REDEPOSITION OR BACKSTAIN INHIBITION DURING STONEWASHING PROCESS

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ABSTRACT
The present invention relates to the inhibition of backstaining or redeposition during the stonewashing process by applying a lipolytic enzyme, preferably cutinase, thereby avoiding that the blue color redeposits on the fabric or garment.
REDEPOSITION OR BACKSTAIN INHIBITION DURING STONEWASHING PROCESS

CROSS-REFERENCE TO RELATED APPLICATIONS


FIELD OF THE INVENTION

[0002] The present invention relates to compositions and methods for reducing or preventing the backstaining of dye on textile materials, especially indigo on denim and specially the backstaining of pocket parts of denim during the stonewashing of denim fabric.

BACKGROUND OF THE INVENTION

[0003] By stonewashing of denim the usually blue-dyed denim is given a faded or worn appearance with the characteristic white and blue contrast. Stonewashing the denim material is typically carried out in the presence of pumice stone or cellulase or a combination thereof and results in the removal of dye to give areas of lighter color. The use of cellulase instead of pumice stone has the advantages that it is more environmentally friendly, more economical and prevents that the denim is damaged by the rough treatment with the pumice stones. However, the use of cellulase is not without disadvantages.

[0004] The dye removed from the denim material after the treatment with cellulase or by a conventional washing process may cause “backstaining” or “redeposition” onto the denim material, e.g. re-coloration of the blue threads and blue coloration of the white threads, resulting in a less contrast between the blue and white threads. In order to remove the dye the denim manufacturers are using huge amount of surfactants to make parts white again at a soaping process with heavy washing condition. The heavy washing condition causes color change or color-fading problems for finished denim products. Also additional water has to be used in the subsequent soaping process.

[0005] The problem of redeposition or backstaining of dye during stonewashing has also been addressed by adding anti-redeposition chemicals, such as surfactants or other agents into the cellulase wash. Also the use of different cellulases with less specific activity on denim has been tried. WO 94/07983 describes the use of a cellulase to inhibit the backstaining of denim. WO 94/29426 and WO 93/25655 describes backstain inhibition by treatment with a redoposition cellulase composition and added protease as an improvement over the use of redeposition cellulase alone.

[0006] Although, these methods aim to solve the problem with the backstaining or redeposition of dye onto the denim material, they may still be improved. In particular, the backstaining or redeposition of dye onto the pocket parts of the denim material poses a problem.

SUMMARY OF THE INVENTION

[0007] We have developed a process for treating fabric, especially indigo-dyed denim, with a composition comprising a lipolytic enzyme.

[0008] This treatment reduces the risk of back-staining (redemption of dye onto textile) even when less water is used. The enzymatic treatment of released dyestuff will decrease process time as well as the amount of energy and water needed to achieve a satisfactory quality of the textile, and the color of the wastewater is reduced.

[0009] The method of the invention can result in a decreased number of washes, thereby increasing the productivity and decreasing the consumption of water and chemicals, including surfactants.

[0010] Accordingly, the present invention provides a method for reducing the backstaining of fabric or textile, comprising contacting the fabric or textile with a composition comprising an effective amount of a lipolytic enzyme (EC 3.1.1).

[0011] In another aspect, the present invention relates to a stonewashing composition comprising a lipolytic enzyme and a cellulase.

[0012] In a third aspect, the invention relates to the use of the composition for reducing backstaining of fabric or textile.

DETAILED DISCLOSURE OF THE INVENTION

[0013] Denim that is stonewashed with the addition of an effective amount of added lipolytic enzyme during cellulase treatment shows a reduction in the level of backstaining, especially the backstaining of pocket parts.

[0014] The method of the present invention comprises contacting the denim to be enzymatically stonewashed with a composition comprising the lipolytic enzyme in an amount sufficient to reduce backstaining and thus, to decrease the blue-coloring of e.g. the pocket parts.

[0015] The amount of added lipolytic enzyme depends upon others on the purity and amount of cellulase used in the stonewashing process, the contact time, the amount of dye removed during stonewashing, the activity of the cellulase, the pH and temperature of the stonewashing process, the formulation of the product and the like.

[0016] The composition to be added may further comprise various agents, such as understood by the skilled person, e.g. surfactants. Other materials can also be used with the composition as desired, including stones, fillers, solvents, buffers, pH control agents, enzyme activators, builders, enzyme stabilizers, other anti-redeposition agent and the like. The composition may be formulated at a solid product, granular product or as a liquid product.

[0017] The lipolytic enzyme may be added to the composition containing the cellulase for use in stonewashing process or added directly to the stonewashing bath or to a subsequent rinse treatment. The lipolytic enzyme may also
be added to a composition for washing purposes thereby reducing or inhibiting the backstaining of removed dye during the washing process.

[0018] Fabrics

[0019] The process of the present invention applies to fabrics in general. In the context of this invention fabrics include fabrics or textiles prepared from man-made fibers, e.g. polyester, nylon, etc., as well as cellulosic fabrics or textiles.

[0020] The term “cellulosic fabric/textile” indicates any type of fabric, in particular woven fabrics, prepared from a cellulosic-containing material, containing cellulose or cellulose derivatives, e.g. from wood pulp, and cotton. The main part of the cellulose or cellulose derivatives present on the fabric is normally size with which the yarns, normally warp yarns, have been coated prior to weaving. In the present context, the term “fabric” is also intended to include garments and other types of processed fabrics. Examples of cellulosic fabric is cotton, viscose (rayon); lyocell; all blends of viscose, cotton or lyocell with other fibers such as polyester; viscose/cotton blends, lyocell/cotton blends, viscose/wool blends, lyocell/wool blends, cotton/wool blends; flax (linen), ramie and other fabrics based on cellulose fibers, including all blends of cellulosic fibers with other fibers such as wool, polyamide, acrylic and polyester fibers, e.g. viscose/cotton/polyester blends, wool/cotton/polyester blends, flax/cotton blends etc. The fabric may also include man-made fibers alone such as polyester fibers.

[0021] The process of the invention is preferably applied to cellulosic-containing fabrics, such as cotton, viscose, rayon, ramie, linen or mixtures thereof, or mixtures of any of these fibers with synthetic fibers. In particular, the fabric may be denim. The fabric may be dyed with vat dyes such as indigo, direct dyes such as Direct Red 185, sulfur dyes such as Sulfar Green 6, or reactive dyes fixed to a binder on the fabric surface. In a preferred embodiment of the present process, the fabric is indigo-dyed denim, including clothing items manufactured therefrom.

[0022] In a most preferred embodiment, the fabric subjected to the process of the invention is made of hydrophobic fibers such as polyamide fibers, e.g. nylon, acrylic fibers, viscoyn and polyester fibers. As mentioned above the fabric may be made of mixtures of different fibers. Especially contemplated is polyester or polyester/cotton mixtures, which are the material used for pocket parts of garments, in particular cotton garments or denim jeans.

[0023] Enzyme


[0025] In the context of this invention lipolytic enzymes are classified in EC 3.1.1.1 and include true lipases, esterases, phospholipases, and lyso-phospholipases. More specifically the lipolytic enzyme may be a lipase as classified by EC 3.1.1.3, EC 3.1.1.25 and/or EC 3.1.1.26, an esterase as classified by EC 3.1.1.1, EC 3.1.1.2, EC 3.1.1.6, EC 3.1.1.7, and/or EC 3.1.1.8, a phospholipase as classified by EC 3.1.1.14 and/or EC 3.1.1.32, a lyso-phospholipase as classified by EC 3.1.1.5 and a cutinase as classified in EC 3.1.1.74.

[0026] The lipolytic enzyme preferably is of microbial origin, in particular of bacterial, of fungal or of yeast origin.

[0027] In a particular embodiment, the lipolytic enzyme used may be derived from a strain of Absidia, in particular of.- Absidia blakesleena and Absidia corymbifera, a strain of Achromobacter, in particular of Achromobacter iophaagus, a strain of Aeromonas, a strain of Alternaaria, in particular of- Alternaaria brassicicola, a strain of Aspergillus, in particular of Aspergillus niger and Aspergillus flavus, a strain of Achromobacter, in particular of Achromobacter iophaagus, a strain of Aureobasidium, in particular of Aureobasidium pullulans, a strain of Bacillus, in particular of Bacillus pumilus, Bacillus strearrothermophilus and Bacillus subtilis, a strain of Beauveria, a strain of Brochothrix, in particular of Brochothrix thermosohata, a strain of Candida, in particular of Candida cindreae (Candida rugosa), Candida paralipolytica, Candida tsukubaensis, Candida auriculariae, Candida humicola, Candida foliarum, Candida cindreae (Candida rugosa) and Candida antarctica, a strain of Chromobacter, in particular of Chromobacter viscosum, a strain of Coprinus, in particular of Coprinus cinereus, a strain of Fusarium, in particular of Fusarium oxysporum, Fusarium solani, Fusarium solani pisi, and Fusarium roseum culmorum, a strain of Geotricium, in particular of Geotricium penicillitatum, a strain of Hansenula, in particular Hansenula anomala, a strain of Humicola, in particular of Humicola brevispora, Humicola lanuginosa, Humicola brevis var. thermoida, and Humicola insolens, a strain of Hypoxyzma, a strain of Lactobacillus, in particular of Lactobacillus curvatus, a strain of Matheriza, a strain of Mucor, a strain of Paecilomyces, a strain of Penicillium, in particular of Penicillium cyclopium, Penicillium crustosum and Penicillium expansum, a strain of Pseudomonas in particular of Pseudomonas aeruginosa, Pseudomonas alcaligenes, Pseudomonas cepacia, syn. Burkholderia cepacia, Pseudomonas fluorescens, Pseudomonas fragi, Pseudomonas maltophilia, Pseudomonas mendocina, Pseudomonas mephitica lipolytica, Pseudomonas alcaligenes, Pseudomonas plantarii, Pseudomonas pseudoacligenes, Pseudomonas putida, Pseudomonas stutzeri, and Pseudomonas wisconsinensis, a strain of Rhizoctonia, in particular of Rhizoctonia solani, a strain of Rhizomucor, in particular of Rhizomucor miehei, a strain of Rhizopus, in particular of Rhizopus japonicus, Rhizopus microsporus and Rhizopus nodosus, a strain of Rhodospiridium, in particular of Rhodospiridium toruloides, a strain of Rhodotorula, in particular of Rhodotorula glutinis, a strain of Sperobolomyces, in particular of Sperobolomyces shibataanus, a strain of Thermonyces, in particular of Thermomyces lanuginosus (formerly Humicola lanuginosa), a strain of Thiarosporella, in particular of Thiarosporella phaseolina, a strain of Trichoderma, in particular of Trichoderma harzianum, and Trichoderma reesei, and/or a strain of Verticillium.

[0028] In a more preferred embodiment, the lipolytic enzyme used according to the invention is derived from a strain of Aspergillus, a strain of Achromobacter, a strain of Bacillus, a strain of Candida, a strain of Chromobacter, a strain of Fusarium, a strain of Humicola, a strain of
Hyphozyma, a strain of Pseudomonas, a strain of Rhizomucor, a strain of Rhizopus, or a strain of Thermomyces.

In a more preferred embodiment, the lipolytic enzyme used according to the invention is derived from a strain of Bacillus pumilus, a strain of Bacillus stearamotherophilus, a strain of Candida cylindracea, a strain of Candida antarctica, in particular Candida antarctica Lipase B (obtained as described in WO 88/02775), a strain of Humicola insolens, a strain of Hyphozyma, a strain of Pseudomonas cepacia, or a strain of Thermomyces lanuginosus.

In the context of this invention biopolyester hydrolytic enzyme include esterases and poly-hydroxalkanoate depolymerases, in particular poly-3-hydroxyalkanoate depolymerases. In fact an esterase is a lipolytic enzyme as well as a biopolyester hydrolytic enzyme.

In a more preferred embodiment, the esterase is a cutinase or a suberinase. Also in the context of this invention, a cutinase is an enzyme capable of degrading cutin, e.g. Lin T S & Kolattukudy P E, *J. Bacteriol.* 1978, 133 (2) 942-951, a suberinase is an enzyme capable of degrading suberin, e.g., Kolattukudy P E, *Science* 1980, 208 990-1000, Lin T S & Kolattukudy P E, *Physiol. Plant Pathol.* 1980, 171-15, and The *Biochemistry of Plants*, Academic Press, 1980, Vol. 4 624-634, and a poly-3-hydroxyalkanoate depolymerase is an enzyme capable of degrading poly-3-hydroxyalkanoate, e.g. Foster et al., *FEMS Microbiol. Lett.* 1994, 118 279-282. Cutinases, for instance, differ from classical lipases in that no measurable activation around the critical micelle concentration (CMC) of the tributyrine substrate is observed. Also, cutinases are considered belonging to a class of serine esterases.

The biopolyester hydrolytic enzyme preferably is of microbial origin, in particular of bacterial, of fungal or of yeast origin.

In a preferred embodiment, the biopolyester hydrolytic enzyme is derived from a strain of Aspergillus, in particular Aspergillus oryzae, a strain of Alternaria, in particular Alternaria brassicicola, a strain of Fusarium, in particular Fusarium solani, Fusarium solani pisi, Fusarium roseum culmarum, or Fusarium roseum sambucium, a strain of Helminthosporum, in particular Helminthosporum sativum, a strain of Humicola, in particular Humicola insolens, a strain of Pseudomonas, in particular Pseudomonas mendocina, or Pseudomonas putida, a strain of Rhizoctonia, in particular Rhizoctonia solani, a strain of Streptomyces, in particular Streptomyces scabies, or a strain of Ulocladium, in particular Ulocladium consortiale. In a most preferred embodiment the biopolyester hydrolytic enzyme is a cutinase derived from a strain of Humicola insolens, in particular the strain Humicola insolens DSM 1800.

In another preferred embodiment, the poly-3-hydroxyalkanoate depolymerase is derived from a strain of Alcaligenes, in particular Alcaligenes faecalis, a strain of Bacillus, in particular Bacillus megaterium, a strain of Camomonas, in particular Camomonas testosteroni, a strain of Penicillium, in particular Penicillium furcatum, a strain of Pseudomonas, in particular Pseudomonas fluorescens, Pseudomonas lipoxygei and Pseudomonas oleovorans, or a strain of Rhodospirillum, in particular Throphosphirillum rubrum.

Specific examples of readily available commercial lipases include Lipolase® (WO 98/35026) Lipolase™ Ultra, Lipzyme®, Palatase®, Novozym® 435, Lecitase® (all available from Novozymes A/S).

Examples of other lipases are Lumafast™, Ps. mendocina lipase from Genencor Int. Inc.; Lipomax™, Ps. pseudocaligines lipase from Gist Brocades/Genencor Int. Inc.; Fusarium solani lipase (cutinase) from Unilever; Bacillus sp. lipase from Solvay Enzymes. Other lipases are available from other companies.

Process Conditions

In the case of denim textiles (especially indigod dyed denim), the process according to the invention can be carried out simultaneously with a treatment with cellulase (and optionally pumice) to create a desired worn look by forming local variations in color density, as described in American dye stuff reporter, Sept. 90, D. Kochavi, T. Videback and D. Cedroni, Optimizing processing conditions in enzymatic stone washing. The process of the invention can also be carried out simultaneously with enzymatic desizing, i.e. removal of starch size by means of an alpha-amylase. In a further aspect, the process is a conventional washing process, wherein the enzyme of the invention is added to a conventional detergent composition.

The process of the invention may be carried out at conventional conditions in a washing machine conventionally used for stone-washing, e.g. a washer-extractor. The enzyme of the invention should be added in an effective amount. By the term “effective amount” is meant the amount sufficient to reduce backstaining as compared to the backstaining effect when not applying the enzyme of the invention. Typical conditions are a temperature of 40-60° C. and a pH of 4.5-7.5. However, the process conditions must be chosen according to the characteristics of the enzyme in question. They are generally in the range 20-100° C., pH 4.5-10.5, typically 30-90° C., pH 4.5-7.5 especially 40-60° C., pH 4.5-6.5. Optionally, conventional additives may be used, e.g. a buffer, a surfactant (anionic and/or non-ionic) and/or a polymer (such as PVP, polyacrylate and polyacylamide).

Materials and Methods

Enzymes:

Cutinase A (Cutinase variant from Humicola Insolens according to U.S. Pat. No. 5,827,719).

Cutinase B (Cutinase variant from Humicola Insolens according to U.S. Pat. No. 5,827,719).

Denimax® 362S (available from Novozymes A/S).

Lipolase® (available from Novozymes A/S).

Lipolase™ Ultra (available from Novozymes A/S).

Cellulase® I (available from Novozymes A/S).

Lipolytic Activity

The lipolytic activity may be determined using tributyrine as substrate. This method is based on the hydrolysis of tributyrine by the enzyme, and the alkali consumption is registered as a function of time.
One Lipase Unit (LU) is defined as the amount of enzyme which, under standard conditions (i.e. at 30.0°C; pH 7.0; with Gum Arabic as emulsifier and tributyryl as substrate) liberates 1 mmol titrable butyric acid per minute (1 KLU=1000 LU).

A folder AF 95/5 describing this analytical method in more detail is available upon request to Novozymes A/S, Denmark, which folder is hereby included by reference.

Cellulolytic Activity

The cellulytic activity may be measured in endo-glucanase units (EGU), determined at pH 6.0 with carboxymethyl cellulose (CMC) as substrate.

A substrate solution is prepared, containing 34.0 g/l CMC (Hercules 7 LFD) in 0.1 M phosphate buffer at pH 6.0. The enzyme sample to be analyzed is dissolved in the same buffer, 5 ml substrate solution and 0.15 ml enzyme solution are mixed and transferred to a vibration viscometer (e.g. MIVI 3000 from Sofraser, France), thermostated at 40° C. for 30 minutes.

One EGU is defined as the amount of enzyme that reduces the viscosity to one half under these conditions. The amount of enzyme sample should be adjusted to provide 0.01-0.02 EGU/ml in the reaction mixture. The arch standard is defined as 880 EGU/g.

The cellulolytic activity may also be determined in endo-cellulase units (ECU) by measuring the ability of the enzyme to reduce the viscosity of a solution of carboxymethyl cellulose (CMC).

The ECU assay quantifies the amount of catalytic activity present in the sample by measuring the ability of the sample to reduce the viscosity of a solution of carboxymethyl cellulose (CMC). The assay is carried out at 40° C., pH 7.5; 0.1 M phosphate buffer; time 30 min; using a relative enzyme standard for reducing the viscosity of the CMC. Hercules 7 LFD substrate; enzyme concentration approx. 0.15 ECU/ml. The arch standard is defined as 8200 ECU/g.

Color Measurement

A Nippon Denshoku's spectrophotometer (SE 2000), which was in accordance with JIS Z8722, ASTM E308, ASTM E313 and ASTM D1925, was used according to the manufacturer's instructions to evaluate the chromaticity using the change in the color space coordinates L* a* b* (CIELAB-system), where as usual:

L* gives the change in white/black on a scale from 0 to 100, and a decrease in L* means an increase in black color (decrease in white color) and an increase in L* means an increase in white color (decrease in black color).

a* gives the change in red/green, and a decrease in a* means an increase in green color (decrease in red color), and an increase in a* means an increase in red color (decrease in green color).

b* gives the change in blue/yellow, and a decrease in b* means an increase in blue color (decrease in yellow color), and an increase in b* means an increase in yellow color (decrease in blue color) (Vide WO 96/12846 NOVO).

The Nippon Denshoku's spectrophotometer (SE 2000) was operated in the L*a*b* color space. The light source was D65 standard light. The software used for evaluation was ColorMate Version 4.05. The illumination and light-receiving conditions of this instrument are 0-45° after spectrum method based on JIS Z-8722 and was calibrated using the white and black tiles. Each result was an average of 4 measurements. Fabric rinsed without enzyme and mediator was measured and the coordinates L*a*b* were calculated and entered as a reference. The coordinates of the samples were then for each of L*, a*, b* calculated as the difference of the average of the measurements on each swatch from the reference value.

The present invention is further illustrated in the following examples, which are not in any way intended to limit the scope of the invention as claimed.

EXAMPLE 1

Comparison of Anti-Back Staining Effect between Cutinase A and Endolase

An Indigo solution was prepared by washing denim with model washing agent. The compositions of model washing agent are as follows:

- Sodium dihydrogen phosphate: 6.2 g/20 L
- Sodium citrate: 5.8 g/20 L
- Novasol P: 2.4 g/20 L
- Carezyme 1000 L (available from Novozymes A/S): 2.8 g/20 L

The washing conditions were as follows:

| Temperature: 55°C | Washing Time: 120 min | Enzyme: Model washing agent | Enzyme dosage: 1 g/L | Washing liquor: Deionized water (3° dH)/20 L | Denim: Kurabo KD511 | Bath ratio: 1:20 |

Washing machine: Wascator (FOM71 MP-Lab.)

Swatches (10 cm x 10 cm) of polyester and polyester/cotton was washed with the indigo solution (pH=6.5) prepared above with Cutinase A and a cellulase (Denimax® 362S), respectively. The conditions were:

| Temperature: 55°C | Washing Time: 60 min | Enzyme: Cutinase A and Endolase (Novozym® 613, 3090 ECU/g) | Enzyme dosage: 0, 1, 3, 5, 10 mg enzyme protein/L | Swatch: Polyester, Polyester/Cotton | Swatch size: 10 cm x 10 cm | T-O-M: 120 rpm |

| Enzyme dosage: 10 (cm x 10 cm) Polyester/Cotton | Swatch size: 2 | Polyester/Cotton x 2/L |

| Enzyme dosage: 10 (cm x 10 cm) Polyester | Swatch size: 2 | Polyester x 2/L |
Results:

<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Textile</th>
<th>0 mg/L(\times 10^3)</th>
<th>1 mg/L(\times 10^3)</th>
<th>3 mg/L(\times 10^3)</th>
<th>5 mg/L(\times 10^3)</th>
<th>10 mg/L(\times 10^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutinase A</td>
<td>Polyester</td>
<td>68.4 +/- 0.8</td>
<td>71.6 +/- 0.2</td>
<td>75.7 +/- 0.2</td>
<td>79.6 +/- 0.4</td>
<td>84.0 +/- 0.2</td>
</tr>
<tr>
<td></td>
<td>Polyester/Cotton</td>
<td>71.8 +/- 0.1</td>
<td>73.8 +/- 0.1</td>
<td>75.9 +/- 0.1</td>
<td>74.5 +/- 0.1</td>
<td>76.9 +/- 0.2</td>
</tr>
<tr>
<td>Endolase</td>
<td>Polyester</td>
<td>68.4 +/- 0.8</td>
<td>69.6 +/- 0.3</td>
<td>68.8 +/- 0.5</td>
<td>69.3 +/- 0.4</td>
<td>68.6 +/- 0.4</td>
</tr>
<tr>
<td></td>
<td>Polyester/Cotton</td>
<td>71.8 +/- 0.1</td>
<td>72.4 +/- 0.2</td>
<td>72.7 +/- 0.2</td>
<td>72.1 +/- 0.1</td>
<td>72.7 +/- 0.4</td>
</tr>
</tbody>
</table>

*Enzyme protein base

The above results show a significant anti-back staining effect on polyester and polyester/cotton by the cutinase compared with the cellulase. The cellulase did not show any anti-back staining effect on the fabric swatches.

**EXAMPLE 2**

**Anti-Back Staining Effect of Cutinase A and B and Lipolase.**

An Indigo solution was prepared by washing denim with Denimax® 362S in deionised water. The conditions were as follows:

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Washing Time</th>
<th>Washing liquor</th>
<th>Enzymes</th>
<th>Enzyme dosage</th>
<th>Swatch</th>
<th>Swatch size</th>
<th>Bath ratio</th>
<th>T-O-M</th>
</tr>
</thead>
<tbody>
<tr>
<td>55°C</td>
<td>60 min</td>
<td>Indigo solution (pH = 6.5)</td>
<td>Cutinase A and B and Lipolase® 100 L, type EX</td>
<td>0, 10, 30, 50 mg enzyme protein/L (Table 2) and 0, 1, 3, 5 mg enzyme protein/L (Table 3)</td>
<td>Polyester and Polyester/Cotton</td>
<td>10 cm x 10 cm</td>
<td>(Polyester x 2, Polyester/Cotton x 2)/L</td>
<td>120 rpm</td>
</tr>
</tbody>
</table>

<p>| TABLE 2 Anti-back staining effect of enzymes on polyester and polyester/cotton (L* value) |</p>
<table>
<thead>
<tr>
<th>Textile</th>
<th>Enzyme</th>
<th>0 mg/L(\times 10^3)</th>
<th>10 mg/L(\times 10^3)</th>
<th>30 mg/L(\times 10^3)</th>
<th>50 mg/L(\times 10^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyester</td>
<td>Cutinase A</td>
<td>65.4 +/- 0.3</td>
<td>84.6 +/- 0.1</td>
<td>89.0 +/- 0.0</td>
<td>89.7 +/- 0.1</td>
</tr>
<tr>
<td></td>
<td>Cutinase B</td>
<td>65.7 +/- 0.2</td>
<td>88.5 +/- 0.1</td>
<td>90.3 +/- 0.2</td>
<td>90.8 +/- 0.2</td>
</tr>
<tr>
<td></td>
<td>Lipolase</td>
<td>65.1 +/- 0.2</td>
<td>86.0 +/- 0.4</td>
<td>88.1 +/- 0.2</td>
<td>69.0 +/- 0.4</td>
</tr>
<tr>
<td>Polyester/Cotton</td>
<td>Cutinase A</td>
<td>67.9 +/- 0.3</td>
<td>76.3 +/- 0.2</td>
<td>83.3 +/- 0.0</td>
<td>84.6 +/- 0.1</td>
</tr>
<tr>
<td></td>
<td>Cutinase B</td>
<td>68.6 +/- 0.1</td>
<td>82.3 +/- 0.1</td>
<td>86.7 +/- 0.1</td>
<td>86.9 +/- 0.1</td>
</tr>
<tr>
<td></td>
<td>Lipolase</td>
<td>88.3 +/- 0.3</td>
<td>69.2 +/- 0.1</td>
<td>71.8 +/- 0.1</td>
<td>73.6 +/- 0.2</td>
</tr>
</tbody>
</table>

*Enzyme protein base

**TABLE 3 Anti-back staining effect of cutinase with low enzyme dosage (L* value)**

<table>
<thead>
<tr>
<th>Textile</th>
<th>Enzyme</th>
<th>0 mg/L(\times 10^3)</th>
<th>1 mg/L(\times 10^3)</th>
<th>3 mg/L(\times 10^3)</th>
<th>5 mg/L(\times 10^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyester</td>
<td>Cutinase A</td>
<td>63.7 +/- 0.1</td>
<td>68.6 +/- 0.5</td>
<td>75.9 +/- 0.6</td>
<td>81.2 +/- 0.4</td>
</tr>
<tr>
<td></td>
<td>Cutinase B</td>
<td>63.9 +/- 0.2</td>
<td>71.0 +/- 0.1</td>
<td>76.3 +/- 0.3</td>
<td>79.3 +/- 0.6</td>
</tr>
</tbody>
</table>
The above results show an anti-back staining effect on polyester and polyester/cotton by the cutinases and Lipolase.

**EXAMPLE 3**

**Anti-Back Staining Effect of Cutinase and Lipases at Acid pH Condition**

An Indigo solution was prepared by washing denim with Cellusoft® L in deionised water. The conditions were as follows:

- **Temperature:** 55°C
- **Washing Time:** 120 min
- **Enzyme:** Cellusoft® L
- **Enzyme dosage:** 1 g/L
- **Buffer:** 1 M Acetate buffer (pH = 5)
- **Washing liquor:** Deionised water (5° dH)/20 L
- **Denim:** Kurobo KD511
- **Bath ratio:** 1:20
- **Washing machine:** Wascator (FOM71MP-Lab.)

**Results:**

<table>
<thead>
<tr>
<th>Textile</th>
<th>Enzymes</th>
<th>0 mg/L</th>
<th>10 mg/L</th>
<th>30 mg/L</th>
<th>50 mg/L</th>
<th>100 mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyester</td>
<td>Cutinase A</td>
<td>65.5 +/- 0.2</td>
<td>65.7 +/- 0.4</td>
<td>71.0 +/- 0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyester</td>
<td>Cutinase B</td>
<td>66.3 +/- 0.2</td>
<td>69.7 +/- 0.4</td>
<td>72.2 +/- 0.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 4**

Anti-back staining effect of Cutinase A and B (L* value)

<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Textile</th>
<th>0 mg/L</th>
<th>10 mg/L</th>
<th>30 mg/L</th>
<th>50 mg/L</th>
<th>100 mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutinase A</td>
<td>Polyester</td>
<td>68.8 +/- 0.5</td>
<td>74.7 +/- 1.0</td>
<td>79.9 +/- 0.2</td>
<td>79.9 +/- 0.1</td>
<td>82.2 +/- 1.6</td>
</tr>
<tr>
<td>Cutinase A</td>
<td>Polyester/Cotton</td>
<td>65.3 +/- 0.9</td>
<td>66.8 +/- 0.2</td>
<td>68.1 +/- 0.8</td>
<td>67.5 +/- 1.0</td>
<td>69.9 +/- 0.6</td>
</tr>
<tr>
<td>Cutinase B</td>
<td>Polyester</td>
<td>66.7 +/- 0.3</td>
<td>80.3 +/- 0.2</td>
<td>82.4 +/- 0.6</td>
<td>82.7 +/- 0.2</td>
<td>81.7 +/- 0.6</td>
</tr>
<tr>
<td>Cutinase B</td>
<td>Polyester/Cotton</td>
<td>67.4 +/- 0.9</td>
<td>69.2 +/- 0.4</td>
<td>69.2 +/- 1.0</td>
<td>70.6 +/- 0.1</td>
<td>70.8 +/- 0.5</td>
</tr>
</tbody>
</table>

*Enzyme protein
9. The method of claim 1, wherein the pH is in the range of 4.5-7.5 and the temperature is in the range of 40-60°C.

10. The method of claim 1 for simultaneous reducing the backstaining and formation of localized color variation, wherein the composition further contains a cellulase and/or pumice.

11. A stonewashing composition comprising a lipolytic enzyme and a cellulase.

12. The composition of claim 11, further comprising a surfactant.

13. The composition of claim 11, wherein the lipolytic enzyme is a biopolyester hydrolytic enzyme.

14. The composition of claim 13, wherein the lipolytic enzyme is a cutinase (EC 3.1.1.74).