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(54) Process for the pre-treatment of cotton and its blends with synthetic fibers

Verfahren zur Vorbehandlung von Baumwolle Gemisch mit synthetischen Fasern

Procédé de pré-traitement du coton et de ses mélanges avec des fibres synthétiques

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Description

[0001] The present invention relates to a composition, a process and methods of using aqueous solutions of water-soluble polymers, in particular polyvinylpyrrolidone (PVP) polymer in the pre-treatment of textiles comprising cellulosic fibres or a mixture of cellulosic fibres and non-cellulosic fibres.

Background of the invention

[0002] In order to arrive at textiles which are ready to be used for e.g. cloth-making, said textiles have to go through a chain of several different procedures. Each procedure provides the textiles with different properties. Examples for such procedures are pre-treatment, dyeing or finishing. The pre-treatment procedure of textiles comprising cellulosic fibers, for example cotton fibers, exists of several steps of cleaning treatments, i.e. desizing, scouring or bleaching, aiming to achieve an absorbent, hydrophilic, clean and colorless, material prepared for subsequent dyeing and finishing operations. Without thorough pre-treatment of the cellulosic fibers, neither dyeing nor finishing of the same or the respective blends with synthetic fibers gives results of high quality.

[0003] The current general pre-treatment procedure for textiles comprising cellulosic fibers by Pad Steam application requires high amounts of caustic soda (NaOH) for scouring (25-50 g/l NaOH (solid)) and/or bleaching, i.e. saponification of natural cotton waxes and fatty substances. Such high amounts of NaOH in combination with Pad Steam conditions (saturated steam of 98-100°C during 10-45 min dwelling time) are often harmful to the cellulosic fiber and can lead to reduced fabric strength, i.e. tensile and tear strength, and depolymerization of the cellulosic molecular chain, i.e. a chemically damaged fiber.

[0004] Longer steaming times with higher amounts of NaOH during alkaline scouring can often lead to crease and lay marks when the fabric is put down on a conveyor or roller belt. These crease or lay marks are visible after dyeing only and result in a faulty, non-repairable fabric appearance.

[0005] Therefore, there is a demand for a pre-treatment procedure which is less harmful to the cellulosic fiber. One approach is the so-called bio-scouring of textiles, which is a pre-treatment procedure for textiles aimed to washing and removal of natural polysaccharides and wax or polymer synthetic remains in or on cellulosic fibers using enzymes. This scouring process is preferred because it is environmentally friendly compared to conventional processes. EP 1 194 631 B for examples relates to a one-bath method for bio-scouring and dyeing of textiles using enzymes during the bio-scouring of the textiles. However, bio-scouring enzymes such as pectinolytic enzymes show only insufficient performance.

[0006] Various pre-treatment procedures of textiles are further disclosed in US-B-6261828, US-A-5749923, US-A-5711764, US-A-2002/115194, JP-A-H0967777.

[0007] It is therefore an object of the present invention to provide an improved process for the pre-treatment procedure for textiles comprising cellulosic fibers. It is further an object of the present invention to provide an improved composition for use in at least one step of the pre-treatment procedure.

[0008] These and other objects are achieved by the process of the claims 1-7.

Summary of the invention

[0009] One object of the present invention is solved according to a **first aspect** by a process for removing impurities from textiles comprising cellulosic fibres or a mixture of cellulosic fibres and non-cellulosic fibres, wherein the process comprises at least one pre-treatment procedure according to the claims.

[0010] In one embodiment of the process according to the invention the PVP polymer has an average molecular weight ranging from 50,000 to 500,000 g/mol, preferably ranging from 100,000 to 400,000 g/mol, further preferred ranging from 200,000 to 300,000 g/mol.

[0011] In one embodiment of the process according to the invention further at least one water-soluble polymer different from PVP polymer is used and selected from the group consisting of pure or derivatised polyvinylalcohol (PVA) homo- or copolymer; polyacrylate homo- or copolymer; polyalkyleneglycol homo- or copolymer, in particular polyethyleneglycol homo- or copolymer; modified polyalkyleneglycol homo- or copolymer, in particular modified polyethyleneglycol homo- or copolymer, in particular alkylpolyethyleneglycol homo- or copolymer, alkoxypolyethyleneglycol homo- or copolymer, acylpolyethyleneglycol homo- or copolymer; polyvinylbutyral homo- or copolymer; non-ionic or anionic modified polyesters; or non-ionic or anionic modified oligoesters; modified polystyrene, in particular low crosslinked polystyrene grafted with polyethylene glycol (TentaGelAmino Resin), or aminomethyl polystyrene; or mixtures thereof.

[0012] In the process according to the invention the pre-treatment procedure comprises a scouring-step which comprises the addition of at least one pectinolytic enzyme to remove pectic polysaccharides from cellulosic fibers, e.g. a pectate lyase.

[0013] In the process according to the invention further in at least the desizing step of the pre-treatment procedure a saccharifying enzyme to break down starch size from cellulosic fibers, e.g. an alpha-amylase is added.

[0014] In one embodiment of the process according to the invention the scouring step is carried out at a pH between 5 and 10, or between 7 and 8, or at 7.25.

[0015] In one embodiment of the process according to the invention the scouring step is carried out at a temperature between 50°C and 100°C, or between 70°C and 90°C, or at 80°C.

[0016] Further the use of polyvinylpyrrolidone polymer as an additive in the pre-treatment procedure for inhibiting crease and/or lay marks of cellulosic fibers and/or for improving liquor retention ability, whiteness, absorbency levels and/or tensile strength of cellulosic fibers is disclosed. In the present application it is disclosed a composition comprising a pectinolytic enzyme and at least one water-soluble polymer.

[0017] In one embodiment of the composition the pectinolytic enzyme is a pectate lyase.

[0018] In one embodiment of the composition the at least one water-soluble polymer is selected from polyvinylpyrrolidone (PVP) homopolymer, polyvinylpyrrolidone copolymer, in particular a copolymer comprising monomers selected from vinylpyrrolidone and vinylalcohol or acrylamide or acrylic acid or methylmethyacrylate, or vinylacetate, or diallyldimethyl ammonium chloride (DADMAC) or mixtures thereof, wherein preferably the PVP homo- or copolymer has an average molecular weight of 50,000 to 500,000 g/mol, preferably of 100,000 to 400,000 g/mol, further preferred of 200,000 to 300,000 g/mol; pure or derivatised polyvinylalcohol (PVA) homo- or copolymer; polyacrylate homo- or copolymer; polyalkyleneglycol homo- or copolymer, in particular polyethyleneglycol homo- or copolymer; modified polyalkyleneglycol homo- or copolymer, in particular modified polyethyleneglycol homo- or copolymer, in particular alkylpolyethyleneglycol homo- or copolymer, alkoxypolyethyleneglycol homo- or copolymer, acylpolyethyleneglycol homo- or copolymer; polyvinylbutyral homo- or copolymer; non-ionic or anionic modified polyesters; or non-ionic or anionic modified oligoesters; modified polystyrene, in particular low crosslinked polystyrene grafted with polyethylene glycol (TentaGelAmino Resin), or aminomethyl polystyrene; or mixtures thereof.

[0019] In one embodiment of the composition the composition further comprises at least one additive selected from the group of non-ionic or anionic detergent, sequestering agent, peroxide stabilizer, or saccharifying enzyme, preferably in form of alpha-amylase, or mixtures thereof. It is disclosed a method of increasing the effect of a pectinolytic enzyme, characterized by admixing said enzyme with at least one water-soluble polymer.

[0020] In one embodiment of the method the at least one water-soluble polymer is selected from polyvinylpyrrolidone (PVP) homopolymer, polyvinylpyrrolidone copolymer, in particular a copolymer comprising monomers selected from vinylpyrrolidone and vinylalcohol or acrylamide or acrylic acid or methylmethyacrylate, or vinylacetate, or diallyldimethyl ammonium chloride (DADMAC) or mixtures thereof, wherein preferably the PVP homo- or copolymer has an average molecular weight of 50,000 to 500,000 g/mol, preferably of 100,000 to 400,000 g/mol, further preferred of 200,000 to 300,000 g/mol; pure or derivatised polyvinylalcohol (PVA) homo- or copolymer; polyacrylate homo- or copolymer; polyalkyleneglycol homo- or copolymer, in particular polyethyleneglycol homo- or copolymer; modified polyalkyleneglycol homo- or copolymer, in particular modified polyethyleneglycol homo- or copolymer, in particular alkylpolyethyleneglycol homo- or copolymer, alkoxypolyethyleneglycol homo- or copolymer, acylpolyethyleneglycol homo- or copolymer; polyvinylbutyral homo- or copolymer; non-ionic or anionic modified polyesters; or non-ionic or anionic modified oligoesters; modified polystyrene, in particular low crosslinked polystyrene grafted with polyethylene glycol (TentaGelAmino Resin), or aminomethyl polystyrene; or mixtures thereof.

[0021] The use of the composition disclosed in the present application in the pre-treatment of textiles comprising cellulosic fibres or a mixture of cellulosic fibres and synthetic fibres is also disclosed.

[0022] The process according to the invention has the advantage that crease and lay marks are reduced, preferably inhibited during further processing of the textile, in particular during Pad Steam Processing in a steamer.

[0023] Another advantage of the process according to the invention is that the liquor retention ability and liquor pick-up property of the textile comprising cellulosic fibers treated according to the process of the invention is improved. Thus the dosage of NaOH, H_2O_2 and detergent needed for scouring and/or bleaching can be reduced. This will result in a more economical processing and minimizes the danger of fiber damage since less bleaching chemicals are used.

[0024] A further advantage of the process according to the invention is that the degree of whiteness and absorbency level after bleaching, in particular after Pad Steam Processing using H_2O_2, can be improved if the textile comprising cellulosic fibers is treated according to the process according to the invention.

[0025] Further, the process according to the invention, as well as the respective composition, method and use of the composition according to the invention have the advantage that the activity of the pectinolytic enzyme is enhanced by the water-soluble polymer, preferably by polyvinylpyrrolidone polymer and thus, the scouring ability for textiles comprising cellulosic fibers, in particular the bio-scouring ability of the process and composition according to the invention is improved.

[0026] Finally, it was shown that a combination of a water-soluble polymer and a pectinolytic enzyme provides an efficient bio-scouring step in the pre-treatment procedure for textiles comprising cellulosic fibers.

Detailed description of the invention

[0027] The process according to the invention is a pre-treatment procedure for textiles comprising cellulosic fibers or a mixture of cellulosic fibers and synthetic fibers, wherein the process comprises contacting the textile with at least polyvinylpyrrolidone polymer (PVP polymer).

[0028] The term *"pre-treatment procedure"* or *"pre-treating"* as used in the context of the present invention encompasses all procedures carried out to improve wettability and absorbency, dye absorption capacity, cleanness of the textile (i.e. removal of impurities), to increase whiteness, removal of tension irregularities or material irregularities resulting e.g. from a previously conducted weaving process.

[0029] Impurities contained in e.g. raw cotton from which textiles comprising cellulosic fibers can be made are, for example, natural associated impurities like hemicellulose, pectins, proteins and salts, or processing-related impurities like, for example, fatty substances, oils and waxes. It is therefore a feature of the pre-treatment procedure to remove said impurities from the cellulosic fiber by physical, chemical and biological processes in order to provide an even dye absorption capacity and to maximize the absorbency.

[0030] The pre-treatment procedure can be distinguished from subsequently following finishing procedures like dyeing, printing or equipment (e.g. equipment with fire-retardant properties) of the textile e.g. by the use of the chemicals. For example, during the dyeing or printing a dye has to be used, whereas in the pre-treatment procedure no such chemical is used. The finishing procedures aim at leaving the chemicals, e.g. the dye on or at or within the textile comprising cellulosic fibers, whereas the pre-treatment procedure aims at providing textiles comprising cellulosic fibers satisfying the requirement of subsequently following finishing steps like dyeing, printing or equipment. The pre-treatment procedure can be conducted continuously, e.g. using the Pad Steam technology, semi-continuously, e.g. using the Cold Pad Batch technology; or discontinuously.

[0031] The pre-treatment procedure comprises at least one desizing step, one scouring step and one bleaching step as defined in the claims. The pre-treatment can comprise further steps like rinsing steps.

[0032] In one embodiment, the pre-treatment procedure consists of three steps in the mentioned order: desizing, scouring and bleaching.

[0033] The term *"desizing"* as used in the context of the present invention means the removal of sizing agents, in particular of natural sizing agents like starch or starch derivatives including protein-based starches, which are commonly employed during weaving. The removal of sizing agent can occur by degrading or solubilizing the sizing agent, in particular with the aid of at least one desizing agent. The desizing agent comprises saccharifying enzymes. Hot water, surfactants or other chemicals like sodium persulfate or hydrochloric acid are also desizing agents.

[0034] In the present invention the saccharifying enzyme, in particular an amylase is used in combination with at least a PVP polymer.

[0035] The term *"saccharifying enzyme"* as used in the context of the present invention is to be understood as an enzyme which is capable of breaking down starch size on cellulosic fibers into soluble, in particular water-soluble compounds. The saccharifying enzyme can be derived from a natural source or from an alternative source including from recombinant technologies or from genetic or chemical modification. Further, the saccharifying enyzyme can be a wild type enzyme or a mutant enzyme, including functional homologues of the saccharifying enzyme. Functional homologue refers to a saccharifying enzyme that differs in the amino acid sequence or the nucleic acid sequence encoding the amino acid sequence from a wild type enzyme but is still functionally active. On the protein level a functional homologue may contain one or more mutations comprising amino acid exchanges, insertions or deletions. The saccharifying enzyme may also be chemically or enzymatically modified.

[0036] Preferably alpha-amylase is used as saccharifying enzyme.

[0037] In one embodiment, as saccharifying enzyme an alpha-amylase is used. In particular, the alpha-amylase is used in a liquid formulation. Such a liquid formulation is known under the tradenames Bactosol® HPA liq. from Archroma or Optisise® NEXT from Genencor® /DuPont (CAS-No. 9000-90-2).

[0038] The desizing step can be carried out at pH value in the range between 5 to 10, or between 6 to 9, or between 7 to 8, or at 7. Further, the desizing step can be carried out at a temperature range of between 50°C to 100°C, or between 70°C to 90°C, or at 80°C.

[0039] The term *"scouring"* as used in the context of the present invention is to be understood as the removal of further impurities, in particular of naturally occurring waxes or fatty substances or pectic polysaccharides.

[0040] The term *"pectic polysaccharides"* as used in the context of the present invention is to be understood as polysaccharides that are rich in galacturonic acid. Pectic polysaccharides include, but are not limited to pectins, pectinates, pectates, and pectic acids.

[0041] Scouring of textiles comprising cellulosic fibers in particular encompasses the removal of fats or waxes by saponification, wherein said fats or waxes are converted into water soluble or water miscible compounds. This part of the scouring step requires the presence of at least an alkali, e.g. NaOH (caustic soda).

[0042] Scouring of textiles comprising cellulosic fibers further encompasses the removal of pectic polysaccharides. The removal of pectic polysaccharides can be conducted in the presence of at least one enzyme. If at least one enzyme is present during the scouring of textiles comprising cellulosic fibers, the term *"bio-scouring"* or *"bio-scouring-step"* is used. The at least one enzyme is in particular a pectinolytic enzyme. In one embodiment pectate lyase is used as enzyme.

[0043] In the context of the present invention, the term *"pectinolytic enzyme"* means a pectinolytic enzyme, preferably exhibiting lyase activity, which degrades pectic polysaccharides, such as homogalacturonan, rhamnogalacturonan I and rhamnogalacturonan II, preferably by trans-elimination, into soluble, in particular water-soluble compounds (i.e. an enzyme in group EC 4.2.2.x). The pectinolytic enzyme can be derived from a natural source or from an alternative source including from recombinant technologies or from genetic or chemical modification. Further, the pectinolytic enyzyme can be a wild type enzyme or a mutant enzyme, including functional homologues of the pectinolytic enzyme. Functional homologue refers to a pectinolytic enzyme that differs in the amino acid sequence or the nucleic acid sequence encoding the amino acid sequence from a wild type enzyme but is still functionally active. On the protein level a functional homologue may contain one or more mutations comprising amino acid exchanges, insertions or deletions. The pectinolytic enzyme may also be chemically or enzymatically modified.

[0044] One advantage (besides others already mentioned above) of using a pectinolytic enzyme during bio-scouring of textiles comprising cellulosic fibres is that the removal of other impurities, for example wax and proteins, from the cellulosic fiber of textiles is facilitated.

[0045] Preferably, pectate lyase is used as pectinolytic enzyme. Pectate lyase belongs to the family of lyases, specifically those carbon-oxygen lyases acting on polysaccharides. The systematic name of this enzyme class is (1→4)-alpha-D-galacturonan lyase (CAS-No. 9015-75-2; EC or IUB 4.2.2.2). Pectate lyase cleaves glycosidic linkages preferentially on polygalacturonic acid.

[0046] In one embodiment as pectinolytic enzyme a pectate lyase is used. Preferably the pectate lyase is used in form of a concentrated liquid formulation comprising the pectate lyase enzyme in pH-neutral form. Such a liquid formulation is for example known under the tradenames Bactosol® CBS liq. from Archroma, PrimaGreen® EcoScour liq. from Genencor®/DuPont (CAS-No. 9015-75-2), BioScour NPL from Piscean, Addscour LLP conc. from Advanced Enzymes (CAS-No. 9032-75-1), or 601-L from Novozymes (CAS-No. 9015-75-2).

[0047] In the present invention the bio-scouring of textiles comprising cellulosic fibers is conducted using the composition according to the invention comprising a pectinolytic enzyme and at least polyvinylpyrrolidone.

[0048] This has one advantage (besides others already mentioned above) that the activity of the pectinolytic enzyme is enhanced by the polyvinylpyrrolidone polymer and thus, the scouring ability for textiles comprising cellulosic fibers, in particular the bio-scouring ability of the process and composition according to the invention is improved.

[0049] The scouring of textiles comprising cellulosic fibers can further encompass the hydrolysis of proteins, dissolution of amino compounds, dissolution of mineral matter, emulsification and solubilisation of oils, removal and dispersion of dirt particles.

[0050] The scouring step can be carried out a pH value in the range between 5 to 10, or between 6 to 9, or between 7 to 8, or at 9, or at 7.25. Further, the scouring step can be carried out at a temperature range of between 50°C to 100°C, or between 70°C to 90°C, or at 80°C.

[0051] The term *"bleaching"* as used in the context of the present invention means the removal of coloring impurities of either natural or procedural origin from the textile comprising cellulosic fibers. The coloring impurities are usually chromophor compounds which can be degraded using bleaching agents. Thus, the degree of the whiteness level can be increased. Suitable bleaching agents are therefore of oxidizing or reducing nature, like caustic soda (NaOH) and/or H_2O_2. Further additives may be present like detergents, wetting agents, sequestering agents or the like.

[0052] In the present invention an alkaline composition comprising H_2O_2 is used, in combination with at least a PVP polymer.

[0053] In one embodiment a mixture of NaOH and H_2O_2 is used, in combination with at least a PVP polymer.

[0054] One advantage (besides others already mentioned above) of using a combination of NaOH / H_2O_2 and at least a PVP polymer is the improvement of the degree of whiteness of the textile comprising cellulosic fibers wherein at the same time, the tensile strength of the textile comprising cellulosic fibers is also improved (compared to the tensile strength of a textile comprising cellulosic fibers which is bleached using only NaOH/H_2O_2 but no PVP polymer).

[0055] The bleaching step can be carried out a pH value in range between 9 to 12, or at 11.

[0056] Further, the bleaching step can be carried out at a temperature range of between 92°C to 102°C or at 98°C.

[0057] In the present invention the pre-treatment procedure comprises at least a desizing step a scouring step and a bleaching step using an alkaline composition comprising H_2O_2 wherein at least PVP polymer is used in all three steps and a saccharifying enzyme is used in the desizing step and a pectinolytic enzyme is used in the scouring The term *"textile"* as used herein refers without limitation to, fabrics, in particular woven or knitted goods.

[0058] The textile can consist essentially of cellulosic fibers. The term *"textile(s) comprising cellulosic fibers"* as used in the context of the present invention means that the textile can consist of cellulosic fibers and non-cellulosic fibers, wherein the non-cellulosic fibers can be synthetic fibers or non-cellulosic fibers of natural origin. The textile can comprise or consist essentially of a mixture of cellulosic fibers and synthetic fibers. Further, the textile can comprise or consist essentially of a mixture of cellulosic fibers and non-cellulosic fibers of natural origin. Further, the textile can comprise or consist essentially of a mixture of cellulosic fibers and non-cellulosic fibers of natural origin and synthetic fibers.

[0059] The term *"cellulosic fiber"* as used in the context of the present application refers without limitation to fibers derived from cellulose containing material, in particular from cotton, linen, jute, hemp, regenerated cellulose or mixtures thereof. Thus, cellulosic fiber means that the fibers essentially comprise or consist of cellulose-based material derived from cotton, linen, jute, hemp, regenerated cellulose or mixtures thereof.

[0060] The term *"synthetic fibers"* as used in the context of the present application refers to without limitation to non-cellulosic fibers which essentially comprise or consist of polyamide, polyester and/or polyurethane.

[0061] Instead of or in addition to synthetic fibers, the textile comprising cellulosic fibers can comprise further non-cellulosic fibers of natural origin like wool or silk.

[0062] The textile can comprise or consist of at least 70%, or at least 80%, or at least 90% cellulosic fibers, and wherein at most 30% (difference to 100%), or at most 20%, or at most 10% are non-cellulosic fibers, which are selected from synthetic fibers, in particular polyamide, polyester and/or polyurethane, or other non-cellulosic fibers of natural origin like wool or silk or mixtures thereof.

[0063] In one embodiment, the textile consists of 100% cellulosic fibers.

[0064] The term *"contacting",* respectively *"contacting textiles comprising cellulosic fibers"* as used in the context of the present invention means that the textile comprising cellulosic fibers is at least partly, preferably essentially completely impregnated or soaked with the respective agent(s) or additive(s) required in the process according to the invention, e.g.

[0065] the textile comprising cellulosic fibers is essentially completely impregnated with PVP polymer or with water or with the composition disclosed in the present application comprising a pectinolytic enzyme and at least one water-soluble polymer, or with (a) mixture(s) with one or more compounds as described herein.

[0066] The term *"polymer"* as used in the context of the present application encompasses homopolymer (consisting of only one kind of monomers) as well as copolymer (consisting of at least two kinds of monomers wherein the monomers differ from each other, e.g. by having different sum formulas). The term *"copolymer"* as used in the context of the present invention encompasses every kind of copolymer, like block copolymer or random copolymer.

[0067] The term *"water-soluble polymer"* as used in the context of the present invention is to be understood as a polymer which is capable of being at least partly dissolved in water. The water-soluble polymer can be soluble in water at 25°C at a concentration of up to 5.0 g/l, or up to 15.0 g/l, or up to 30.0 g/l, or up to 40.0 g/l to give an optically, respectively visible clear solution. The water-soluble polymer can be selected from the group consisting of pure or derivatised polyvinylalcohol (PVA) homo- or copolymer; polyacrylate homo- or copolymer; polyalkyleneglycol homo- or copolymer, in particular polyethyleneglycol homo- or copolymer; modified polyalkyleneglycol homo- or copolymer, in particular modified polyethyleneglycol homo- or copolymer, in particular alkylpolyethyleneglycol homo- or copolymer, alkoxypolyethyleneglycol homo- or copolymer, acylpolyethyleneglycol homo- or copolymer; polyvinylbutyral homo- or copolymer; non-ionic or anionic modified polyesters; or non-ionic or anionic modified oligoesters; modified polystyrene, in particular low crosslinked polystyrene grafted with polyethylene glycol (TentaGelAmino Resin), or aminomethyl polystyrene; or mixtures thereof.

[0068] In particular, water-soluble polymers can be built from one or more of the monomers vinylpyrrolidone, vinylalcohol, acrylamide, vinylacetate or acrylate.

[0069] One advantage of using a water-soluble polymer in combination with a pectinolytic enzyme is, that the water-soluble polymer increases the effect of the pectinolytic enzyme. This means, that the pectinolytic enzyme shows improved lyase activity, i.e. improved degradation of pectic polysaccharides. In particular the combination of PVP polymer and pectinolytic enzyme shows this advantage. Thus, a method of increasing the effect of a pectinolytic enzyme, characterized by admixing said enzyme with at least one water-soluble polymer is also one aspect of the present invention.

[0070] Suitable water-soluble polymers can be obtained e.g. under the trade name Arostit TL 0280 (polyvinylpyrrolidon, CAS-No. 9003-39-8)) from Archroma (Indonesia), or under the trade name PEG M 5000 FL (methoxypolyethyleneglycole, CAS-No. 9004-74-4) from Clariant (BU ICS), or under the trade name Mowital B3OH (polyvinylbutyral, CAS-No. 68648-78-2) from Kuraray, or under the trade name Texcare SRN 300 (non-ionic polyester, CAS-No. 152442-40-5) from Clariant (BU ICS), or under the name B.S.A. (bovine serum albumin, CAS-No. 9048-46-8) from Sigma Aldrich.

[0071] In the process according to the invention at least PVP polymer is used as water-soluble polymer. It is possible to add further water-soluble polymers selected from the group as defined above.

[0072] The term *"polyvinylpyrrolidon polymer"* or *"PVP polymer"* as used in the context of the present invention means a polymer comprising at least vinylpyrrolidon as monomer, or a a polymer mixture, wherein at least two polymers are present, wherein each of the at least two polymers comprises at least vinylpyrrolidon as monomer. Thus, the term *"polyvinylpyrrolidon polymer"* or *"PVP polymer"* encompasses PVP homopolymer (consisting of only vinylpyrrolidon monomers) and PVP copolymer or a mixture of PVP homopolymer and PVP copolymer(s), wherein the PVP copolymer comprises at least vinylpyrrolidone monomer and one or more monomers selected from vinylalcohol or acrylamide or acrylic acid or methylmethyacrylate, or vinylacetate, or diallyldimethyl ammonium chloride (DADMAC).

[0073] The ratio of vinylpyrollidone monomer: other monomer(s) in the PVP copolymer can be in the range of 99:1 to 1:99, or 90:10 to 10:90, or 80:20 to 20:80, or 70:30 to 30:70, or 60:40 to 40:60 or 50:50. In particular the ratio of vinylpyrollidone monomer : other monomer(s) in the PVP copolymer can be 80:20.

[0074] The PVP polymer can have an average molecular weight of 50,000 to 500,000 g/mol, preferably of 100,000 to

400,000 g/mol, further preferred of 200,000 to 300,000 g/mol, having a residual monomer content of less than 0.01%. The amount of PVP polymer is 0.1 to 2% by weight, or 0.2 to 1.5 % by weight or 0.4 to 1% by weight, or 0.15% by weight, or 0.45% by weight, or 0.9% by weight with respect to total amount of the respective composition used in which the PVP polymer is present.

[0075] The advantage of using a PVP polymer is that crease and lay marks of cellulosic fibers during processing, in particular during Pad Steam Processing in a steamer can be inhibited. Further the PVP polymer has a favorable impact on liquor pick-up of the thus pre-treated textile comprising cellulosic fibers which has further also improved liquor retention ability. Also the degree of whiteness and absorbency level after bleaching as well as tensile strength, in particular after pad steam bleaching with H_2O_2 is improved, if PVP polymer is used.

[0076] In one embodiment the PVP polymer is a copolymer comprising vinylpyrrolidone and acrylamide as monomers.

[0077] In one embodiment the PVP polymer is a copolymer comprising vinylpyrrolidone and acrylamide as monomers, wherein the ratio of vinylpyrrolidone : acrylamide is 80:20.

[0078] In one embodiment the PVP polymer is a copolymer comprising vinylpyrrolidone, acrylamide and diallyldimethyl ammonium chloride (DADMAC) as monomers.

[0079] In one embodiment the PVP polymer is a copolymer comprising vinylpyrrolidone, acrylamide and diallyldimethyl ammonium chloride (DADMAC) as monomers, wherein the ratio of vinylpyrrolidone : acrylamide : DADMAC is 80:17:3.

[0080] In one embodiment the PVP polymer is a copolymer comprising vinylpyrrolidone and acrylic acid as monomers.

[0081] In one embodiment the PVP polymer is a copolymer comprising vinylpyrrolidone and acrylic acid as monomers, wherein the ratio of vinylpyrrolidone : acrylic acid is 80:20.

[0082] In one embodiment the PVP polymer is a copolymer comprising vinylpyrrolidone and methylmethacrylate as monomers.

[0083] In one embodiment the PVP polymer is a copolymer comprising vinylpyrrolidone and methylmethacrylate as monomers, wherein the ratio of vinylpyrrolidone: methylmethacrylate is 80:20.

[0084] In one embodiment the PVP polymer is a copolymer comprising vinylpyrrolidone and vinylacetate as monomers.

[0085] In one embodiment the PVP polymer is a copolymer comprising vinylpyrrolidone and vinylacetate as monomers, wherein the ratio of vinylpyrrolidone : vinylacetate is 80:20.

[0086] In particular, the PVP polymer is used according to the invention as an additive in the pre-treatment procedure for inhibiting crease and lay marks of cellulosic fibers, respectively of textiles comprising cellulosic fibers and for improving liquor retention ability, whiteness, absorbency levels and tensile strength of cellulosic fibres.

[0087] The term *"liquor retention* ability" as used in the context of the present invention refers to the ability of textiles comprising cellulosic fibers to retain more liquor and humidity during steaming on the textile, which has a favorable impact on the avoidance of crease and lay marks, since higher amounts of humidity (liquor/water) remain in or on the textile comprising cellulosic fibers after impregnation. This avoids too fast drying up of textile parts directly exposed to the steamer atmosphere and also minimizes the chemical damage of the textile after steaming. Further, the better liquor retention ability can result in an increased liquor pick up during impregnation of the textile comprising cellulosic fibers with agent(s) /additive(s) used during the process according to the invention, in particular during the pre-treatment procedure. This supports a more efficient reaction of agent(s) / additive(s) used during scouring step and/or bleaching step, which results in an improved performance in terms of whiteness and absorbency levels of the textile comprising cellulosic fibers. It is disclosed a composition comprising a pectinolytic enzyme as defined above, and at least one water-soluble polymer as defined above.

[0088] The pectinolytic enzyme can be present in the composition in form of a concentrated liquid formulation comprising a pH-neutral pectate lyase enzyme.

[0089] The composition can be designed in form of a liquid solution or dispersion or as co-lyophilisate.

[0090] The term *"co-lyophilisate"* as used herein refers to a stable preparation of the composition obtained by rapid freezing and dehydration of the frozen composition under high vacuum.

[0091] In one embodiment, the composition comprises pectate lyase, at least one water-soluble polymer and at least one further additive.

[0092] The at least one additive can be selected from the group comprising non-ionic or anionic detergent, sequestering agent, saccharifying enzyme, peroxide stabilizer or mixtures of one or more of these additives.

[0093] The non-ionic detergent can be selected from the group comprising polyglycol ether derivatives and fatty alcohol alkoxylates or mixtures thereof. The anionic detergent can be a phosphoric acid ester. Suitable non-ionic or anionic detergents can be obtained under the trade name Hostapal XTRA liq. c. from Archroma (Thailand) (mixture of non-ionic detergents), or under the trade name Hostapal UH liq. from Archroma (China) (mixture comprising C_{10}Guebert alcohol, ethoxylated (7 EO) phosphoric ester salt), or under the trade name Hostapal DTC pa. From Archroma (Pakistan) (mixture comprising carboxylated / ethoxylated (7 EO) isotride canol), or under the trade name ALKOL D (= Imbentin T070) from Dr. Kolb AG (CAS-No. 9043-30-5; Iso-tridecanol ethoxylated (7 EO)).

[0094] Under the term *"sequestering agent"* an agent is to be understood in the context of the present application which is capable of chelating earth alkalines, in particular calcium or magnesium, and/or heavy metals, in particular iron

(Fe). Sequestering agents can be based on diethylenetriamine penta(methylene phosphonic acid) (DTPMP), polyacrylate and/or gluconate.

[0095] Further, a peroxide stabilizer can be present in the bleaching step, in particular if Pad Steam Bleaching is conducted. The peroxide stabilizer can be based on polyhydroxyphosphonates, polyacrylate and/or gluconate.

[0096] In one embodiment, the composition disclosed comprises pectate lyase, at least one water-soluble polymer, in particular PVP polymer, a non-ionic detergent, a sequestering agent, and an alpha-amylase.

[0097] The composition disclosed is used in the process for removing impurities according to the invention. In particular the composition is used in the pre-treatment procedure of textiles comprising cellulosic fibres or a mixture of cellulosic fibres and synthetic fibres. In particular the composition is used in the scouring step of the pre-treatment procedure of textiles comprising cellulosic fibres or a mixture of cellulosic fibres and synthetic fibres.

[0098] In one embodiment of the process according to the invention, the composition comprising pectate lyase, water-soluble polymer, in particular PVP polymer, alpha amylase, sequestering agent and non-ionic detergent is being applied on a padding unit and/or roller compartment and exposed during 20 min at 80°C in a steamer (conditioned with saturated steam).

Experimental methods

[0099] The average molecular weight of the PVP polymer used herein (Arostit TL0280, CAS No. 9003-39-8) is 200.000 to 300.000 g/mol according to the GPC (Gel Permeation Chromatography) method. The residual monomer content in the PVP polymer is below 0.01% by weight.

[0100] The activity of the pectate lyase used herein was measured according a test method from DuPont Industrial Bioscience (C401-00). The principle of this test method is based on the fact that pectate lyase catalyzes the formation of double bonds in polygalacturonic acid, which can be read with an UV/VIS-Spectrophotometer at 235 nm wavelength. The double bond formation is proportional to the enzyme activity. The activity is displayed in PLU/g pectate lyase, which can be calculated out of the product between the standard equivalent curve (PLU/ml) and the sample dilution divided through the weight of sample (g).

[0101] In general, the pectate lyase is combined with a non-ionic detergent, a sequestering agent, chelating earth alkalines (Ca, Mg) and heavy metals (Fe) and, optional an alpha-amylase breaking down starch size on cotton woven fabrics.

Examples

[0102] The following chemicals were used throughout the examples.

Table 1: List of chemicals used in the Examples.

Product	Basic chemistry (main component)	Supplier	Concentration	CAS-Nr. (main component)	Dosage in recipe (g/l)
Optise ® NEXT liq.	α-amylase	Genencor® / DuPont	14'600 AAU/g	9000-90-2	1.0
PrimaGreen® EcoScour liq.	Pectate lyase	Genencor®/ DuPont	74'806 PLU/g	9015-75-2	2.0 / 5.0
Hostapal XTRA liq.c.	Mixture of non-ionic surfactants	Archroma (Thailand)	80%	mixtures	5.0
Arostit TL0280	Polyvinylpyrrolidone	Archroma (Indonesia)	30%	9003-39-8	5.0 / 15.0 / 30.0
Sirrix ANTOX liq.	DTPMP	Archroma (China)	28-32%	15827-60-8	3.0

[0103] The following compositions were used in the Examples:

Table 2: Compositions used in the Examples.

Compositions A, B, C and E are reference examples.

Component	Composition (units in g/l)					
	A	B	C	D	E	F
Arostit TL0280 liq. (pure PVP polymer, Mw=200,000 g/mol)	0	0	15	15	30	30
Optise® NEXT liq. (alpha-amylase)	1	1	1	1	1	1
Hostapal XTRA liq.c. (non-ionic detergent)	5	5	5	5	5	5
Sirrix ANTOX liq. (sequestering agent)	3	3	3	3	3	3
PrimaGreen® EcoScour liq. (pectate lyase)	0	2	0	2	0	2

Example 1: Determination of crease (lay) mark inhibition during Pad Steam application 100% cotton woven fabric (CM50xCM50/150x80) was impregnated (liquor pick up 100%) with a composition according to Table 2 and steamed for 20 min at 80°C.

[0104] The wet crease angle recovery was directly measured after steaming. The test method followed a procedure described in AATCC 66-2003, option 2 on wet fabric, whereas a fabric sample of 40 x 15 mm was folded end-to-end, exposed for 5 min at room temperature with a 500 g weight on top and afterwards the recovery angle from a circular scale in degree (°) was evaluated. The results are shown in Table 3.

Table 3: Wet crease recovery angle according to AATCC 66-2003, option 2.

Composition	PVP [%]	Pectate lyase activity [PLU/g]	Crease angle recovery (warp)	Crease angle recovery (weft)	Crease angle recovery (warp + weft)
A	0	0	52°	57°	109°
B	0	150	53°	55°	108°
C	0.45	0	80°	92°	172°
D	0.45	150	82°	92°	174°
E	0.90	0	86°	91°	177°
F	0.90	150	85°	93°	178°

[0105] The results shown in Table 3 clearly demonstrate the positive impact of the PVP polymer on the wet crease angle recovery. All values are improved compared to compositions containing no PVP polymer. The higher the degree achieved after recovery, the less crease tendency and the less danger of crease and lay marks during steaming can be expected.

Example 2: Determination of the liquor retention ability

[0106] 100% cotton woven fabric (CM50xCM50/150x80) was impregnated (liquor pick up 100%) with a composition according to Table 2 and steamed for 20 min at 80°C. After steaming the fabric was dried without rinsing and conditioned at 20°C (± 2°C) and 65% (± 2%) relative humidity for at least 4 hours.

[0107] The evaporation test followed a procedure described for evaluation of moisture management properties according to the test method from M&S (Marks & Spencer). A conditioned specimen was weighed and afterwards exposed to 1.0 ml of distilled water in a petri dish. Then the weight of the specimen was evaluated after each 5 min up to 30 min time. The remaining water in the fabric was calculated in % with regard to the initial weight (at 0 min) of the fabric.

Table 4: Liquor retention ability according to M&S (Marks & Spencer).

Composition	Time [min]	PVP [%]	Pectate lyase activity [PLU/g]	Remaining water [%]
B	0	0	150	**100**
D		0.45	150	100
C		0.45	0	100

(continued)

Composition	Time [min]	PVP [%]	Pectate lyase activity [PLU/g]	Remaining water [%]
B	5	0	150	**98.7**
D		0.45	150	98.6
C		0.45	0	98.6
B	10	0	150	**96.1**
D		0.45	150	96.3
C		0.45	0	96.2
B	15	0	150	**94.6**
D		0.45	150	94.6
C		0.45	0	94.7
B	20	0	150	**92.4**
D		0.45	150	93
C		0.45	0	93.1
B	25	0	150	**88.1**
D		0.45	150	89.1
C		0.45	0	89
B	30	0	150	**85.5**
D		0.45	150	87.3
C		0.45	0	87.2

[0108] The results shown in Table 4 demonstrate an improvement in liquor retention in particular after dwelling times > 20 min. The more water remains after a certain time in the fabric (i.e. the less weight difference compared to the initial weight), the better the liquor retention ability and the better the effects described.

[0109] The ability to retain more liquor and humidity during steaming on the textile also has a favorable impact on avoidance of crease and lay marks, since higher amounts of humidity (liquor/water) remain on the textile after impregnation. This avoids too fast drying up of fabric parts directly exposed to the steamer atmosphere and also minimizes the chemical damage of the fabric after steaming.

[0110] Higher liquor retention ability also results in an increased liquor pick up during impregnation. This supports a more efficient reaction of (scouring and bleaching) chemicals with the fiber. Thus, higher liquor retention ability leads to an improved performance in terms of the whiteness and absorbency levels achieved after scouring and bleaching.

Example 3: PVP in continuous pre-treatment: Performance improvement during alkaline scouring and H_2O_2-bleaching (Pad Steam).

[0111] The performance of the process according to the invention, respectively the performance of the composition according to the invention used in the bio-scouring step can be determined using a Ruthenium Red dyestuff solution applied to the textile after treating the same with the composition according to the invention, which indicates the amount of pectin remaining on the cotton fiber. The lighter the red color after the dyeing process, the less pectin remained on the cotton fiber and, thus, the better are the scouring abilities, in particular the bio-scouring abilities of the composition according to the invention, respectively the process according to the invention.

[0112] 100% cotton woven fabric (CM80/2xCM80/2/160x72) was impregnated (liquor pick up 100%) with a composition according to Table 2, steamed for 20 min at 80°C and 98°C, respectively, and afterwards washed off with hot, warm and cold demineralized water.

[0113] The degree of whiteness (C.I.E.) was measured using a Datacolor Spectrophotometer (650).

Table 5: Whiteness improvement during Pad Steam processing (3 step treatment).

Process	Composition	PVP [%]	Enzyme activity [AAU/g] [PLU/g]	C.I.E.	YellowIndex (DIN 6167)	Ruthenium Red [%]
Grey fabric (untreated)		-	0	-11.2	30.9	100
Desizing (pick up 100%, 20 min at 80°C)	A	0	0	8.7	25.4	76.2
	C	0.45	150	11.1	24.7	36.6
Scouring (pH 9.0, pick up 100%, 20 min at 80°C)	A	0	0	8.3	25.5	32
	D	0.45	150	11.6	24.4	31.2
Bleaching (pH 11, 9.5 g/l H_2O_2 (100%), pick up	A	0	0	56.3	11.5	29.5
	C	0.45	0	65.8	8.8	29
100%, 20 min at 98°C)						

[0114] The absorbency level was measured according a modified AATCC test method (197-2012-Vertical Wicking of Textiles, Clariant Internal Test Method TM 7302) or the drop test method according to TEGEWA: a drop of colored water was placed on the surface of the fabric and the time was evaluated (in sec.), until the drop had been completely absorbed up from the fabric and b) according the wicking height method, whereas a sufficient amount of dye solution was filled into a Petri dish, minimal height 15 mm. Then the textile test stripes were suspended in the dye solution so that the bottom end just penetrated the surface of the solution. The stripes were dipped for approximate 2-3 mm. The time was evaluated with a stop watch and after 5 min, the stripes were removed and dried between layers of absorbent paper. The height was evaluated in mm.

Table 6: Absorbency improvement during Pad Steam processing (3 step treatment).

Process	Composition	PVP [%]	Enzyme activity [AAU/G] [PLU/g]	Wicking height [mm]	Drop test [sec]
Grey fabric (untreated)		0	0	0	>60
Desizing (pick up 100%, 20 min at 80°C)	A	0	0	1	>60
	C	0.45	150	5	>60
Scouring (pH 9.0, pick up 100%, 20 min at 80°C)	A	0	0	12	26
	D	0.45	150	18	8
Bleaching (pH 11, 9.5 g/l H_2O_2 (100%), pick up 100%, 20 min at 98°C)	A	0	0	22	2
	C	0.45	0	29	1

[0115] Table 5 and Table 6 show that addition of PVP polymer leads to better performances in terms of whiteness and absorbency levels. The higher the wicking height and the shorter the time of the drop test, the better the absorbency of the fabric.

[0116] Tensile strength was determined according to ISO 13934-1. A test specimen is extended at a constant rate until it ruptures. The maximum force at rupture is recorded. The higher the value (force) or the more close the value compared to the untreated, grey fabric, the better the performance.

Table 7: Tensile strength improvement during Pad Steam processing (determination after scouring & bleaching).

Process	Composition	PVP [%]	Pectate lyase activity [PLU/g]	Tensile strength [cN] (warp direction only)
Grey fabric		-	-	1074.3

(continued)

Process	Composition	PVP [%]	Pectate lyase activity [PLU/g]	Tensile strength [cN] (warp direction only)
Scouring (pH 9.0, pick up 100%, 20 min at 80°C)	D	0.45	150	1050.5
Bleaching (pH 11, 9.5 g/l H_2O_2 (100%), pick up 100%, 20 min at 98°C)	D	0.45	0	1020.8
Process	**Composition**	**PVP [%]**	**Pectate lyase activity [PLU/g]**	**Tensile strength [cN] (warp direction only)**
Reference process (50.0 g/l NaOH (solid), 9.5 g/l H_2O_2 (100%))				
- Scouring		-	-	975.8
- bleaching		-	-	922.5

[0117] Table 7 demonstrates that the tensile strength of the textile is clearly improved in the presence of PVP compared to the reference processes.

Example 4: Determining the bio-scouring effect in continuous Pad Steam application on 100% cotton woven fabric

[0118] 100% cotton woven fabric (CM80/2xCM80/2/160x72) was impregnated (liquor pick up 100%) with the respective composition, steamed for 20 min at 80°C at pH 7.0 and afterwards washed off with hot, warm and cold demineralized water.

[0119] The dryed textile samples were then dyed in a Launder-O-Meter (LOM) at liquor ratio 20:1 at 50°C for 30 min in 250 ml of a 0.05% w/w Ruthenium Red staining solution in phosphate buffer at pH 6.0. After dyeing, the samples were washed off with warm demineralized water, dried and then, color strength (%) and color difference (dE*) were measured with Datacolor Spectrophotometer 650.

Table 8: Continuous bio-scouring effects.

Composition	Dosage [g/l]	Pectate lyase activity [PLU/g]	PVP [%]	Ruthenium Red [%]	dE*
Grey fabric (untreated)	-	-	-	100	47.1
100% H_2O	-	0	0	76.1	43.6
10% PrimaGreen® EcoScour liq., 90 % H_2O	2	150	0	55	38.5
15% PrimaGreen® EcoScour liq., 35% Arostit TL0280, 50% H_2O	20 35	224 393	0.21 0.367	50.8 45.7	38.2 34.5
10% PrimaGreen® EcoScour liq., 40% Arostit TL0280, 50% H_2O	20 35	150 262	0.24 0.42	52.1 50.1	36.6 36.6
5% PrimaGreen® EcoScour liq., 45% Arostit TL0280, 50% H_2O	20 35	75 131	0.27 0.472	57.6 52.5	41.2 38.6
2.5% PrimaGreen® EcoScour liq., 47.5% Arostit TL0280, 50% H_2O	20 35	37 65	0.285 0.499	65.9 62.1	43.1 42.2
16% PrimaGreen® EcoScour liq., 64% Arostit TL0280, 20% H_2O	20 35	239 419	0.384 0.672	55.8 50.9	39.9 38.7

[0120] As shown in Table 8 pectate lyase in combination with PVP polymer leads to a reduced color strength of Ruthenium Red and minimizes color difference compared to the untreated, grey fabric, demonstrating the improved bio-scouring effect in the continuous pre-treatment. The lower the values for the color strength (%) and color difference (dE*) compared to the untreated, grey material, the better the bio-scouring effect.

Claims

1. A process for removing impurities from textiles comprising cellulosic fibres or a mixture of cellulosic fibres and non-cellulosic fibres, wherein the process comprises at least one pre-treatment procedure, wherein the pre-treatment procedure comprises at least a desizing step using a saccharifying enzyme, a scouring step using a pectinolytic enzyme and a bleaching step using an alkaline composition comprising H_2O_2, **characterized in that** the pre-treatment procedure comprises contacting textiles comprising cellulosic fibres or a mixture of cellulosic fibres and non-cellulosic fibres with at least polyvinylpyrrolidone (PVP) polymer in in all three steps.

2. A process according to claim 1, wherein the PVP polymer has an average molecular weight ranging from 50,000 to 500,000 g/mol, preferably ranging from 100,000 to 400,000 g/mol, further preferred ranging from 200,000 to 300,000 g/mol.

3. A process according to any one of the preceding claims wherein further at least one water-soluble polymer different from PVP polymer is used and selected from the group consisting of pure or derivatised polyvinylalcohol (PVA) homo- or copolymer; polyacrylate homo- or copolymer; polyalkyleneglycol homo- or copolymer, in particular polyethyleneglycol homo- or copolymer; modified polyalkyleneglycol homo- or copolymer, in particular modified polyethyleneglycol homo- or copolymer, in particular alkylpolyethyleneglycol homo- or copolymer, alkoxypolyethyleneglycol homo- or copolymer, acylpolyethyleneglycol homo- or copolymer; polyvinylbutyral homo- or copolymer; non-ionic or anionic modified polyesters; or non-ionic or anionic modified oligoesters; modified polystyrene, in particular low crosslinked polystyrene grafted with polyethylene glycol, or aminomethyl polystyrene; or mixtures thereof.

4. A process according to any of the preceding claims, wherein in in the scouring step, the pectinolytic enzyme to remove pectic polysaccharides from cellulosic fibers comprises at least pectate lyase.

5. A process according to any of the preceding claims, wherein in the desizing step, the saccharifying enzyme comprises alpha-amylase to break down starch size from cellulosic fibers.

6. A process according to any of claims 1 to 4, wherein the scouring step is carried out at a pH between 5 and 10, or between 7 and 8, or at 7.25.

7. A process according to claims 1 to 4 and 6, wherein the scouring step is carried out at a temperature between 50 and 100°C, or between 70 and 90°C, or at 80°C.

Patentansprüche

1. Verfahren zur Entfernung von Verunreinigungen aus Textilien aufweisend Cellulose-Fasern oder eine Mischung aus Cellulose-Fasern und nicht-Cellulose-Fasern, wobei das Verfahren mindestens einen Vorbehandlungs-Prozess aufweist, wobei der Vorbehandlungs-Prozess mindestens aufweist einen Desizing-Schritt unter Verwendung eines Verzuckerungsenzyms, einen Scheuerschritt (scouring step) unter Verwendung eines pektinolytischen Enzyms, und einen Bleichschritt unter Verwendung einer alkalischen Zusammensetzung aufweisend H_2O_2, dadurch charakterisiert, dass der Vorbehandlungs-Prozess aufweist, Textilien, aufweisend Cellulose-Fasern oder eine Mischung aus Cellulose-Fasern und nicht-Cellulose-Fasern, mit Polyvinylpyrrolidon (PVP) Polymer während allen drei Schritten in Kontakt zu bringen.

2. Verfahren nach Anspruch 1, wobei das PVP Polymer ein durchschnittliches Molekulargewicht zwischen 50.000 und 500.000 g/mol besitzt, vorzugsweise zwischen 100.000 und 400.000 g/mol, noch bevorzugter zwischen 200.000 und 300.000 g/mol.

3. Verfahren nach irgendeinem der vorstehenden Ansprüche, wobei mindestens ein weiteres, vom PVP Polymer unterschiedliches, wasserlösliches Polymer verwendet wird, und ausgewählt wird aus der Gruppe bestehend aus reinem oder derivatisiertem Polyvinylalkohol (PVA) Homo- oder Copolymer; Polyacrylat Homo- oder Copolymer; Polyalkylenglykol Homo- oder Copolymer, speziell Polyethylenglykol Homo- oder Copolymer; modifiziertes Polyalkylenglykol Homo- oder Copolymer, speziell modifiziertes Polyethylenglykol Homo- oder Copolymer, speziell Alkyl-

polyethylenglykol Homo- oder Copolymer, Alkoxypolyethylenglykol Homo- oder Copolymer, Acylpolyethylenglykol Homo- oder Copolymer; Polyvinylbutyral Homo- oder Copolymer, nicht-ionische oder anionische modifizierte Polyester; oder nicht-ionische oder anionische modifizierte Oligoester; modifizierte Polystyrole, speziell schwach vernetzte Polystyrole gepfropft mit Polyethylenglykol, oder Poly(Aminomethylstyrol); oder Mischungen davon.

4. Verfahren nach irgendeinem der vorstehenden Ansprüche, wobei das pektinolytische Enzym zur Entfernung von pektinischen Polysacchariden aus Cellulose-Fasern im Scheuerschritt (scouring step) mindestens Pektatlyase aufweist.

5. Verfahren nach irgendeinem der vorstehenden Ansprüche, wobei im Desizing-Schritt das Verzuckerungsenzym alpha-Amylase aufweist, um den Stärke-Mantel (starch size) der Zellulose-Fasern aufzubrechen.

6. Verfahren nach irgendeinem der Ansprüche 1 bis 4, wobei der Scheuerschritt (scouring step) in einem pH zwischen 5 und 10, oder zwischen 7 und 8, oder bei 7,25 durchgeführt wird.

7. Verfahren nach Ansprüchen 1 bis 4 und 6, wobei der Scheuerschritt (scouring step) bei einer Temperatur zwischen 50 und 100°C, oder zwischen 70 und 90°C, oder von 80°C durchgeführt wird.

Revendications

1. Procédé d'élimination d'impuretés dans des textiles comprenant des fibres cellulosiques ou un mélange de fibres cellulosiques et de fibres non cellulosiques, dans lequel le procédé comprend au moins une procédure de prétraitement, dans lequel la procédure de prétraitement comprend au moins une étape de désencollage à l'aide d'une enzyme de saccharification, une étape de lavage à l'aide d'une enzyme pectinolytique et une étape de blanchiment à l'aide d'une composition alcaline comprenant H_2O_2, **caractérisé en ce que** la procédure de prétraitement comprend la mise en contact de textiles comprenant des fibres cellulosiques ou un mélange de fibres cellulosiques et de fibres non cellulosiques avec au moins un polymère de polyvinylpyrrolidone (PVP) dans les trois étapes.

2. Procédé selon la revendication 1, dans lequel le polymère de PVP a une masse moléculaire moyenne de 50 000 à 500 000 g/mol, préférentiellement de 100 000 à 400 000 g/mol, plus préférentiellement de 200 000 à 300 000 g/mol.

3. Procédé selon l'une quelconque des revendications précédentes, dans lequel en outre au moins un polymère hydrosoluble différent du polymère de PVP est utilisé et choisi parmi le groupe constitué de : homopolymère ou copolymère d'alcool polyvinylique (PVA) pur ou dérivé ; homopolymère ou copolymère de polyacrylate ; homopolymère ou copolymère de polyalkylèneglycol, en particulier homopolymère ou copolymère de polyéthylèneglycol ; homopolymère ou copolymère de polyalkylèneglycol modifié, en particulier homopolymère ou copolymère de polyéthylèneglycol modifié, en particulier homopolymère ou copolymère d'alkylpolyéthylèneglycol, homopolymère ou copolymère d'alcoxypolyéthylèneglycol, homopolymère ou copolymère d'acylpolyéthylèneglycol ; homopolymère ou copolymère de poly(butyral de vinyle) ; polyesters modifiés non ioniques ou anioniques ; ou oligoesters modifiés non ioniques ou anioniques ; polystyrène modifié, en particulier polystyrène faiblement réticulé greffé avec du polyéthylène glycol, ou aminométhyl-polystyrène ; ou mélanges de ceux-ci.

4. Procédé selon l'une quelconque des revendications précédentes, dans lequel dans l'étape de lavage, l'enzyme pectinolytique destinée à éliminer des polysaccharides pectiques des fibres cellulosiques comprend au moins une pectate lyase.

5. Procédé selon l'une quelconque des revendications précédentes, dans lequel, dans l'étape de désencollage, l'enzyme de saccharification comprend de l'alpha-amylase pour fragmenter la taille de l'amidon provenant des fibres cellulosiques.

6. Procédé selon l'une quelconque des revendications 1 à 4, dans lequel l'étape de lavage est réalisée à un pH compris entre 5 et 10, ou entre 7 et 8, ou à 7,25.

7. Procédé selon les revendications 1 à 4 et 6, dans lequel l'étape de lavage est réalisée à une température comprise entre 50 et 100 °C, ou entre 70 et 90 °C, ou à 80 °C.

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

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- *CHEMICAL ABSTRACTS,* 9003-39-8 **[0070] [0099]**
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