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BIBLIOGRAPHIC AND PATENT SEARCH: USE OF ENZYMES IN TEXTILE INDUSTRY

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Summary

BIBLIOGRAPHIC AND PATENT SEARCH: USE OF ENZYMES IN TEXTILE INDUSTRY

1. Introduction

The **CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS (CSIC)** requested a background search regarding the use of enzymes in textile industry, with the aim of making those patent and non-patent documents that are part of the state of the art related to this technology available to the Center.

A "STATE OF THE ART" report (Phase I) was sent to the CSIC, which included inventions related to the use of enzymes in textile industry.

CSIC reviewed this STATE OF THE ART report (Phase I) and selected:

- 2 documents related to Cleaning pretreatment
- 2 documents related to Chall marks
- 9 documents related to Bleaching process
- 3 documents related to Surface functionalization
- 8 documents related to Hydrophilicity
- 2 documents related to Hydrophobicity
- 28 documents related to Dyeing process
- 21 documents related to Cellulose fibres

2. Patent documents

Table 1 shows a summary of the organisms and enzymes described in each patent document, as well as the most important methods and conditions.

Table 1. Enzymes, methods, and conditions of each patent document.

	PUBLICATION NUMBER	ENZYME	CONDITIONS/ METHODS
CLEANING PRETREATMENT			
1	US2021032805 AA	Lipase	Conditions: 25 to 60 °C and pH in the range 4.5 to 9.
2	US2009258406 AA	Esterase (*Bacillus*).	Describes the use of carboxyl esterases (EC 3.1.1.1) for preventing pilling. These esterases are stable for long periods or active at alkaline pH and at a temperature of greater than or equal to 60 °C.

CHALL MARKS			
3	US2008063774 AA	*Micrococcineae spp* serine proteases	Methods of cleaning, comprising the steps of a) contacting a surface and/or an article comprising a fabric with at least one cleaning composition of the present invention; and b) optionally washing and/or rinsing the surface or material. pH conditions: 3-5
4	CN102444026 A	Proteinase	Steps: hydrolysis, stuffing and dye fixing
BLEACHING PROCESS			
5	US2010192308 AA	Cutinase, alkaline pectase, alkaline xylanase, alkaline cellulose, and carbohydrate oxidase	The bleaching conditions are pH 10 and temperature 55-70 °C.
6	CN1944785 A	Alpha-amylase, PVA degrading enzyme, lipase, proteinase, alkaline pectase, xylanase, cellulase, sugar oxidase	Different conditions in different steps (See the abstract of the document for more details) Bleaching bath conditions: pH value 7.0～8.0
7	CN103437140 A	Amylase	The method comprises the procedures of singeing, desizing, bleaching, mercerizing, and heat-shaping
8	CN102168381 A	Polyphenol oxidase (laccase Denilite II S)	A method for pre-treating cotton fabric (See the abstract of the document for more details)
9	CN104831516 A	Amylase	The method comprises the procedures of singeing, desizing, bleaching, mercerization and heat setting
10	US5912407 A	Pectinase	Conditions: pH of 9.0 – 12.0 and 50 °C of temperature
11	CN103374823 A	5-10 parts of cutinase, 5-10 parts of protease,	A cotton fabric bio-enzyme and a method for performing co-bath scouring and bleaching on

		5-10 parts of alkaline pectinase, 20-30 parts of alkaline xylanase, 5-10 parts of B-1, 4-glucan glucano-hydrolase, 10-20 parts of glucose oxidase and 15-25 parts of laccase.	a cotton fabric (the control temperature is at 50-60 ℃)
12	CN102899880 A	Amylase and glucoamylase	Different conditions (See the abstract of the document).
13	US2008070284 AA	Hydrolases, laccases, peroxidases or chloroperoxidases	Conditions: pH 3-8 and 20-70 °C.
SURFACE FUNCTIONALIZATION			
14	WO9742294 A1	Cellulase enzyme	A method for modifying fabric surface during laundering consisting of contacting said fabric surface with an aqueous solution of the laundry detergent composition. pH conditions: 7-9.5
15	WO10001356 A1	Serine protease	Describes a composition with this enzyme (See the abstract of the document for more details)
16	US2015291944 AA	Lipase	Describes a detergent composition with this enzyme (See the abstract of the document for more details)
HYDROPHILICITY			
17	CN104313890 A	Cutinase, papain, one or more subtilopeptidase A	Components: 0.1-1% of a biological enzyme, 1-10% of a wetting penetrating agent, 1-5% of a chelating agent, and 1-5% of a pH conditioning agent.
18	GB2432585 A1	Pectate lyase, a-amylase and cutinase	The treatment of the textile takes place substantially at a pH of 7.0 - 9.0 and at a temperature of 30 °C – 40 °C.
19	CN107829316 A	Pectase 1.5 % -2.5%, lipase 0.5 -1 %,	Treatment temperature is 45 - 55 °C, and pH value is 5-6.

		cellulase 1- 2% and proteinase-1 0.8 -1.2 %	
20	US2007275453 AA	Hydrolase that degrades cutine.	The amount of enzyme used is normally between 1 and 400 g of protein per kg of fibre.
21	US6066494 A	A combination of cellulase and pectinase	Tª conditions: 20 °C – 60 °C
22	KR20100034379 A	Cutinase	Conditions: pH 6-9, 30-70 °C
23	US5599698 A	Nitrile hydratases enzyme	Conditions: pH 7, 10-30 °C
24	CN101565902 A	Protease	Conditions: pH 7.0-9.0, 30-60 ℃
HYDROPHOBICITY			
25	US5733750 A	Lipase or esterase	(a) reacting the cellulosic polymer with a carboxylic acid or an ester thereof, (b) catalyzing the process with a lipase or other esterase capable of esterification of the cellulosic polymers
26	US2020291333 AA	Endo-β-1,3-glucanase enzyme	The cotton is contacted with the aqueous wash liquor at a temperature of from 5 °C to 40 °C or less
DYEING PROCESS			
27	CN109281209 A	Serine hydroxymethylase	2 steps with different conditions (See the abstract of the document)
28	CN101144249 A	Refining enzyme GJB	Different conditions in different steps (See the abstract of the document)
29	CN111058314 A	Amylase and cellulase	The mass ratio of the cellulase to the amylase is 2:1, pH value is 4.5 and the temperature of the solution is 80 ℃
30	CN109423893 A	Protease	Components: biological enzyme 25- 35 parts, 10-20 parts of natural dye, 4-12 parts of chitosan, polyacrylic acid 3-6 parts of 5-12 parts of ester type compound, surfactant, 150-220 parts of water. pH conditions: pH 5.5.

31	CN108486929 A	It does not specify the enzyme	A kind of colouring method of cotton socks. Pigment printing paste temperature are controlled at 30-40 °C, and 1-2 °C of heating rate/min is warming up to 60-70 °C, keeping the temperature 20-30 min
32	CN102154230 A	Cellulose, pectinase, xylanase, lipase and laccase	Components: 15 to 50 weight parts of neutral cellulose, 30 to 70 weight parts of pectinase, 10 to 30 weight parts of xylanase, 5 to 30 weight parts of lipase and 10 to 15 parts of laccase
33	CN106436354 A	Cellulase, protease, amylase	Components: acidic cellulase, protease, amylase 2:3:1 (pH 4 – 5)
34	US2012036649 AA	Perhydrolase	pH conditions: pH 6-8
35	WO12023021 A1	Laccase enzyme from *Arthrographis sp. MTCC5479*	Conditions: pH 3 to 5.5. and at 35 to 50 °C.
36	RU2244772 C1	Amino acid or a nitrogen-containing enzyme, or an enzyme of the class of oxidoreductases	A method of low-temperature dyeing of textile materials (dyeing at 75-80 °C)
37	CN103321056 A	It does not specify the enzyme	Conditions: 50-60 ℃, time 40-60 min, pH value 8-9
38	CN110592970 A	Amylase	In the desizing step, the dosage of amylase is 2-5 g/L and the temperature is 55-60 ℃
39	CN108251319 A	Cutinase	Method to produce cutinase. The incubation stage : any recombinant bacterium is inoculated into fermentation medium, at 25-31 ℃. Lower stir culture 15-36 h.
40	CN101424048 A	Cutinase/Protease	Components: the wool fabric impregnation process in mass concentration 0.2%-2.0% protease, wetting and penetrating agent 0-20 g/L,

			Conditions: 30 ℃-60 ℃ of temperature, pH 7.0-9.0,0.5-2 hours.
41	CN106436358 A	Low-temperature enzyme refining agents	A natural dyeing composition. 6-12 parts of low-temperature enzyme refining agents. Temperature control is 70 – 80 °C.
42	CN109355939 A	Refining enzyme 301L (Novi believes (China) Biotechnology Co., Ltd).	Temperature is 55~65 °C, and heating rate is 2 °C/min. Modification time is 25~35 min.
43	CN108728963 A	Enzyme refining agent	Steps: Mixed yarn, pre-treatment, washing and dyeing
44	CN101736616 A	Protease	Employing neutral enzymatic white silk (pH 7 – 7.5) or alkaline enzyme white silk (pH 8.5 – 10). Temperature conditions: 45 ℃ ± 2 ℃
45	CN111101389 A	Pectinase and neutral amylase.	Conditions: pH value of the biorefinery is 6.5-7.5, the treatment temperature is 40-50 ℃, the treatment time is 20-30 min and the bath ratio is 1: (10-15).
46	CN107718779 A	Lacasse	Conditions: pH value 4-5, 58-60 °C
47	CN102899929 A	Not specify the enzyme	Conditions: pH 7-8, 20 – 30 °C
48	CN110735332 A	Cellulase	Conditions: pH buffer and 55-65 C
49	CN102704282 A	Deoxidation enzymes	pH conditions: pH 6-8
50	CN103243564 A	Mixture of neutral amylase, a scourzyme or a neutral cellulase	Conditions: control temperature is 30 ℃～50 ℃ and pH is between 6.5～7.5
51	US2007166805 AA	Cellulase	A method for enhancing the hydrolysis of cellulose by cellulase comprising introducing to said cellulose a GR2 protein in the presence of said cellulase. pH conditions: pH 4 - 6.5
52	CN106223003 A	Pectase and cellulase	Components: pectase 0.5-1g/L, cellulose enzyme 1-3g/L.

			Different conditions in different steps (See the abstract of the document)
53	CN110230217 A	Acidic cellulase DM-8639: wide temperature amylase DM-8652: neutrality is thrown Light enzyme DM-8688A: lipase	Enzyme proportions: 15 - 20: 5 - 8: 1 - 4: 5 - 10.
54	CN107513872 A	Enzyme intermixture	Steps: Prerinse ; Peracid treatment after bleaching ; Deoxygenation after ferment treatment, remove remnants bleaching agent ; Wash dye ; Silk dye ; Caustic soda is added ; Adjust temperature ; Concussion cleaning, peracid treatment, again concussion cleaning ; Clean and dry after fixation, softening and complete dyeing.
CELLULOSE FIBRES			
55	US6159720 A	Endoglucanase and cellulase	A process for removing nap of cellulose-containing fibers, a process for reducing cellulose-containing fibers and a process for decolouring denim-dye.
56	US2018171544 AA	Cellulases	A process for biofinishing a cellulose-containing textile. Process for treating a cellulose-containing textile, comprising (a) desizing; (b) scouring; (c) bleaching; (d) dyeing;
57	US2012322997 AA	Xylanases and cellulases	Conditions: pH ranges 5.5 - 8.5 and medium temperature ranges 40 - 90° C.
58	US2012088291 AA	Perhydrolases	The textile material is contacted with the enzymatic textile treatment composition at a temperature of 60° C - 75° C., for a processing time of 30 to 60 minutes.

59	US2017145628 AA	Pectinase	(a) desizing the textile with an amylase. (b) scouring the textile with the composition. The process is carried out at pH 6-8.
60	US2019106690 AA	Cellulase	A variant of a parent cellulase, wherein the variant comprises an alteration at one or more positions (See the abstract of the document for more details)
61	US2006035361 AA	Cellulase	A novel cellulase resistant to surfactants and/or having a high activity under alkaline conditions.
62	CN106223001 A	Amylase, cellulase, hemicellulase, pectase	Components: amylase 0.5 ～2g/l, cellulase 0.5 ～1.5g/l, hemicellulase 0.5～1.5g/l, pectase 1.0～2.0g/l pH conditions: pH 7 - 10
63	WO08039353 A2	Pectate lyase	Conditions: pH 6 - 8, 2 minutes - 24 hours, 25°C - 60°C. The chemical bleaching agent is hydrogen peroxide and is present in an amount of about 1000 ppm to 3000 ppm.
64	US2010098807 AA	Endoglucanase	Conditions: pH 3 and 30 °C.
65	US6017751 A	Lipase and amylase	A process for desizing a cellulose-containing textile, comprising treating the textile with an enzyme hybrid which comprises a catalytically active amino acid sequence of a lipase or an amylase linked to an amino acid sequence comprising a cellulose-binding domain. Conditions: 30-100 °C, such as 35-60 °C, and pH 7-9.
66	CN110106690 A	Pectase and alpha amylase.	Conditions: pH 6-9 and 55-70 °C
67	WO06106097 A1	Cellulases and pectinases	Conditions: pH 2 - 5 and 45 - 65°C.

68	WO20099719 A1	Cellulases	The enzymes show improved stability in protease containing detergents in long-term experiments at 30 °C temperature.
69	WO9854332 A1	Cellulase	Describes a cellulase preparation. The treatment can be performed by using a cellulase preparation having a protein concentration of 10 to 30 mg/L at a temperature of about 0 to 60 °C.
70	US5919272 A	Cellulase	A method of reducing redeposition or backstaining of dye on dyed cellulose-containing fabric subjected to enzymatic stone-washing with a wash liquor containing cellulase.
71	US2008070284 AA	Hydrolases or laccases or peroxidases or chloroperoxidases.	Methods for oxidizing, for carrying out coupling reactions or for carrying out cross-linking reactions. Conditions: pH 3-8 and 20-70 ° C.
72	CN104480695 A	It does not specify the enzyme	Conditions: pH scope of bleaching liquid between 8 - 10
73	GB2432585 A1	Pectin lyase, cutinase and a- amylase	Conditions: pH 8, 30 – 40 °C
74	IN201741003741 A	Catalase, Alkyl cysteine sulfoxide lyase, Glutathione reductase, Superoxide dismutase, Lipoxygenase, Beta-gluronidase, Cellulose, Pectinase and Protease	Components: Catalase 40- 75 µg/mL, Alkyl cysteine sulfoxide lyase 0.1- 0.35 mg/mL, Glutathione reductase 0.03- 0.18 µg/mL, Superoxide dismutase 25- 75 µg/mL, Lipoxygenase 0.2 - 0.75 mg/mL, Beta-gluronidase 8 µg/mL - 25 ng/mL, Cellulose 0.2-2 mg/mL, Pectinase 2 U/mL – 6 U/mL, Protease 0.1 - 0.7 U/mL Conditions: non-alkaline pH and 60 -95 °C.
75	US2009297495 AA	Enzymes with hydrolase activity	Describes new enzymes with hydrolase activity (See the abstract of the document for more details).

Each of the inventions is summarized in more detail below, highlighting the enzymes that are involved in the processes, as well as the methods and conditions carried out.

Cleaning pretreatment

1. US2021032805 AA

This document describes a method for dyeing or coating synthetic fibers, yarns including synthetic fibers, or fabrics including synthetic fibers, the method comprising:

a) Providing a multitude of fibers including synthetic fibers, at least one yarn including the synthetic fibers, or at least one fabric including the synthetic fibers, or at least one yarn including the synthetic fibers.

b) Providing at least one powdered dye or a powdered precursor dye, or providing at least one aqueous dye formulation or at least one aqueous precursor dye formulation.

c) Providing an aqueous system comprising at least one **lipase enzyme**.

d) Pre-treating said multitude of fibers, said yarn, or said fabric with the aqueous system comprising the at least one lipase enzyme, temperature in the range from **25 to 60 °C**, and at a **pH in the range from 4.5 to 9**.

e) Coating or dyeing said pre-treated multitude of fibers, said pre-treated yarn, or said pre-treated fabric with said powdered dye, powdered precursor dye, aqueous dye formulation, or one aqueous precursor dye formulation.

The dye is a vat dye selected from the group consisting of indigo, indigoid dyes, isoindigo, indirubin, 6,6'-dibromoindigo, Tyrian purple, indanthren dyes, anthrachinon dyes, anthraquinone dyes, naphthalene dyes, and mixtures thereof.

The precursor dye is a leuko dye selected from the group consisting of leuko-indigo, leuko-indigoid dyes, leuko-isoindigo, leuko-indirubin, leuko-6,6'-dibromoindigo, leuko-Tyrian purple, leuko-indanthren dyes, leuko-anthrachinon dyes, leuko-anthraquinone dyes, leuko-naphthalene dyes, and mixtures thereof.

2. US2009258406 AA

The document describes the use of **esterases** for protecting against or reducing and/or preventing pilling, preferably in textiles, particularly artificial fibers, more preferably polyester fibers, as well as the use of esterases for the cleaving of plastics, in particular, polyester compounds.

The document describes the use of esterases (EC 3.1.1), especially **carboxyl esterases** (EC 3.1.1.1), preferably para-nitrobenzyl esterases, especially those that can be obtained from microorganisms (***Bacillus***) (See Annex I SEQ ID NO: 1)

Chall marks

3. US2008063774 AA

This document describes novel ***Micrococcineae spp*** **serine proteases** having multiple substitutions. It describes isolated serine protease variants having an amino acid sequence comprising at least two amino acid substitutions, wherein the substitutions are made at positions equivalent to the positions in a *Cellulomonas 69B4* protease comprising the amino acid sequence set forth in SEQ ID NO:2 (See Annex I).

The variant proteases have at least one improved property as compared to the wild-type *Cellulomonas 69B4* protease comprising the amino acid sequence set forth in SEQ ID NO:2. At least one improved property is selected from the group consisting of acid stability, thermostability, casein hydrolysis, keratin hydrolysis, cleaning performance, and LAS stability.

The document also describes cleaning compositions which includes this variant serine proteases. The cleaning compositions comprise a sufficient amount of a pH modifier to provide the composition with a neat pH of from about 3 to about 5, wherein the compositions are essentially free of materials that hydrolyze at a **pH of from about 3 to about 5**.

The present invention also provides methods of cleaning, comprising the steps of a) contacting a surface and/or an article comprising a fabric with at least one cleaning composition of the present invention; and b) optionally washing and/or rinsing the surface or material.

4. CN102444026 A

The document describes a method for producing high-performance superfine fiber synthetic leather for clothes.

By adopting the technologies of combined hydrolysis of diethanol amine and **multiple enzyme preparations**, surface adsorption modification of hydrolyzed gelatin and cross-linking immobilization of glutaraldehyde, the water vapor permeability of the superfine fiber synthetic leather is improved. The superfine fibers are fully dispersed and lubricated by adopting a combined greasing technology of multiple greasing agents, so that the softness and the hand feel property of the superfine fiber synthetic leather are improved. By adopting a one-bath dyeing technology of a metal complex dye and a disperse dye in a ratio of 1:1 and a colour fixing technology of a macromolecular colour fixing agent, the luster and the dyeing fastness of the superfine fiber synthetic leather are improved. Also, by adopting a technology of combining mechanical raising and cutting, the 'writing effect' of the superfine fiber synthetic leather is improved.

Steps:

(1) Hydrolysis dipping: 35～40 ℃ hydrolysis temperatures, 10～30 minutes time. Comprises 300%～1000% water, 0.1～0.3% diethanol amine, 0.3～1% pancreatin and 0.3～1% neutral proteinase.

(2) Stuffing is filled: comprise 300%～1000% water; 5%～10% sulphated castor oil fatting agent, 5%～10% sulphation rapeseed oil fatting agent and 5%～10% sulfuric acid fish oil, 35～40 ℃ of temperature, 5～20 minutes action time.

(3) Dye fixing. comprises 300%～1000% water, 1%～3% 1: 1 type premetallized dye and 1%～3% disperse dyes. 90～95 ℃ of temperature; 60～120 minutes time.

Bleaching process

5. US2010192308 AA

This document describes a method for scouring and bleaching cotton fabric with a composite enzyme preparation in one bath, comprising:

1) scouring the cotton fabric with a composite enzyme preparation, wherein the scouring enzyme preparation is compounded with cutinase, alkaline pectase, alkaline xylanase, alkaline cellulose, and carbohydrate oxidase. The scouring bath composition comprises: the composite enzyme preparation 0.5-1.5 g/L, penetrant NC 1-5 g/L, glucose 1.5-3 g/L, oxidation bleaching stabilizer R8-3 3 g/L, and Triton X-100 0.5-1 g/L, the processing conditions are: the mass ratio of the cotton fabric and the scouring bath 1:20, **pH 8-10, temperature 55-70 °C**, and processing time 60 min, and the mass percentages of the composite enzyme preparation are **cutinase 10%-20%, alkaline pectase 20%-30%, alkaline xylanase 20%-30%, alkaline cellulose 5%-10%, and carbohydrate oxidase 15%-25%;**

2) after scouring, bleaching the cotton fabric in the same bath, wherein tetra acetyl ethylenediamine 0.5-2 g/L is directly added into the scouring bath after scouring, and the **bleaching conditions** are: pH 10, temperature 55-70 °C, and processing time 30 min.

6. CN1944785 A

This document describes an enzyme process for desizing, boiling off and bleaching cotton fabric.

Desizing: cotton is bathed with the enzyme preparation 0.5-3.5 g/L and JFC bleeding agent 4 g/L. Treatment conditions: the mass ratio is 1: 20, pH 7.0 and 40 ℃ of temperature. The enzyme preparation consists of PVA digestive enzyme 40%-50%, and **lipase** 10%-20%.

Boiling. Composition: enzyme preparation 0.3-1.5 g/L, glucose 0.5-3 g/L, BHJ-1 high-efficiency refining agent 2-5 g/L, waterglass 3-10 g/L and sodium ethylene diamine tetraacetate 3-5 g/L. Treatment conditions are the mass ratio is 1: 20, pH 8.0-8.5, and 50-55 ℃ of temperature are handled 60-90 min. The **enzyme preparation** consists of alkaline pectase 30%-40%, cellulase 10%-22%, protease 6%-14%, lipase 8%-22%, carbohydrate oxidase 8%-12% and zytase 10%-18%.

Bleaching bath consists of **carbohydrate oxidase** 0.5-2 g/L, glucose, or oligosaccharides 0.5-3 g/L and JFC bleeding agent 4 g/L. Treatment conditions are the mass ratio is 1:20, and at first the pH value is 7.0-8.0, handles 60 min at 50 ℃ and generates hydrogen peroxide. Then, transfers pH to 10, and rise the temperature to 90 ℃.

Add **catalase** 3 g/L. Treatment conditions: cotton fabric is 1:10, pH 8.5, cold wash 5 min for 65 ℃.

7. CN103437140 A

The document describes a pre-treatment process for polyester cotton bleached cloth. The pretreatment process comprises the procedures of singeing, desizing, bleaching, mercerizing and heat-shaping.

In the bleaching procedure, the materials are 0.2-0.4 part of potassium borate (the bleaching liquor), 0.8-1.2 part(s) of diethylenetriaminepenta acid (DTPMP), 0.8-2 part(s) of acrylic acid maleic acid copolymer, 0.5-1 part of 1, 5-anhydrous glucitol, 1-2 part(s) of caprolactam activator, 0.4-0.7 part of tetraacetylethylenediamine (TAED), 3-8 parts of sodium hydroxide, 3-7 parts of hydrogen peroxide and 900-1000 parts of water. When the pretreatment process is used for processing fabrics, prominent damage to the fabrics is small. As enzyme desizing is adopted, the desizing process is improved; the bleaching liquor adopted in the bleaching procedure can effectively improve the whiteness of the fabrics; meanwhile, the pretreatment cost is lowered.

Conditions: add **amylase** 2 000L 4g, NaCl 3g, bleeding agent 3.5 g., bleaching liquid is 0.3 part of potassium borate; 1 part of diethylene triamine pentamethylene phosphonic; 1.5 parts of acrylic acid maleic acids; 0.8 part of 1,5-anhydrous grape sugar alcohol; 1.5 parts of caprolactam class activator; 0.6 part of tetraacetyl ethylene diamine; 7 parts of NaOH; 5 parts of hydrogen peroxide; 1000 parts of water.

8. CN102168381 A

The document describes a method for pre-treating cotton fabric by using a biological enzyme/mediator system and bleaching the cotton fabric by using hydrogen peroxide, which comprises the steps of:

(1) prepare an enzyme bath by using polyphenol oxidase and a mediator, adjust the pH value to 5.0 - 7.0, ultrasonically treating or oscillating the enzyme bath for 5 to 10 minutes, and then add non-ionic penetrating agent to obtain the biological enzyme/mediator system.

(2) soak the desized and scoured cotton fabric into the biological enzyme/mediator system, and oscillate the cotton fabric for 10 to 40 minutes at a temperature of 50 to 60 °C.

(3) take the cotton fabric out, squeez the cotton fabric by a padder and then soak the squeezed cotton fabric in a hydrogen peroxide system, oscillate for 20 to 60 minutes, wash and dry. The method disclosed by the invention has a simple process and low cost; the cotton fabric is pretreated through the biological enzyme/mediator system, thus the follow-up oxygen bleaching process is effective in three aspects of low temperature, time saving and hydrogen peroxide saving, and the synergistic effect can be used for improving the traditional process. The method saves energy and reduces consumption, is environment-friendly and has good application prospect.

(1) 2%-4% of **polyphenol oxidase** (laccase Denilite II S) and 0.2%-0.4% of amboceptor (I-hydroxybenzotriazole) are configured to the enzyme bath; bath ratio is 1: 20-1: 40, adjust pH is 5.0-7.0, in 50-60 ℃ of ultrasonic or oscillation treatment 5-10min; add the 2%-6%o.w. f non-ionic penetrant again, gets biology enzyme/mediator systems.

(2) move back and boil cotton fabric and immerse in above-mentioned biology enzyme/mediator systems, in 50-60 ℃ of oscillation treatment 10-40min. Then, in 70-100 ℃ of oscillation treatment 20-60min, bath ratio is 1: 20-1: 40, wash and dry.

9. CN104831516 A

The document describes a polyester cotton bleached cloth pretreatment technology. The technology comprises singeing, desizing, bleaching, mercerization and heat setting. The desizing process utilizes an enzyme desizing cold piling technology, a desizing enzyme and an osmotic agent. The bleaching liquid comprises 0.2-0.4 parts of potassium borate, 0.8-1.2 parts of diethylenetriaminepenta (methylenephosphonic acid), 0.8-2 parts of an acrylic acid-maleic acid copolymer, 0.5-1 part of 1,5-anhydroglucitol, 1-2 parts of a caprolactam activator, 0.4-0.7 parts of tetraacetyl ethylenediamine, 3-8 parts of sodium hydroxide, 3-7 parts of hydrogen peroxide and 900-1000 parts of water. The pre-treatment technology has the advantages that it causes a small damage to the fabric, improves the desizing rate, and reduce the costs.

Conditions: add **amylase** 2 000L 4g, NaCl 3g, bleeding agent 3.5 g, bleaching liquid is potassium borate 0.3 part; Diethylene triamine pentamethylene phosphonic 1 part; acrylic acid maleic acid 1.5 parts; 1,5-anhydrous grape sugar alcohol 0.8 part; 1.5 parts of caprolactam class activator; Tetraacetyl ethylene diamine 0.6 part; 7 parts of NaOH; hydrogen peroxide 5 parts; 1000 parts of water.

10. US5912407 A

The document describes a method for scouring of cellulosic material, comprising the steps of:

(a) preparing an aqueous enzyme solution comprising **pectinase** (polygalacturonase or pectin methyl esterase); and

(b) treating cellulosic material with an effective amount of the pectinase solution of step (a) at a **pH** of **9.0 -12.0**, a temperature of **50 °C** or above, in the presence of a low calcium ion concentration (the calcium chelating agent is ethylenediamine tetraacetate (EDTA)), wherein scouring is achieved and (c) exposing the cellulosic material to a chemical treatment (oxidative bleaching process).

The enzyme solution further comprises **one or more enzymes** selected from the group consisting of protease, glucanase, and cellulase.

In a preferred embodiment of the invention a 100% cotton knitted or desized woven textile fabric is treated with the aqueous enzyme solution comprising a *Bacillus sp.* pectate lyase at a level of 0.1-50 APSU/g fabric, a *Humicola sp*. cellulase at a level of 0.1-50 CEVU/g fabric and a *Bacillus sp.* protease at a level of 0.01-1.0 KNPU/g fabric at a pH range

of 9-12 and at a temperature range of 20-65 °C for 2-18 hours. In the case of a greige woven cotton fabric, the alpha-amylase enzyme from a *Bacillus sp.* at a level of 0.1-25 KNU/g fabric and a *Humicola sp.* lipase at a level of 0.1-5.0 KLU/g fabric is added to the mixture so as to effect a simultaneous desizing and enhanced scouring effect.

11. CN103374823 A

The document describes a cotton fabric bio-enzyme and a method for performing co-bath scouring and bleaching on a cotton fabric. The cotton fabric bio-enzyme comprises the following components in parts by weight: **5-10 parts of cutinase, 5-10 parts of protease, 5-10 parts of alkaline pectinase, 20-30 parts of alkaline xylanase, 5-10 parts of B-1, 4-glucan glucano-hydrolase, 10-20 parts of glucose oxidase and 15-25 parts of laccase.** The cotton fabric bio-enzyme disclosed by the invention is adopted for performing co-bath scouring and bleaching on the cotton fabric, the treatment conditions are mild, the damages to the fabric are small, the process flow is short, and it consumes less energy.

Bleaching liquid is comprised by 2-4% of enzymes, 5-10 % of hydrogen peroxide, 1-2% of tetraacetyl ethylene diamine, 0.1-0.3 % of penetrating agent JFC and surplus is water.

12. CN102899880 A

The document describes a method for performing bio-enzyme bleaching on cotton and blended fabrics thereof by a multienzyme coupling system. According to the method, desizing raffinate of the cotton and the blended fabrics thereof is utilized, the fabrics are desized by **amylase** under the assistance of **glucoamylase** of different mass fractions and different vigour in a steeping or padding stacking (steaming) method, and the raffinate is catalyzed to the maximum degree, so that the mass concentration of glucose in the raffinate is improved. The cotton and the blended fabrics thereof are bleached by using **glucose oxidase** of different mass fractions and different vigour under the action of catalyzing the glucose by the glucose oxidase to generate hydrogen peroxide. By the method, the weight loss ratio of the fabrics is 8 to 9 %, the whiteness is 80, the arrangement technology has small influence on the physical and mechanical properties of the fabrics, and chemical reagents of a hydrogen peroxide stabilizing agent are not used in the integral process, so that the method is less pollutant and low in cost.

Utilizing the time of the auxiliary amylase dipping of starch carbohydrase is 1～3h, temperature is 60～70 ℃, and the pH value is 5～6.

The temperature of starch padding is 60～70 ℃, and the pH value is 5～6.

The time of banking up is 2～4h, and the temperature is 40-50 ℃.

Steaming time is 3～5min, and steam temperature is 100～102 ℃.

13. US2008070284 AA

This document describes enzyme-based methods for carrying out oxidizing reactions (redox reactions) and for carrying out coupling and/ or cross-linking reactions, characterized in, that

a) these oxidations, coupling and/or cross-linking reactions are carrying out using **hydrolases** such as lipases, esterases, proteases, amidases, transferases, acylases, glycosidases, glycotransferases or using oxidoreductases, such as preferably peroxidases, chloroperoxidases and laccases, either individually or in combination with one another.

Preferably enzymes of the class 3 (Hydrolasen) 3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4 and 3.1.7 such as e.g.:

carboxyl ester hydrolases (3.1.1), thiol ester hydrolases (3.1.2), phosphoric acid monoester hydrolases (Phosphatases) (3.1.3), phosphoric acid diester hydrolases (3.1.4), diphosphoric acid monoester hydrolases (3.1.7)

Particularly preferred among these are enzymes of group 3.1.1.3 lipases (triacylglycerol lipases, triglycerolacyl hydrolases).

Particularly preferred are also enzymes of the class 1 (oxidoreductases):

cellobiose: quinone-1-oxidoreductase 1.1.5.1, bilirubin oxidase 1.3.3.5, cytochrome oxidase 1.9.3, oxygenases, lipoxygenases, cytochrome P450 enzymes 1.13 and 1.14, superoxide dismutase 1.15.11, ferrioxidase, for example, ceruloplasmin 1.16.3.1

b) the oxidizing reactions are performed using the mentioned enzymes together with special (redox) enhancer compounds.

c) these coupling and /or cross-linking reactions are carrying out with compounds which should be modified such as natural (i.e. having natural origin) or artificial (i.e. synthetically produced) monomers to polymers or mixtures of natural and artificial polymers or fibre materials (preferably lignocellulose-containing, cellulose-containing or protein-like natural polymers).

d) special coupling and/or cross-linking enhancer compounds or coupling and/or cross-linking precursor compounds which are the coupling and/or cross-linking agents activated by the enzymes are used.

The mentioned methods can be used for the protection or minimizing of the yellowing of wood pulps, particularly preferred high yield pulps, plastics, textiles, paintings, or carpet floors and/or all material exposured to light (UV) and/or oxygen, and/or temperature.

The methods are performed at pH 3-8, at 20-70 °C.

Surface functionalization

14. WO9742294 A1

A detergent composition comprising a) at least 0.1% by weight, of a detersive surfactant; b) at least 0.001% by weight, of **cellulase enzyme**; and c) at least 0.05% by weight, of a water-soluble or dispersible, modified polyamine fabric surface modifying agent, said agent comprising a polyamine backbone corresponding to the formula:

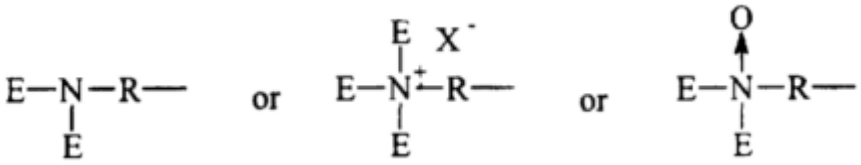
[H2N-R]n+ι -[N-R]m-[N-R]n-NH2 having a modified polyamine formula

$$V_{(n+1)}W_mY_nZ$$

or a polyamine backbone corresponding to the formula:

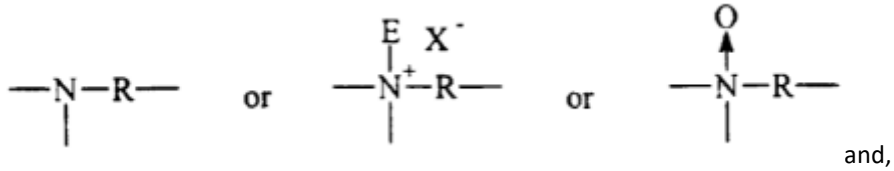
I H j R

[H2N-R]n-k+l— [N-R]m-[N-R]n-{N-R]k-NH2 having a modified polyamine formula V(n_ιc-r-i)WmYnY ^Z, wherein k is less than or equal to n, said polyamine backbone prior to modification has a molecular weight greater than 200 Daltons, wherein i) V units are terminal units having the formula:



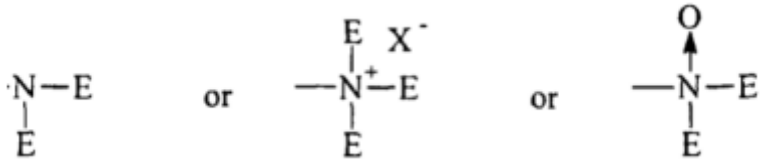
ii) W units are backbone units having the formula:

—N-R— or —N !Λ-R— or — ? N-R— E E E iii) Y units are branching units having the formula:



and,

iv) Z units are terminal units having the formula:



wherein backbone linking R units are selected from C2-C12 alkylene, C4-C12 alkenylene, C3-C12 hydroxyalkylene, C4-C12 dihydroxy¬ alkylene, Cg-Ci2 dialkylarylene, -(Rlθ)xRl-, -(R1 O)XR5(OR!)X-, - (CH2CH(OR2)CH2O)z-

(RlO)yRl(OCH2CH(OR2)CH2)w-, - C(O)(R4)rC(O)-, -CH2CH(OR2)CH2-, and mixtures thereof; wherein Rl is C2-C6 alkylene and mixtures thereof; R2 is hydrogen, -(Rlθ)xB, and mixtures thereof; R3 is Cj-Cjg alkyl, C7- C12 arylalkyl, C7-C12 alkyl substituted aryl, Cg-C^ aryl, and mixtures thereof; R4 is C1-C12 alkylene, C4-C12 alkenylene, Cg- C12 arylalkylene, C6-C10 arylene, and mixtures thereof; R5 is C\- C12 alkylene, C3-C12 hydroxy-alkylene, C4-C12 dihydroxyalkylene, C8-C12 dialkylarylene, -C(O)-, -C(O)NHR6NHC(O)-, -Rl(ORl)-, - C(O)(R4)rC(O)-, -CH2CH(OH)CH2-, -

CH2CH(OH)CH2O(Rlθ)yRl-OCH2CH(OH)CH2-, and mixtures thereof; R*> is C2-C12 alkylene or C6-C12 arylene; E units are selected from hydrogen, C1-C22 alkyl, C3-C22 alkenyl, C7-C22 arylalkyl, C2-C22 hydroxyalkyl, -(CH2)pCO2M, -(CH2)qSO3M, - CH(CH2CO2M)-CO2M, -(CH2)pPO3M, -(Rlθ)xB, -C(O)R3, and mixtures thereof; provided that when any E unit of a nitrogen is a hydrogen, said nitrogen is not also an N-oxide; B is hydrogen, C 1 -Cβ alkyl, -(CH2)q-SO3M, -(CH2)pCO2M, -

(CH2)q(CHSO3M)CH2SO3M, -(CH2)q-(CHSO2M)CH2SO3M, - (CH2)pPO3M, -PO3M, and mixtures thereof; M is hydrogen or a water soluble cation in sufficient amount to satisfy charge balance; X is a water soluble anion; m has the value from 4 to 400; n has the value from 0 to 200; p has the value from 1 to 6, q has the value from 0 to 6; r has the value of 0 or 1 ; w has the value 0 or 1 ; x has the value from 1 to 100; y has the value from 0 to 100; z has the value 0 or l.

The cellulase enzyme is selected from cellulases derived from *Humicola insolens, Humicola grisea var. thermoidea, Bacillus sp., Aeromonas sp*., the hepatopancreas of the marine mollusc *Dolabella Auricula Solande*x, and mixtures thereof.

The document also describes a method for modifying fabric surface during laundering consisting of contacting said fabric surface with an aqueous solution of the laundry detergent composition.

15. WO10001356 A1

The document describes an animal fiber treatment composition comprising a genetically engineered proteolytic enzyme to increase its molecular weight and reduce its diffusion into the fiber by fusing the enzyme coding sequence with the polymer-encoding nucleotide sequence of a protein nature whose monomeric units may be sequences of 4 to 50 either any n-repeating natural amino acid residues (n> 2) or fusion of n-repeat coding sequences of the enzyme or fusion of nucleotide sequence of enzyme with nucleotide sequence of a peptide with self-assembling properties.

The protein-like polymer comprises the amino acid sequence VPGG, APGVGV, or VPGXG, where X represents any natural or modified amino acid repeated n times (where n> 2).

The self-assembling peptide is a lipid affinity domain sequence of mammalian surfactant proteins.

The proteolytic enzyme is a **serine protease (*Bacillus subtilis* subtilisin E).**

16. US2015291944 AA

The document describes a **lipolytic enzyme** variant or an active fragment thereof comprising an amino acid modification to a parent lipolytic enzyme, wherein the modification is at a productive position of the lipolytic enzyme variant, wherein

at least one modification of the modifications tested at the productive position meet at least one of the following criteria:

a) a position wherein the minimum performance indices (PI) relative to TLL parent for expression, CS-61 micro-swatch activity at pH 8.2, activity on p-Nitrophenyl ester substrates at pH 6 or pH 8.2, and detergent stability, LAS stability or thermostability are greater than or equal to 0.9, and in addition have a PI for any one of these tests that is greater than or equal to 1.0;

b) a position wherein the minimum performance indices (PI) relative to TLL parent for expression, CS-61 micro-swatch activity at pH 8.2, activity on p-Nitrophenyl ester substrates at pH 6 or pH 8.2, and detergent stability, LAS stability or thermostability are greater than or equal to 0.8, and in addition have a PI for any one of these tests that is greater than or equal to 1.2;

c) a position wherein the minimum performance indices (PI) relative to TLL parent for expression, CS-61 micro-swatch activity at pH 8.2, activity on p-Nitrophenyl ester substrates at pH 6 or pH 8.2, and detergent stability, LAS stability or thermostability are greater than or equal to 0.5, and in addition have a PI for any one of these tests that is greater than or equal to 1.5.

The amino acid positions of the lipase variant are numbered by correspondence with the amino acid sequence of ***Thermomyces lanuginosus*** **lipase TLL** set forth in SEQ ID NO:3 (See Annex I).

The cleaning composition further comprises **at least one additional enzyme** selected from the group consisting of hemicellulases, cellulases, peroxidases, lipolytic enzymes, metallolipolytic enzymes, xylanases, lipases, phospholipases, esterases, perhydrolases, cutinases, pectinases, pectate lyases, mannanases, keratinases, reductases, oxidases, phenoloxidases, lipoxygenases, ligninases, pullulanases, tannases, pentosanases, malanases, β-glucanases, arabinosidases, hyaluronidases, chondroitinases, laccases, and amylases.

Hydrophilicity

17. CN104313890 A

The document describes an enzyme treating liquid used for improving hydrophilicity of nylon. The enzyme treating liquid comprises the following components by weight: 0.1-1% of a **biological enzyme**, 1-10% of a wetting penetrating agent, 1-5% of a chelating agent, and 1-5% of a pH conditioning agent, with the balance being water.

The enzyme treating liquid effectively improves hydrophilicity of surfaces of nylon fabric and does not influence wear comfort, mechanical strength, or other properties of the nylon fabric.

The enzyme could be **cutinase, papain and one or more subtilopeptidase A**.

18. GB2432585 A1

This document describes a method of treatment of a textile comprising: providing a quantity of sized textile comprising cellulose based fibres; providing a composition of active enzymes comprising an enzyme for the degradation of starch; an enzyme for the hydrolysis of the ester bonds of triglycerides and cutin; and an enzyme for the degradation of pectin; and treating the textile with the composition to substantially remove size and to substantially improve the hydrophilic properties of the fibres.

The treatment of the textile takes place substantially at a pH of between 7.0 and 9.0 and at a temperature of between 30 – 40 °C.

The enzyme for the degradation of pectin is **endo pectate lyase (EC 4.2.2.2) (pH 8).** The enzyme for the degradation of starch is **an a-amylase (EC 3.2.1.1) (pH 8).** The enzyme for the hydrolysis of the ester bonds of triglycerides and cutin is **cutinase (EC 3.1.1.74) (pH 8).**

19. CN107829316 A

The document describes a kind of improvement of cotton/anion activated carbon fibre fabric burnt-out printing process, which includes the steps of pre-treatment, refining, burn-out printing, washing, drying.

The composition includes **pectase 1.5 -2.5%, lipase 0.5 -1%, cellulase 1- 2% and proteinase 0.8 -1.2%,** 1.8g/L of non-ionic surface active agent and 6g/L of acetic acid. The treatment temperature is 45 - 55 °C, pH value is 5-6, and processing time is 30-35min.The present invention improves fabric state and hydrophily.

20. US2007275453 AA

This document describes a method for the treatment of polyacrylonitrile fibre containing vinyl acetate as a comonomer, characterised in that it comprises the contact of the fibre with an enzyme solution to modify the chemical surface of the fibre, increasing the number of hydrophilic hydroxyl groups.

The polyacrylonitrile fibre containing vinyl acetate as comonomer with an enzyme with esterase action. The enzyme esterase is a **hydrolase** that degrades cutine.

The enzyme contains the catalytic triad of serine-histidine-aspartic acid.

The amount of enzyme used is normally between 1 and 400 g of protein per kg of fibre.

21. US6066494 A

This document describes a method of altering water wettability and absorbency in textile fibers (cotton fibers) without alkaline scouring, said method comprising treating said fibers with an enzyme in an aqueous medium, said enzyme being a combination of **cellulase and pectinase**, said aqueous medium being substantially free of surface active agents.

Specific examples of fungal cellulases include those derived from *Trichoderma sp.,* including *Trichoderma longibrachiatum, Trichoderma viride, Trichoderma koningii, Pencillium sp., Humicola, sp.,* including *Humicola insolens, Aspergillus sp*., and *Fusarium sp.* Bacterial cellulases are derived from such organisms as *Thermomonospora sp., Cellulomonas sp., Bacillus sp., Pseudomonas sp., Streptomyces sp.,* and *Clostridium sp*.

Examples of proteases are trypsin, chymotrypsin and subtilisins; thiol proteases, examples of which are bromelain and papain; aminopeptidases; and carboxypeptidases.

Said method is conducted at a **temperature 20 °C to about 60 °C**.

The aqueous medium is buffered by an inorganic buffering agent.

The method further comprises immersing said fibers in boiling water for a period of time ranging from about 0.3 minute to about 6 minutes prior to treating said fibers with said enzyme.

22. KR20100034379 A

This document describes a method for surface modification of polyester fibers, and more particularly to the surface of polyester fibers biochemically using a **novel lipolytic enzyme derived from *Sphingobium* Chungbukkens KCTC 2955 BP** (See Annex I SEQ ID NO:4)

The polyester fiber-modifying composition comprises a stabilizer or a water-insoluble fiber substrate containing at least one type of cation selected from Ca^{2+}, Fe^{2+}, Zn^{2+}, Mn^{2+} and an enzyme.

Conditions: **pH 6-9, 30-70 °C.**

23. US5599698 A

This document describes a process for preparing modified polyacrylonitrile (acrylonitrile homopolymer or copolymer of acrylonitrile and a vinyl ester or acrylate), comprising treatment polyacrylonitrile with an effective amount of a **nitrile hydratases enzyme** (lysates of *Brevibacterium imperiale CBS 49874* bacteria containing this enzyme) at an enzymatically active temperature and pH, wherein surface --CN groups of said polyacrylonitrile are hydrolyzed to --CO--NH_2 groups, wherein said treating is carried out with stirring in the presence of 2,000-12,000 U/mL of said enzyme on 0.2-2 grams of said polyacrylonitrile, in a medium containing 100 mM phosphate buffer at pH 7, at a temperature of 10 -30 °C for 12-24 hours.

24. CN101565902 A

The document describes a **wool-fabric protease** anti-felting method based on weak oxidation and **cutinase** pre-treatment.

- Extraction preliminary treatment: introduce the wool fabric in chloroform-methanol or carbon tetrachloride-methanol solvate, reflux extraction 2-24 hour, removes the cloth cover residual impurity with ethanol or methyl alcohol and hot water wash again.

- Weak oxide preliminary treatment: 30% hydrogen peroxide 1-5 g/L, wetting and penetrating agent 0-20 g/L, pH 7.0-9.0, temperature 40-60 ℃, processing time 0.25-1h.

- **Protease treatment**. Conditions: handle the solution of bathing, pH 7.0-9.0, 30-60 ℃ of temperature, processing time 0.5-2h to protease mass concentration 0.2%-2.0%, wetting and penetrating agent 0-20 g/L.

Hydrophobicity

25. US5733750 A

This document describes a process for chemical finishing of fabrics, fibers, or yarns containing insoluble cellulosic polymer, the cellulosic polymer also contains free hydroxy groups, the process comprising the steps of:

(a) reacting the cellulosic polymer with a carboxylic acid or an ester thereof,

(b) catalyzing the process with a **lipase** or other esterase capable of esterification of the cellulosic polymers.

suitable lipases may be the *Rhizomucor miehei* lipase (e.g. prepared as described in EP 238 023), *Humicola lanuginosa* lipase e.g. prepared as described in EP 305 216 (available from Novo Nordisk under the trade name Lipolase™), *Candida antarctica* lipase A or B, or *Pseudomonas cepacia* lipase.

The **microbial lipase is a chemically modified lipase obtained by the coupling of a polyethyleneglycol to amino acid residues in the lipase.**

Example: A cotton swatch (2×2 cm) was added to a solution of decanoic acid (50 mg) in butanone (10 mL). Lipase from Candida antarctica (available from Novo Nordisk A/S) was then added and the mixture was vigorously stirred at 50 °C for 24 hours. The swatch was then rinsed thoroughly in butanone (3×10 mL) and dried at room temperature for 2 hours. The swatch was then treated with an aqueous solution (5 mL) of sodium hydroxide (1M) at 40 °C. for 1 hour. The swatch was removed and the solution was then acidified with hydrochloric acid to a pH of 2. Extraction of this solution with chloroform (5 mL) afforded an extract which was evaporated in vacuo.

26. US2020291333 AA

This document describes a method of treating cotton comprising: (i) contacting cotton with an aqueous wash liquor comprising water and an **endo-β-1,3-glucanase enzyme** (E.C. class 3.2.1.39), (ii) optionally rinsing the cotton; and (iii) drying the cotton. (See SEQ ID NO: 1 or SEQ ID NO: 2 or SEQ ID NO: 3 or SEQ ID NO: 4 or SEQ ID NO: 5 or SEQ ID NO: 6 or SEQ ID NO: 7 of the attached document 26- US2020291333 AA).

The cotton is in the form of a mixed fabric comprising cotton and one or more additional materials, preferably polyester.

The cotton is contacted with the aqueous wash liquor at a temperature of from 5 °C to 40 °C or less.

The endo-β-1,3-glucanase enzyme is obtained from ***Paenibacillus sp, Zobellia galactanivorans*** or ***Thermotoga petrophila*** micro-organism.

The aqueous wash liquor comprises a surfactant which is selected from non-ionic and anionic surfactant and mixtures thereof. Also, the aqueous wash liquor comprises peroxygenase enzyme.

This enzyme is used for manufacture of a cotton-containing fabric having improved soil repellency, reduced malodour, anti-wrinkle benefits, and/or improved drying.

Dyeing process

27. CN109281209 A

The document describes a method for promoting cocoon fiber dyeability based on enzymatic modification:

(1) Immerse the cocoon fiber in **serine hydroxymethylase** solution. Serine hydroxymethylase 2-10 U/mL, 5- phosphoric acid 0.25-1mmol/L, 2-10mmol/L of tetrahydrofolic acid and 5-15mmol/L of formaldehyde, **pH 7-9**, **25-40 °C** of temperature, time 2-8 hours. Wash the cocoon fiber after this treatment.

(2) Cocoon fiber is immersed in **protein kinase A** solution, this change serine and threonine residues phosphorylation in cocoon fiber. 2.5-10 U/mL of protein kinase A, 10-50 mmol/ of atriphos L, 1-10 mmol/L of cyclic adenosine monophosphate, **pH 6.5-8.0**, 20-40 °C of temperature, time 4-12 hours. After the treatment wash and dry the cocoon fiber.

28. CN101144249 A

The document describes a process of a vegetable dye to dye purified cotton knitting fabric.

The purified cotton knitting fabric is washed with hot water and cold water after being scoured. Mordant dyeing and vegetable dyeing are performed for the purified cotton knitting fabric after being treated with the biological enzymes. The purified cotton knitting fabric is batched or packed through cold water washing, hot water washing, drying, conventional pre-shrinking and constant breadth.

(1) Add **biological enzyme (refining enzyme GJB)** (1.5-3g/L) and washing agent (3-5g/L). Heat to the temperature: 95 ℃-100 ℃ (speed of heating: 1-3 ℃/min and time: 50-90min).

Hot water injection once, speed of heating: 1-3 ℃/min, hot water temperature: 70 ℃-100 ℃, duration of runs: 5-20min.

Cold wash once, water temperature: 10 ℃-40 ℃, duration of runs: 5-15min.

(2) Pure cotton fabric through biological enzyme pre-treatment carries out mordant dyeing and dyes plant dyeing.

Place in the overflow dyeing machine. 50 ℃-70 ℃, handle: 20-60min, and heating rate keeps 1 ℃-3 ℃/min.

Evenly add: 0.5-10% lining dry weight percentage behind the vegetable colour material; warm to 70 ℃-95 ℃, heating rate keeps 0.5-2 ℃/min, run for 30-120min.

Cold wash: bath ratio 1: 20-50, water temperature: 10-40 ℃, time: 5-20 minutes.

Industrial soap: 1-3%, water temperature: 50-80 ℃, 1-3 ℃/min, 5-20 minutes.

Hot water wash: water temperature: 70 ℃-95 ℃, heating rate: 2 ℃-3 ℃/min, time: 5-20min.

Cold wash 1-2-time, water temperature: 10-40 ℃, time: 5-15 minutes.

Oven dry: temperature: 90 ℃-120 ℃.

29. CN111058314 A

The document describes a method for improving the dyeing uniformity of cotton fabrics under the alkaline condition of cationic pigments. The invention comprises the following processes:

(1) preparing 0.03mol/L sodium periodate solution, heating the solution to 60 ℃, immersing the cotton fabric in the solution at a bath ratio of 20:1, and carrying out oxidation treatment for 30 min.

(2) preparing an aqueous solution containing **cellulase and amylase**, wherein the mass ratio of the cellulase to the amylase is 2:1, adjusting the **pH value to 4.5, heating the solution to 80 ℃**, immersing the treated fabric at a bath ratio of 20:1, wherein the mass ratio fabric: cellulase: amylase is 100:2:1, and treating for 1 h.

(3) cooling the solution to 30 ℃, adding sodium hydrosulphite and glucose to ensure that the concentrations of the sodium hydrosulphite and the glucose are both 0.1mol/L, treat the fabric for 1h, and then fully washing and drying the fabric.

30. CN109423893 A

The document describes a kind of anti-shrinkage of cotton fabric, which is characterised in that the following steps are included:

Dyeing pre-treatment process: preparing cotton fabric, temperature control is at 110-120 °C, bath ratio 1: 20-1:30, time 15-25min. Highly effective pre-treating reagent are then added, dosage is 1-4 g/L. Then is naturally cooling to room temperature after heat preservation 10 min and is washed after being warming up to 50-60 °C.

Treated cotton fabric is subjected to biological enzyme dyeing 25 min, bath ratio 1:5-1:10, dyeing temperature maintains 60-70 °C. The biological enzyme dye composite includes the following components in mass: 25- 35 parts of **biological enzyme**, 10-20 parts of natural dye, 4-12 parts of chitosan, 3-6 parts polyacrylic acid, 5-12 parts of ester type compound, surfactant and 150-220 parts of water. Adjust pH to 5.5.

Washed 4-5 times with deionized water, each wash time is 5- 10 min. Dry after washing.

31. CN108486929 A

The document describes a kind of colouring method of cotton socks. Steps: scouring and bleaching, fermenting, cation change processing, the first washing, pigment dyeing, the second washing, dehydration, drying.

Pigment printing paste temperature are controlled at 30-40 °C, and 1-2 °C of heating rate/min is warming up to 60-70 °C, keeping the temperature 20-30 min.

The cation modifier is an epoxychloropropane amino derivative.

32. CN102154230 A

The document describes a neutral low-temperature refining enzyme and use thereof in pre-treatment of fabrics. The neutral low-temperature refining enzyme comprises **15 to 50 weight parts of neutral cellulase, 30 to 70 weight parts of pectinase, 10 to 30 weight parts of xylanase, 5 to 30 weight parts of lipase and 10 to 15 parts of laccase.** When the neutral low-temperature refining enzyme is used, cotton seed hulls, pectic substances, waxiness can be removed effectively, the water absorptivity, fiber strength and dyeing property of cotton fabrics can be improved, dye can be saved, process time can be reduced, and the production efficiency can be improved.

Neutral cellulase is SDC-A series, SDC-D series or the SDC-C series available from Ningxia Sunson Industrial Group Co., Ltd.

Lipase is the neutral lipase series available from Ningxia Sunson Industrial Group Co., Ltd.

Laccase is the laccase series available from Ningxia Sunson Industrial Group Co., Ltd.

Conditions:

- PH value: 5.0-7.0
- Mangle temperature: 50-60 ℃
- Steam box temperature: 60-70 ℃
- Time: 40-60 minutes
- Neutral low-temperature refining enzyme: 5-10 g/L, 100% liquid carrying rate

33. CN106436354 A

The document describes an ecological dyeing and finishing technology of a blended knitted fabric.

Alkali pre-treatment： Prepare blended fabric, bath ratio 1:25-1:35, 40-45 °C, washed with hot water 30 min. Washed with cold water after hot water washing, bath ratio is constant, temperature is 20-25 °C, then dehydrated.

Cellulase treatment technique: the biology enzyme of use is acidic **cellulase, protease, amylase** 2:3:1 mixture, biological enzyme dosage 0.5- 1 g/L, process time 20-30min, pH is adjusted to 4-5.

Steps and conditions:

- Supersonic treatment at 50 -60 °C.
- Dispersion dyeing process.
- Staining process at 70 – 80 °C.
- Dry at 25 – 35 °C

34. US2012036649 AA

This document describes an enzymatic textile bleaching composition, comprising:

(i) a **perhydrolase enzyme** (See SEQ ID NO: 5 Annex I); present at a concentration of about 1 to about 2.5 ppm.

(ii) an ester substrate for said perhydrolase enzyme (propylene glycol diacetate). Present in the composition in an amount of about 2,000 to about 4,000 ppm.

(iii) a hydrogen peroxide source; present at a concentration of about 1,000 to about 3,000 ppm.

(iv) a surfactant and/or an emulsifier; alcohol ethoxylate

(v) a peroxide stabilizer; phosphonic acid

(vi) a sequestering agent; polyacrylic acid

(vii) a buffer that maintains a pH of about 6 to about 8.

The enzymatic textile bleaching composition also comprises a bioscouring enzyme (pectinase).

The document also describes a method for bleaching a textile, comprising contacting the textile with an enzymatic textile bleaching composition for a length of time and under conditions suitable to permit measurable whitening of the textile, thereby producing a bleached textile, wherein the bleached textile comprises at least one of decreased textile damage, bulkier softer handle, and increased dye uptake when compared to a chemical textile bleaching method that comprises contacting the textile with a chemical textile bleaching composition that does not comprise a perhydrolase enzyme.

The textile is contacted with the enzymatic textile bleaching composition at a bleaching temperature of about **60 to about 70 °C** for a processing time of about 40 to about 60 minutes.

35. WO12023021 A1

This document describes a method for isolating **laccase enzyme from *Arthrographis sp. MTCC5479*** strain comprising of:

a. growing *Arthrographis sp. MTCC5479* strain in sterile liquid culture medium.

b. inoculating production medium containing flasks with strain obtained in step a,

c. incubating the medium obtained in step b, at 30 °C on rotary shaker at the speed of about 180 rpm for nearly 72 hrs.

d. inducing the culture obtained in step c after 72 hrs with Xylidine 0.00001 to 0.0001% (v/v), $CuS0_4$, $5H_2O$, 0, 0.0025 to 0.025% (w/v) or 100 µM to 1000 µM,

e. incubating the culture obtained in step d at nearly 30 °C for about 12- 15 days.

f. withdrawing the culture obtained in step e, and separating **laccase** enzyme excreted into the medium from cell mass by centrifugation at nearly 8000 X g for nearly 10 minutes.

The enzyme functions at pH 3 to 5.5. and at 35 to 50 °C.

g. concentrating and purifying the enzyme obtained in step f.

36. RU2244772 C1

This document describes a method of low-temperature dyeing of textile materials with active dyes, including pre-processing the material with a composition containing auxiliary substances and a dye intensifier, and subsequent dyeing at 75-80 °C, characterized in that an organic nitrogen-containing additive is used as an intensifier of dyeing, including an amino acid or a **nitrogen-containing enzyme**, or an **enzyme of the class of oxidodeructases** - EU peroxidase 1.11.1.3. in a concentration of 0.2-2.5% by weight of the material to be painted, and dyeing is carried out for 120-130 minutes.

The nitrogen-containing enzyme could be **collagenase EU 3.4.24.3.** or **1,4-beta-D-glucan-glucanohydrolysis EC 3.2.1.4.**

37. CN103321056 A

The document describes a cotton fiber dyeing technique.

Pre-treatment, add enzyme that process the cotton fiber, wherein, the consumption of enzyme is 0.5-1.5g, 5060 ℃ of temperature, time 40-60min, pH value 8-9.

Dyeing 0-20 min at 55-60 ℃. Dye post processing, in temperature of 90 ℃, washing 10-15min and oven dry.

38. CN110592970 A

The document provides a dyeing and finishing processing method of full-colour modal polyester peach skin yarn-dyed fabric, which comprises the following steps: pre-treatment → dyeing → post-treatment → rewinding → warping → slashing → weaving → post-treatment. The after-finishing process comprises the following steps: zero shrinkage pre-shrinking → singeing → desizing → water milling → air washing + enzyme washing → sizing → pre-shrinking.

In the desizing step, the dosage of **amylase** is 2-5 g/L, the temperature is 55-60 ℃, the stacking time is 30-50 minutes, and the speed is 50-100 m/min.

In the air washing and enzyme washing steps, the dosage of the **polishing enzyme** is 1.5-5 g/L, the temperature is 50-60 ℃, the time is 30-90 minutes, and the cloth feeding amount is 800-1200 meters.

39. CN108251319 A

The document describes a kind of fermentation of **cutinase (*Humicola insolens*)** and a cotton fabric enzyme refinery practice (See Annex I SEQ ID NO: 6).

A method of fermenting and producing cutinase, which includes the following steps:

The incubation stage: any recombinant bacterium is inoculated into fermentation medium at 25-31 °C. Lower stir culture 15-36 h.

The fermentation inducement stage: Derivant is added during the fermentation (25 - 33 °C). Derivant is methanol and sorbierite.

40. CN101424048 A

The document describes a method for performing an anti-felting process of a wool fabric by a two-bath process by applying **cutinase/protease**.

The extraction preliminary treatment: wool fabric is treated with 87: 13 chloroform/methanol of volume ratio, or carbon tetrachloride/methanol mixed solvent, reflux extraction 2-24 hour.

Impregnation process in mass concentration 0.5%-5.0%, wetting and penetrating agent 0-5g/L, 30-60 ℃ of temperature, pH 7.0-9.0,1-6-hour.

Protease Treatment: the wool fabric impregnation process in mass concentration 0.2%-2.0% of protease, wetting and penetrating agent 0-20g/L. 30 ℃-60 ℃ of temperature, pH 7.0-9.0, 0.5-2 hour.

41. CN106436358 A

The document describes a natural dyeing composition for polyester fiber fabrics and application of the natural dyeing composition.

The natural dyeing composition is prepared from 4-6 parts of high-efficiency emulsifier (Sultafon D), 4-8 parts of high-efficiency penetrating agent, 2-5 parts of high-efficiency chelating dispersant, 1-3 parts of alkali-resisting pre-treating agent, 30-50 parts of natural dyes, 20-30 parts of nanometer environmental-friendly dyes (particle diameter is 60-90nm), 6-12 parts of **low-temperature enzyme refining agents**, 5-8 parts of nanomaterials (nano tin dioxide particulate), 4-8 parts of chitosan, 12-15 parts of polyacrylate compound, 1-4 parts of dispersant, 2-4 parts of levelling agent, 6-12 parts of surfactant and 200-300 parts of water.

Temperature control is 70-80 ℃.

42. CN109355939 A

The document describes a kind of cotton fiber fabric modified dyeing method.

The cotton fiber fabric bath ratio is 1:7~9, the dosage of enzyme is 1~2g/L, and the dosage of bio-modification agent is 5~10g/L. They use the **refining enzyme 301L** (Novi believes (China) Biotechnology Co., Ltd).

Bio-modification agent is biological modifier A S.

Modification temperature is 55-65 °C, the heating rate is 2 °C/min, and the time is 25-35 min.

43. CN108728963 A

The document describes a kind of spinning of cationic fiber mixed yarn and colouring methods, which include the following steps:

- It is prepared by mixed yarn: The qualified quantitative carded sliver is made through blowing, cotton carding, mixing in doubling step in cationic fiber, then in cotton carding work.
- Pre-treatment with the **enzyme,** refining agent and bleeding agent (20g/L, 3g/L, 2g/L respectively). The enzyme can remove spot in yarn.
- Washing at 60 – 95 °C.
- Dyeing: 5-10 parts of tristyrylphenol polyoxyethylene ether sulfonation ammoniums, 3-6 parts of nonylphenol polyoxyethylene ether, 15-25 parts 2,3- dihydroxy naphthlene -6- sodium sulfonates, 2-8 parts of epoxychloropropane, 7-10 parts glacial acetic acid, 30-60 parts of water.

44. CN101736616 A

The document describes a technology for dyeing and finishing real silk/corn fabric.

- Preliminary treatment.
- Enzyme treatment.
- Dyeing process: 0-1g/L acetic acid, 0-2g/L deep-dyeing agent DL-6, 0.5-2g/L high temperature disperses levelling agent; 100-110 ℃ of dyeing temperatures, insulation 30-40min.

- Heat-setting process.

Employing **neutral enzymatic white silk (pH 7 – 7.5)** or **alkaline enzyme white silk (pH 8.5 – 10)** in the white operation. **Protease** consumption is 1-4g/L, processing time is 1-4 hour and 45 ℃ ± 2 ℃ of temperature.

45. CN111101389 A

The document describes an environment-friendly dyeing method of mulberry bark fiber blended yarns which comprises:

- Pre-treatment: performing biological refining treatment on the blended yarn by adopting an enzyme refining liquid, deactivating enzyme at a high temperature (between 85 and 90 ℃), taking out and drying. The enzyme used is a mixed enzyme consisting of **pectinase and neutral amylase.** The enzyme refining solution comprises the following components: 3-5 g/L of pH buffer, 3-6 g/L of EDTA, 1 g/L of mixed enzyme and 3-8 g/L of sodium dodecyl benzene sulfonate. **The pH value of the biorefinery is 6.5-7.5, the treatment temperature is 40-50 ℃**, the treatment time is 20-30min, and the bath ratio is 1: (10-15).

- Prepare a dye solution: dissolving natural plant dye and dyeing assistant in deionized water in a dye barrel to prepare biological dye solution.

- Dyeing: injecting the prepared biological dye solution into a dyeing barrel, raising the temperature to 60-65 ℃, adding the pretreated yarn for dyeing, raising the temperature to 90-95 ℃ at the speed of 1-2 ℃/min, and then preserving the heat for 15-20 min.

- Post-treatment: taking out the dyed yarn, soaping the yarn for 18-25min by using 65-70 ℃ soaping liquid, and then cleaning the yarn by using cold water; taking out the yarn, and drying at 45-50 ℃.

46. CN107718779 A

The document describes a kind of denim fabric. Denim fabric is made up of 60-70% cotton yarns, 28-32% terylene and 1-5% spandexs.

Enzyme pre-treatment： Put the denim fabric in the **laccase** solution (5-8g/L), regulate **pH value** to **4-5,** and **58-60 °C** of temperature.

Take 8-10 parts of caustic soda, 0.5-0.6 parts of bleeding agent, 6-7 parts of indigo, 7-9 parts of sodium hydrosulphite, 76-83 parts of water, stirring uniformly, dye liquor is reduced into 45-55 min at 52-56 °C.

Soap boiling technique: put the denim fabric in the soap boiling liquid containing soap powder 1.5-1.8 g/L. The bath ratio 1:20-22 (18-20 min at 100 °C).

Components of the antibacterial treatment: 25 – 35 parts of crumple resin, 5 – 12 parts of stiffening agent, 10 – 20 parts of rhizome of nutgrass flats edge extract solution, 4 – 8 parts of methylcellulose, 2 – 6 parts of poly- third glycol, 25 – 35 parts of water, 1 – 4 parts of dispersant and 0.5 – 2 parts of buffer.

After dyeing denim fabric crumples liquid with antibacterial and soaked, then heated it 1-2 °C/min to 70-90 °C.

47. CN102899929 A

The document describes a processing method of salt-free dyeing through activated dye, which includes the steps of:

(1) acid pickling and enzyme washing of cotton fabric after the pretreatment of scouring and bleaching

(2) mixing water with organic solvent at volume ratio of (1:4) -(1:9) to form a mixed solution, and then adjusting the pH value of the mixed solution to pH 7-8

(3) dyeing the pre-treated cotton fabric in 20-30 °C activated dye by using the mixed solution, then carrying out water scrubbing, acid pickling, soaping, hot-water scrubbing, colour fixing and softening on the dyed cotton fabric, and finally recovering the solvent. Organic solvent is absolute ethyl alcohol or acetone.

High temperature type reactive dyes is reactive yellow HE4R, red HE3B, deep blue HER or emerald green blue HA. Middle resist reactive dyes is: active yellow 3 R S, red 3BSN, black B or deep blue KNB.

48. CN110735332 A

The document describes dyeing methods of low-salt and low-alkali bamboo fiber yarns.

- Pretreatment: performing biological refining treatment on the bamboo fiber yarn by adopting an enzyme refining liquid (**cellulase**), deactivating the enzyme at high temperature, taking out and drying. The enzyme refining solution comprises the following components: 3-5g/L of pH buffer, 1-2 g/L EDTA, 1g/L of cellulase, 0.5-1 g/L of glacial acetic acid and 5-8 g/L of soda ash. The temperature of the biorefining treatment is **55-65 ℃**, the time is 30-45min.
- Preparing a dye solution: adding natural plant dye into a dye barrel, adding anhydrous sodium sulphate and glacial acetic acid according to a certain proportion, injecting water to prepare a solution, and add an environment-friendly accelerating agent to prepare a biological dye solution.
- Dyeing: injecting the prepared biological dye solution into a dyeing barrel, raising the temperature to 60-65 ℃, and add the pre-treated yarn for dyeing.
- Post-treatment: taking out the dyed yarns, soaping the yarns for 8-15min by using a soaping liquid at the temperature of 98-100 ℃, fixing the yarns for 3-5min by adopting high-temperature and then cleaning the yarns by using cold water.

49. CN102704282 A

The document describes a technology for producing a high-standard fluorescent safe protective polyester and cotton interwoven fabric by using a domestic fluorescent disperse dye. Steps:

(1) Bleaching pretreatment: enhancing bleaching of a polyester and cotton interwoven fabric by adopting a jig dyeing machine and removing residual hydrogen peroxide on the interwoven fabric by using a **hydrogen peroxide removing enzyme** to improve the dyeing uniformity of the fabric.

(2) High-temperature and high-pressure dyeing:

[1] Performing heat dyeing for 4 times at the temperature of 60 °C, so that the fluorescent disperse dye is absorbed uniformly on the surface of the fabric as much as possible.

[2] Strictly controlling the dyeing rate and the pH value (6-8) by adopting a method for controlling a dyeing temperature rise curve to satisfy the level dyeing conditions.

(3) Reductive washing: performing reductive cleaning, oxygen rinsing and acid washing neutralization after dyeing, rewashing, drying, sizing, and inspecting the finished product, wherein a mixed solution of rongalite and caustic soda is adopted in the reductive cleaning.

50. CN103243564 A

The document describes a method for processing Lyocell bamboo fiber through a composite bio-enzyme.

(1) **Neutral starch enzyme and neutral cellulase** mixed by weight 2: 1 or scouring enzyme mixes as compound biological enzyme by weight with neutral cellulase at 1: 2.

(2) With water as solvent, add compound biological enzyme, the activator that promotes the compound bio enzyme activation, the bleeding agent or the wetting agent of coordinated enzyme destarch, the control bath ratio is 1: 50～60.

(3) Control destarch temperature is 50 ℃～65 ℃, and the Lyocell bamboo fibre is placed the destarch slurries, and destarch is treated to 1～1.5 hour.

Preparation neutral starch enzyme and neutral cellulase, concentration range is respectively 3g/L -5g/L, 2g/L - 4g/L; the **control temperature is 30 ℃～50 ℃ and pH is between 6.5～7.5.**

Neutral starch enzyme is commercially available Suhong Desizyme 2000L, Aquazym 240L or Aquzym Ultra 1200N, and the vigour of neutral starch enzyme is 2200 U.

Neutral cellulase is commercially available Cellusoft CR, Cellusoft Combi or Cellusoft 1.5L, and the vigour of neutral cellulase is 2400 U.

Activator is inorganic salts, comprises NaCl, KCl or $CaCl_2$ the concentration of activator in the destarch slurries is 4g/L - 5g/L.

51. US2007166805 AA

This document describes a method of enhancing the hydrolysis of cellulose by cellulase comprising introducing to said cellulose a **GR2 protein** in the presence of said cellulase.

Cellulase is isolated from ***Trichoderma.spp, Aspergillus spp,*** or ***Humicol spp***. Cellulase is selected from the group consisting of: *Trichoderma cellulase*, endoglucanase 5 from *Thermomonospora fusca*; the catalytic domain of endoglucanase 5 from *Thermomonospora fusca*; the catalytic core of endoglucanase V from *Humicola insolens*; endoglucanase I (Cel7A) from *Trichoderma reesei*; cellobiohydrolase I (Cel7B) from *Trichoderma reesei*; and endoglucanase 1 from *Acidothermus cellulolyticus.*

GR2 protein is one from pfam01357 and is a group 2 grass pollen allergen protein. NCBI Protein Accession #PI 4947, Lol p3, Ph1 p2, Zea m2, and Zea m3.

The novel method has commercial utility in various applications in that cellulose found in but not limited to sources such as textiles, paper, and rope.

Applicants herein show that GR2s lack cellulose hydrolytic activity by themselves, but when combined with any of a variety of cellulytic enzymes GR2s strongly enhance the hydrolysis of cellulose. The results indicate that GR2s to increase the accessibility of cellulose to enzymatic attack. GR2s also are shown herein to reduce the mechanical strength of paper and to affect binding of direct cotton dyes to cellulose. When combined with any cellulytic enzymes GR2s strongly enhance the hydrolysis of cellulose for any of a number of applications, including chemical derivitization of cellulose, bioethanol production, paper recycling, improvement of forage digestibility, and the like.

52. CN106223003 A

The document describes a dyeing and finishing technology of a kind of polyester cotton blending fabric, which comprise the steps:

(1) Pre-treatment, polyester cotton blending fabric is boiled (105-115 ℃ process 15-30min) and is submitted to an enzyme washes process. Bleaching liquor includes refining agent 1-3g/L, caustic soda 2-5g/L, hydrogen peroxide 6-10g/L, hydrogen peroxide stabilizer 0.5-1g/L. After washing again immersing in ferment treatment liquid, process 30-60 min at 70-80 ℃. The ferment treatment liquid includes: **pectase** 0.5-1g/L, **cellulose enzyme** 1-3g/L, glacial acetic acid 0.5-1g/L, penetrating agent 1-2g/L.

(2) Mercerising is shaped by the at room temperature alkali immerging of the fabric after pre-treatment.

(3) Immerse the fabric after (2) mercerising is shaped in the dye liquor that disperse dyes are formed. Bath ratio is 1:15-30. Dye liquor includes disperse dyes 1-3% (owf), pH buffer agent 1-2 g/L, levelling agent 1-2 g/L. Warm up to 90 - 110 °C with the heating rate of 0.8-1 °C/min, warm water washing, hot-air seasoning after infrared preliminary drying. Padding the suspended substance dye liquor that reducing dye is formed under room

temperature again, pad reducing solution, decatize is reduced, oxidation, and warm water washing is soaped, then washed drying.

Reducing solution includes caustic soda 5-25 g/L, sodium hydrosulphite 1-10 g/L, thiourea dioxide 1-5 g/L, at 102-105 ℃.

(4) Final finishing, will carry out softness, flame-proof treatment successively.

53. CN110230217 A

The document describes a kind of vegetable colour fixing agent for silk printing and dyeing.

Components: 10-16 parts of gum tragacanth, 5-7 parts of aloe vera gel, 4-8 parts of colophony powder, 1-3 parts of alkali mine soil, 0.5-1 parts of diatomite, 0.1-0.5 parts of kaolin, 1-2 parts of compound biological enzyme, 3-5 parts of ethyl alcohol.

The compound bio enzyme is matched by following component according to parts by weight: acidic **cellulase** DM-8639: wide temperature **amylase** DM-8652: neutrality is thrown **light enzyme DM-8688A**: **lipase**=15 - 20: 5 - 8: 1 - 4: 5 - 10.

Aloe vera gel are heated to 85 – 90 °C, it is in molten condition, then it is cooled to 40 °C or less. It is added after excess ethyl alcohol dilution seals still aging 30-45 days, centrifugal treating, and separate removal precipitated impurities. Alkali mine soil, diatomite and kaolin is added in obtained solution and adjusts pH value to 7.5-8.5, stands 1-2h, filtering removal impurity. Then the solution is warm to 55-60 °C. Colour fixing agent is concentrated to molten condition in ethanol evaporation. It is cooled to room temperature; compound biological enzyme is added and stirs evenly for use.

54. CN107513872 A

The document describes a mixed base dyeing technique of silk blend looped fabric. The technique comprises the following steps : Prerinse ; Peracid treatment after bleaching ; Deoxygenation after ferment treatment, remove remnants bleaching agent ; Wash dye ; Silk dye ; Caustic soda is added portion wise after adding soda ash ; Adjust temperature; peracid treatment ; Clean and dry after fixation, softening, complete dyeing.

Step in which is implicated the enzyme: Blended knitted cloth is immersed in 55~60 ℃ of **enzyme intermixture**, after being incubated 3~5min, with 1.5~2 ℃/min speed, is cooled to 30~35 ℃. Then blended knitted cloth is immersed in oxygen scavenging system, removes remnants bleaching agent.

Cellulose fibres

55. US6159720 A

The inventors of the present invention have now isolated from ***Humicola insolens*** a novel highly active **cellulase** and its gene, which can be used extremely advantageously in the treatment of various cellulose-containing fibers.

The novel cellulase according to the present invention is a protein or a modified protein having a portion of an amino acid sequence shown in SEQ ID NO: 7 (See Annex I) or a sequence from position 1 to position 284 of the amino acid sequences shown in SEQ ID NO: 7.

The cellulase according to the present invention is used in various applications in its original form or as a cellulase preparation. In particular, it is used to give desired properties to cellulose fibers. More specifically, it is used for removing nap of cellulose-containing fibers, performing weight reduction processing, and performing decolouring processing of denim-dyed, cellulose-containing fibers.

A cellulase preparation may be prepared by mixing the cellulase according to the present invention with ingredients generally contained in cellulase preparations, examples of which include excipients (e.g., lactose, sodium chloride, sorbitol), surfactants and antiseptics.

Although contact temperature, the amount of cellulase and other conditions may be decided depending on various conditions in a system, for example, in nap removal of cellulose-containing fibers, treatment can be performed at about 50-60 °C using cellulase at a protein concentration of 5-50 mg/L. In the process for reducing cellulose-containing fibers, treatment can be performed at about 50-60 °C using cellulase at a protein concentration of 100-300 mg/L. Moreover, in the process for decolouring denim-dyed, cellulose-containing fibers, treatment can be performed at about 50-60 °C using cellulase at a protein concentration of 2-10 mg/L.

56. US2018171544 AA

This document describes an enzyme composition comprising, a first polypeptide having **GH45 cellulase activity** and biofinishing activity, and a second polypeptide having **GH45 cellulase activity** and biofinishing activity (See SEQ ID NO: 8 - Annex I).

This invention also relates to a recombinant host cell comprising the two polypeptides.

This document also describes a process for biofinishing a cellulose-containing textile, comprising (a) treating the cellulose-containing textile with the first polypeptide; and (b) treating the cellulose-containing textile with the second polypeptide.

It also describes a process for treating a cellulose-containing textile, comprising

(a) desizing; (b) scouring; (c) bleaching; (d) dyeing.

Glycoside hydrolases (GHs) are a large group of enzymes that cleave glycosidic bonds between individual carbohydrate monomers in large polysaccharide molecules. Cellulases cleave the beta 1-4 bond between glucose monomers in the cellulose polymer. GH enzymes all share one of two common mechanisms, called inverting and retaining, for introducing a water molecule at a glycosidic bond thus cleaving the polysaccharide.

The GH Family 45 cellulase enzymes (formerly Family K) act with inversion of anomeric configuration to generate the alpha-D anomer of the oligosaccharide as a product. It has been elucidated that, in the active site, one aspartic acid amino acid acts as a general acid and another as a general base.

57. US2012322997 AA

This document describes a process for producing cellulose fibers, characterized by comprising the association of at least one enzymatic treatment with at least one acid step wherein the acid step is applied sequentially before or after the enzymatic treatment during the process for obtaining cellulose fibers and wherein in the enzymatic treatment **hydrolytic enzymes selected from the group consisting of cellulases, xylanases and mixtures thereof is used.** The hydrolytic enzymes used are commercial enzymes and some suppliers of them are: Novozymes, Verenium, logen, AB Enzymes and others.

The retention time during the enzymatic treatment ranges from 40 to 240 minutes, the **pH of the medium ranges from 5.5 to 8.5 and medium temperature ranges from 40 to 90° C**, and hydrolytic enzyme charge ranges from 0.10 to 2.0 kilogram of enzyme/ton cellulose.

58. US2012088291 AA

This document describes a method for adjusting the colour tone of dyed cellulosic textile fibre material comprising contacting said textile material with an enzymatic textile treatment composition comprising

(i) a **perhydrolase enzyme** (See SEQ ID NO:9 - Annex I)

(ii) an ester substrate (selected from propylene glycol diacetate, ethylene glycol diacetate, glycerol triacetate, ethyl acetate, and glycerol tributyrate) for said perhydrolase enzyme, and

(iii) a hydrogen peroxide source.

This composition also comprises a surfactant and/or emulsifier, a fluorescence whitening agent, an enzymatic desizing agent, a biopolishing agent and a combination product.

The textile material is contacted with the enzymatic textile treatment composition at a temperature of **60 °C to 75 °C**, for a processing time of 30 to 60 minutes.

59. US2017145628 AA

This document describes a composition which comprises a **pectinase** and a surfactant. The pectinase is a neutral **pectate lyase**.

This composition **also comprises one or more enzymes** selected from the group consisting of amylase, catalase, cutinase, lipase, mannanase, oxidase, protease, and xylanase.

The document also describes a method for treating a textile, comprising

(a) desizing the textile with an amylase.

(b) scouring the textile with the composition.

60. US2019106690 AA

The document describes a variant of a parent **cellulase**, wherein the variant comprises an alteration at one or more positions corresponding to positions 292, 274, 266, 265, 255, 246, 237, 224 and 221 of the mature polypeptide of SEQ ID NO: 11 (See Annex I), and wherein the variant has cellulase activity.

The variant of a parent GH45 cellulase, wherein the variant comprises a catalytic domain and a cellulose binding domain, wherein the cellulase binding domain is heterologous to the catalytic domain, and wherein the variant has an improved biofinishing activity compared with the parent GH45 cellulase.

61. US2006035361 AA

The document describes a novel **cellulase** resistant to surfactants and/or having a high activity under alkaline conditions.

The present inventors conducted intensive studies, and as a result, successfully obtained a novel cellulase resistant to surfactants and/or having a high activity under alkaline conditions, by substituting the 162nd and/or 166th amino acid residues with different amino acid residues in the amino acid sequence of a cellulase (NCE5) consisting of the amino acid sequence of SEQ ID NO: 12 (See Annex I).

The document also describes different methods:

A method of treating a cellulose-containing fabric, a method of reducing fuzzing of a cellulose-containing fabric or reducing a rate of the formation of fuzz, a method of reducing weight to improve the touch and appearance of a cellulose-containing fabric, a method of colour clarification of a coloured cellulose-containing fabric and a method of reducing stiffness of a cellulose-containing fabric or reducing a rate of the formation of stiffness.

62. CN106223001 A

The document describes an **enzymatic solution** which comprises amylase 0.5 ～2g/l, cellulase 0.5～1.5g/l, hemicellulase 0.5～1.5g/l, pectase 1.0～2.0g/l, enzyme activates agent 0.1～10mL/L, wetting and penetrating agent JFC1g/l. Composite enzyme solution **pH value is 7～10**.

63. WO08039353 A2

This document describes a bioscouring composition comprising a purified ***Bacillus subtilis*** **pectate lyase** in an aqueous solution. The composition further comprising an enzymatic bleaching system or a chemical bleaching agent (See SEQ ID NO: 13 – Annex I).

The chemical bleaching agent is an oxidative bleach, sodium peroxide, sodium hypochlorite, calcium hypochlorite, sodium dichloroisocyanurate, or a combination thereof.

The composition also comprises a desizing agent, a bio-polishing agent, a dye and a second enzyme selected from the group consisting of pectinase, a cutinase, a cellulase, a hemicellulase, a protease, a lipase, an amylase and combinations thereof.

The enzymatic bleaching system comprises an ester source, a perhydrolase, and a hydrogen peroxide source.

The document also describes a one-step treatment composition for treating textiles comprising:

(a) a pectate lyase obtained from *Bacillus subtilis* having a molecular weight of about 43 kD, a pi of about 7.3 under reducing SDS-PAGE conditions, and an optimal pH of about 5.0 to about 11.0.

(b) one or more desizing enzymes; and (c) one or more chemical bleaching agents and/or enzymatic bleaching system.

The suitable conditions comprise a **pH of about 6 to 8**, a length of time of about 2 minutes to 24 hours, a temperature of about **25 to 60 °C**, and wherein the chemical bleaching agent is hydrogen peroxide and is present in an amount of about 1000 ppm to 3000 ppm.

64. US2010098807 AA

The present inventors found a novel protein having endoglucanase activity and a gene thereof from ***Penicillium pinophilum*** **PF1365** (FERM BP-10780). The document describes an **endoglucanase PPCE**, a **cellulase preparation containing endoglucanase PPCE** (See Annex I – SEQ ID NO:14) and a method of treating a cellulose-containing fabric utilizing endoglucanase PPCE or the cellulase preparation. The protein exhibited extremely high activities to improve the appearance of a cellulose-containing fabric and to impart a “stonewash” appearance to a coloured cellulose-containing fabric.

Further, endoglucanase PPCE exhibited surprising features that its optimum pH and optimum temperature were remarkably low, i.e., around **pH 3 and 30 °C**, respectively, by comparison with known cellulases for fabric processing.

The document describes a method of treating a cellulose-containing fabric, comprising the step of bringing the cellulose-containing fabric into contact with the protein, a cellulase preparation comprising the protein, or a detergent composition comprising the protein or the cellulase preparation.

65. US6017751 A

The document describes a process for desizing a cellulose-containing textile, comprising treating the textile with an enzyme hybrid which comprises a catalytically active amino acid sequence of a **lipase** (e.g. triacylglycerol lipases, EC 3.1.1.3) or **an amylase (**e.g. α-amylases, EC 3.2.1.1) linked to an amino acid sequence comprising a cellulose-binding domain.

The **α-amylase** is obtainable from ***Bacillus licheniformis***. The amino acid sequence of said **lipas**e is of a lipase obtainable from a species of ***Humicola, Candida, Pseudomonas*** **or** ***Bacillus***.

The cellulose-binding domain is obtainable from a cellulase, a xylanase, a mannanase, an arabinofuranosidase, an acetylesterase or a chitinase.

66. CN110106690 A

The document describes a kind of cellulose fibre-dacron interweaved fabric dyeing and finishing processing method, include the following steps:

(1) Fabric pre-treatment: fabric being impregnated in pretreatment liquid and carries out biological enzyme one-step method, adjusting pH 6-9, temperature is 55-70 °C, and the processing time is 50-100 min.

(2) Dyeing and finishing processing: disperse dyes-high temperature resistant reactive dye two-bath dyeing method is carried out to fabric obtained by the pre-treatment of step 1.

(3) Fabric post-treatment: soft finish.

Pre-treatment liquid comprises the following components in parts by weight: **4-10 parts of biological enzyme**, 8-15 parts of hydrogen peroxide, 2-3 parts of tetraacetyl ethylene diamines, 5-8 parts of bleeding agents, 1-3 parts of stabilizers, 60-80 parts of water.

The biological enzyme includes mass ratio **1:(1-2) pectase and alpha-amylase.**

67. WO06106097 A1

The document describes a process for treating non-dyed textile, which comprises treating said non- dyed textile with (a) at least two different enzymes of which (a1) at least one enzyme is selected from **cellulase** and (a2) at least one enzyme is selected from **pectinas**e, and (b) at least one additional active ingredient, selected from wetting agents, non-ionic surfactants, and defoamers over a period of at least 15 minutes.

Said process is carried out at a **pH value in the range from 2 to 5** and at temperature in the range from **45 to 65 °C**.

68. WO20099719 A1

The document describes a variant of a **GH45 cellulase** polypeptide, or an active fragment thereof, comprising substitutions in the positions 167, 210, 215, 220 and 225, wherein the amino acid positions are numbered with reference to the amino acid sequence of the mature ACM88 cellulase deriving from the ***Acremonium thermophilum* GH45** (SEQ ID NO: 15 – See Annex I).

The variants show improved stability in protease containing detergents in long-term experiments at **30 °C temperature**.

The document also describes a method for treating cellulosic material, wherein the method comprises reacting the cellulosic material with the variant.

69. WO9854332 A1

The document describes a **cellulase** preparation comprising an amino acid sequence consisting of the amino acids of the 1- to 397-positions in the sequence represented by SEQ ID NO: 16 (See Annex I) or modified proteins thereof.

The preparation enables elimination of fluffs and weight loss treatment of cellulose-containing fibers, bleaching of cellulose-containing, denim-dyed fibers and weight loss treatment of deacetylated triacetate rayon in a small amount within a short period of time as compared with the conventional ones.

The treatment can be performed by using a cellulase preparation having a protein concentration of 10 to 30 mg/L at a temperature of about **0 to 60 ° C.**

70. US5919272 A

The document describes a method of reducing redeposition or backstaining of dye on dyed cellulose-containing fabric subjected to enzymatic stone-washing with a wash liquor containing **cellulase**, comprising reducing the concentration of di- or trivalent cation in the wash liquor to less than 20 mg/l.

The divalent cation is Ca^{2+}or Mg^{2+} and the acid cellulase is from a strain of ***Trichoderma, Irpex, Glostridium*** **or** ***Thermocellum.***

The liquor further comprises a buffer which is a phosphate, borate, citrate, acetate, adipate, triethanolamine, monoethanolamine, diethanolamine, carbonate, diamine, diaminoethane, imidazole, or amino acid buffer. Also, it comprises a surfactant.

71. US2008070284 AA

The document describes enzyme-based methods for carrying out oxidizing reactions (redox reactions) and for carrying out coupling and/ or cross-linking reactions, characterized in

a) these oxidations, coupling and/or cross-linking reactions are carrying out using **hydrolases** such as lipases, esterases, proteases, amidases, transferases, acylases, glycosidases, glycotransferases or using oxidoreductases, such as preferably peroxidases, chloroperoxidases and laccases, either individually or in combination with one another

b) the oxidizing reactions are performed using the mentioned enzymes together with special (redox) enhancer compounds

c) these coupling and /or cross-linking reactions are carrying out with compounds which should be modified such as natural (i.e. having natural origin) or artificial (i.e. synthetically produced) monomers to polymers or mixtures of natural and artificial polymers or fibre materials (preferably lignocellulose-containing, cellulose-containing or protein-like natural polymers)

in combination with compounds which are coupled and/or cross-linked such as the same or similar compounds like natural, (i.e. having natural origin) or artificial (i.e. synthetically produced) monomers to polymers or mixtures of natural and artificial polymers or fibre materials (preferably lignocellulose-containing, cellulose-containing or protein-like natural polymers) especially

in combination with property-changing compounds such as monomer to polymer substances (natural or synthetic) either simultaneously or one after the other or with compounds belonging to other substance groups like e.g. UV absorbing substances, radical scavengers, etc., and characterized in, that

d) special coupling and/or cross-linking enhancer compounds or coupling and/or cross-linking precursor compounds which are the coupling and/or cross-linking agents activated by the enzymes are used.

Enzymes are **hydrolases or laccases or peroxidases or chloroperoxidases.**

Enzymes such of the group of 2.2, 2.4, 3.1, 3.2, 3.4, 3.5 (hydrolases) and/or oxidoreductases of the class 1 and particularly of the groups 1.10.3.2 (laccases), 1.11.1.7. (peroxidases) and 1.11.1.10 (chloroperoxidases) are used.

72. CN104480695 A

The document describes a dyeing and finishing method capable of improve the luster and the hand feeling of all cotton.

The dyeing and finishing processing method comprise the procedures: singeing, carrying out rolled-enzyme cold piling, boiling, bleaching, tentering, sizing, mercerizing, pretensioning, whitening, printing, ageing, washing with water, soft sizing, calendering and preshrinking.

In scouring process, the time of banking up is 60 - 80min. Add 20 - 50g/L of caustic soda.

The dyeing and finishing processing method improving cotton gloss and feel, is characterized in that: in described bleaching process, the pH is between 8 – 10. In bleaching process, hydrogen peroxide concentration is 2 - 4g/L, and the time of banking up is 40 – 60 min.

73. GB2432585 A1

Describes a method of treatment of a textile comprising: providing a quantity of sized textile comprising cellulose-based fibres; providing a composition of active enzymes comprising: an enzyme for the degradation of starch; an enzyme for the hydrolysis of the ester bonds of triglycerides and cutin; and an enzyme for the degradation of pectin; and treating the textile with the composition to substantially remove size and to substantially improve the hydrophilic properties of the fibers.

Conditions: **pH 8, T 30 -40 °C.**

The enzyme for the degradation of pectin is an **alkaline pectin lyase (EC 4.2.2.2),** the enzyme degradation of starch is an **α-amylase** and the enzyme for the hydrolysis of the ester bonds of triglycerides and cutin is **cutinase (EC 3.1.1.74)**.

74. IN201741003741 A

The document describes an enzymatic scouring agent for the treatment of cellulose material using the inventive mixture containing the following enzymes, **catalase** 40 - 75 µg/mL, **Alkyl cysteine sulfoxide lyase** 0.1 - 0.35 mg/mL, **Glutathione reductase** 0.03 - 0.18 µg/mL, **Superoxide dismutase** 25 - 75 µg/mL, **Lipoxygenase** 0.2 - 0.75 mg/mL, **Beta-gluronidase** 8 µg/mL – 25 ng/mL, **Cellulose** 0.2 - 2 mg/mL, **Pectinase** 2 U/mL – 6 U/mL, **Protease** 0.1 - 0.7 U/mL and a mixture thereof, ranging from 0.2 percent to 8 percent by the weight of goods and an (MLR) maintained between 1: 20 and 1: 3; provides an enzymatic scouring using the bio-enzyme wherein the cellulose material is treated with an inventive mixture, specifically, putting the cellulose material at a temperature 20 - 40 °C; adding the inventive mixture maintained with non-alkaline pH; heating to a temperature 60 -95 °C; rinsing it for 0: 10 - 1: 30 hours; discharging the scouring bath and taking immediately for dyeing bath, involves the steps of removing of impurities, oil and wax.

75. US2009297495 AA

The invention provides polypeptides, for example, enzymes and catalytic antibodies, having a **hydrolase activity**, e.g., an esterase, acylase, lipase, phospholipase, or protease activity, including thermostable and thermotolerant hydrolase activities, and enantiospecific activities, and polynucleotides encoding these polypeptides, including vectors, host cells, transgenic plants and non-human animals, and methods for making and using these polynucleotides and polypeptides. (See claim 1 of the attached document 75- US2009297495 AA to obtain more information about the sequences).

The document also describes a method for washing an object comprising:

(a) providing a composition comprising a polypeptide having a hydrolase activity

(b) providing an object; and

(c) contacting the polypeptide of step (a) and the object of step (b) under conditions wherein the composition can wash the object.

3. Annex

SEQ ID NO: 1 (DOCUMENT 2 - US2009258406 AA)

ESTAS SECUENCIA ESTAN MAL EN EL DOCUMENTO QUE MANDARON DE PONS (DEL AA 16 PASA AL 20) Y NO ENCUENTRO LA ORIGINAL

MTHQIVTTQYGKVKGTTENGVHKWKGIPYAKPPVGQWRFKAPEPPGVWEDVLDATAYGPICPQPSDLLSLSYTELPRQSE
DCLYVNVFAPDTPSQNLPVMVWIHGGAFYLGAGSEPLYDGSKLAAQGEVILVVTLNYRLGPFGFLHLSSFDEAYSDNLGLLD
QAAALKWVRENISAFGGDPDNVTVFGESAGGMSIAALLAMPAAKGLFQKAIMESGASRTMTKEQAASTSAAFLQVLGIN
EGQLDKLHTVSAEDLLKAADQLRIAEKENIFQLFFQPALDPKTLPAEPEKAISEGAASGIPLLIGTTRDEGYLFFTPDSDVHSQE
TLDAALEYLLGKPLAEKAADLYPRSLESQIHMMTDLLFWRPAVAYASAQSHYAPVWMYRFDWHPKKPPYNKAFHALELPF
VFGNLDGLERMAKAEITDVKQLSHTIQSAWITFAKTGNPSTEAVNWPTYHEETRETLILDSEITIENDPESKRQKLFPSKGE

488AA

Hay otras 4 con el mismo problema

SEQ ID NO: 2 (DOCUMENT 3 - US2008063774 AA)

FDVIGGNAYTIGGRSRCSIGFAVNGGFITAGHCGRTGATTANPTGTFAGSSFPGNDYAFVRTGAGVNLLAQVNNYSGGRV
QVAGHTAAPVGSAVCRSGSTTGWHCGTITALNSSVTYPEGTVRGLIRTTVCAEPGDSGGSLLAGNQAQGVTSGGSGNCRT
GGTTFFQPVNPILQAYGLRMITTDSGSSP

SEQ ID NO: 3 (DOCUMENT 16 - US2015291944 AA)

EVSQDLFNQFNLFAQYSAAAYCGKNNDAPAGTNITCTGNACPEVEKADATFLYSFEDSGVGDVTGFLALDNTNKLIVLSFR
GSRSIENVVIGNLNFDLKEINDICSGCRGHDGFTSSWRSVADTLRQKVEDAVREHPDYRVVFTGHSLGGALATVAGADLRG
NGYDIDVFSYGAPRVGNRAFAEFLTVQTGTLYRITHTNDIVPRLPPREFGYSHSSPEYWIKSGTLVPVTRNDIVKIEGIDATGG
NNQPNIPDIPAHLWYFGLIGTCL

SEQ ID NO: 4 (DOCUMENT 22 - KR20100034379 A)

MERHRMAKLPQDVRVDPRILAVFGDYGEPAGPDMSSREELIGFMNSPEAQEAVAADAAFFASAVSEECAPSQGIVYETRV
FTSQPDGNQIKIQYIRPEGAGILPCVYYMHGGGMAYLSAFDPNYRAWGRIMAAQGVAVAMVDFRNSLLPSSAPEIASPFP
AGLNDCVAGLKWVHAHAEELQIDPDKIIVAGESGGGNLALATALKLNRDGDIGLIKGVYALCPFIAGQWPHPDHPSSAANE
GIFISIGNNRLTLAYGIEAFERQDPLAWPIFASEADLKGLPQTVISVNECDPLHEGVAFYRKLLAAGVPARCRSLIGTVHAVEIL
PRCAPDVSANTANDIAYPARTGK

SEQ ID NO:5 (DOCUMENT 34 - US2012036649 AA)

MAKRILCFGDSLTWGWVPVEDGAPTERFAPDVRWTGVLAQQLGADFEVIEEGLSARTTNIDDPTDPRLNGASYLPSCLAT
HLPLDLVIIMLGTNDTKAYFRRTPLDIALGMSVLVTQVLTSAGGVGTTYPAPKVLVVSPPPLAPMPHPWFQLIFEGGEQKTT
ELARVYSALASFMKVPFFDAGSVISTDGVDGIHFTEANNRDLGVALAEQVRSLL

SEQ ID NO:6 (DOCUMENT 39 - CN108251319 A)

QLGAIENGLESGSANACPDAILIFARGSTEPGNMGITVGPALANGLESHIRNIWIQGVGGPYDAALATNFLPRGTSQANIDE
GKRLFALANQKCPNTPVVAGGYSQGAALIAAAVSELSGAVKEQVKGVALFGYTQNLQNRGGIPNYPRERTKVFCNVGDAV
CTGTLIITPAHLSYTIEARGEAARFLRDRIRA

SEQ ID NO: 7 (DOCUMENT 55 - US6159720 A)

MRSSPLLRSAVVAALPVLALA

ADGKSTRYWDCCKPSCGWAKKAPVNQPVFSCNANFQRLTDFDAKSGCEPGGVAYSCADQTPWAVNDDFAFGFAATSIA
GSNEAGWCCACYELTFTSGPVAGKKMVVQSTSTGGDLGSNHFDLNIPGGGVGIFDGCTPQFGGLPGQRYGGISSRNECD
RFPDALKPGCYWRFDWFKNADNPSFSFRQVQCPAELVARTGCRRNDDGNFPAVQIPSSSTSSPVGQPTSTSTTSTSTTSSP
PVQPTTPSGCTAERWAQCGGNGWSGCTTCVAGSTCTKINDWYHQCL

SEQ ID NO: 8 (DOCUMENT 56 - US2018171544 AA)

ADGKSTRYWDCCKPSCSWPGKASVNQPVFACSANFQRISDPNVKSGCDGGSAYACADQTPWAVNDNFSYGFAATSISG
GNEASWCCGCYELTFTSGPVAGKTMVVQSTSTGGDLGTNHFDLAMPGGGVGIFDGCSPQFGGLAGDRYGGVSSRSQCD
SFPAALKPGCYWRFDWFKNADNPTFTFRQVQCPSELVARTGCRRNDDGNFPVFTPPSGGQSSSSSSSSSAKPTSTSTSTTS
TKATSTTSTASSQTSSSTGGGCAAQRWAQCGGIGFSGCTTCVSGTTCNKQNDWYSQCL

OR

MRSTPVLRTTLAAALPLVASAASGSGQSTRYWDCCKPSCAWPGKAAVSQPVYACDANFQRLSDFNVQSGCNGGSAYSCA
DQTPWAVNDNLAYGFAATSIAGGSESSWCCACYALTFTSGPVAGKTMVVQSTSTGGDLGSNHFDIAMPGGGVGIFNGC
SSQFGGLPGAQYGGISSRDQCDSFPAPLKPGCQWRFDWFQNADNPTFTFQQVACPAEIVARSGCKRNDDSSFPVFTPPS
GGNGGTGTPTSTAPGSGQTSPGGGSGCTSQKWAQCGGIGFSGCTTCVSGTTCQKLNDYYSQCL

OR

MRSSTILQTGLVAVLPFAVQAASGSGKSTRYWDCCKPSCAWSGKASVNRPVLACDANNNPLNDANVKSGCDGGSAYTCA
NNSPWAVNDNLAYGFAATKLSGGTESSWCCACYALTFTSGPVSGKTLVVQSTSTGGDLGSNHFDLNMPGGGVGLFDGCK
REFGGLPGAQYGGISSRSECDSFPAALKPGCQWRFDWFKNADNPEFTFLQVQCPSELTSRTGCKRNDDSQFPAFTPPSGG
GSNPSTPTTPPSSGGGGSGCAAAMYAQCGGSGFSGCTNCPSGSTCKAINDYYHQCA

OR

MRSSTVLQTGLVAALPFAVQAASGSGQSTRYWDCCKPSCSWSGKASVNRPVLACDANNNPLSDASVKSGCDGGSAYTCA
NNSPWAVNDQLSYGFAATKLSGGTESSWCCACYALTFTSGPVAGKTMVVQSTSTGGDLGSNHFDINMPGGGVGLFDGC
TRQFGGLPGAQYGGISSRSQCDSFPAALKPGCQWRFDWFQNADNPNFTFKQVQCPSELTSRTGCKRNDDSQFPVFTPPS
GGGTNPSTPTTPPSSGGGSGCTADKYAQCGGGSGWSGCTNCPSGSTCKTINDYYHQCA

SEQ ID NO: 9 (DOCUMENT 58 - US2012088291 AA)

The perhydrolase enzyme is the S54V variant of SEQ ID NO:9

MAKRILCFGDSLTWGWVPVEDGAPTERFAPDVRWTGVLAQQLGADFEVIEEGLSARTTNIDDPTDPRLNGASYLPSCLAT
HLPLDLVIIMLGTNDTKAYFRRTPLDIALGMSVLVTQVLTSAGGVGTTYPAPKVLVVSPPPLAPMPHPWFQLIFEGGEQKTT
ELARVYSALASFMKVPFFDAGSVISTDGVDGIHPTEANNRDLGVALAEQVRSLL

SEQ ID NO: 10 (DOCUMENT 59 - US2017145628 AA)

The amino acid sequence of the pectinase has at least 60% sequence identity with SEQ ID NO: 10.

MKKLISIIFIFVLGVVGSLTAAVSAEAASALNSGKVNPLADFSLKGFAALNGGTTGGEGGQTVTVTTGDQLIAALKNKNANT
PLKIYVNGTITTSNTSASKIDVKDVSNVSIVGSGTKGELKGIGIKIWRANNIIIRNLKIHEVASGDKDAIGIEGPSKNIWVDHNEL
YHSLNVDKDYYDGLFDVKRDAEYITFSWNYVHDGWKSMLMGSSDSDNYNRTITFHHNWFENLNSRVPSFRFGEGHIYNN
YFNKIIDSGINSRMGARIRIENNLFENAKDPIVSWYSSSPGYWHVSNNKFVNSRGSMPTTSTTTYNPPYSYSLDNVDNVKSI
VKQNAGVGKINP

SEQ ID NO:11 (DOCUMENT 60 - US2019106690 AA)

La numeración está mal, faltaría un aa entre el 235 y el 240

MRSTPVLRTTLAAALPLVASA

ASGSGQSTRYWDCCKPSCAWPGKAAVSQPVYACDANFQRLSDFNVQSGCNGGSAYSCADQTPWAVNDNLATGFAATS
IAGGSESSWCCACYALTFTSGPVAGKTMVVQSTSTGGDLGSNHFDIAMPGGGVGIFNGCSSQPGGLPGAQYGGISSRDQ
CDSFPAPLKPGCQWRFDWFQNADNPTFTFQQVQCPAEIVARSGCKRNDNGNFPVFTPPSGGQSSSSSSSSSAKPTSTSTS
TTSTKATSTTSTASSQTSSSTGGGCAAQRWAQCGGIGFSGCTTCVSGTTCNKQNDWYSQCL

SEQ ID NO:12 (DOCUMENT 61 - US2006035361 AA)

QSGSGRTTRYWDCCKPSCAWPGKGPAPVRTCDRWDNPLFDGGNTRSGCDAGGGAYMCSDQSPWAVSDDLAYGWAA
VNIAGSNERQWCCACYELTFTSGPVAGKRMIVQASNTGGDLGNNHFDIAMPGGGVGIFNACTDQYGAPPNGWGQRYG
GISQRHECDAFPEKLKPGCYWRFDWFLNADNPSVNWRQVSCPAQIVAKSGCSR

SEQ ID NO: 13 (DOCUMENT 63 - WO08039353 A2)

ADLGHQTLGSNDGWGAYSTGTTGGSKASSSNVYTVSNRNQLVSALGKETNTTPKIIYIKGTIDMNVDDNIKPLGLNDYKDP
EYDLDKYLKAYDPSTWGKKEPSGTQEEARARSQKNQKARVMVDIPANTTIVGSGTNAKVVGGNFQIKSDVIIRNIEFQDAY
DYFPQWDPTDGSSGNWNSQUDNITINGGTHIWIDHCTFNDGSRPDSTSPKYYGRKYQHHDGQTDASNGANYITMSYNY
YHDHDKSSIFGSSDSKTSDDGKLKITLHHNRYKNIVQRAPRVRFGQVHVYNNYYEGSTSSSSYPFSYAWGIGKSSKIYAQNN
VIDVPGLSAAKTISVFSGGTALYDSGTLLNGTQINASAANGLSSSVGWTPSLHGSIDASANVKSNVINQAGAGKLN

SEQ ID NO: 14 (DOCUMENT 64 - US2010098807 AA)

MKLTFLLNLAVAASAQQSLCSQYSSYTSGQYSVNNNLWGESSGSGSQCTYVNSISSSGVSWSTTWNTSGGSTSVKSYANS
QLSGLTKKLVSNLQSIPTSVQWSYSNTNIVADVSYDLFTAADINHVTYSGDYELMIWLGKYGGAQPLGSQIGTANVGGAT
WQLWYGVNGSQKTYSFVASSQTTSWNGDILQFFKYLQSNQGFPASSQYLIDLQFGTEPFTGSQTTLTVNHWSASVN

OR

QQSLCSQYSSYTSGQYSVNNNLWGESSGSGSQCTYVNSISSSGVSWSTTWNWSGGSTSVKSYANSQLSGLTKKLVSNLQSI
PTSVQWSYSNTNIVADVSYDLFTAADINHVTYSGDYELMIWLGKYGGAQPLGSQIGTANVGGATWQLWYGVNGSQKTY
SFVASSQTTSWNGDILQFFKYLQSNQGFPASSQYLIDLQFGTEPFTGSQTTLTVNHWSASVN

SEQ ID NO: 15 (DOCUMENT 68 - WO20099719 A1)

LDGKSTRYWDCCKPSCGWAGKASVNQPVFSCSADWQRISDFNAKSGCDGGNAYSCADQTPWAVNDNFSYGFAATAIA
GGSEQSWCCACYALTFNSGPVAGKTMVVGSTSTGGDLGENHFDLAIPGGGVGIFNGCQSQFGGLPGAQYGGIQDRSQC

SSFPAPLQPGCQWRFDWFQNADNPTFTFQRVQCPSELTSRTGCKRDDDANYPVFNPPSGNPSGGNPPGGNPPGTTTTR
RPATTTGSSPGPTQSHYGQCGGIGYSGPTVCASGTTCQVLNPYYSQCL

SEQ ID NO: 16 (DOCUMENT 69 - WO9854332 A1)

MNRTMAPLLLAASILFGGAAA

QQTVWGQCGGIGWSGPTSCAPGSACSTLNPYYAQCIPGATSITTSTRPPSGPTTTTRATSTTSSPPPTSSGVRFAGVNIAGF
DFGCTTDGTCVTSKVYPPLKNFTGANNYPDGIGQMQHFVNDDGMTIFRLPVGWQYLVNNNLGGTLDSTSISKYDQLVQG
CLSLGVYCIIDIHNYARWNGGIIGQGGPTNAQFTSLWSQLASKYASQSRVWFGIMNEPHDVNINTWAATVQEVVTAIRNA
GATSQYISLPGNDYQSAAAFISDGSAAALSQVTNPDGSTTNLIFDVHKYLDSDNSGTHAECTTNNIDGAFAPLATWLRQNN
RQAILTETGGGNVQSCIQDLCQQIQYLNQNSDVYLGYAGWGAGSFDSTYILTETPTGSGNSWTDTSLVSSCLARL

Los 2 últimos aa no están en el documento de PONS, pero sí en la secuencia en la patente. Los otros en rojo, estaban mal en el documento de PONS, los he comprobado en la patente