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Total Textile Care with Eco-Friendly Solutions

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For the online newsletter, please visit us at www.enzymeindia.com

EDITORIAL

Dear Friends,

Welcome to the Summer edition of Enzyme World. As always, it is our editorial goal to provide our readers with articles that have practical value for the industries in which they work. In addition, we hope to keep you informed of significant happenings in the world economic and political scene as it affects these various industries. We also want to be a resource for your questions relating to enzyme use, whatever the industry. Our value added service "Ask the Enzyme Experts" is always available for your questions. Here we offer expertise and advice in many different fields where enzymes are used. Simply forward your question to ew@enzymeindia.com and we will get back to you and possibly even print the answer in the next issue of Enzyme World.

In this issue of Enzyme World, we cover practical applications of enzymes in the textile industry. Issues such as the bioscouring of gray cotton without polluting the environment; reducing the pilling phenomenon in textile processing and finally, ecofriendly pretreatment of knits fabrics. In future issues, we will continue to provide a diverse range of applications where enzymes provide a solution. We hope each issue of Enzyme World will provide useful enzyme solutions for you.

Continuous Pretreatment & Bleaching of Textiles

Typically, this multi-step process involves the use of hazardous chemicals like caustic bleaching agents, wetting agents and surfactants. The net result is a reduction in fabric strength and color quality. Further, the chemically polluted water left over places significant pressure on an already fragile environment. Advanced Enzymes is a pioneer in providing safe, enzyme-based, bio-solutions for the textile industry. This article discusses eco-safe solutions for woven fabric processing.

Pilling and Biopolishing in Textiles

Pilling is a major problem in Textile and Apparel manufacturing. Pilling is defined as the tendency of fibers to work loose from a surface and form balled or matted particles that remain attached to the surface of the fabric. For the end consumer, it affects fabric aesthetics and comfort. For the manufacturer, fabric pilling is a headache that affects the appearance and wear-ability of finished apparels. It turns out that pilling is a complex phenomenon comprised of multiple stages that progressively accelerate the rate of fiber removal from the yarn structure, thus shortening the life span of garments and other textile products.

Ecofriendly Pretreatment of Knits – Dollarisation

Bioscouring is an important step in removing non-cellulosic impurities from grey cotton. Unfortunately, the typical process uses highly alkaline chemicals like caustic soda, soda ash, silicate and soaping agents are used. These agents not only damage the cotton structure, but the process itself results in a significant amount of pollution in the form of wastewater as well as high energy costs. AET provides an ecofriendly solution that is both energy saving and cost effective.

The SEB Group of Companies, Advanced Enzymes, Specialty Enzymes, ABTL Nutrient, Advenza and Advanced Enzytech are committed to providing innovative enzyme solutions through the research and development of products that support the many different industries we serve. The goal of Enzyme World is to be a resource to manufacturers, providing practical, ecologically responsible information on the use of enzymes in every day production operations.

Be well,

Mike Smith

PILLING AND BIOPOLISHING IN TEXTILES

Pilling is a major problem in Textile and Apparel manufacturing. Pilling is defined as the tendency of fibers to work loose from a surface and form balled or matted particles that remain attached to the surface of the fabric. For the end consumer, it affects fabric aesthetics and comfort. For the manufacturer, fabric pilling is a headache that affects the appearance and wear-ability of finished apparels. It turns out that pilling is a complex phenomenon comprised of multiple stages that progressively accelerate the rate of fiber removal from the yarn structure, thus shortening the life span of garments and other textile products.

Pilling is particularly problematic for knitted fabrics. At the same time, knitted fabrics have several advantages over woven fabrics, such as higher production rates, lower production costs and softer fabric structures. Still, the pilling problem that results from the slack fabric structure remains a significant objection. Essentially there are a number of methods to reduce pilling in commercial use. One approach is to apply surface active agents, like a polymeric coating that binds fibers to the fabric surface. These are often friction reducing lubricants, such as acrylic copolymers. Shearing and Singeing are common methods used to produce a clean, smooth surface on fabrics. Singeing, in particular has the very real potential to scorch the fabric surface. The down side of surface active agents include a reduction in hydrophilicity and the gradual loss of the agent after a few washes, which eventually makes fabrics harsh and fuzzy.

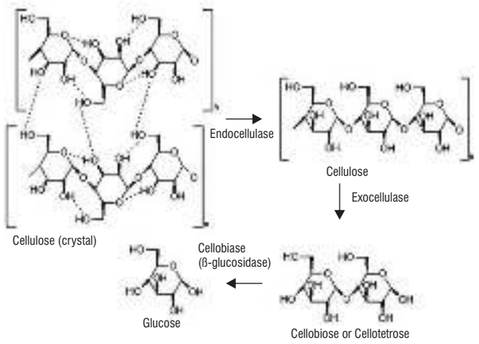
Enzymatic removal of fuzz is carried out under milder conditions and is absolutely safe, efficient and permanent. Cellulase enzymes give fabrics a clear, even surface appearance. They reduce the tendency to pill and improve softness, especially when compared to traditional softeners. More importantly, they accomplish this without polluting the environment. As a result, Cellulases are increasingly being applied to textile finishing. They are widely used to remove fibrils and fuzz fibers from cotton fabrics, or to produce a “stone-washed” look in denim garments. However, there is some loss of tensile strength with cellulase enzymes.

ACTION

Cotton is composed of cellulose fibers. Cellulose itself is a linear polymer of β-1,4-glucose units. The individual cellulose chains vary in length and can exceed more than 10,000 glucose units. It is highly crystalline in nature and insoluble in water because of the extensive hydrogen bonding between multiple cellulose chains. The insolubility and crystalline nature of cellulose make it very resistant to degradation.

What we normally call Cellulase, is actually a complex of cellulase enzymes. These enzymes bind to cellulose producing a specific catalytic action that results in the hydrolysis of 1,4-β-D glycosidic linkage in cellulose polymers. Natural cellulases are produced from the fermentation of certain fungi and bacteria. The complex of cellulase is a mixture of three major groups: endoglucanase, cellobiohydrolase (CBH) and cellobiase. Endoglucanase causes random hydrolysis in the interior of cellulose molecules resulting in smaller cellulose chains. CBH then hydrolyzes cellobiose (a disaccharide or dimer of two glucose units) from the polysaccharide chains. In either type of hydrolysis a reducing and a non reducing group is created at each point of scission. CBH splits cellobiose from the ends of cellulose and cellobiase produces two units of glucose from cellobiose.

Cellulase on action



SPECIFIC CELLULASE ACTIVITY IN DETAIL

Within each major group of cellulase, there are several different enzymes with similar function. For example, cellobiohydrolases are composed of CBHI and CBHII. Among the endoglucanases, there are at least six (EGI, EGII, EGIII, EGIV, EGV and EGVI) and at least two β-glucosidases. Most EG and CBH enzymes contain a Cellulose Binding Domain (CBD) as well as an active site linked with a glycosylated peptide link. Among the endoglucanases, EGIII is the only one that lacks the CBD and must rely on its catalytic domain for activity.

Endoglucanases mainly hydrolyze internal bonds in the cellulose polymer, producing new chain ends and thereby causing a considerable decrease in cellulose DP. CBH is needed for complete hydrolysis of crystalline region producing dimers of glucose. CBH enzymes are exoglucanases, which initiate hydrolysis at the chain ends. CBHII splits cellobiose from the non-reducing end and CBH I from the reducing ends of cellulose chains. Cellobiohydrolases can also act on crystalline cellulose without the aid of endoglucanases.

FACTORS AFFECTING HYDROLYSIS

Temperature, pH and time are only part of the process. Other issues include the following:

1) Fiber type and cross-sectional shape

2) Yarn type and construction

3) Fabric type and construction

4) Fabric finishes

5) The type of spinning system affects the pilling resistance of fabric. Yarns produced by different kinds of spinning systems have structural differences that impact pilling resistance. Ring spun yarn has real twist and good fiber orientation, while open end yarn has real twist but poor fiber orientation. In both, yarn construction and orientation is different. Commonly, ring spun yarn has approximately 20-40% higher hairiness than open end.

6) Any production process that results in a significant reduction in friction, such as with textile drums, jet or soft flow, etc., the result will be a reduction in the pilling resistance.

7) Inhibition of enzyme activity can occur and hence the rates of hydrolysis are affected by the presence of disaccharides, glucosidases, and other byproducts.

8) Mercerized cotton has more area available for cellulase to attack due to the swelling of the fibers..

9) For textile processing, the most important cellulase enzymes are predominantly EG, CBH.

TESTING

A) Both conventionally scoured and H_2O_2 bleached cotton single jersey knitted fabric 200 GSM was processed in a Soft Flow Machine.

Five different cellulase compositions were applied as follows:

SAMPLE	WEIGHT LOSS (%)	STRENGTH LOSS (%)	PILLING VALUE
1	3.85	10.8	4
2	6.6	8	5
3	2.7	8.6	4-5
4	2.5	9	4-5
5	3	12	5

B) A test comparing 2% caustic scoured, 4% caustic scoured and Bioscoured cotton using single jersey knitted fabric were processed in a Soft flow Machine, all are bleached with H_2O_2.

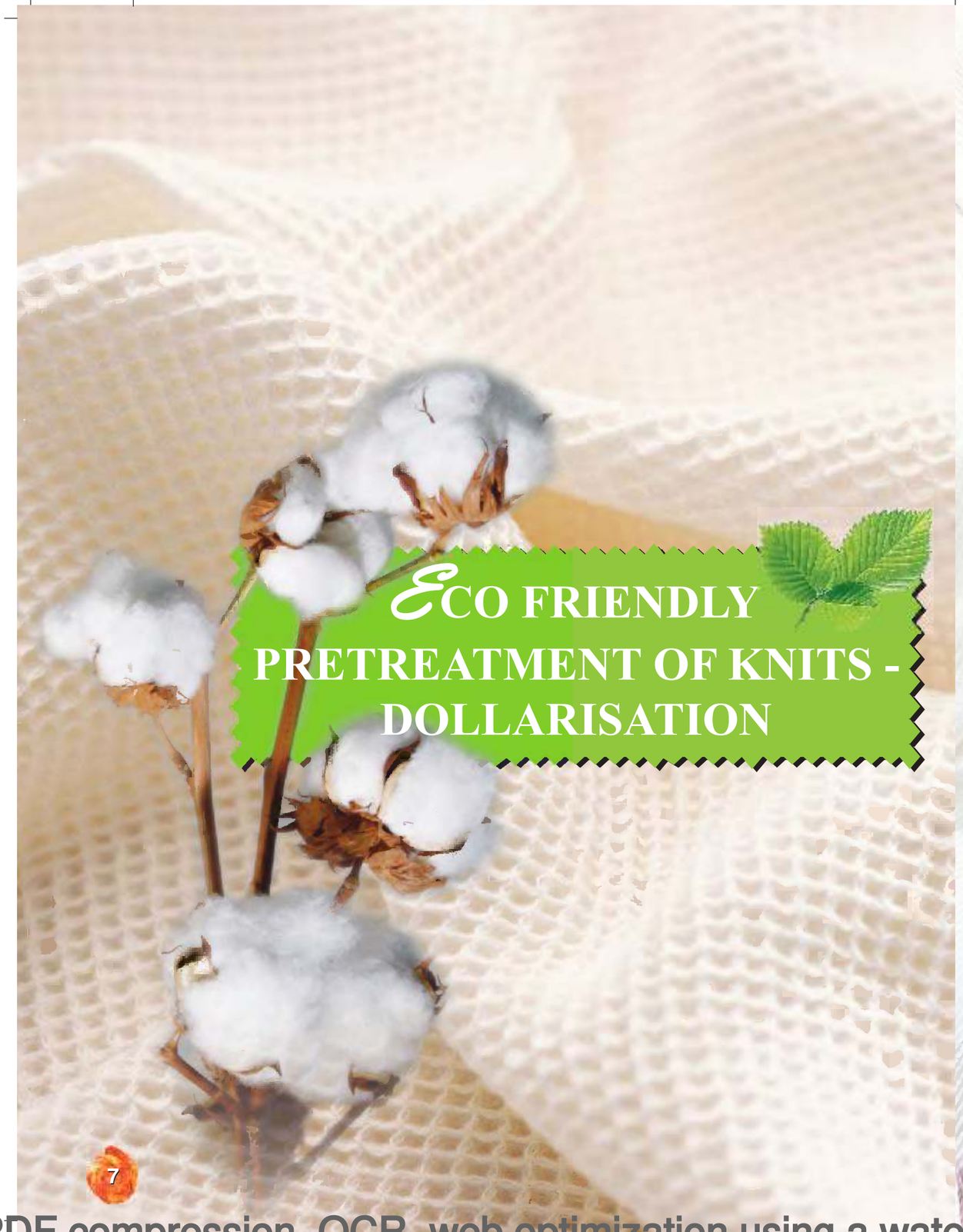
PRODUCT USED- SEBRITE

SAMPLE	WEIGHT LOSS (%)	STRENGTH LOSS (%)	PILLING VALUE
CONVENTIONAL (4%)	6	13	5
CONVENTIONAL (2%)	2.4	8.2	4-5
ADSCOUR	0.8	4	5

Bioscoured cotton showed high pilling resistance , lower weight loss and less strength loss, i.e. more pilling resistance and greater value. This result may due to the untouched cellulose structure compared to a conventional chemical boil. While the 4% caustic boiling bath showed high pilling resistance, when studied in detail, it showed the fibrils formed in high caustic treatment are so weak that they are cut off by the mechanical action of the pilling tester. Here weight loss is significantly greater.

CONCLUSION

Cellulase Enzymes are Important tools in the Cotton textile Industry. They provide an Economical and Environmental friendly way to treat cotton & its blends. The potential issue of loss in tensile strength can be reduced by using proper combination of EG & CBH enzymes as demonstrated in Advanced Enzyme Technologies Ltd Product, SEBrite. Cost effective and eco-friendly biopolishing results can be achieved by proper application with right blending of Cellulase enzymes after Bioscouring.



ECO FRIENDLY PRETREATMENT OF KNITS - DOLLARISATION

NEED OF BIOSCOURING

Grey cotton in any form needs to be scoured in order to remove natural and foreign impurities as well as make the fabric hydrophilic. Scouring removes wax and fat from the cuticle, pectin, hemicellulose and proteinaceous matter from the primary wall.

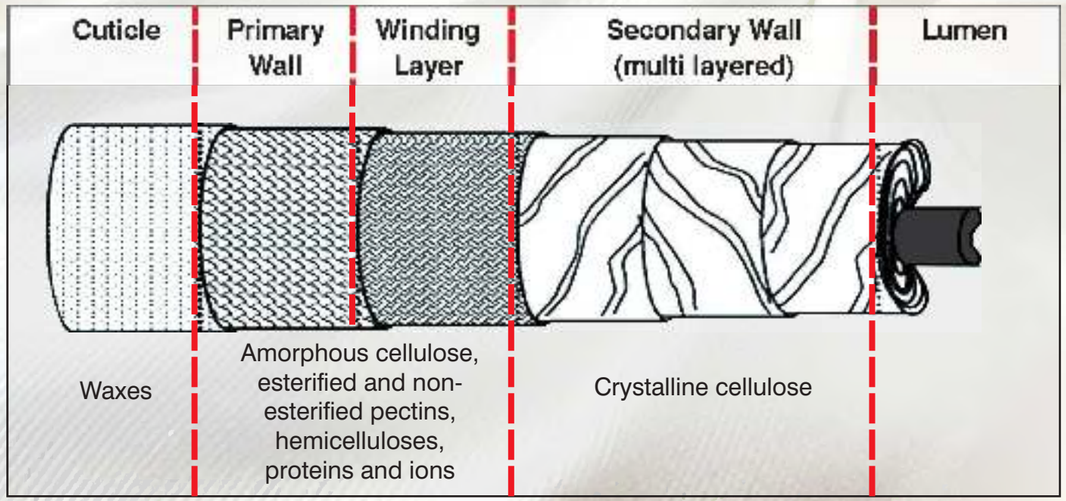
Today, highly alkaline chemicals like caustic soda, silicate and soaping agents are used for scouring to remove the non-cellulosic impurities from cotton. The use of 3-4% NaOH on cotton fabric not only results in damage to the cotton structure, but the intensive rinsing and added acid needed for neutralization results in a significant increase in the volume of effluent. These hazardous chemicals result in an increase in COD (chemical oxygen demand), BOD (biological oxygen demand) and TDS (total dissolved solids) in the wastewater. Furthermore, they attack the cellulose fibers leading to a heavy loss of both strength and weight in the fabric. The net result is low quality cotton, a polluted environment and the high usage of energy and water.

NEED OF ECOFRIENDLY KNIT PRETREATMENT PACKAGE:

In process, one can obtain better results using the AET Knit Pretreatment Package. Enzymes, which are substrate specific, only attack natural and foreign impurities, resulting better quality cotton and an eco-friendly environment.

COTTON STRUCTURE:

Cotton fiber has the following structure:



COMPOSITION OF DRY MATURED COTTON AS FOLLOWS:

Constituents	Composition (%)	
	Whole fibre	Outer layer
Cellulose/xylo-glucan	94	54
Waxes	0.6-13	14
Pectic substances	0.9-1.2	9
Protein (nitrogen substances	0.6-13	8
Ash	1.2	3
Organic acids	0.8	-
Others	1.4	12

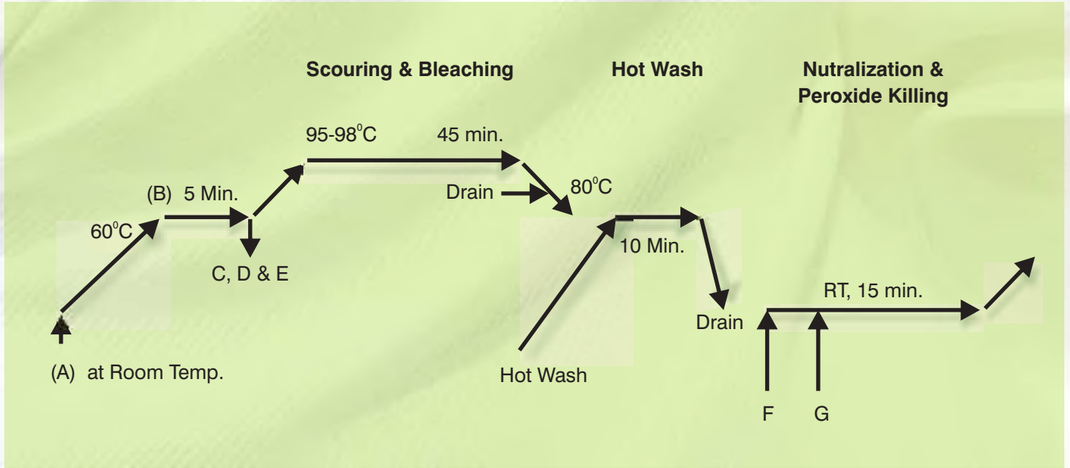
The outer layer, which includes the cuticle, primary and winding layer, contains the impurities we want to remove. The goal is to achieve quality hydrophilic cotton fabric. Removing the impurities without damaging the fabric is only possible with enzymes, which are substrate specific.

AET KNIT PRETREATMENT PACKAGE:

PRODUCTS:

Addscour PCLP : Blended Enzymes	**Sebaux WDS : Dispersing Agent**	**Sebwet CP: Wetting Agent**

PROCESS:



Charge Sebwet CPNF - 0.3% (A) at room temperature. Raise temperature to 60°C and dose Addscour LPP powder / Addscour PCLP liquid - 0.8% (B) Maintain temperature for 5 minutes. Charge Sebaux WDS - 0.25% (C), Hydrogen Peroxide – 1.5% (D), & Soda Ash – 1% (E). Raise temperature to 95°C, Hold for 45 min., Drain, Hot wash, Acetic acid (F), Addox 10L (G) Neutralization & Peroxide killing.

RESULTS ANALYSIS:

A) Drop Test

Method	Time (sec)
Alkaline scouring	Instant
Bio scouring	Instant

B) Sink Test

Method	Time (sec)
Alkaline scouring	1-2 Sec
Bio scouring	Instant

C) Weight Reduction

Method	Percentage
Alkaline scouring	7.89%
Bio scouring	3.42%

D) Whiteness

Method	Whiteness Index
Alkaline scouring	69.03
Bio scouring	69.05

E) Residual Bath

Parameter	Plane Water	Bio Scoured Bath	Alkaline Bath
T.D.S.	200 ppm	3300 ppm	>7000 ppm
pH	7.4	10.3	>13

F) Pectin content

Residual pectin (%) - Ruthenium Red Test

Alkaline Scouring (Conventional)	3850
Bio Scouring	1632

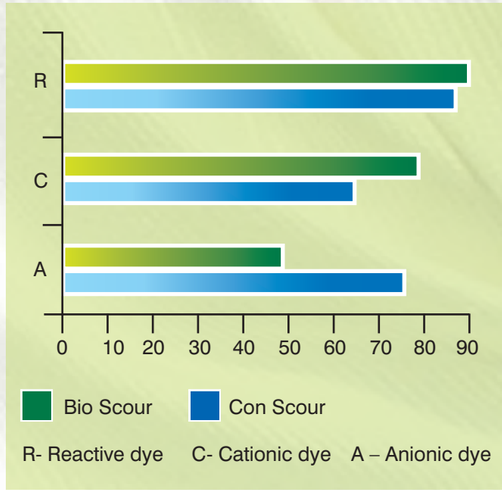
G) COD

COD values (mg O2/1) Residual bath

Alkaline Scouring (Conventional)	3850
Bio Scouring	1632

H) Dye Exhaustion

- Reactive dye exhaustion increase by 4%
- Cationic increase by 20%
- Anionic reduce by 34%



I) Finishing

Application	Alkaline Scouring	Bio Scouring
Wicking height	14.6 cms	15.6 cms
Drop test	1 sec	Instant
Sink test	2-3 sec	Instant

J) Pilling

Method	Pilling Scale
Alkaline Scouring	1-2
Bio Scouring	4-5

CONVENTIONAL SCOURING PROCESS

NaOH	:	**3%**
Sebwet CMP Eco	:	**0.5%**
Sebaux CSQ	:	**0.5%**
Seblub L	:	**0.3%**
H2O2	:	**1.5%**
Sebstab V Conc	:	**0.3%**
Temp	:	**95°C**
Time	:	**60 Min**

ADVANTAGES OF AET KNIT PRETREATMENT PACKAGE:

- Produces lower weight loss
- Is less polluting to wastewater, 50% reduction in COD, BOD and TDS
- Lower energy consumption
- Zero damaging to the fabric and the environment
- Provides a safe working environment
- Softer cotton textiles
- Reduced water consumption
- Complete removal of non-cellulosic impurities
- Uniform and high absorptive pretreated goods
- High accessibility of cotton substrate for dyestuff uptake

COST :TOTAL COST FOR 100 KG FABRIC

- Alkaline Scouring-

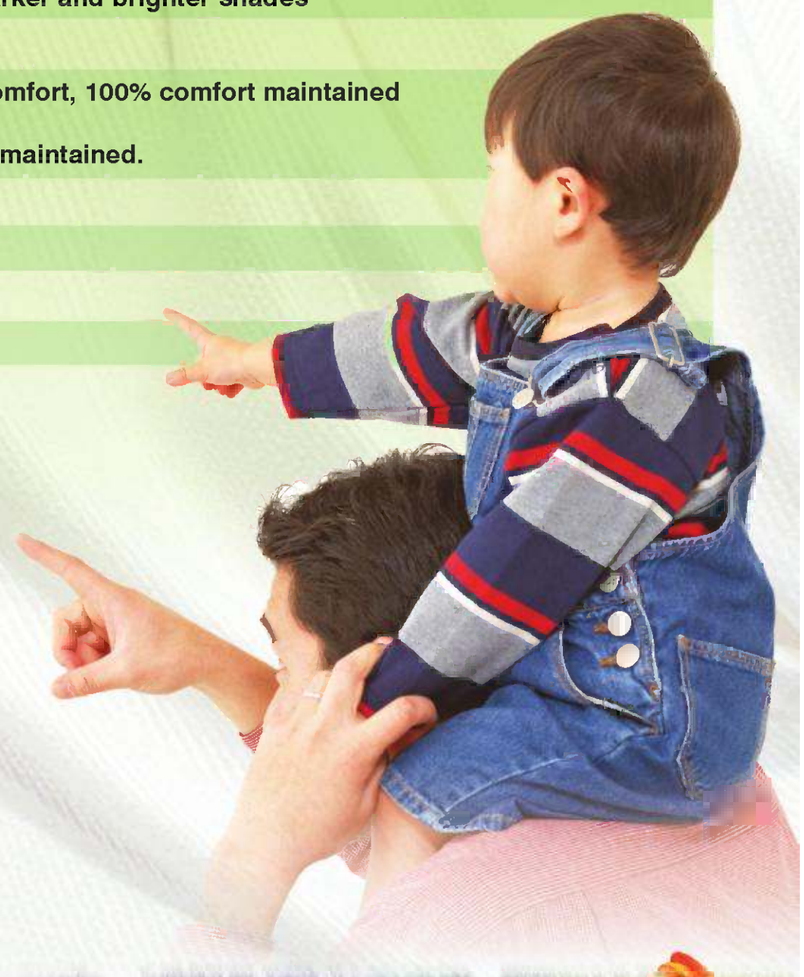
Process	INR (Rs)	$$$
1. Various chemical costs	571	14
2. 4% fabric weight loss more	700	17
3. Finishing	500	12
4. 100% risk in pollution	§	§
5. Dead cotton risk	§	§
Total cost	1771+§+§	43+§+§

- Bio Scouring

	INR (Rs)	$$$
1. Package cost	521.00	12
2. Finishing cost	250.00	6
3. Other cost	0.00	0.00
Total cost	771	18

CONCLUSION ON BIOSCOURING PACKAGE FROM AET :

- **Obtain 100% Bio processed cotton**
- **Savings of up to Rs. 100000.00 / $ 2300 per day for a unit with production of 10 MT / Day or equal to savings up to 40% (will vary from unit to unit and fabric to fabric).**
- **Additional dye pickup, darker and brighter shades**
- **Cotton is known for its comfort, 100% comfort maintained and customer happiness maintained.**
- **No Risk.**
- **No pollution.**



PRETREATING AND BLEACHING TEXTILES USING ENZYMES

INTRODUCTION

Grey cotton, in any form, must be scoured and bleached before use. Scouring and bleaching removes natural and foreign impurities as well as making the fabric Hydrophilic. The process can be achieved by removing wax and fat from the Cuticle, Pectin, Hemicellulose and Proteinaceous matter from the primary wall and natural pigments from the cotton fibers.

Typically, highly alkaline chemicals like caustic soda, soda ash, silicate and soaping agents are used for scouring. But the use of 3-4% sodium hydroxide (NaOH) damages and weakens the cotton structure. The intensive rinsing and amount of acid that is needed to neutralize cotton enlarges the volume of effluent pollution. These hazardous chemicals result in an increase of COD (chemical oxygen demand), BOD (biological oxygen demand) and TDS (total dissolved solids) in wastewater. The alkaline and acid chemicals also attack cellulose, leading to significant loss of strength and weight in the fabric. The net result is low quality cotton, a polluted environment and high usage of energy, chemicals and water.

Advanced Enzyme Technology, Limited (AETL) produces eco-safe and efficient solutions for pretreatment and bleaching of textiles. Enzymes, which are substrate specific, are environmentally friendly and only attack natural and foreign impurities in textiles, resulting in stronger, heavier and better quality cotton. Enzymes are naturally biodegradable and, therefore, do not add pollutants to effluents.

AETL PROCESS DETAILS

A good pretreatment shows no residual sizing starch, no husks, good absorbency and a bright white color. All these are achieved in three steps for woven fabrics and in two steps for knits.

For Woven Conventional Vs Enzymatic Process

STEP	CONVENTIONAL	ENZYMATIC
De-sizing (Starch removing)	Using acid, Oxidative agent	YES
Scouring (Pectin, Wax and other non-cellulosic material removing	Caustic along with Wetting Agent	YES
Bleaching (Destruction of natural coloring matter)	Hydrogen peroxide or sodium hypochlorite	YES

AETL produces an eco-friendly system that results in minimum weight loss, significantly less effluent load and a better property fabric.

a. Desizing

i Pad Batch Method

4-8 gm/l	-	Supersize XS
2-3 ml/l	-	Sebwet CP
1-2 ml/l	-	Sebaux PD
Liquor pick up	-	100
Impregnation temperature	-	RT up to 50°C
Batch	-	4-8 hrs
Hot wash		

ii Pad steam method

3-4 ml/l	-	Rapidex/HT40L
2-3 ml/l	-	Sebwet CP
1-2 ml/l	-	Sebaux PD
Liquor pick up	-	100
Pad		60 - 90°C
Steam	-	5-10 min at 100°C saturated steam
Hot wash		

b. Combined Desizing, Scouring and Bleaching

Desizing and Cracking

2-4 ml/kg	-	Sebwet CP
2-4 ml/kg	-	Rapidenz HT 40L
1-2 ml/kg	-	Sebaux PD

↓

Injecta

↓

Scouring and Bleaching
Impacta

(CHEMICAL PROCESS)

1-2 ml/kg	-	Sebwet CP
4-6 ml/kg	-	Sebstab SCC
30-40 ml/kg	-	NaOH(50%)
25-30 ml/kg	-	H2O2(50%)

or

(ENZYMATIC PROCESS)

1-2 ml/kg	-	Sebwet CP
4-6 ml/kg	-	Sebstab SCC
8-10 ml/kg	-	Addscour PCLP
25-30 ml/kg	-	H2O2(50%)

pH 10.5 - 11

↓

Reacta

↓

Washing after steaming

↓

Neutralization

APPLICATION TESTING

The quality of the pretreatment was assessed by subjecting the bleached textile material to the following tests:

1. Whiteness- Berger.
2. Residual peroxide - Titrimetrically with 0.1N KMnO4
3. The average degree of polymerization (DP) - Viscometrically by Cuprammonium Hydroxide
4. The hydrophilicity - the absorption time (Sink , Drop or Capillary).
5. Starch - Tegewa Method.

RESULTS

TEST PARAMETER	CHEMICAL	ENZYMATIC
WHITENESS	75.60	75.8
WEIGHT REDUCTION	5.20	2.80
HYDROPHILICITY (DROP TEST)	2 Sec	INSTANT
HYDROPHILICITY (SINK TEST)	2 Sec	INSTANT
DYE PICK UP		15% MORE

CONCLUSION

AETL's Enzymatic process for continuous treatment is comparable to chemical treatment in whiteness and superior in weight reduction, hydrophilicity and dye Pickup. In addition, enzyme pretreatment is not only cost effective, but is environmentally friendly resulting much less pollution in effluent load.

Concern about the effects of Acetaminophen

Acetaminophen (most notably sold under the brand name Tylenol) is most commonly used for pain relief. While this common drug already sits in most cabinets and has not changed, the new element to this discussion is the increased public awareness that it is the most common cause of acute liver failure in the U.S. In acute liver failure, the organ fails quickly, sometimes in as little as 48 hours, as opposed to the more usual forms of liver failure that take years to develop. Generally, this form of liver failure comes from an overdose of acetaminophen. While the amount that is considered an overdose is relative, the fact is the more acetaminophen taken daily for long periods of time increases the susceptibility to higher amounts of toxicity. The potential toxicity of this commonly used over-the-counter pain reliever is a huge topic right now. Thus, last month a Food and Drug Administration advisory committee met to review what could be done to reduce accidental poisoning from acetaminophen. Currently, the maximum dose is 1,000 milligrams, up to four times per day; the FDA advisory panel wants to lower that amount to 625 milligrams. In 2008, the California Poison Control System logged 16,352 cases of suspected acetaminophen overdose, according to the agency's executive director, Stuart Heard. Most cases were not serious; however 4,000 people were hospitalized. With the awareness on the issue growing, acetaminophen users seem to be turning to more natural pain relievers.

Miller-Coors Merger

Recently, SABMiller Plc, a global brewer based in London, and Molson Coors Brewing Co., with headquarters in Denver and Montreal, merged their U.S. operations. Their vision is “to become the best beer company in America,” said Leo Kiely, who will be CEO of the joint venture. More importantly, they aim to be a stronger competitor to Anheuser-Busch Cos., the dominant U.S. brewer. Currently, Anheuser-Busch has a 48% market share and has been the nation's dominant brewer since the 1980's. Together, Miller and Coors will have a 29% market share. In addition, the companies expect to save $500 million a year by combining their operations with estimated net revenues of $6.6 billion. While none of Miller's six breweries or the two breweries operated by Coors will close, the discussion about central headquarters is still in the works. Ultimately, these companies hope to save money and become a better competitor in the massive U.S. beer and ale market. The merger of the number 2 and 3 brewing companies places significant competition in the brewing industry.

The Allergy Problem

Allergies are on the rise. More and more people are diagnosed with allergies. The question is, why? There are varying theories that attempt to solve this puzzle, yet somehow most seem to fall short. For example, the hygiene theory claims that our nation's addiction to antiseptics, antibiotics and cleanliness prevents our immune systems from developing the ability to ward off real infections. This theory falls short when it comes to low-income urban areas in the U.S., where children are exposed more to germs and yet their rate of allergies remain high. Other theories include deficiencies in vitamin D, which has strong effects on parts in the immune system, or an excess of dietary folic acid (U.S. rates of allergies began to rise around the same time that the government mandated fortification of many foods with the vitamin). However a study published in June in the Journal of Allergy and Clinical Immunology found the opposite -- that people with higher levels of folate in their blood (the natural form of folic acid) were 30% less likely to have allergies. Nevertheless, this growing problem continues to puzzle healthcare professionals. The first step is to discover the cause of the increase. Then scientists can work reverse the trend.

1) Which enzyme digested egg albumin into peptides and amino acids best in alkaline conditions?

a) Amylase b) Catalase
c) Lipase d) Pepsin

2) The "lock and key hypothesis" attempts to explain the mechanism of

a) Vacuole formation b) Pinocytisis
c) Sharing of electrons d) Enzyme specificity

3) A positive test for starch was indicated by formation of…..

a) A blue / black with iodine
b) Orange / red with Benedicts
c) Peach / yellow with fenol red
d) Disappearance of egg albumin

4) Why were the enzymes catalase and amylase placed in a 37˚water bath?

a) That is body temperature
b) Temperature seeds enzyme activity
c) Both 2 and 3 are true
d) None of the above

5) Which enzyme unwinds DNA?

a) Amylase b) Nuclease
c) Helicase d) None of the above

6) All enzymes are made up of which biomolecules?

a) Protein b) RNA
c) Both 1 and 2 d) None of the above

7) Which of the following enzymes would digest a fat?

a) Sucrase b) Fatase c) Protease d) Lipase

8) A catalyst is a substance which

a) Increases the rate of chemical reaction but is itself unchanged by the reaction
b) Is toxic to most cells
c) Is composed mostly of lipids
d) Does not usually participate in any chemical reactions

9) An enzyme that hydrolyzes protein will not act upon starch. This fact is an indication that enzymes are?

a) Hydrolytic
b) Specific
c) Catalytic
d) Synthetic

10) Which environmental factor "denatured" catalase?

a) Cooking b) Low ph
c) Sodium peroxide d) Hydrogen peroxide

Answers: 1 (d), 2 (d), 3 (a), 4 (a), 5 (c), 6 (c), 7 (d4), 8 (a), 9 (b), 10 (d)