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(54) **DYE SCAVENGING TEXTILE MATERIAL II**

(57) The present invention relates to a dye scavenging textile material and method for manufacturing thereof.

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Description

[0001] The present invention relates to a dye scavenging textile material and method for manufacturing thereof.

[0002] It is well known that a typical mix of articles in a laundry wash will have somewhat different colours, even if sorted into the so-called "white" and "coloured" batches. Although fading of dyes is more prevalent from new, unlaundered, or heretofore infrequently laundered goods, even articles with considerable fastness to washing, or having a long history of numerous previous launderings, may continue to bleed small amounts of dyestuff or colorant into the bath or wash water. The well-known, but aggravating and undesirable result of such fading is that at least part of the extraneous, free flowing dyestuff which has bled from its original material article may then be absorbed, adsorbed, reacted with, or otherwise physically deposited on or associated with other articles in the same wash liquor, thus discolouring this latter item.

[0003] Attempts to solve this problem have included treating the dyes or colorants so that they have a greater affinity for the dyed material. Attempts have also been made to eliminate dyestuffs discharged in the wash water. International PCT Patent Publication No. WO-A-97/48789 discloses a method of controlling undesirable dye or colorant discharged in wash water, comprising placing in the wash a dye scavenging substrate which when added to the wash scavenges and absorbs extraneous dye. WO-A-97/48789 also discloses a method of manufacturing the dye scavenging substrate.

[0004] The currently employed methods have the drawback that the formed textile material needs to be treated with the dye scavenging compound, which requires a long and laborious process and specialized equipment. It is an object of the present invention to provide an alternative method for manufacturing a dye scavenging substrate that simplifies existing processes.

[0005] It is a further object of the present invention to provide a method for manufacturing a dye scavenging substrate, which method results in the dye scavenging substrate having improved properties, in particular improved dye scavenging capabilities, improved mechanical properties and/or improved sustainability.

[0006] Surprisingly, the inventors of the present invention have found that some or all of the above objects may be achieved by an alternative process in which not the preformed textile material, but rather the fibers from which the textile material is formed are treated with the dye scavenging compounds prior to the formation of the textile material and then combined with untreated fibers to obtain the dye scavenging textile material. The thus obtained materials are more versatile with respect to their properties and show improved dye scavenging capabilities and increased sustainability while retaining good mechanical strength.

[0007] In a first aspect, the present invention thus provides for a dye scavenging textile material, preferably a nonwoven, woven or knitted fabric, a braided rope or ball, comprising

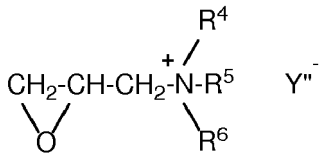
(a) 30 to 95 % by weight, preferably 50 to 90% by weight, more preferably 65 to 80 % by weight, absorbent fibers made of a cellulosic material, preferably comprising or consisting of cellulose, more preferably regenerated cellulose fibers, said fibers comprising at least one dye scavenging compound selected from:

(i) a N-trisubstituted ammonium-2-hydroxy-3-halopropyl compound having the general formula (I):

$$X'\text{-}CH_2\text{-}CHOH\text{-}CH_2\text{-}N^+(R^1R^2R^3)\ Y'^- \qquad (I)$$

wherein R^1, R^2, R^3 are each independently methyl, ethyl, propyl, butyl, benzyl or a hydroxyl substituted derivative thereof, X' is a halogen atom, and Y'^- is chloride, bromide, sulfate or sulfonate;

(ii) a salt of epoxy propyl ammonium having the general formula (II):



(II)

wherein R^4, R^5, R^6 and Y''^- have the same meaning as R^1, R^2, R^3 and Y'^-, respectively, as defined above, or

(iii) a combination thereof; and

(b) 5 to 70 % by weight, preferably 10 to 50 % by weight, more preferably 20 to 35 % by weight, polymeric fibers, said fibers not comprising a dye scavenging compound according to formula (I) or (II), preferably not comprising any dye scavenging compound.

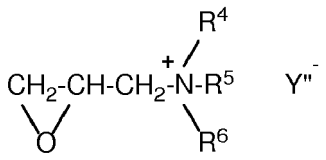
[0008] In another aspect, the invention also encompasses a method for manufacturing a dye scavenging textile

(a) providing absorbent fibers made of a cellulosic material, preferably comprising or consisting of cellulose, more preferably regenerated cellulose fibers;
(b) applying to the fibers at least one dye scavenging compound selected from:

(i) a N-trisubstituted ammonium-2-hydroxy-3-halopropyl compound having the general formula (I):

$$X'\text{-}CH_2\text{-}CHOH\text{-}CH_2\text{-}N^+(R^1R^2R^3)\ Y'^- \qquad (I)$$

wherein R^1, R^2, R^3 are each independently methyl, ethyl, propyl, butyl, benzyl or a hydroxyl substituted derivative thereof, X' is a halogen atom, and Y'^- is chloride, bromide, sulfate or sulfonate;
(ii) a salt of epoxy propyl ammonium having the general formula (II):



(II)

wherein R^4, R^5, R^6 and Y''^- have the same meaning as R^1, R^2, R^3 and Y'^-, respectively, as defined above, or
(iii) a combination thereof; and

(c) forming a dye scavenging textile material of the fibers obtained in step (b) and polymeric fibers not comprising a dye scavenging compound according to formula (I) or (II), preferably not comprising any dye scavenging compound, wherein the textile material is preferably a nonwoven, woven or knitted fabric, a braided rope or ball.

[0009] "At least one", as used herein, relates to one or more, i.e. 1, 2, 3, 4, 5, 6, 7, 8, 9, or more. If used in combination with a compound, the term does not relate to the absolute number of molecules but rather to the number of different types of said compound. "At least one dye scavenging compound" thus means that at least one type but that also 2 or more different dye scavenging compound types can be present.

[0010] If not indicated otherwise, all percentages are by weight relative to the total weight of the composition. "About", as used herein in relation to a numerical value, means said value ±10%, preferably ±5%. If a numerical value is given without any decimal place, such as "99%", this refers to "99.0%", if not indicated otherwise.

[0011] "Free of" or "essentially free of", as used herein interchangeably in relation to a specific type of component, means that the referenced composition does not contain the respective component in deliberately added form. In various embodiments, this means that the respective component is present in concentrations of no more than 1 wt.%, preferably no more than 0.5 wt.%, more preferably no more than 0.1 wt.% of said component relative to the total weight of the composition. Most preferably, said component is not contained at all.

[0012] "Absorbent", as used herein in relation to the fibers, means that said fibers can absorb other compounds, in particular the dye scavenging compounds, in liquid form, such as an aqueous solution.

[0013] The absorbent fibers are preferably cellulosic fibers, i.e. comprise or consist of cellulose. The fibers can be natural or regenerate cellulose-based fibers, such a cotton or rayon, or mixtures of natural and regenerate fibers. Particularly preferred are regenerated cellulose fibers, such as viscose, modal and lyocell or combinations thereof. It is preferred that the fibers used are made from purified cellulose, in particular cellulose that contains less than 10% by weight of other components, such as hemicellulose or lignin. It is preferred that the cellulose from which the fibers are formed is essentially free of hemicellulose and lignin. It is also preferred that the fibers used in the textile materials and methods described herein are not wood pulp. In any case, the fibers used herein are water-insoluble, i.e. they do not dissolve in water under the given conditions, but remain in solid form.

[0014] Methods to produce such regenerate cellulose fibers are well-known in the art and involve the chemical conversion of purified cellulose, for example from wood pulp or other natural sources, into a soluble compound, which is then dissolved and forced through a spinneret to produce filaments which are chemically solidified, resulting in fibers.

[0015] Suitable lyocell fibers are for example marketed under the Tencel® brand by Lenzing, AT.

[0016] While the fibers are preferably cellulose-based, it is similarly possible to use fibers that comprise or consists of cellulose derivatives, such as cellulose ester, in particular cellulose acetate.

[0017] The above definition of the fibers particularly applies to the absorbent fibers used for the application of the dye scavenging compounds. While the polymeric fibers that are combined with the fibers treated with the dye scavenging

compound may be any of the afore-described cellulosic fibers and even may be the same fiber type as the one treated with the dye scavenger, in various embodiments, the untreated polymeric fibers that are combined with the treated polymeric fibers are a different type of fiber. In various embodiments, the fibers may be selected from cellulose or synthetic fiber types, such as polyester. Particularly preferred are polyester fibers, such as poly(lactic acid) fibers. However, alternatively also cotton or viscose fibers, such as for example lyocell fibers, may be used. "Treated fiber", as used herein, relates to those fibers to which the dye scavenging compounds have been applied, in particular according to the methods described herein. "Untreated fiber", as used herein, thus relates to those fibers not treated with the dye scavengers. Both are combined in the materials and methods of the invention, as it has surprisingly been found that a combination of such treated and untreated fibers provides for materials with advantageous properties compared to a fabric that has been completely treated with dye scavengers.

[0018] In various embodiments, the absorbent fibers are cellulosic fibers, preferably viscose, and the untreated fibers are non-cellulose polymeric fibers, preferably polyester fibers, more preferably poly(lactic acid) fibers.

[0019] The fibers are then combined to form the textile material. As already described above, the treated fibers are preferably used in amounts by weight of 30 to 95 % by weight, preferably 50 to 90% by weight, more preferably 65 to 80 % by weight, such as, for example 70, 75 or 80 % by weight, relative to the total weight of the fibers of which the textile material consists. The untreated fibers are used in amounts of 5 to 70 % by weight, preferably 10 to 50 % by weight, more preferably 20 to 35 % by weight, such as, for example, 20 or 25 or 30% by weight, relative to the total weight of the fibers of which the textile material consists. In various embodiments, the textile material does not contain any other fiber types, i.e. is completely formed from the treated and untreated fibers described herein.

[0020] Any diameter or denier of fiber can be used in the present invention. Preferred are however dimensions as typically used in yarn/textile manufacturing.

[0021] In various embodiments, the dye scavenging compound is a compound of formula (I) or (II), wherein R^1, R^2, R^3 or R^4, R^5, R^6 are each independently methyl, ethyl, propyl, butyl, benzyl or a hydroxyl substituted derivative thereof, preferably methyl, ethyl, n-propyl or n-butyl, more preferably methyl or ethyl, most preferably methyl. X' is a halogen atom, preferably selected from Cl or Br.

[0022] Y'^- and/or Y''^- are selected from chloride, bromide, sulfate or sulfonate, preferably chloride. It is understood that when Y' or Y'' is a sulfate or sulfonate anion, that this refers to ½ sulfate/sulfonate ion, i.e. that the anion is shared by two positively charged ammonium compounds.

[0023] The dye scavenging compound is preferably a salt of epoxy propyl ammonium having the general formula (II), preferably a glycidyltrimethylammonium salt, also known as (2,3-epoxypropyl)trimethylammonium salt, more preferably the chloride salt, available in solid form or as a 72% aqueous solution from Sigma Aldrich, wherein R^4, R^5, R^6 are each methyl and Y''^- is chloride.

[0024] Alternatively, the compound may be a compound of formula (I), for example 3-chloro-2-hydroxypropyltrimethylammonium chloride, available from Sigma Aldrich, wherein R^1, R^2, R^3 are each methyl, X' is chlorine, and Y'^- is chloride.

[0025] It is of course also encompassed that more than one compound of formula (I) or (II) are used in combination or that the compound is used in combination with another dye scavenging compound not of formula (I) or (II). In the latter embodiments, it is however preferred that the dye scavenging compound(s) or formula (I) or (II) are used in an amount of at least 30 wt.-%, preferably at least 50 wt.-% relative to the total weight of dye scavenging compounds used.

[0026] In step (b) of the method described herein, the dye scavenging compound is applied to, absorbed by or impregnated into the fibers. Preferably, in step (b), the dye scavenging compound is applied to the fibers in form of an aqueous solution, preferably an alkaline aqueous solution comprising a base and optionally further comprising at least one surface active agent to improve wetting of the fibers. Suitable surface active agents are known in the art. The aqueous solution may be contacted with the fibers by any suitable means, for example by dipping or submerging the fibers in the bath or by spraying the solution onto the fibers. The step may be carried out continuously in that the fibers are passed by a suitable means through a bath of the solution or the solution is sprayed onto the fibers while they are transported.

[0027] In various embodiments, the alkaline solution comprises a basic solution comprising water and a base, preferably NaOH. Preferably, the caustic solution for use in the preparation of the alkaline solution comprises water and the base, such as NaOH, in a range by weight of from 5% NaOH to 50% NaOH or 2-40% NaOH or 5-35% NaOH or about 5% or about 30% NaOH. The water and the base (e.g. NaOH) in the caustic solution used for preparation of the alkaline solution may alternatively be used in a respective ratio by weight of from about 10:90 to about 50:50, preferably from about 80:20 to about 60:40, more preferably about 70:30 water:base. The caustic solution may be a 30% solution of NaOH available under the trade name Caustic Soda Liquor from Micro-Bio (Ireland) Ltd, Industrial Estate, Fermoy, County Cork, Ireland.

[0028] It is preferred that the alkaline solution comprises a final ready-to-use concentration of NaOH of about 0.5 to about 5% by weight relative to the total weight of the solution, for example about 0.6 to about 3.0% or about 0.7 to about 2.0 or about 0.8 to about 1.5 or about 0.9 to about 1.1 % by weight. This may for example mean that 3% of a 30% caustic solution of NaOH in water is used.

[0029] The alkaline solution preferably comprises the dye scavenging compound in an amount of from 0.5 to 20 % by

weight, for example 1 to 15 % by weight or 2 to 12 % by weight, for example about 6, 7, 8, 9, 10, 11 or 12 % by weight. In various embodiments, the ratio of the dye scavenger to the remaining parts of the alkaline solution, namely the basic solution (comprising water and the base and optional additional components, such as surfactants), by weight ranges of from about 0.02:1 to about 0.5:1, for example 0.05:1 to about 0.2:1. It will be appreciated that these ratios preferably refer to the dye scavenging compound in solid form, preferably to glycidyltrimethylammonium chloride.

[0030] The dye scavenging compound (I) and/or (II) is preferably used in an amount such that in the final textile material after step (c), it is present in amounts of from about 4.4 g to about 5.5 g, more preferably from about 4.6 g to about 5.1 g, most preferably about 4.9 g per square meter (m^2) of the final textile material. "Final textile material", as used herein, refers to the textile material in its ready to use form, i.e. in its dry form. In various embodiments, the amount of the dye scavenging compounds in the final textile material ranges from 5 to 20 % by weight of the textile material, preferably 10 to 15% by weight.

[0031] Preferably, the alkaline solution is at a temperature of from about 10 °C to about 70 °C, more preferably about 15-50°C. In various embodiments, its temperature is about 20°C or about 45°C.

[0032] After the fibers have been contacted with the dye scavenging compound in step (b) in form of an alkaline solution, the method may optionally comprise the step (b1) of contacting the fibers with an acid solution, for example, but without limitation, by passing the fibers through a bath containing an acid solution. Alternatively, the acid solution may be applied by other means, such as those described above for the alkaline solution. The acid solution may comprise water and an acid, such as a hydrochloric acid (HCl) solution, preferably a 4-12 M, for example about 4.3 to about 5 or about 11.6 M, HCl solution. The acid solution preferably has a pH from about 1.5 to about 2.5, more preferably a pH of about 2.1. Preferably, a pH probe is placed in the bath containing the acid solution in order to maintain the pH at about 2.1. Thus, the pH probe conveniently signals the water requirement and this is dosed when required to give the correct pH automatically.

[0033] Preferably, the acid solution is at a temperature of from about 10 °C to about 70 °C, more preferably about 15-50°C, more preferably about 20 or about 45 °C.

[0034] The acid solution may also contain a perfume and/or a non-ionic surfactant, such as an alkoxylated fatty alcohol (FAEO). Alternatively, such components may be used to treat the fibers in a later step or used to treat the formed textile material after step (c).

[0035] After step (b) and/or after step (b1), the fibers may be subjected to pressure to remove the liquid from the fibers. Said pressure may be applied by passing the fibers through rollers, e.g. a pair of rollers, optionally pneumatically actuated rollers, or using an air manifold to maintain constant and consistent air pressure. Such application of pressure is particularly preferred after step (b1), as it is desirable to remove the liquid (the acid solution used to neutralize the alkaline solution containing the dye scavenging compound), prior to drying the fibers.

[0036] In various embodiments, step (b), i.e. the contacting step, may comprise the additional steps of subjecting the fibers to pressure, preferably of from about 0.04 MPa to about 0.40 MPa; and/or wrapping the fibers in a water impermeable material and rotating the fibers, preferably for a period of from about 12 hours to about 60 hours; removing the water impermeable material, if present; and subjecting the fibers to a pressure of from about 0.15 MPa to about 0.40 MPa. These steps may, for example, be carried out prior to step (b1).

[0037] In various embodiments, a drying step (b2) is carried out before the fibers are used in step (c) for the formation of the textile material. Preferably, in step (b2), the drying temperature is from about 95 °C to about 125 °C, preferably from about 100 °C to about 120 °C, most preferably about 115 °C. Optionally, in step (b2), the substrate is dried by passing the substrate along one or more drying cylinders, which drying cylinders are optionally at a temperature of from about 95 °C to about 125 °C, preferably from about 100 °C to about 120 °C, most preferably about 115 °C.

[0038] Optionally, after step (b)/(b1) and prior to step (b2)/(c), the method may comprise one or more of the additional steps of:

(i) passing the fibers through a first fresh water rinse;
(ii) subjecting the fibers to pressure, preferably of from about 0.10 MPa to about 0.30 MPa;
(iii) passing the fibers through a second fresh water rinse; and
(iv) subjecting the fibers to a pressure, preferably of from about 0.10 MPa to about 0.30 MPa.

[0039] Preferably, when present, the first and second fresh water rinses take the form of a bath containing water, optionally at a temperature of from about 10 °C to about 30 °C, preferably about 20 °C.

[0040] In step (c) the fibers of step (b) and the untreated fibers are used to form a textile material. The textile material may be any textile material, including, without limitation, a woven, non-woven or knitted fabric, a braided rope or ball or any other desirable configuration. The purpose of the textile material is to provide a carrier for the dye scavenging material, and to provide a sufficient area over which said dye scavenging material is accessible to the liquid in the bath or wash water in which the dye scavenging textile material is to be used. The untreated fibers may be used to provide the material with sufficient mechanical strength. Preferred applications are in laundry applications, in particular in auto-

matic washing machines, such as front loaders or top loaders widely used.

[0041] The textile material typically is selected such that it has sufficient wet strength and sufficient resistance to abrasion with other materials in a bath such as laundry wash or rinse waters. Consequently, the textile materials of the present application are strong and robust to be suitable for all washing machine types. Strength and robustness might be defined by the tensile strength. Tensile strength refers to the resilience of the sheet against ripping. The direction of tensile strength can be distinguished between machine direction (MD) and cross direction (CD). When the textile material, for example in form of a cloth or laundry sheet, is produced, the lengthwise direction (direction of production) is the machine direction. The direction rectangular thereto is the cross direction. Relevant is of course also the tensile strength in respect of moisture. Thus, the sheets should be robust and stable if wet (i.e. if immersed for 10 seconds in water) as well as if dry (as obtained by a supplier). Thus, the textile material has, if wet, preferably a tensile strength in machine direction (MD) from 200 N/m to 1500 N/m, preferably from 400 N/m to 1400 N/m, especially from 600 N/m to 1300 N/m, especially preferred from 750 N/m to 1200 N/m and/or in cross direction (CD) from 50 N/m to 1000 N/m, preferably from 100 N/m to 800 N/m, especially preferred from 150 N/m to 500 N/m. If dry, it preferably has a tensile strength in machine direction (MD) from 1200 N/m to 2800 N/m, preferably from 1400 N/m to 2600 N/m, especially from 1500 N/m to 2400 N/m, especially preferred from 1600 N/m to 2200 N/m and/or in cross direction (CD) from 200 N/m to 1500 N/m, preferably from 250 N/m to 1000 N/m, especially from 300 N/m to 800 N/m.

[0042] It has been found that respective tensile strengths enable stable and robust products which are at the same time flexible and permeable to washing liquor. At the same time, the feel is good so that consumers' requirements are also fulfilled here.

[0043] All values for tensile strength, wet and dry, as well as cross direction and machine direction, have been and can be determined using a standard testing machine from Zwick GmbH, Ulm, Germany. The tensile strength according to the present invention is determined according to ISO 9073-3 (of the year 1989).

[0044] With respect to the look and feel of the sheet, the thickness of the sheet is preferably from 0.62 mm to 1.5 mm, preferably from 1.0 mm to 1.2 mm. The thickness is especially relevant for the question of permeability. Thicker sheets might not be permeable to washing liquor. Thinner sheets might not be robust enough; especially in aggressive top loaders with spindles they might be destroyed. This would not lead to a reduced efficacy of the laundry sheet but to reduced approval by the consumer.

[0045] Preferably, the textile material is a non-woven.

[0046] Methods to form such textile materials are known in the art. A non-woven may, for example, be wet-laid or spun-laid, defining the length of the fibers. It is preferred that the fibers have a length of about from 2 mm to 5 mm for wet-laid non-woven and/or from 30 mm to 50 mm for spun-laid non-woven.

[0047] In these methods of manufacturing a textile material, the fibers prepared as described herein are used in combination with untreated fibers (i.e. without a dye scavenging compound). In any of the embodiments described herein, all the fibers may be in form of a yarn.

[0048] The textile material made from the fibers may be a cellulosic material, but depending on different fiber types used in addition to the ones treated with the dye scavenging compounds, is preferably a composite material in that it also comprises non-cellulosic material. Accordingly, the material may comprise a naturally occurring material or a synthetic material or a mixture thereof.

[0049] The textile material may additionally comprise a binder such as polyvinylacetate, although in various embodiments no such a binder is included.

[0050] The textile material is preferably formed to a density of 40-200 g/m^2, 40-80 g/m^2, 55-75 g/m^2, or 60-75 g/m^2, more preferably about: 65g/m^2. The values apply to the textile material in its ready-to-use form, i.e. its dry form. The density can be determined according to ISO 9073-1 (of the year 1989). Such a density is preferred as respective textile sheets have an improved performance compared with other sheets, as they can absorb large amounts of dyes from the washing liquor in short times compared with other dye catching laundry sheets. At the same time, the sheets are still flexible and water permeable, so that they provide for consumer acceptance and allow to add them to delicate textile fabrics such as microfiber fabrics or others.

[0051] The textile material preferably takes the form of a cloth or laundry sheet. The dimensions of the material, once cut for use in a domestic wash, are approximately 25 cm x 12 cm. It will, however, be appreciated that any other suitable dimensions may be used.

[0052] In various embodiments, the textile material further comprises a dye transfer inhibitor (DTI) different from the dye scavenging compounds of formula (I) or (II). Suitable DTIs are known in the art and are typically polymeric in nature. Polymeric dye transfer inhibiting agents are known in the art for reducing or preventing dye-transfer during the laundering process. Polymeric dye transfer inhibiting agents useful herein include polyvinylpyrrolidone and copolymers thereof. Polyvinylpyrrolidone ("PVP") has an amphiphilic character with a highly polar amide group conferring hydrophilic and polar attracting properties, and also has apolar methylene and methane groups, in the backbone and/or the ring, conferring hydrophobic properties. The rings may also provide planar alignment with the aromatic rings, in the dye molecules. PVP is readily soluble in aqueous and organic solvent systems. PVP is commercially available in either powder or aqueous

solutions in several viscosity grades. The detergent compositions of the present invention preferably utilize a copolymer of N- vinylpyrrolidone and N- vinylimidazole (also abbreviated herein as "PVPVI"). It has been found that copolymers of N-vinylpyrrolidone and N-vinylimidazole can provide excellent dye transfer inhibiting performance when utilized in this invention.

[0053] In a preferred embodiment, the copolymer of N-vinylpyrrolidone and N-vinylimidazole polymers has an average molecular weight range from 5,000 to 1 ,000, 000, more preferably from 5,000 to 200,000. A highly preferred copolymer for use in detergent compositions according to the present invention has a number average molecular weight range from 5,000 to 50,000, more preferably from 8,000 to 30,000 and, most preferably from 10,000 to 20,000. The number average molecular weight range is determined by light scattering as described in Barth J. H. G. and Mays J. W. Chemical Analysis Vol 1 13. "Modern Methods of Polymer Characterization."

[0054] The copolymers of N-vinylpyrrolidone and N-vinylimidazole useful in the present invention can have a molar ratio of N-vinylimidazole to N-vinylpyrrolidone from 1:1 to 0.2:1 , more preferably from 0.8:1 to 0.3:1 , most preferably from 0.6:1 to 0.4:1. It should be understood that the copolymer of N-vinylpyrrolidone and N-vinylimidazole can be either linear or branched.

[0055] Copolymers of poly (N-vinyl-2-pyrollidone) and poly (N-vinyl-imidazole) are commercially available from a number of sources including BASF. A preferred DTI is commercially available under the tradename Sokalan® HP 56 K from BASF (BASF SE, Germany).

[0056] Mixtures of more than one polymeric dye transfer inhibiting agent may be used.

[0057] The DTIs, if present, are used in amounts such that the final textile material contains them in an amount that ranges from about 0.005 to about 0.5 % by weight relative to the total weight of the textile material, preferably of from about 0.02 to 0.05 % by weight. In various embodiments, this equals absolute amounts of from about 0.0001 to about 0.5 g/square meter, preferably about 0.01 g/square meter.

[0058] The DTIs may be added during fiber preparation but alternatively may also be applied to the formed textile material. In various embodiments, it is added after the textile materials has already been formed. The addition may be inline (in a continuous process) or, alternatively, off-line.

[0059] The textile materials as obtainable according to the methods described herein may comprise further components, including, without limitation, enzymes, such as cellulases, perfumes, softening additives, surfactants, soaps, soil repellents and other components typically used in laundry detergents and textile treatment additives, such as softeners.

[0060] The invention will now be described in greater detail, with reference to the accompanying non-limiting examples. It is understood that all embodiments disclosed herein in relation to the methods of the invention are similarly applicable to the thus obtained textile materials and vice versa. Specific embodiments and features of the embodiments are to be seen as disclosed for each and every embodiment so that features disclosed in the specification can be combined with each other with the embodiment still being within the scope of the present invention.

[0061] In the following examples, the present invention is further described in preferred embodiments but it is understood that it is not limited thereto.

EXAMPLES

[0062] The tests carried out follow the AISE test published on the website (www.aise.eu) and named "Minimum protocol for comparative tests of detergents" (Version V5.1 April 2016).

Gyrowash

[0063] GyroWash is a mechanical device used to carry out washing tests for textiles. Is equipped with a water bath, has a rotor fixed to an axis, which has arranged radially several stainless containers of 75±5mm of diameter, 125±10mm of height and a capacity of 550±50mL. The shaft-and-vessel assembly rotates with a frequency of 40±2min^{-1}. The water bath temperature is regulated by means of a thermostat, to maintain the test solution at the specified temperature ±2°C.

[0064] Treatment was carried out for 30 minutes at 40°C. Water volume was 100 mL. Number of replicates (internal/external) was 2 fabrics per cylinder (1 cotton; 1 polyamide) / 2 external repetitions for each color.

Products

[0065] All products tested were cellulose sheets with capacity to absorb dyes. These sheets have been cut in ¼ of their dimension and have been named as follows:

DB2: Reference 1 (commercially available dye scavenging laundry sheet w/o DTI)

T2B: Reference 2 (commercially available dye scavenging non-woven laundry sheet; 65 g/m^2; made of 50 wt.-%

wood pulp, 30 wt.-% viscose, and 20 wt.-% Binder (treated with GTMAC and DTI (Sokalan® HP 66 ex BASF) at a concentration of 0.1 g/m^2)
T2E: textile material according to the invention (non-woven; 65 g/m^2; made of 75 wt.-% viscose fibers treated with gylcidyltrimethylammonium chloride (GTMAC)/ 25% untreated poly(lactic acid) fibers)
T2F: textile material according to the invention (non-woven; 65 g/m^2; made of 75 wt.-% viscose fibers treated with gylcidyltrimethylammonium chloride (GTMAC)/ 25% untreated poly(lactic acid) fibers) with DTI (Sokalan® HP 56 K ex BASF) at a concentration of 0.1 g/m^2
T2G: textile material according to the invention (non-woven; 65 g/m^2; made of 75 wt.-% viscose fibers treated with gylcidyltrimethylammonium chloride (GTMAC)/ 25% untreated poly(lactic acid) fibers) with DTI (Sokalan® HP 56 K ex BASF) at a concentration of 0.05 g/m^2
T2H: textile material according to the invention (non-woven; 65 g/m^2; made of 75 wt.-% viscose fibers treated with gylcidyltrimethylammonium chloride (GTMAC)/ 25% untreated poly(lactic acid) fibers) with DTI (Sokalan® HP 56 K ex BASF) at a concentration of 0.01 g/m^2

Water hardness

[0066] 2.5 mmol/L ± 0.2 mmol/L calculated as $CaCO_3$ (250 ppm = 14 ± 0.5 °dH) is the water hardness used in the making of the detergent solution needed for the development of this test. The Ca/Mg ratio will be 3 ± 0.5.

Dosage

[0067] In order to make the test solution, the recommended dosage of the detergent ECE2 (standard detergent ex WFK, product number 88031) is 95.6 g for 15L of water. We prepared 12L of solution using 76.5g.
[0068] The detergent had the following composition:

Ingredient	Amount (wt.-%)
Linear sodium alkyl benzene sulfonate	9,7 %
Ethoxylated fatty alcohol C12-18 (7 EO)	5,2 %
Sodium soap	3,6 %
Anti foam DC2-4248S	4,5 %
Sodium aluminium silicate zeolite 4A	32,5 %
Sodium carbonate	11,8 %
Sodium salt of a copolymer from acrylic and maleic acid (Sokalan CP5)	5,2 %
Sodium silicate (SiO2:Na2O = 3,3:1)	3,4 %
Carboxymethylcellulose	1,3 %
Diethylene triamine penta (methylene phosphonic acid)	0,8 %
Sodium sulfate	9,8 %
Water	12,2 %

Colour set

[0069] Four dye donators and one dye acceptor have been used for this test:

Dye Donators:

1 = Direct Black 22 (0.3g)
2 = Direct Orange 39 (0.3g)
3 = Direct Red 83.1 (0.3g)
4 = Acid Blue 113 (0.3g)

Dye Acceptors

Standard cotton according to DIN 53919 (size 5.5 x 16 cm^2)

Example 1: Washing test

[0070] Dye donator (0.3 g) and dye acceptor (cotton) were placed in the container (no addition of steel balls). Both textiles are not fixed to each other. The volume to give the correct liquor: fabric ratio 100:1 is added and the containers are placed in the preheated (40ºC) GyroWash machine.

[0071] The dye acceptors (cotton (CO)) are used for all 4 dye donators. After the washes the textiles are removed and rinsed twice.

[0072] The textiles were evaluated spectrophotometrically at the beginning and at the end of the test in order to calculate the amount of color accepted (stained) for each specimen.

The characteristics for the measurements are the following:

- Measuring geometry: d / 8º
- D65 / 10° observer
- Measuring diameter: 30 mm
- 420 nm cut off (filter)
- Gloss: without
- Opening size: Large

[0073] The filter use cuts the effect of the optical brightener of the reference detergent as defined in the European test method. Each color must be evaluated independently following the UNE-EN ISO 105-A04 standard (Instrumental evaluation of the degree of discharge of the control tissues). Following this rule, the result obtained in gray scale index of discharge (SSR) is given by the following equations: Gray scale difference equivalent to the color difference obtained:

$$\Delta E_{GS} = \Delta E_{CIELAB} - 0{,}4 \cdot \sqrt{(\Delta E^{*2} - \Delta L^{*2})} \quad [1]$$

The gray scale index is calculated by means of equations:

$$SSR = 6{,}1 - 1{,}46 \cdot ln(\Delta E_{GS}) \quad [2]$$

$$SSR = 5 - 0{,}23 \cdot \Delta E_{GS} \quad [3]$$

[0074] Depending on the calculated SSR index, it must be rounded to a single decimal number according to the following:

5.00 to 4.75 = 5

4.74 to 4.25 = 4-5

4.24 to 3.75 = 4

3.74 to 3.25 = 3-4

3.24 to 2.75 = 3

2.74 to 2.25 = 2-3

2.24 to 1.75 = 2

1.74 to 1.25 = 1-2

<1.25 = 1

Table 1. Results obtained for cotton textiles

Cotton	DB2	T2B	T2E	T2F	T2G	T2H	
Dye 1	4.10	3.06	3.59	4.24	4.27	4.29	**SSR calculated**
Dye 2	1.86	1.19	2.39	2.43	2.66	3.03	
Dye 3	4.05	2.47	3.38	4.32	4.30	4.36	
Dye 4	4.03	4.04	4.28	4.36	4.32	4.02	
Dye 1	4	3	3-4	4	4-5	4-5	**SSR according to ISO105-A04**
Dye 2	2	1	2-3	2-3	2-3	3	
Dye 3	4	2-3	3-4	4-5	4-5	4-5	
Dye4	4	4	4-5	4-5	4-5	4	

[0075] The results show that the sheets according to the invention generally perform better than the reference sheets.

Example 2: Color sheet proofing

[0076] The color sheets were evaluated spectrophotometrically at the end of the test in order to calculate the color strength (K/s) of each.

[0077] In order to measure the color strength, the Kubelka-Munk theory was used which allows the relation between reflectance and absorbance.

$$K/s = \frac{(1-R)^2}{2R} \qquad [4]$$

[0078] It is known that the strength of a pigment is related to absorption property thus using the equation [4] allows to measure the strength measuring experimentally the reflectance.
The characteristics for the measurements are the following:

- Measuring geometry: d / 8º
- D65 / 10º observer
- Measuring diameter: 30 mm
- 420 nm cut off (filter)
- Gloss: without
- Opening size: Large

[0079] The following table shows the K/s measured for each color catcher:

Table 2: K/S average

	DB2	T2B	T2E	T2F	T2G	T2H
Dye 1	0.2529	0.2699	0.3697	0.2435	0.2529	0.2147
Dye 2	0.7914	0.7635	0.9796	1.0390	0.9095	0.8760

(continued)

	DB2	T2B	T2E	T2F	T2G	T2H
Dye 3	0.1138	0.1127	0.1822	0.1160	0.1126	0.0986
Dye 4	0.1358	0.0823	0.1427	0.1333	0.1255	0.1180

[0080] The results show that the color catcher sheets which absorb more color are not the ones that show best wash performance, meaning that color absorption by the sheet and dye transfer inhibition are not linearly related.

Claims

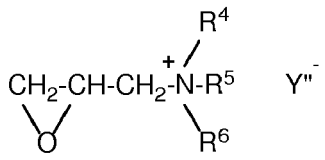
1. Dye scavenging textile material, preferably a nonwoven, woven or knitted fabric, a braided rope or ball, comprising

(a) 30 to 95 % by weight, preferably 50 to 90% by weight, more preferably 65 to 80 % by weight, absorbent fibers made of a cellulosic material, preferably comprising or consisting of cellulose, more preferably regenerated cellulose fibers, said fibers comprising at least one dye scavenging compound selected from:

(i) a N-trisubstituted ammonium-2-hydroxy-3-halopropyl compound having the general formula (I):

$$X'\text{-}CH_2\text{-}CHOH\text{-}CH_2\text{-}N^+(R^1R^2R^3)\ Y'^- \qquad (I)$$

wherein R^1, R^2, R^3 are each independently methyl, ethyl, propyl, butyl, benzyl or a hydroxyl substituted derivative thereof, X' is a halogen atom, and Y'^- is chloride, bromide, sulfate or sulfonate;
(ii) a salt of epoxy propyl ammonium having the general formula (II):



(II)

wherein R^4, R^5, R^6 and Y''^- have the same meaning as R^1, R^2, R^3 and Y'^-, respectively, as defined above, or
(iii) a combination thereof; and

(b) 5 to 70 % by weight, preferably 10 to 50 % by weight, more preferably 20 to 35 % by weight, polymeric fibers, said fibers not comprising a dye scavenging compound according to formula (I) or (II), preferably not comprising any dye scavenging compound.

2. Dye scavenging textile material according to claim 1, wherein the fibers not comprising a dye scavenging material are selected from the group of cellulosic and polyester fibers, preferably viscose, cotton, and poly(lactic acid), more preferably poly(lactic acid).

3. Dye scavenging textile material according to any one of the preceding claims, further comprising a dye transfer inhibitor, preferably selected from copolymers of poly (N-vinyl-2-pyrollidone) and poly (N-vinyl-imidazole).

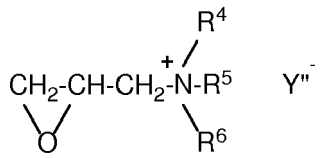
4. A method for manufacturing a dye scavenging textile material according to any one of the preceding claims, the method comprising the steps of:

(a) providing absorbent fibers made of a cellulosic material, preferably comprising or consisting of cellulose, more preferably regenerated cellulose fibers;
(b) applying to the fibers at least one dye scavenging compound selected from:

(i) a N-trisubstituted ammonium-2-hydroxy-3-halopropyl compound having the general formula (I):

$$X'\text{-}CH_2\text{-}CHOH\text{-}CH_2\text{-}N^+(R^1R^2R^3)\ Y'^- \qquad (I)$$

wherein R^1, R^2, R^3 are each independently methyl, ethyl, propyl, butyl, benzyl or a hydroxyl substituted derivative thereof, X' is a halogen atom, and Y'^- is chloride, bromide, sulfate or sulfonate;
(ii) a salt of epoxy propyl ammonium having the general formula (II):



(II)

wherein R^4, R^5, R^6 and Y''^- have the same meaning as R^1, R^2, R^3 and Y'^-, respectively, as defined above, or
(iii) a combination thereof; and

(c) forming a dye scavenging textile material of the fibers obtained in step (b) and polymeric fibers not comprising a dye scavenging compound according to formula (I) or (II), preferably not comprising any dye scavenging compound, wherein the textile material is preferably a nonwoven, woven or knitted fabric, a braided rope or ball.

5. The method according to claim 4, wherein the dye scavenging compound is applied to the fibers in form of an aqueous solution, preferably an alkaline aqueous solution comprising a base, more preferably NaOH, and optionally further comprising at least one surface active agent to improve wetting of the fibers.

6. A method according to claim 5, wherein in step (b),

(i) the basic solution comprises NaOH in an amount of about 0.5 to about 5% by weight relative to the total weight of the solution, preferably about 0.6 to about 3.0% or about 0.7 to about 2.0 or about 0.8 to about 1.5 or about 0.9 to about 1.1 % by weight; and/or
(ii) the alkaline solution comprises the dye scavenging compound in an amount of from 0.5 to 20 % by weight, preferably 1 to 15 % by weight or 2 to 12 % by weight; and/or
(iii) the alkaline solution is at a temperature of from about 10°C to about 30°C, more preferably about 20°C; and/or
(iv) the application in step (b) is achieved by passing the fibers through a bath containing an alkaline solution of said dye scavenging compound.

7. The method according to any one of claims 4 to 6, wherein the method further comprises one or more of the following steps after step (b) and prior to step (c):

(b1) contacting the fibers with an acid solution; and/or
(b2) drying the fibers.

8. The method according to claim 7, wherein in step (b1),

(i) the acid solution comprises water and a hydrochloric acid (HCl) solution, preferably a 11.6 M HCl solution; and/or
(ii) the acid solution has a pH from about 1.5 to about 2.5, preferably a pH of 2.1; and/or
(iii) the acid solution is at a temperature of from about 10°C to about 30°C, more preferably about20°C.

9. The method according to any one of claims 7 or 8, wherein in step (b2),

(i) the drying temperature is from about 95°C to about 125°C, preferably from about 100°C to about 120°C, most preferably about 115°C; and/or
(ii) the fibers are dried by passing the fibers along one or more drying cylinders.

10. The method according to any one of the preceding claims, wherein in step (b), the compound is glycidyltrimethyl-ammonium chloride (GTMAC).

11. The method according to any one of the preceding claims, wherein the absorbent fibers and/or the polymeric fibers

are not wood pulp.

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EUROPEAN SEARCH REPORT

Application Number
EP 18 17 4342

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 25 27 962 A1 (BAYER AG) 13 January 1977 (1977-01-13) * claims; example 2 * -----	1-11	INV. C11D3/00 C11D17/04 D06M13/385
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C11D
D06M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 August 2018	Hillebrecht, Dieter

CATEGORY OF CITED DOCUMENTS

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