which protease molecules vary, certain bonds will be cleaved depending on which enzyme is used.

2. Enzymes are very efficient catalysts
   For example, the enzyme cellulase, which is found abundantly in the sea and in the tropical rain forest, is so efficient that in one minute, one enzyme molecule can catalyse the breakdown of five million molecules of hydrogen peroxide to water and oxygen.

3. Origin - natural source
   Enzymes are present in all biological systems. They come from natural systems and when they are degraded, the amino acids in which they are made may be readily absorbed back into nature.

4. Enzymes work only on renewable raw material
   Fruits, cereals, milk, fats, meat, cotton, leather and wood are some typical candidates for enzymatic conversion in industry. Both the usable products and the waste of most enzymatic reactions are non-toxic and readily broken down.
Need of enzymes in the textile industry

The textile processing industry produces many by-products. Processing and dyeing operations impart various finishes to fabric. These finishes give a specific look to fabrics. The traditional chemicals are being replaced by enzymes. Enzymes are biodegradable and eco-friendly. They are safe to use and they help in reducing chemical pollution, which is a concern for the textile industry.

Conventional Processes and Enzymes in the Textile Industry

A. Enzymatic desizing of cotton fabric

Although many different enzymes have been used to size cotton fabric, the most common one is alpha-amylase. This enzyme helps to break down starch present in the fabric. The enzyme is then removed by washing.

B. Scouring with enzymes

Before cotton yarn or fabric can be dyed, it goes through a number of processes in a textile mill. One important stage is scouring—the complete or partial removal of the non-cellulosic components of native cotton such as flax, pectic, hemicelluloses, and mineral salts. Scouring uses a fabric high and even “wetted out” that can be treated and dried successfully. Today, self-foaming (coefficient of surface tension) sodium hydroxide is used for scouring. These chemicals not only remove the impurities but also allow the chemicals to self-clean. In other words, the fabric is cleaned by the chemicals it contains. A high pH solution is used at 80°C to dissolve impurities, and 60°C for subsequent washing.

The use of an effective desizing method reduces the environmental impact. The production efficiency of desizing is critical. The cost of desizing is high, and the enzyme cost is low. The desizing process is essential for the improvement of fabric properties. This process is efficient, and specific for each type of fabric.

C. Enzymes for denier finishing

Most denim jeans or other denim garments are subjected to a finishing treatment to give them a slightly worn look. In the traditional stone-washing process, friction between blue jeans and an abrasive stone is used to give denim garments a worn look. However, too much abrasion can damage the fabric. Enzymatic methods and enzymatic methods are used to damage the fabric, lower the weight of the garment, and reduce the amount of water and energy required for finishing. The use of an enzyme solution can reduce the amount of water and energy required for finishing. This process is also more efficient and cost-effective.

Denim garments are dyed with indigo, which adheres to the surface of the fabric. The cellulose molecule binds to the indigo solution, which is then washed out. The enzyme solution is then added to the fabric, which reacts with the indigo solution, resulting in a blue color.

Both neutral cellulases acting at pH 6.8 and acid cellulases acting at pH 4.6 are used for the abrasion of denim. These enzymes are available in a wide range of concentrations, which can be adjusted to achieve the desired level of abrasion.
properties. These can be used either alone or in combination in order to obtain a specific look. Practical, ready-to-use formulas containing enzymes are available.

Application research in this area is focused on preventing or enhancing backstaining depending on the style required. Backstaining is defined as the redeposition of released dye onto the garments. This effect is very important in denim finishing. Backstaining at low pH values (pH 4-6) is relatively high, whereas its significant lower in the neutral pH range.

Neutral cellulases are therefore often used when the objective is minimal backstaining.

Enzymes have opened up new possibilities in denim finishing by increasing the variety of finishes available. For example, it is now possible to fade denim to a greater degree, without running the risk of damaging the garment. The denim industry is driven by fashion trends. The use of cellulase enzymes to modify the surface of denim can help the designer create new styles and trends. The combination of new textures, intense colors, unique finishing techniques and less solidly handmade products became the most widely used technique of fashion and design. Since denim fabric is already a textile innovation, denim also includes finishing of the other garments.

d. Cellulases for the Biopolishing of cotton fabric and Lyocell

Cotton and other cellulosic fabrics can be biopolished using a combination of different cellulases. These enzymes are capable of improving the surface of cotton fabric. The main advantage of biopolishing is the reduction of the porosity of the fabric. This, in turn, results in a smoother surface, even if it is called "in the bare hands. These porosity can increase in various ways. Moreover, since they result in an unattractive, knotty appearance. After biopolishing, the fabric shows a much lower pilling tendency. Other benefits of removing fuzz are a softer, smoother feel and superior color brightness. Unlike conventional softeners, which tend to be washed out and often result in a grasy feel, the softness-enhancing effects of biopolishing are washable and non-grasy.

For cotton fabrics, the use of biopolishing is optimal for finishing the fabric. However, biopolishing is almost essential for the new polyoleic. This is why make is known by the trade name "Trivial". Lyocell is made from wood pulp and characterized by a tendency to pill. Easy when wet. Its simple texture, fabric on the surface of the fabric pick-up if they are not removed. Finished garments made with lyocell will end up colored in. This is the reason why lyocell fabric is biopolished with cellulases during finishing. Cellulases also enhance the attractive, silky appearance of lyocell. Lyocell was invented in 1991 by Courtaulds Fibres from Ascendas, part of Asia Nippon and at the time was the first man-made fiber created in 30 years.

e. Enzymes for wool and silk finishing

The biopolishing of cotton and other fibres based on cellulase came first, but in 1995 enzymes were also introduced for the biopolishing of wool. Wool is made of protein and so this further treatment features a protease that modifies the wool fibers. The treatment itself is the result of the finishing of the surface of wool garments. It is made from wool. Enzymes in the finishing process are used to improve the smoothness of the fabric, i.e., to reduce the porosity of the fabric.

Proteases are also used to treat silk. Threads of silk must be degummed to become smooth. In monomeric substance that covers the skin, silk, "Toglietti", degumming is performed in an alkaline solution containing a protease. The treatment because the skin (the fiber) is also starched. Moreover, the use of proteases is based on the modern "Toglietti" process. They remove the skin without damaging the fiber, leaving high concentrations of enzymes that is no difficulty and the silk threads process through with little damage.

f. Storming with enzymes

Omnipresent acting enzymes offered in the market place are 'Enzymes for denim'. Advanced Enzymes with its application research has come up with two enzyme technology,' ADDSOUR', and 'ADSCOUR'. Further improvements of enzymes offer remarkable solubility, color brightness, and superior color with greater efficiency. The demand for high colour retention with lightweight effect after processing is on the rise. Unless a specific cellulase is designed to do this, such effects cannot be achieved. Advanced Enzymes now have the strength of Advanced Enzymes, "CELLULASE" and "ADSCOUR" to solve significant application in textile processing.

g. Enzymes for acrylic finishing

The strength of Advanced Enzymes, "CELLULASE" and "ADSCOUR" applications. Cellulase offers a significant application in textile processing.

Specialty Products by Advanced Enzymes

- **Enzymatic dying of cotton fabric**: Although many different products are available in this market place for dying, however, dyeing efficiency as the key parameter. Dyeing is the heart of all textile processing and efficient dyeing waste is a key factor achieved with Advanced Enzymes. "ADSCOURS" range of enzymes offering efficient dyeing as well as ATLAS.

Dyes are continuously processed for deepness and liberty by Advanced Enzymes.

- **Scouring with enzymes**: Omnivore leading enzymes offered in the market place are "Enzymes for denim". Advanced Enzymes with its application research has come up with two enzymes technology, 'ADDSOUR', and 'ADSCOUR'. Further improvements of enzymes offer remarkable solubility, color brightness, and superior color with greater efficiency. The demand for high colour retention with lightweight effect after processing is on the rise. Unless a specific cellulase is designed to do this, such effects cannot be achieved. Advanced Enzymes offers ADDSOUR, SEWITE, and DERMABIDE series of products to impact such finishes. Products are available in acid and neutral pH processing at ambient or high temperatures.

Dipak Reda
G.M. Marketing
**Advanced Enzymes Product List for the Textile Industry**

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<th>Application</th>
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<td>One step, desizing and bio-bleaching enzyme with protective embossing</td>
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**Advanced Enzymes New Product Release**

**One step and denim desizing stonewashing**

**Solution from Advanced Enzymes:** FADEX HB 5M

During the weaving of cotton fabric, the filaments are exposed to concentrated mechanical stress. Prior to weaving on mechanized looms, cotton yarns are often treated with chemicals like sodium or calcium carbonate or CMC / PVA / PAA in order to prevent their hand (strength and volume) to relax during weaving. Cotton yarns and other fibres can be applied to yarn in order to improve the results of cotton weaving. Also, allows for higher wearing, lower pilling, and higher brightness. Wax-based auxiliaries are predominantly hydrophilic water-based lubricants.

**The Conventional Process**

In general, after the fabric is cut and woven, the fabric proceeds to a desizing stage, followed by one of more additional finishing processes. Desizing and the removal of unwanted fines from the fabric is carried out as a preliminary step in order to prevent the formation of pilling in the final product. However, the process requires the manufacturer of the fabric to use a number of enzymes, which can lead to high costs and complex waste disposal processes.

**Post Desizing:** Desizing, the desizing agent is subjected to various finishes using different methods. For many...
Enzymes and backstaining

STANCLEAR is the answer from Advanced Enzymes

Denim is cotton cloth that has been dyed, usually blue, with the dye indigo. One desirable characteristic of indigo-dyed denim is the ablation of dyed threads with white threads, which upon normal wear and tear gives denim a white on blue appearance. A popular look for denim is the stone-washed look. Traditionally stonewashing has been performed by laundering the denim material in the presence of pumice stone, which results in fabric with a faded or worn appearance with the desired effect of blue contrast appearance. Now it's being done using enzymes.

This stonewashing look primarily consists of washing out to yield a material with more texture and character, while maintaining the desirable stone-wash or back contrast and a material that is easy to wear.

Enzymes, particularly cellulases, are already used in stone washing to remove pumice dust fibers that are produced as a result of the stone washing process. For the traditional stonewashing process, use of a fiber cationic detergent like sodium N-lauroyl sarcosinate is required. Use of enzymes for stone washing has become a popular method for achieving the same results without the harmful effects of surfactants or caustic materials; for example, sodium hydroxide in the process causes wear and tear on the machinery, it causes environmental waste problems as due to the grit produced and result in high labor costs associated with the manual removal of the stones from pumice of elements. Consequently, regulation or elimination of stones in the wash may be desirable.

However, even though the use of enzymes such as cellulases and their derivatives contribute to stone’s affinity, there are some problems associated with the use of enzymes for this purpose. For example, one problem with some AID CELLULASES is that they are degraded by bleaching and bleaching oxidants of some of the dye back onto the fabric during the enzymatic stone washing process. Such reapplication causes blue coloration of the surface, resulting in a blue contrast between the blue and white threads and abrasion points (i.e. a blue or blue look rather than the blue and white look in the wash).

The problem of reapplication of dye during stone washing has been a concern of denim processors. Previous attempts to address the problem included addition of extra anti-reapplication chemicals, such as surfactants or other agents into the cellulase wash to help disperse the loosened indigo dye and reduce backstaining. In addition, denim processors have tried using cellulases with less specific activity on denim along with extra rinsing. This results in additional chemical costs and longer
processing times. Another method to address the
redepiction problem includes adding a mild bleaching
agent or stain-removing agent in the process. This method
affects the final shade of the garment and increases
processing times.

While these methods aid to some degree in the
reduction of redeposition, the methods are not entirely
satisfactory and some objectionable backstaining remains.

Use of enzymes and stones together may be advantageous
in overcoming this redeposition problem, however, it leaves
the processor with some of the problems associated with
the use of stones. Based on the shortcomings of previous
attempted methods, there is a need for a more
environmentally friendly and more cost-effective method to
address the issue of backstaining of dye during presentation-
treatment.

Accordingly, Advanced Enzymes, a division of Advanced
Chemicals, Inc., has undertaken to find an enzymatic
replacement or process that would enhance the removal of \( N \)-alkyl derivatives from backstaining. Backstaining
Cellulase, a product of Advanced Chemicals, is used. To
overcome the problem, the Advanced Enzymes team came up with
STANCLEAR, or Backstaining removing agent, which replaces
acetate.

Users have found that treatment of indigo-dyed
denim with a solution containing the Backstaining
Cellulase and added STANCLEAR removes the
backstaining, or backstaining remaining. The treatment
of Acid Cellulase or Backstaining Cellulase in the test
water treatment significantly improves the performance in the
treatment between white and blue fabrics, which are very
complex dye patterns. A simple recipe for removal is
bleach with sodium hypochlorite. The benefits are:

1. Time savings
2. Improved resistance to backstaining
3. Uniform results
4. Improved fastness
5. Increased abrasion
6. Better washability

STANCLEAR is certainly an answer to tedious chemical
processes based on bleaching agents.

A lab scale 5 kg garment washing machine was used for the
trials. Approximately 1 kg of indigo-dyed garment was placed
in the machine. The machine was filled with 20 L hot water and
brought it to 55 °C, pH was adjusted to 4.5 using acetic acid.

Once pH was established, Acid Cellulase STANCLEAR (ATSL
ENZYM) was added at a rate of 1 ml of product/L of wash liquor.
STANCLEAR™ was used in two ways in two different sets of
trials. In the first trial, STANCLEAR™ was used along with
Acid Cellulase (treatment time 60 min) and in the second trial,
STANCLEAR™ was used in the mining bath after
Acid Cellulase (treatment time 10 min). Dose used was 1-1.5 g/L. After this, the
bath was chopped, mixed and finished.

It was observed that the denim treated with STANCLEAR
had better white appearance and whiteness compared to denim
not treated with STANCLEAR. STANCLEAR™ used in the same
bath with cellulase yielded better backstaining and lesser
abrasion. Whereas STANCLEAR™ used in the mining bath gave
higher abrasion and marginally lesser backstaining removals. But
both the cases were better than chemical based backstaining
removing chemicals. The documented data and treated
swatches shall be available upon request.

STANCLEAR™ was an effective solution to problems occurring
during the cellulase treatment, primarily for backstaining issues
without leading to too much of base indigo shades.

Here is the OAKTAGE releasing STANCLEAR enzyme:

1. Backstaining
2. Improved whiteness
3. Improved colorfastness
4. Improved abrasion
5. Better washability

Indigo Denim

Inspired by modern processing technology and driven by
the demand for stylish, fast, and producible means of
washing, bleaching, and dyeing, efforts are ongoing to
revive denim garments and production, for example, a whole
look. Denim is a wash and well-bleaching technique wherein
the fabric consists of a cotton pre-washed with blue dye and
the waist consists of an undyed, substantially white cotton
yarn. The waist may be prewashed, for example, by
evacuation with a caustic solution to remove hemicelluloses
and waxes. Blue denim, a fabric often used for producing
blue jeans, is a three-layer fabric body (K 2/2), for example,
which has a warp which is dyed blue by means of indigo

Bleaching

Indigo Denim
dye or a combination of indigo blue and sulphur black dyes, mainly on the fabric surface. A variation of the black dye typically employed for denim is made of Ultra Black and Indigo Black. An example of a true blue dye typically employed to make it blue is indigo Blue. When the combination of indigo and a blue dye is employed to produce the blue denim look, the kernels of blue dye are separate, as with cotton; however, they are being applied by a light blue and black vat in which the dye is applied to the fabric, and the resulting blue look is visible on the underside of the fabric, in contrast to the blue look from the indigo dye. Industrial launderers have used attempts to produce stylish textile designs by employing various techniques including chemical methods, such as stone washing, and/or chemical methods, such as enzyme and enzyme washing.

A. Chemical Method

First, the fabrics are cut into the desired size and/or shape. The garments are then washed, followed by a neutralization step and rinsing. The garments are then removed from the rinsing machine, turned right side out, and washed in a suitable machine with a suitable wash and rinse liquid to remove any remaining dye. The garments are then removed from the machine, the stones are removed, and the garments are bleached with sodium hypochlorite to produce a desired shade of colour. This bleaching process is done where the fabric is treated with sodium hypochlorite at 60°C and pH 11-12 for up to 30 minutes, followed by a neutralization step and rinsing. Use of hypochlorite is undesirable, both because chlorine itself is undesirable and because the neutralization subsequently generates high amounts of salts leading to disposal and pollution problems like increase in BOD and COD levels in effluent and subsequent effluent processing cost.

B. Enzyme Method - BIOTECHNOLOGY

Modern society expects biotechnology to be the answer for many world-wide problems, like pollution of air, water, soil, and land. It provides an answer to the problems of industrial use of biotechnology, known as white biotechnology, that new products and processes aimed at the use of renewable resources, as well as the application of green technologies with low energy consumption and environmentally healthy practices.

Textile processing is a growing industry that traditionally has used a lot of water, energy, and harsh chemicals, starting from pasticバス for cotton growing to high amounts of waste waters that result in waste streams.
causing high environmental burdens. As textile fibres are polymers, the majority being of natural origin, it is reasonable to expect there would be a lot of opportunities for the application of white biotechnology for textile processing. Enzymes - nature’s catalysts - are the logical tools for development of new biotechnology-based solutions for textile wet processing.

Enzyme-based products are the biotechnological alternative to chemical-based Bleaching of Indigo-derivatives. Here also two categories are available:

I. Laccase-based systems/products

II. ECOwash BB - A product that is developed for commercially use in the textile industry, advanced enzymes

II. Laccase Systems

Laccases (EC 1.10.3.2) are multifunctional oxygen oxidoreductases bearing for a family of multiheme copper oxidases. Laccases are widely documented in higher plants, fungi, some insects and bacteria. They are characterised by five (butaquo) hemes occurring in various substrates, including phenolic, polyphenolic, different substituted phenolic, aromatic, aliphatic and even inorganic compounds like lignin. Laccase needs the substrates for a one-electron oxidation mechanism, and they are aerobic oxidation as an electron acceptors. Among Laccase, the primary products include melanin, various pigments, chemical and biologically active substances present in and various characteristics are different. The copper binding sites of Laccases are, however, strictly conserved.

In order to create a successful bio-based pretreatment for denim, Laccase was introduced first for enzymatic bleaching processes. The group of enzymes called Laccases or Phenol Oxidases possesses the ability to catalyse the oxidation of a wide range of phenolic substances, including indigo. Laccases alone are not effective as bleaching agents, but need to be applied with a mediator molecule, which is the actual substrate of the Laccase and which regenerates electron transfer from, for example, indigo to molecular oxygen. Laccase mediator systems have been used to reduce backstaining, amena abrasion levels and bleach indigo in denim processing. However, it has not been possible to show bleaching affects with a Laccase mediator system on grey cotton.

Commercially available Laccase are applied on denims at pH 4.5 - 5.5 and temperature 50 - 60°C at dose level of 1.46 UG an 9NL RPS, 1.8 Pretreatment time depend on the amount of treating required; 3.3 min vary from anything between 15 to 60-min Laccaces has limitations to use. It has been used after cellulosic treatment or pre-treatment stone treatment for effective bleaching effect. Direct use after desizing will yield to non-effective fading. Cost to performance ratio is another limiting factor as of now. So there is need for further improvement in Laccase for denim Bleaching.

III. ECOwhash BB

Driven by more and more demand from our clients for eco-friendly processes, limitations in the available tools to bleach indigo and with the mission to provide eco-safe solutions, Advanced Enzymes has developed an enzyme and non-mediator based enzyme solution: ECOwhash BB to bleach indigo denim.

ECOWASH BB is a unique blend of several enzymes from the class of oxidoreductase, works in neutral pH range of 6.0 - 7.0 and temperature of 50 - 65°C.

A quick comparison of Laccase and ECOwhash BB is as follows:

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>LACCASE</th>
<th>ECOWHASH BB</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH Range</td>
<td>4.5 - 5.5</td>
<td>6.0 - 7.0</td>
</tr>
<tr>
<td>Temperature</td>
<td>50 - 60°C</td>
<td>55 - 65°C</td>
</tr>
<tr>
<td>Dose</td>
<td>1 - 1.5</td>
<td>0.5 - 2.5</td>
</tr>
<tr>
<td>Time</td>
<td>25 - 45 min</td>
<td>25 - 40 min</td>
</tr>
</tbody>
</table>

Advantages of using ECOwhash BB:

1. Faster action time over Laccase
2. Effective for longer durations in aqueous media over Laccase/mediator system
3. Cleaner look and reduced gray effect on denims
4. Reduction in the use of acetic acid
5. Low energy cost
6. Increased production
7. Can be used directly/after pre-treatment, eliminating the need of chemicals pre-treatment processes
8. Less weight loss denims
9. One catalyst
10. Biodegradable
Technology & the People

Advanced Enzymes is driven by its people and technology. Watch for details of new product developments - neutral cellulases for biofueling and ambient temperature neutral cellulases for high cost real dam finishing in the next issue.

Advanced Enzymes products soon to be launched
a. Mimosapasting
b. Wetting Enzymes
c. Dye Wash Off Enzymes
d. Softening Enzymes

A better life, A better world, With Enzymes

The protein that enzymes feed. If enzymes have potential to replace non-enzymatic chemical in this and other industries - Advanced Enzymes has a qualified team of experts both at laboratories and on the field who are working day-in and day-out to develop products to make the world healthier. At Advanced Enzymes, we envision a more sustainable world, and we are committed to making the planet a better place.

In the News

AETL to set up 3 biotech facilities

Potential Of Enzymes Yet To Be Tapped

Enzymes-Small

New eco-friendly option to process leather developed

Financial World

Food and Beverages News

The Financial Express
Enzyme Quiz

Choose the answer which BEST completes the following statements or answer the following questions. Circle the number of the answer which is correct.

1. An enzymatic reaction that occurs at 20°C would be expected to double the rate of reaction at a temperature of...
   (1) 20°C  
   (2) 40°C  
   (3) 60°C  
   (4) 10°C

2. A substrate cannot bind to an enzyme if the enzyme has...
   (1) a tertiary structure  
   (2) no active sites  
   (3) an inactive precursor  
   (4) an allosteric inhibitor

3. Noncompetitive inhibitors render the enzyme...
   (1) inactive  
   (2) less stable  
   (3) bound to the incorrectly subsite  
   (4) binding to the incorrectly subsite

4. Under what conditions will an allosteric enzyme bind to a substrate?
   (1) when an allosteric inhibitor binds to its active site  
   (2) when an activating modulator binds to its allosteric site  
   (3) when an allosteric inhibitor binds to its active site  
   (4) whenever it is a sufficient substrate  
   (5) when any modulator joins its active site

5. In negative feedback mechanisms, when excess metabolic products fill all allosteric enzyme sites...
   (1) the substrate is produced  
   (2) the metabolic reaction is halted  
   (3) the pathway is extending modulations  
   (4) metabolic activity is increased

6. According to the induced-fit hypothesis, the active site of an enzyme...
   (1) is rigid and reactive  
   (2) is generally located to its substrate perfectly  
   (3) is a change in shape to fit any substrate  
   (4) binds to any substrate  
   (5) is a specific substrate imperfectly, creating a stressed situation

7. Enzymes accelerate biochemical reactions by...
   (1) raising the energy of activation  
   (2) altering the direction of the reaction  
   (3) raising cellular temperatures  
   (4) changing equilibrium concentrations  
   (5) lowering activation energy

8. Cyanide bonds easily to the metallic portion of cytochrome molecules (respiratory enzymes). Which concept does this most directly illustrate?
   (1) Basic hindrance  
   (2) Competitive inhibition  
   (3) Induced fit  
   (4) Noncompetitive inhibition  
   (5) Enzyme

Base your answers to questions 9 and 10 below on reading the passage that follows and on your knowledge of biology.

A student ground 1 gram of beef liver to a powder, placed the ground part in a field, and added 1 ml of perchloric acid. The gas that was generated was collected. A glowing spirit burn out flames when placed in the gas. The student then repeated the procedure, using one gram of boiled liver and one gram of liver treated with a strong acid. When perchloric acid was added to each sample of liver, no gas was generated.

9. The gas that was generated was most likely...
   (1) Oxygen  
   (2) Nitrogen  
   (3) Carbon Dioxide  
   (4) Hydrogen  
   (5) Ammonia

10. If the substance in the liver that acted on the perchloric acid was an enzyme, it could...
   (1) be specific to the living tissue that had been killed  
   (2) be specific to the living tissue that had been killed  
   (3) be specific to the living tissue that had been killed  
   (4) be specific to the living tissue that had been killed  
   (5) be specific to the living tissue that had been killed

Base your answers to questions 11 and 12 below on the passage that follows and on your knowledge of biology.

A student ground 1 gram of beef liver to a powder, placed the ground part in a field, and added 1 ml of perchloric acid. The gas that was generated was collected. A glowing spirit burn out flames when placed in the gas. The student then repeated the procedure, using one gram of boiled liver and one gram of liver treated with a strong acid. When perchloric acid was added to each sample of liver, no gas was generated.

11. The gas that was generated was most likely...
   (1) Oxygen  
   (2) Nitrogen  
   (3) Carbon Dioxide  
   (4) Hydrogen  
   (5) Ammonia

12. If the substance in the liver that acted on the perchloric acid was an enzyme, it could...
   (1) be specific to the living tissue that had been killed  
   (2) be specific to the living tissue that had been killed  
   (3) be specific to the living tissue that had been killed  
   (4) be specific to the living tissue that had been killed  
   (5) be specific to the living tissue that had been killed

Base your answers to questions 13 and 14 below on the passage that follows and on your knowledge of biology.

A student ground 1 gram of beef liver to a powder, placed the ground part in a field, and added 1 ml of perchloric acid. The gas that was generated was collected. A glowing spirit burn out flames when placed in the gas. The student then repeated the procedure, using one gram of boiled liver and one gram of liver treated with a strong acid. When perchloric acid was added to each sample of liver, no gas was generated.

13. The gas that was generated was most likely...
   (1) Oxygen  
   (2) Nitrogen  
   (3) Carbon Dioxide  
   (4) Hydrogen  
   (5) Ammonia

14. If the substance in the liver that acted on the perchloric acid was an enzyme, it could...
   (1) be specific to the living tissue that had been killed  
   (2) be specific to the living tissue that had been killed  
   (3) be specific to the living tissue that had been killed  
   (4) be specific to the living tissue that had been killed  
   (5) be specific to the living tissue that had been killed