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(54) **TEXTILE SUBSTRATE WITH ENHANCED BIODEGRADABILITY**

(57) The invention relates to a textile composite, comprising a textile substrate, which comprises a synthetic polymer and cotton, and a composition for enhancing the biodegradability of the textile substrate, wherein the composition is absorbed by the cotton.

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Description

[0001] The invention relates to textile composites comprising a textile substrate, which comprises a synthetic polymer, a method for producing textile composites and the use of a composition to enhance the biodegradability of textile substrates, which comprises a synthetic polymer.

[0002] The use of synthetic polymers in the textile industry is advantageous for a plurality of reasons. For instance, synthetic polymers, such as highly elastic Lycra filaments, can be used to provide stretchable yarns and fabrics. On the other hand, synthetic polymers, such as polyester can be used to provide textiles with high recovery forces. Further, contrary to hairy cotton yarns, synthetic polymers can be produced by extrusion thereby providing a flat surface which can be advantageous for the processing of the filaments, for instance into yarns, during weaving, knitting or other textile manufacturing process steps.

[0003] However, one disadvantage of synthetic polymers is their low biodegradability compared to natural fiber sources, such as cotton. Therefore, attempts have been made to increase the biodegradability of products comprising synthetic polymers. For instance, according to US 2015/0037865 A1, it is known to add biodegradability enhancing additives into molten polymers during extrusion thereof. Thereby, products comprising synthetic polymers can be realized, in which the biodegradability enhancing additives are uniformly distributed within the cross section of the product (Fig. 1a). However, this method requires a certain amount of additives to be distributed throughout the material for increasing the biodegradability of the product. Further, the necessity to incorporate the additives during extrusion leads to the problem that some products or intermediate products are not available with biodegradability enhancing additives on the market. In particular for small-scale productions, producing respective intermediate products is often not economic. Further, particular requirements coming with the extrusion process, such as temperature and pressure, makes this technic not available for any material.

[0004] In order to solve this problem, US 2015/0037865 A suggests disposing a biodegradation increasing composition on the material of a product having low biodegradability.

[0005] The composition used therefore is designed to increase the oxo-biodegradation of the material by the use of transition metal salts. Oxo-biodegradation refers to a two-step process. The first step is an abiotic, chemical process that requires the presence of oxygen so that degradation of a material can occur through oxidation. The second step of oxo-biodegradation is a biological process that requires the presence of at least one biodegradative living organism that is capable of biodegradative consumption of the material that has been degraded in the first step.

[0006] However, there is a need of further increasing the biodegradability of textile substrates comprising synthetic polymers. Further, there is a need to decrease costs for materials to be used for this purpose and/or to decrease the manufacturing times of respective textile substrates. Further, there is a need to increase the biodegradability of such textiles substrates without impairing, or at least with less impairment, the advantages of the synthetic polymers used therein.

[0007] It is an object to solve the above problems, in particular to provide a textile composite comprising a textile substrate, which comprises a synthetic polymer, a method for producing a textile composite and a use of a composition to enhance the biodegradability of a textile substrate, wherein the biodegradability of the textile substrate is enhanced, the costs for the production of such textile is decreased and/or adverse effects on the material characteristics of the textile substrate induced by the means for enhancing its biodegradability are decreased, in particular avoided.

[0008] These and other objects are achieved by the subject of the independent claims.

[0009] The invention relates to a textile composite comprising a textile substrate, which comprises a synthetic polymer, and a composition, which is disposed on the textile substrate. In particular, the composition enhances the biodegradability of the textile substrate.

[0010] The term "textile substrate" as used herein in particular encompasses a fiber, in particular a staple fiber or a filament, a yarn comprising fibers, a warp comprising yarns, in particular extending in a plane or being bundled into a rope, a fabric, in particular a woven fabric, a nonwoven fabric or a knitted fabric, and/or a garment, in particular trousers.

[0011] The term "fiber" as used herein in particular incorporates staple fibers and filaments. Staple fibers are in particular fibers of a definite length, in particular a length greater than 2 mm, 3 mm, 5 mm, 8 mm or 10 mm and/or a length of maximally 500 mm, 200 mm, 150 mm, 100 mm, 80 mm, 60 mm, or 45 mm. Filaments are in particular fibers with a length which is larger than the length of staple fibers, more in particular a length which extends along the entire length or width of the textile substrate, most in particular with an indefinite length.

[0012] The term "synthetic fiber" as used herein in particular incorporates fibers comprising a synthetic polymer, in particular fibers comprising the synthetic polymer in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 99% and/or fibers consisting of the synthetic polymer.

[0013] The term "synthetic polymer" as used herein in particular refers to human-made polymers, in particular to polymers synthesized by polymerizing of one or more kinds of monomers under laboratory/industrial conditions. Processes for preparing a variety of synthetic polymers, in particular the specific synthetic polymers mentioned below, are well known in the art.

[0014] The textile substrate may comprise or consist of the synthetic polymer. If the textile substrate is a fiber,

the textile substrate preferably consists of the synthetic polymer. However, also in the case of a fiber, the textile substrate can comprise of a mixture of synthetic polymers and natural fiber sources, for instance by extruding two different materials into a filament. If the textile substrate is a yarn, a warp, a fabric or a garment, the textile substrate preferably comprises a mixture of a synthetic polymer, such as polyester, and natural fiber sources, such as wool, silk and/or natural rubber. However, also in the case of a yarn, a warp, a fabric or a garment, the textile substrate can consist of a synthetic polymer. Preferred examples of textile substrates and their material compositions will be given below.

[0015] A composition is in particular to be regarded as being "disposed on the textile substrate", if the textile substrate was contacted by the composition after its formation. For instance, inserting a biodegradability enhancing composition into molten polymers during extrusion thereof is not to be regarded as realizing "disposing the composition on the textile substrate". However, applying the composition to the substrate after its formation, for instance in the case of extrusion of the filament after it leaves a jet or nozzle of the extrusion device, is to be regarded as realizing the wording "disposed on the textile substrate". The wording "disposed on the textile substrate" as used herein in particular incorporates adhering to the textile substrate and/or absorption by the textile substrate. If the textile substrate contains a porous structure, such as a porous fibers, such as cotton fibers, or a yarn comprising a plurality of fibers, disposing is preferably realized by absorption of the composition by the porous fibers. If the textile substrate comprises non-porous fibers, such as synthetic fibers produced by melt spinning or drawing, disposing is in particular realized in that the composition adheres onto the surface of the filaments. Of course, the composition can be disposed on the textile substrate by a combination of adhering and absorbing. For instance, if the textile substrate comprises cotton fibers and synthetic fibers, the composition can be partially absorbed by the cotton fibers and can partially adhere to synthetic fibers. Preferred methods for disposing the composition on the textile substrate are dyeing, spraying, roller coating and/or knife coating.

[0016] The previously described features of the textile composite can in particular apply to any of the subsequently described aspects of the invention.

[0017] According to one aspect of the invention, the composition comprises starch in a weight content between 0.5% and 10%. In particular, the weight content of the starch is at least 1%, 2%, 3% or 4% and/or maximally 9%, 8%, 7% or 6%, preferably between 2 and 10%, more preferably between 3 and 8%, most preferably between 4 and 6%. These weight percent relate to the total weight of the composition. Additionally, or alternatively, the textile composite comprises the composition in a weight content between 0,5 and 25 %, preferably between 1 and 20 %, more preferably between 2 and 15 %, most preferably between 3 and 10 %. These weight percent relate to the total weight of the textile composite. Most preferably, the above defined weight contents of starch with respect to the composition and with respect to the textile composite apply both at the same time. In other words, with respect to the most preferred weight ratios, the textile composite comprises the composition in a weight ratio between 3 and 10 %, wherein the composition comprises starch in a weight content between 4 and 6 %, so that the textile composite comprises starch in a weight content between 0,12 and 0,6 %.

[0018] It has been found that the use of starch in the previously described weight ratio increases the anaerobic biodegradability of the synthetic polymers. In other words, starch in such weight content acts as biodegradability enhancing additive, in particular as anaerobic biodegradability enhancing additive. One advantage of the anaerobic biodegradability provided thereby compared to the known oxo-biodegration is that the two-step procedure of oxo-biodegradation can be avoided, which in total increases the required time for degradation of the synthetic polymers. In particular, it has been found that using starch in the above-defined weight ratio ensures on the one hand, that enough starch is present to increase the biodegradability of the synthetic polymer and on the other hand makes sure that not too much starch is present which could cause adverse effects, such as making the textile substrate too stiff. Further, it has been found that starch does substantially not harm the beneficial advantages of synthetic polymers. Further, it has been found that starch may not only increase the biodegradability of the synthetic polymers but additionally serve to protect the textile substrate. For instance, in the case of textile substrates in the form of yarns which shall be woven into a fabric, the starch in the composition can help to increase the resistance of the yarn to potential damages resulting from extreme mechanical stresses to which they are subjected during weaving. Thereby, starch particularly reduces the risk of warp breakage on the weaving machine. Further, it additionally increases the adhesion of fibers at the surface of the yarn and prevents fiber fly. In particular, starch can thereby act on the one hand as biodegradability enhancing additive and on the other hand as sizing agent.

[0019] Particularly good results of biodegrading have been observed when starch was combined with 2-hydroxy-3-(trimethylammonio)propyl ether. In particular, the composition comprises 2-hydroxy-3-(trimethylammonio)propyl ether in a weight content of at least 0,1 %, 0,3%, 0,5 %, 0,6 % or 0,8 % and/or of maximally 4 %, 3 %, 2 % or 1 %, preferably between 0,3 and 3 %, particularly preferred between 0,5 and 2%, most preferably between 0,6 and 1 %. Particularly preferred, the composition comprises starch in a weight content of between 2 and 15 times, preferably between 3 and 12 times, more preferably between 4 and 10 times, most preferably between 5 and 8 times, the weight content of 2-hydroxy-3-(trimethylammonio)propyl ether.

[0020] As described with respect to the aspect of the

invention relating to the weight content of starch in the composition, the use of anaerobic biodegradation enhancing additives is beneficial over the use of oxo-biodegradation enhancing additives in that the two-step procedure of oxo- biodegradation can be avoided. Another disadvantage of oxo-biodegradation is that the first step, namely the one requiring oxygen, already happens during the use of the textile substrate, for instance during the use of clothing, which can decrease the lifetime of textile substrate. Contrary thereto, anaerobic biodegradation happens when disposing the textile substrate for instance into an aerobic digester, as specified in ASTM D5511 - 18, which usually does not happen during the use of the textile substrate. Thus, another advantage of anaerobic biodegradation is that unindebted biodegradation during the use of the textile substrate can be avoided.

[0021] Thus, another aspect of the invention, which can be combined with the previous and subsequent aspects of the invention, relates to a textile composite comprising a textile substrate, which comprises a synthetic polymer, and a composition, which is disposed on the textile substrate, for enhancing the anaerobic biodegradability of the textile substrate.

[0022] A composition "for enhancing the anaerobic biodegradability" of the textile substrate (anaerobic biodegradability enhancing composition) as described herein particularly refers to a composition comprising an additive for enhancing the anaerobic biodegradability of the substrate (anaerobic biodegradability enhancing additive). Such additive can in particular be starch, in particular in the weight content described with respect to the previous aspect of the invention. Additionally or alternatively, the biodegradability enhancing additive obtainable from the Company Biosphere under the product identifier "BioSphere EPS Powder 1,2,3, 401 Powder Additive" can be used, as anaerobic biodegradability enhancing additive for the realization of this aspect of the invention, preferably in the weight contents described with respect to the previous aspect of the invention. Additionally or alternative, other additives, known by the skilled person, suitable for enhancing the anaerobic biodegradability of synthetic polymers, can be used, preferably in the weight contents described with respect to the previous aspect of the invention, for the realization of this aspect of the invention.

[0023] Preferably, the biodegradability, in particular the anaerobic biodegradability, within the meaning of the previous and subsequent aspects of the invention is measured according to ASTM D 5511, in particular according to ASTM D 5511 - 18. In order to determine whether a composition is suitable to enhance the biodegradation of the textile substrate within the meaning of the invention, two tests according to ASTM D 5511 can be carried out, namely one test with the textile substrate having the composition disposed thereon (test A) and one test with the textile substrate without the composition (test B). In particular, if test A has a larger biodegradation according to ASTM D 5511 after a predetermined time, preferably after 90 days, 120 days and/or 150 days, and/or a certain biodegradation, preferably of at least 80%, 82%, 84%, 86%, 88%, 90 %, 92%, 94%, 96%, 98% or 99%, after a shorter time, the composition is suitable for enhancing the biodegradability of the textile substrate within the meaning of the present invention.

[0024] According to ASTM D 5511, the percentage of biodegradation is calculated by dividing the amount of gaseous carbon produced form the test material (gaseous carbon) during the test by the amount of carbon in the test material (solid carbon) before the test. As the composition, for example if it comprises starch, can also comprise solid carbon, which can be converted into gaseous carbon during the test, it is preferred to exclude the amount of solid carbon provided by the composition from the calculation of percentage biodegradation according to ASTM D 5511 by the following modified calculation according to ASTM D 5511:

Modified calculation according to ASTM D 5511:

[0025] The tests A and B are carried out as described in ASTM D 5511.

[0026] For test B, the percentage of biodegradation is calculated as described in ASTM D 5511, namely by dividing the amount of gaseous carbon produced from the test material by the amount of solid carbon in the test material. The amount of gaseous carbon produced by the test material is measured and calculated as described in ASTM D 5511. The amount of solid carbon in the test material can be calculated by common methods known by the skilled person, such as by considering the weight content of ingredients in the test material, their molar mass and their carbon content.

[0027] For test A, the percentage of biodegradation is calculated by dividing a corrected amount of gaseous carbon by a corrected amount of solid carbon. The corrected amount of gaseous carbon is calculated by subtracting the amount of solid carbon in the composition from the gaseous carbon produced by the test material as measured and calculated according to ASTM D 5511. The corrected amount of solid carbon is calculated by subtracting the amount of solid carbon in the composition from the amount of solid carbon in the test material. Alternatively, the corrected amount of solid carbon might be assumed to be a calculated amount of solid carbon in the textile substrate. The amount of solid carbon in the composition can be calculated by common methods known by the skilled person, such as by taking into account the weight content of the composition in the textile composite, the weight content of the ingredients in the composition, the molar mass of the ingredients and their carbon content.

[0028] Preferably, a composition being suitable to enhance the biodegradation of the textile substrate within the meaning of the present invention leads to a higher biodegradation of Test A compared to Test B measured

according to this modified calculation. By this modified calculation, it can be avoided that the percentage of biodegradation of test A is only higher because the composition itself degrades faster than the textile substrate. By excluding the amount of carbon in the composition from the calculation, it can be ensured that a higher percentage biodegradation of test A compared to test B proves that the composition enhances the biodegradation of the textile substrate.

[0029] Preferably, the textile substrate comprises the synthetic polymer in a weight content of at least 2 %, preferably at least 3%, 4%, 5% or 6 %, and biodegrades, measured according to ASTM D 5511, to at least 95 %, preferably at least 96 %, 97%, 98% or 99 %, within 150 days. Particularly preferably, such biodegradation is achieved for a textile composite comprising the synthetic polymer in a weight content between 2 % and 10 %, preferably between 3 % and 9%, more preferably between 4 % and 8%, most preferably between 5% and 7%. Particularly preferred the synthetic polymer is selected from the group consisting of a polyester, a polyethylene, a polypropylene, polystyrene, a polyamid, a polyaramid, a polyoxymethylene, a polytetrafluorethylene, a polyetheretherketone, a polyphenylenesulfid, polyalkyleneterepthalate, preferably a polybutyleneterephthalate, a polytrimethyleneterephthalate, a polyethyleneterephthalate, a polyurethane, apolyvinylalkohol, a copolymer of two or more thereof or a mixture of two or more thereof, preferably a polyester, polyethylene, polypropylene, polystyrene, polyethylenterephthalate, polyamide, polybutyleneterephthalate, polyurethane, polyvinylalkohol or a mixture of two or more thereof, most preferred is a polyester. Further, the synthetic polymer is preferably present in the form of synthetic filaments, in particular elastomeric filaments. Additionally or alternatively, the preferred biodegradation is achieved by textile substrates further comprising a natural fiber source, in particular cotton, in a weight content of at least 80%, 85%, 90%, 92% or 94%, particularly preferred in a weight content between 80 % and 98 %, preferably between 85% and 97%, more preferably between 90 % and 96%, most preferably between 93% and 95%. Further, the above biodegration is preferably achieved for textile substrates, such as yarns, warps, fabrics, in particular woven fabrics and/or garments. A specific example for which the above biodegration was achieved will be described in detail below.

[0030] In the following, aspects of the invention will be described, which relate to additives of the composition improving the processibility of the composition for the purpose of the invention. These aspects can be combined with the previous aspects of the invention and vice versa. In other words, the following aspects of the invention can improve the processibility of the previously described aspects relating to the use of starch in the claimed weight content and/or of an anaerobic biodegradability enhancing composition. In particular, it has been found advantageous to add a deaerating agent, an emulsifier, a crosslinking agent and/or an organic acid as described in the context of the following aspects of the invention into the composition of the above-described aspect of the invention. It should be clear that the preferred additives described below and their preferred weight contents are preferred for the above-described aspects of the invention and vice versa.

[0031] However, the following aspects of the invention can also be combined with other biodegradability enhancing additives. In particular, the composition being suitable to enhance the biodegradability of the textile substrate (biodegradability enhancing composition) is to be understood as a composition comprising an additive for enhancing the biodegradability of the textile substrate (biodegradability enhancing additive). Such additives can be the previously described additives, in particular starch and/or "BioSphere EPS Powder 1,2,3, 401 Powder Additive". However other biodegradability enhancing additives can be used too. For example, biodegradability enhancing additives, such as transition metal salts and/or transition metal chelate, such as metal stearate selected from the group consisting of chromium stearate, cobalt stearate, copper stearate, iron stearate, manganese stearate, nickel stearate, titanium stearate, vanadium stearate, and combinations thereof, can be used. Other possible biodegradability enhancing additives might encompass unsaturated fats and/or unsaturated fatty acids, oxidative enzymes and/or enzymes that catalyze the hydrolysis of a biodegradable polymer, and/or transition metal salts in the form of fatty acids.

[0032] Further, the following aspects of the invention can also be combined with additives enhancing other biodegradation mechanism, such as oxo-biodegradation. In particular, the following aspects of the invention can be combined with the biodegradability enhancing additives (agents of oxo-biodegration) being disclosed in US 2015/0037865 A1. The content of US 2015/0037865 A1 relating to the agents of oxi-biodegration is hereby incorporated by reference into the disclosure of the present invention.

[0033] According to another aspect of the invention, which can be combined with the previous aspects of the invention, a textile composite is provided. The textile composite comprises a textile substrate, which comprises a synthetic polymer, and a composition, which is disposed on the textile substrate, for enhancing the biodegradability of the synthetic polymer. According to this aspect of the invention, the composition comprises a deaerating agent. Preferably, the composition comprises the deaerating agent in a weight content of at least 3%, 5%, 6%, 7% or 8% and/or of maximally 18%, 16%, 14%, 12% or 10%, preferably between 3% and 16%, more preferably between 5% and 12%, most preferably between 7% and 10%.

[0034] It known in the art to use deaerating agents for increasing the hydrophilicity of yarns by eliminating air pockets in the yarns. Thereby, it shall be ensured that the dye penetrates into the yarn. The inventors have sur-

prisingly found that deaerating agents can also be advantageously used for increasing the uptake of the composition for enhancing the biodegradability of the textile substrate. In particular in cases, in which the textile substrate comprises cotton, it has been found that deaerating agents can increase the uptake of the composition thereby increasing the effect of enhancing the biodegradability. A particularly preferred deaerating agent is LAVA WET MDF. However, other deaerating agents known by the skilled person can also be used.

[0035] The combination of starch, in particular in the above described weight content, with a deaerating agent has been found to be particularly advantageous for the purpose of the invention. Prior to the present invention, it was known to use starch as a sizing agent. However, after weaving, the sizing agent was removed so that starch could not act as a biodegradability enhancing additive on the final fabric and/or clothing. Even if starch would have been left on the fabric, it would have been present only on the outer surface of the yarns where its biodegradability enhancing effect with respect to synthetic polymers inside the yarns would have been limited. By the combination of starch with a dearating agent in one composition, it can be ensured that the composition penetrates into the yarn thereby increasing its biodegradability enhancing effect with respect to synthetic polymers lying inside the yarn, for instance of synthetic filaments lying inside the yarn.

[0036] According to another aspect of the invention, which can be combined with the previous aspects of the invention, a textile composite is provided. The textile composite comprises a textile substrate, which comprises a synthetic polymer, and a composition, which is disposed on the textile substrate, for enhancing the biodegradability of the textile substrate. According to this aspect of the invention, the composition comprises an emulsifier. Preferably, the emulsifier comprises alkyl polyglycol ethers, especially alkyl polyglycol ethers with 10-11 ethylene oxide units. A particularly preferred emulsifier is the emulsifier known as Exosel 118. Additionally or alternatively, the composition comprises the emulsifier in a weight content of at least 4 %, 6 %, 8 %, 10 % or 12 % and/or of maximally 24 %, 20 %, 16 % or 14 %, preferably between 6 and 20 %, particularly preferred between 8 and 16 %, most preferably between 10 and 14 %.

[0037] The inventors have found that mixing the composition in a liquid, in particular into water, prior to applying it to the textile substrate increases the biodegradability enhancing effect. For textile substrates comprising yarns, one explanation could be that the composition can better penetrate in between0 the fibers of the yarns and, in the case of porous structures such as in the case of cotton textile substrates, into the porous structures. However, a problem of mixing the composition with a liquid is that most biodegradability enhancing additives, in particular starch, does not dissolve in water. It has been found that this problem can be solved by the use of an emulsifier. Thus, the use of an emulsifier enables applying the composition to the textile substrate in a liquid form, thereby increasing the biodegradability enhancing effect of the composition. The use of an emulsifier has been found to be particularly advantageous in cases in which the textile substrates comprise yarns and/or cotton and/or in which the composition comprises starch, in particular in the previously described content.

[0038] According to another aspect of the invention, which can be combined with the previous aspects of the invention, a textile composite is provided. The textile composite comprises a textile substrate, which comprises a synthetic polymer, and a composition, which is disposed on the textile substrate, for enhancing the biodegradability of the textile substrate. According to this aspect of the invention, the composition comprises a crosslinking agent. Preferably, the crosslinking agent is a self-crosslinking polyurethan. A particularly preferred crosslinking agent is the crosslinking agent known as Tanapur One. Additionally or alternatively, the composition comprises the crosslinking agent in a weight content of at least 20 %, 30 %, 50 %, 65 %, 70 % or 72,5 % and/or maximally 90 %, 80 % or 75 %, preferably between 50 and 90 %, particularly preferred between 65 and 80 %, most preferably between 70 and 75 %.

[0039] The inventors have found that biodegradability enhancing additives, in particular starch, can detach from the textile substrate, for instance by washing, which decreases the biodegradability enhancing effect of the composition. It has been found that the use of crosslinking agents can solve this problem by ensuring that the biodegradability enhancing additives remain on the textile substrate until they are needed, namely at the end of the lifetime of the textile substrate. The inventors of the present invention have found that the above specified weight contents are of particular advantage as they ensure a proper bonding of the biodegradability enhancing additive until the end of the lifetime of the fabric. It has been found that the relatively large amount of crosslinking agent is of particular advantage for embodiments in which the textile substrate is a denim fabric because such fabrics usually have a long lifetime in which they are subject to a plurality of washing cycles and abrasive wear, which requires a strong bonding of the biodegradability enhancing additive to the textile substrate to ensure that the substrate properly biodegrades at the end of its lifetime. Further, it has been found that such high amount of crosslinking agents are of particular advantage for embodiments in which the textile substrates are of non-porous nature, such as synthetic filaments, because - as the composition cannot be disposed on the textile substrate by absorption - these textile substrates can only hold the composition by adhesion.

[0040] According to another aspect of the invention, which can be combined with the previous aspects of the invention, a textile composite is provided. The textile composite comprises a textile substrate, which comprises a synthetic polymer, and a composition, which is disposed on the textile substrate, for enhancing the biode-

gradability of the textile substrate. According to this aspect of the invention, the composition comprises an organic acid, in particular carboxylic acid, with less than ten carbon atoms. Preferably, the organic acid is selected from the group consisting of acetic acid, citric acid, tartaric acid, maleic acid, lactic acid, and oxalic acid, most preferred acetic acid. Preferably, the organic acid has less than nine, eight, seven, six, fife, four or three carbon atoms, most preferably exactly two carbon atoms, such as acetic acid. Additionally or alternatively, the composition comprises the organic acid in a weight content of at least 0,3 %, 0,5 %, 0,8 %, 1,0 % or 1,2 % and/or of maximally 5 %, 3 %, 2 % or 1 %, preferably between 0,5 and 3 %, particularly preferred between 0,8 and 2 %, most preferably between 1 and 1,5 %.

[0041] The inventors have found that the selection of an organic acid as described above leads to a ph value, which is advantageous for the purpose of the invention. A ph value being preferred for the invention has been found to be between 3 and 7, preferably between 3 and 6, more preferably between 4.5 and 5.5. In particular, it has been found that organic acids with the previously described numbers of carbon atoms are of benefit as they enable adjusting the ph value of the composition as desired by keeping the viscosity of the composition relatively low. In this regard, relatively low means low compared to the viscosity which would occur if an acid with a higher number of carbon atoms, such as fatty acids, would be used in the same composition instead of an organic acid with less than ten carbon atoms. It has been found that the low viscosity is of particular advantage in combination with textile substrates comprising porous structures, such as cotton fibers and/or yarns, as it allows the composition to penetrate into the porous structure thereby uniformly enhancing biodegradability through the entire thickness of the textile composite.

[0042] Any of the previously described aspects of the invention, either alone or in any possible combination, can be realized in different embodiments differing from each other in the structure of the textile substrate as described in the following.

[0043] According to one embodiment, the textile substrate is a synthetic fiber, which comprises the synthetic polymer, in particular wherein the composition is disposed on the synthetic fiber. In particular, the synthetic fiber is a staple fiber or a filament, preferably a filament. More in particular the fiber comprises the synthetic polymer in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 99% or 100 %. In particular, the composition is disposed on the synthetic fiber in that it covers at least partially, in particular conceals entirely, the surface of the synthetic fiber.

[0044] According to another embodiment, the textile substrate is a yarn comprising at least one synthetic fiber, which comprises the synthetic polymer. The at least one synthetic fibers can be designed as described with respect to the embodiment in which the textile substrate is a synthetic fiber.

[0045] The at least one synthetic fiber can comprise at least one synthetic filament, in particular at least two, three, four or five synthetic filaments. Additionally, the yarn might comprise a sheath surrounding the at least one synthetic filament. The sheath might also comprise or consist of synthetic staple fibers and/or of natural fibers, in particular cotton staple fibers. In particular, the sheath might comprise synthetic staple fibers, cotton staple fibers or a mixture of synthetic staple fibers and cotton staple fibers in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 99% or 100 %. Additionally or alternatively, the at least one synthetic fiber comprises a plurality of synthetic staple fibers. In particular the yarn may comprise or consist of a plurality of synthetic staple fibers. In particular, the yarn may comprise synthetic staple fibers in a weight content of at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 95%, 99% or 100 %.

[0046] Preferably, the composition is disposed at least in parts on the at least one synthetic fiber. In particular, the composition is disposed on the yarn in that the composition penetrates into the yarn, in particular is distributed through the cross section of the yarn. More in particular, the composition is disposed on the yarn in that it contacts at least a part of the at least one synthetic fiber. In cases in which the yarn comprises at least one synthetic filament, the composition is preferably disposed on the at least one synthetic filament in that it covers at least partially, in particular conceals entirely, the surface of the synthetic fiber and/or in that the composition is distributed in the sheath surrounding the at least one filament.

[0047] In addition to the at least one synthetic fiber, the yarn can comprise natural fibers, in particular cotton fibers, onto which the composition can be disposed. In particular, the yarn can comprise a plurality of synthetic staple fibers and natural staple fibers, in particular wherein the composition is disposed on the synthetic staple fibers and/or on the natural staple fibers. Additionally or alternatively, the yarn can comprise at least one synthetic filament and a sheath of natural fibers, in particular cotton fibers, surrounding the at least one synthetic filament, in particular wherein the composition is disposed on the sheath, in particular absorbed by the cotton of the sheath. Additionally or alternatively the yarn comprises at least one synthetic filament and a sheath surrounding the at least one synthetic filament, wherein the sheath comprises synthetic fibers and/or natural fibers, in particular wherein the composition is disposed on the sheath.

[0048] According to another embodiment, the textile substrate is a fabric, in particular a woven, non-woven or knitted fabric, comprising synthetic fibers or yarns comprising synthetic fibers, which synthetic fibers comprise the synthetic polymer. The synthetic fibers can be designed as described with respect to the embodiment in which the textile substrate is a synthetic fiber. Additionally or alternatively, the yarns can be designed as described with respect to the embodiment in which the textile substrate is a yarn. In particular in embodiments in which the

textile substrate is a woven fabric, at least part of the warp yarns and/or of the weft yarns, in particular at least 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 100 % of the warp yarns and/or of the weft yarns can be designed as described with respect to the embodiment win which the textile substrate is a yarn.

[0049] The synthetic polymer comprised in the above described synthetic fibers is preferably selected from the group consisting of a polyester, a polyethylene, a polypropylene, polystyrene, a polyamid, a polyaramid, a polyoxymethylene, a polytetrafluorethylene, a polyetheretherketone, a polyphenylenesulfid, polyalkyleneterepthalate, preferably a polybutyleneterephthalate, a polytrimethyleneterephthalate, a polyethyleneterephthalate, a polyurethane, apolyvinylalkohol, a copolymer of two or more thereof or a mixture of two or more thereof, preferably a polyester, polyethylene, polypropylene, polystyrene, polyethylenterephthalate, polyamide, polybutyleneterephthalate, polyurethane, polyvinylalkohol or a mixture of two or more thereof, most preferred is a polyester.

[0050] According to another aspect of the invention, which can be combined with the previous aspects of the invention and vice versa, a textile composite is provided. The textile composite comprises a textile substrate, which comprises a synthetic polymer and cotton, and a composition for enhancing the biodegradability of the textile substrate. According to this aspect of the invention, the composition is absorbed by the cotton. The composition can be realized as described with any of the previously described aspects of the invention and any combination thereof.

[0051] The inventors have found that the porous structure of cotton is advantageous in that it enables a large uptake of the composition, in particular by the disposing methods described below. In particular in combination with the previously described biodegradability enhancing additives, deaerating agents, emulsifier, crosslinking agent and/or organic acids, it has been found that cotton acts as suitable carrier for the composition in that it enables a large uptake of the composition, avoids detachment of the composition during the lifetime of the textile substrate and enables a uniform distribution of the composition through the textile substrate which ensures a uniform biodegradation. The following embodiments have been found to be particularly preferred to profit from the absorption capacity of cotton:

[0052] According to one embodiment, the textile substrate is a yarn comprising a plurality of cotton fibers, which comprise the cotton, and at least one synthetic fiber, which comprise the synthetic polymer. In particular, the at least one synthetic fiber comprises a plurality of synthetic staple fibers being intermixed with the cotton fibers. In particular, a respective yarn can be a spun yarn, in particular ring spun yarn, produced from a roving comprising cotton fibers and synthetic fibers or from at least two rovings, one comprising cotton fibers and one comprising synthetic fibers. Additionally or alternatively, the at least one synthetic fiber can comprise at least one synthetic filament being surrounded by a sheath. The sheath can comprise or consist of cotton fibers. Alternatively, the sheath can be a mixture of cotton fibers and additional synthetic fibers, which comprise the synthetic polymer.

[0053] Preferably, in particular in embodiments in which the textile substrate is a yarn, the textile substrate comprises the synthetic polymer in a weight content of between 10 and 30%, in particular between 15 and 25 %, and/or cotton in a weight content between 90 and 70 %, in particular between 85 and 75 %, in particular wherein the cotton carries, in particular absorbs the composition. It has been found that such weight content of cotton and synthetic fiber is advantageous to allow the cotton to absorb enough of the biodegradability enhancing composition to enhance the biodegradability of the textile substrate, in particular of the synthetic polymer. In particular, it has been shown that such weight contents allow the cotton to absorb the composition in a weight content between 0,5 and 25 %, preferably between 1 and 20 %, more preferably between 2 and 15 %, most preferably between 3 and 10 %.

[0054] According to another embodiment, the textile substrate is a fabric, in particular a woven, non-woven or knitted fabric. Preferably, the fabric comprises cotton in a weigh content between 90 and 98 %, more preferably between 92 and 96 %, most preferably between 93 and 95%, and the synthetic polymer in a weight content between 10 and 2 %, more preferably between 8 and 4 %, most preferably between 7 and 5 %. In particular, the fabric comprises a plurality of yarns, wherein at least a part of the yarns comprises at least one synthetic fiber, which comprise the synthetic polymer, and cotton fibers, which comprise the cotton. Preferably, the fabric is a woven fabric wherein at least a part of the warp yarns and/or the weft yarns, in particular all warp yarns and/or weft yarns, comprises at least one synthetic fiber, which comprise the synthetic polymer, and cotton fibers, which comprise the cotton. Preferably these yarns are realized as the yarn in the previously described embodiment, in which the textile substrate is a yarn.

[0055] According to another aspect of the invention, which can be combined with the previous aspects of the invention and vice versa, a textile composite is provided. The textile composite comprises a textile substrate, which comprises a synthetic polymer and indigo. Preferably, the textile substrate is a fabric, more preferably a woven fabric, most preferably a woven denim fabric. A woven denim fabric is in particular to be understood as a woven fabric comprising indigo dyed yarns, preferably indigo dyed warp yarns. Further a woven denim fabric preferably comprises at least one set of warp yarns being woven with the weft yarns in a 3/1 weave or a 1/3 weave. Preferably this set of warp yarns can be called frontside warp yarns. Preferably a woven denim fabric comprises the frontside warp yarns in a numeral content of at least 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% or 100%.

The wording "numeral content" shall relate to the number of frontside warp yarns in relation to the total number of warp yarns. The textile composite further comprises a composition, which is disposed on the textile substrate, for enhancing the biodegradability of the textile substrate. Preferably, the composition is realized according to one or more of the previously described aspects of the invention.

[0056] The inventors have found that disposing a biodegradability enhancing composition, in particular the above described biodegradability enhancing compositions, on textile substrates comprising indigo does not adversely affect the color of the textile substrate, so that typical denim fabrics can be produced with enhanced biodegradability without harming their optical appearance.

[0057] Preferably, the textile substrate is a fabric comprising yarns, in particular a woven fabric comprising warp yarns and weft yarns, wherein at least a part of the yarns is indigo dyed, and wherein at least a part of the yarns comprises the synthetic polymer, and wherein the composition is disposed at least on the yarns which comprise the synthetic polymer. Thereby, it can be ensured that the composition can enhance the biodegradability of the synthetic polymers. In particular, the composition can be disposed only on the yarns which comprise the synthetic polymers. This can for instance be realized by disposing the composition on the yarns during yarn manufacturing or prior to arranging the yarns into a warp of yarns. Alternatively, the composition can be disposed on all yarns having the same orientation as the yarns comprising the synthetic polymers, for example on all warp yarns. This can for instance be realized by disposing the composition prior to weaving on the warp of yarns. Additionally or alternatively, the composition can be disposed on all yarns. This can for instance be realized by disposing the composition on the fabric after weaving.

[0058] Preferably, the yarns which comprise the synthetic polymer are the indigo dyed yarns. More preferably, the indigo dyed yarns comprise cotton by which the composition is at least partially absorbed. The inventors have found that thereby, cotton can act simultaneously as carrier for the biodegradability enhancing composition and as carrier for indigo. Alternatively, the indigo dyed yarns can be other yarns than the yarns on which the composition is disposed. For example, a woven fabric can be provided in which the warp yarns are indigo dyed and in which the composition is disposed on the weft yarns, which comprise the synthetic polymer.

[0059] Preferably, in particular in embodiments in which the textile substrate is a fabric, the textile substrate comprises cotton in a weigh content between 90 and 98 %, more preferably between 92 and 96 %, most preferably between 93 and 95%, and the synthetic polymer in a weight content between 10 and 2 %, more preferably between 8 and 4 %, most preferably between 7 and 5 %. Preferably, the fabric is a woven fabric comprising warp yarns and weft yarns, wherein the warp yarns and/or the weft yarns are textile composites as described with respect to the above embodiments, in which the textile substrates are yarns.

[0060] Preferably, in particular for all of the previously described aspects and embodiments of the invention, the textile composite comprises the composition in a weight content between 0,5 and 25 %, preferably between 1 and 20 %, more preferably between 2 and 15 %, most preferably between 3 and 10 %.

[0061] Preferably, in particular for all of the previously described aspects and embodiments of the invention, the synthetic polymer is selected from the group consisting of a polyester, a polyethylene, a polypropylene, polystyrene, a polyamid, a polyaramid, a polyoxymethylene, a polytetrafluorethylene, a polyetheretherketone, a polyphenylenesulfid, polyalkyleneterepthalate, preferably a polybutyleneterephthalate, a polytrimethyleneterephthalate, a polyethyleneterephthalate, a polyurethane, apolyvinylalkohol, a copolymer of two or more thereof or a mixture of two or more thereof, preferably a polyester, polyethylene, polypropylene, polystyrene, polyethylenterephthalate, polyamide, polybutyleneterephthalate, polyurethane, polyvinylalkohol or a mixture of two or more thereof, most preferred is a polyester.

[0062] The invention further relates to a method for providing a textile composite according to one or mor of the previously described aspects of the invention. The method can be carried out in such a way that a textile composite as described above is provided. Further, the previously described textile composites can be structured in that they can be provided by the method. The method comprises the following steps:

a) providing a textile substrate, which comprises a synthetic polymer;
b) providing a composition for enhancing the biodegradability of the textile substrate; and
c) disposing the composition on the the textile substrate to obtain the textile composite.

[0063] The textile substrate provided in step a) can be any textile substrate as described above. The composition provided in step b) can be any composition as described above. Disposing the composition on the textile substrate in step c) can in particular be realized by dyeing, coating, in particular roller coating and/or knife coating, or spraying.

[0064] Another aspect of the invention relates to a method, which can be realized according to the previously described method and vice versa, for providing a denim fabric, which comprises a synthetic polymer, with enhanced biodegradability. The method comprises the following steps:

a) providing a textile substrate, which comprises a synthetic polymer;
b) providing a composition for enhancing the biodegradability of the textile substrate;

c) disposing the composition on the textile substrate to obtain a textile composite, wherein the textile substrate in step c) is a denim fabric or wherein the textile substrate in step c) is a filament, a yarn or a warp of yarns, which is processed into a denim fabric after carrying out step c).

[0065] As described above, a denim fabric within the meaning of the invention is in particular a fabric comprising indigo dyed yarns, in particular a woven fabric comprising indigo dyed warp yarns and/or weft yarns, preferably indigo dyed warp yarns.

[0066] According to one embodiment, the textile substrate in step c) is a filament and step c) comprises disposing the composition on the filament, in particular wherein step c) is carried out during manufacturing the filament, in particular by fiber drawing, or during finishing of the filament, in particular during fiber dyeing. Preferably, the composition is disposed, in particular by dyeing, coating and/or spraying, on the filament in that it adheres to the outer surfaces of the filament, in particular partially covers or entirely conceals the filament.

[0067] According to another embodiment, the textile substrate in step c) is a yarn and step c) comprises disposing the composition on the yarn, in particular wherein step c) is carried out during manufacturing of a yarn, in particular during spinning, or during finishing of the yarn, in particular during coloring the yarn. Preferably, the yarn comprises cotton which, upon disposing the composition on the yarn, for instance by dyeing, coating or spraying, absorbs the composition.

[0068] According to yet another embodiment, the textile substrate in step c) is a warp comprising a plurality of warp yarns and step c) comprises disposing, in particular by dyeing, spraying and/or coating, the composition on the warp, in particular wherein step c) is carried out during sizing the warp and/or after coloring the warp.

[0069] For the previously described embodiments, according to which the substrate to which the composition is disposed in step c) is a filament, a yarn or a warp of yarns, the method preferably further comprises the following step:

d) processing the textile substrate into a fabric, in particular into a woven, non-woven or knitted fabric, preferably into a woven denim fabric, and preferably dyeing the textile substrates with indigo. The dyeing step can be carried out before or after disposing the composition on the textile substrate. Preferably, dyeing is carried out before disposing the composition on the textile substrate.

[0070] According to yet other embodiments, the textile substrate in step c) is a fabric, in particular a woven, non-woven or knitted fabric, preferably a woven fabric, wherein step c) comprises disposing the composition, in particular by dyeing, spraying or coating, on the fabric, in particular wherein step c) is carried out after dyeing, in particular indigo dyeing, at least part of the textile substrate. In particular, in order to ensure that at least a part of the textile substrate is dyed before step c) is carried out, step a) can comprise providing a textile substrate which is at least partially dyed, for example a woven fabric containing indigo dyed warp yarns. Alternatively, step a) can comprise providing yarns, dyeing the yarns and subsequently processing, in particular weaving, the yarns into a fabric comprising the dyed yarns. The inventors have found that first dyeing at least part of the fabric before applying the composition to it ensures that the dyeing process and the dyeing result is not or at least less adversely affected by the composition.

[0071] According to yet other embodiments, the textile substrate is a garment, wherein step c) comprises disposing the composition on the garment, in particular during washing, such as washing in the garment manufacturing stage or home washing, in particular in the home washing softening stage. For this purpose, the composition can be added into a washing process, in particular into a washing machine, in particular in the case of home washing, or in a washing vat, in particular in the case of washing in the garment manufacturing stage. In particular, the garment is a denim garment, in particular a denim trousers.

[0072] In the method according to any of the previously described embodiments, step b) can comprise the following steps:

b1) providing water, preferably between 10 and 100 liter water, more preferably between 15 and 50 liter water, most preferably between 20 and 40 liter water;
b2) optionally boiling and optionally mixing the water;
b3) optionally adding an emulsifier into the water, preferably between 1 g/l and 30 g/l, more preferably between 3 g/l and 20g/l, most preferably between 5 g/l and 15 g/l;
b4) adding starch, preferably between 1 and 10 g/l, more preferably between 2 and 8 g/l, most preferably between 3 and 5 g/l, and optionally -hydroxy-3-(trimethylammonio)propyl ether, preferably between 0,1 and 2 g/l, more preferably between 0,3 and 1,5 g/l, most preferably between 0,8 and 1,2 g/l, into the water;
b5) mixing the water, preferably for between 10 and 120 minutes, more preferably between 15 and 60 minutes, most preferably between 20 and 40 minutes, in particular to properly distribute the ingredients;
b6) optionally cooling the water;
b7) optionally adding an organic acid with less than ten carbon atoms, preferably between 0,1 and 2 g/l, more preferably between 0,3 and 1,5 g/l, most preferably between 0,8 and 1,2 g/l;
b8) optionally adding a deaerating agent, preferably between 2 g/l and 25 g/l, more preferably between 2 g/l and 18 g/l, most preferably between 5 g/l and 9 g/l, and/or a crosslinking agent, preferably between 30 g/l and 100 g/l, more preferably between 40 g/l and 80 g/l, most preferably between 50g/l and 60g/l; and

b9) optionally mixing the water a second time.

[0073] Another aspect of the invention relates to the use of starch in a composition for enhancing the biodegradability of a textile substrate, which comprises a synthetic polymer, wherein the composition is disposed on the textile substrate. The composition and the textile substrate can be realized according to any of the previously described aspects of the invention and its embodiments.

[0074] It is known to use starch in the textile industry, for instance as sizing agent. However, after weaving yarns into a woven fabric, the sizing agent is removed. The inventors found that starch can be used for increasing the anaerobic biodegrading of textile substrates comprising synthetic polymers and that its application to the textile substrates can be integrated into the textile manufacturing process, such as into the sizing step. Thereby, textile substrates comprising synthetic polymers can be provided with increased biodegradability without increasing the manufacturing time of the fabric. In fact, the processing time can even be reduced. The inventors found that the biodegradability enhancing composition can also be used as sizing agent. Thus, the present invention even enables reducing the number of process steps for the manufacturing of woven fabrics, by omitting the de-sizing step, thereby reducing costs for the production of the woven fabric while at the same time providing enhanced biodegradability.

[0075] Weight contents of the composition, of the textile substrate and of the textile composite as described above and below relate in particular to the total weight of the composition, the textile substrate and the textile composite in dry state. With respect to the composition, this means that water being used in the composition is not considered in the weight of the composition. In other words, a composition consisting exclusively of starch and water would have a starch content of 100 %.

[0076] Further aspects, properties and features of the invention will become apparent and more appreciated from the following description of exemplary embodiments, taking in conjunction with the drawings, in which are dedicated in:

Figure 1a A schematic cross section view of a fiber known in the art, comprising biodegradability enhancing additives;

Figure 1b A schematic cross section view of a fiber with a biodegradability enhancing composition disposed thereon according to one embodiment of the invention;

Figure 1c A schematic cross section view of a fiber with a biodegradability enhancing composition disposed thereon according to another embodiment of the invention;

Figure 2a A schematic cross section view of a yarn with a plurality of fibers with a biodegradability enhancing composition disposed on the yarn and its fibers according to another embodiment of the invention;

Figure 2b A schematic cross section view of a yarn comprising a synthetic filament core and a sheath of staple fibers onto which a biodegradability enhancing composition is disposed;

Figure 3a A schematic cross section view of a woven fabric, wherein the composition is disposed on the warp yarns;

Figure 3b A schematic cross section view of a woven fabric, wherein the composition is disposed on the warp yarns and the weft yarns;

Figure 4a A schematic illustration of a system for immersing a warp of yarns into a bath containing the composition;

Figure 4b A schematic illustration of a system for coating a warp of yarns with a composition;

Figure 4c A schematic illustration of a system for spraying a composition onto a warp of yarns; and

Figure 5 An illustration of steps of a method for providing a biodegradability enhancing composition.

[0077] Figure 1a shows a schematic cross-section view of a filament 1 known in the art in which biodegradability enhancing additives 3 are uniformly distributed within the filament 1. Such filaments can be produced by adding biodegradability enhancing additives into molten polymers during extrusion. Figure 1b and 1C illustrate embodiments of textile composites 7 of the present invention, in which the textile substrate is a filament 1, wherein a biodegradability-enhancing composition 5 is disposed on the filament 1. In Figure 1b, the composition 5 entirely conceals the filament 1. In Figure 1c, the composition 5 partially covers the surface of the filament 1. As illustrated by the dots 3, the biodegradability-enhancing additive is distributed in the composition 5. Preferably, the biodegradability-enhancing additive 3 is starch and is comprised by the composition 5 in a weight content, as previously described in the context of the respective aspect of the invention. The filament 1 preferably comprises one of the previously described synthetic polymers, in particular in the previously described weight contents.

[0078] Figures 2a and 2b show schematic cross-section views of textile composites 7 within the meaning of the present invention, in which the textile substrate is a

yarn 9. The curved lines 11 schematically represent staple fibers 11, wherein the dots 3 still represent biodegradability-enhancing additives. The yarn 9 illustrated in Figure 2a shall represent a yarn consisting of staple fibers 11, in other words being free of filaments.

[0079] In Figure 2a, the biodegradability enhancing additives 3 are uniformly distributed within the yarn 9. In particular, such textile composites shall also be considered to realize textile composites within the meaning of the present invention. In particular, the respective composition is "disposed on the textile substrate" in that the composition was disposed on the textile substrate, namely the yarn, after its formation, for instance spinning. Further, the composition comprising the biodegradability enhancing additive 3 is in particular disposed on the textile substrate in that it is absorbed by the porous structure of the yarn, which porous structure is realized by its plurality of staple fibers 11. In other words, within the meaning of the present invention which, a yarn comprising a plurality of staple fibers shall also be regarded as a porous structure being able to absorb the composition. As described above, "disposed on the textile substrate" within the meaning of the present invention shall in particular be considered to be realized if the composition adheres to the surface of a textile substrate and/or if the composition is absorbed by a porous textile substrate. As illustrated by the reference signs 11' and 11", the yarn 9 can also comprise a mixture of synthetic staple fibers 11' and cotton staple fibers 11". Cotton staple fibers 11" shall in particular be interpreted to represent a porous structure within the meaning of the present invention. Therefore, also the absorption of the composition comprising the biodegradability enhancing additives 3 by the cotton fibers 11" in Figure 2a can realize the disposal of the composition on the textile substrate within the meaning of the present invention.

[0080] Figure 2b illustrates an embodiment comprising a filament 1 and a sheath 13. The sheath 13 comprises staple fibers 11. A textile substrate within the meaning of the present invention can in particular be realized by a structure as shown in Figure 2b in that either the filament 1 comprises the synthetic polymer and/or the staple fibers 11 comprise the synthetic polymer.

[0081] The disposal of the composition comprising the biodegradability-enhancing additives 3 on the textile substrate could either be realized in that the composition is absorbed by the porous structure of the sheath 13, in particular as explained with respect to Figure 2a, or by covering or concealing the filament 1, in particular as illustrated in Figures 1b and 1c, in particular prior to spinning the sheath 13 around the filament 1.

[0082] Figures 3a and 3b illustrate a schematic cross-section view of a textile composite 7, wherein the textile substrate is a woven fabric 15. The illustrated yarn 17 extending from the left to the right shall represent a weft yarn 17, wherein the yarns 19 in the cross-section view shall illustrate warp yarns 19. Figure 3a illustrates an embodiment in which the composition 5 is only disposed on the warp yarns 19. Even though Figures 3a and 3b are sketched in that the composition 5 adheres to the outer surface of the warp yarns 19, it shall be clear that the composition can be disposed on the warp yarns 19 as shown in Figures 2a and 2b. An embodiment as shown in Figure 3a can, for instance, be realized by disposing the composition 5 on the warp yarns prior to weaving, for instance on a rope of warp yarns 19 or on the warp yarns 19 before they are arranged in a warp.

[0083] Figure 3b illustrates an embodiment in which the composition is disposed on the warp yarns 19 and the weft yarns 17. Such embodiment can for instance be realized by disposing the composition on the woven fabric 15 after weaving.

[0084] Figures 4a, 4b and 4c schematically illustrate methods and apparatuses being suitable for disposing the composition on the textile substrates. In Figures 4a to 4c, the textile substrate is illustrated as a warp 21 of warp yarns 19. Of course, the method shown therein can also be used for disposing the composition of filaments, single warp yarns and fabrics, such as woven fabrics.

[0085] Figure 4a schematically illustrates an apparatus for disposing the composition by means of dyeing. The apparatus of Figure 4a comprises a basin 23 filled with a biodegradability enhancing composition 5. The apparatus further comprises a rotatable immersion drum 25 being at least partially immersed into the composition 5. The axis of rotation of the immersion drum 25 is illustrated with reference sign 27. The apparatus further comprises guiding drums 29 downstream and upstream the immersion drum 25. Upon conveying the warp 21 along the immersion drum 25, the warp immerses into the composition 5 so that, after leaving the basin 23, the composition 5 is disposed on the warp yarns 13 of the warp 21, thereby realizing a textile composite within the meaning of the present invention.

[0086] Figure 4b schematically illustrates an apparatus for disposing the composition on the textile substrate by means of coating. The apparatus also comprises a basin 23 being filled with the composition 5, an immersion drum 25 partially immersing into the composition 5 and two guiding drums 29. In addition, the apparatus comprises a coating gram 31 being located above the immersion drum 25 in that the warp 19 can be conveyed between the coating drum 31 and the immersion drum 25 without being immersed into the composition 5. The composition is coated onto the warp yarns 19 by the rotating immersion drum 25 conveying the composition 5 adhering on the outer surface of the immersion drum 25 to the coating drum 31. By deflecting the warp 21 around the coating drum 31, the warp 21 comes in contact with the composition 5 adhering on the outer surface of the immersion drum 25 so that the composition is disposed on the warp 21. Thereby, the warp 21 leaving the basin 23 becomes a textile composite 7 within the meaning of the present invention.

[0087] Figure 4c schematically illustrates the spraying device for disposing the composition om the warp 21 of

warp yarns 19. The spraying device comprises nozzles 33. The nozzles 33 dispose the composition 5 by spraying it on the warp 21, thereby providing a textile composite 7 within the meaning of the present invention. The warp 21 is guided by two guiding drums 29.

Example

[0088] In the following, the method of providing an exemplary textile composite according to the invention is described. In this example, a denim fabric comprising synthetic polymers was provided, wherein the biodegradability of the fabric was enhanced by disposing a biodegradability enhancing composition on parts of the fabric.

[0089] In a first step, a rope of cotton warp yarns was dyed with indigo to obtain a warp of indigo dyed cotton yarns. Subsequently, weft yarns have been provided comprising a filament core and a cotton sheath. The filament core comprised the synthetic polymer, in particular T400 filaments and Lycra filaments obtained from the Lycra company. The weft yarns comprised the cotton in a weight content of 79,5 %, T400 in a weight context of about 13% and Lycra in a weight content of about 7,5%.

[0090] As the warp yarns did not contain synthetic polymers, it was in this case decided to dispose the composition only on the weft yarns. Therefore, the composition was disposed on the weft yarns before weaving the weft yarns of the warp yarns into the woven fabric. However, before, the composition was prepared. The preparation of the composition is described based on Fig. 5. In a first step, water, in particular thirty liter of water, was heated, particularly boiled, and mixed. Subsequently, 10 g/l of an emulsifier, in particular Exosel 118, has been added. Subsequently, 5 g/l of a biodegradability enhancing additive, in particular the biodegradability-enhancing additive "Biosphere EPS Powder 1,2,3,401 Powder Additive", has been added into the boiling water. The composition was than mixed, in particular for thirty minutes, until the emulsifier and the biodegradability enhancing additive was completely mixed. Subsequently, the composition was cooled. Subsequently, an organic acid, in particular acetic acid, has been added in a content of 1 g/l. Subsequently, a cross-linking agent, in particular Tanapuri, in a content of 60 g/l and a deaerating agent, in particular Lava Wet MDF, in a content of 7 g/l was added into the solution.

[0091] After the composition had been prepared by this method, the composition has been disposed on the weft yarns. After disposing the composition onto the weft yarns, the weft yarns were dried.

[0092] Subsequently, the warp yarns and the weft yarns have been woven into a woven denim fabric. The denim fabric comprised cotton in a weight content of about 94%, T400 in a weight content of about 3.5% and Lycra in a weight content of about 2.5%.

[0093] A specimen of the produced denim fabric was taken to determine the anaerobic biodegradation according to ASTM D 5511-18. After 90 days, the biodegradation measured according to ASTM D 5511 was 80.7%. After 120 days, the measured biodegradation was 93.06%. After 150 days, the measured biodegradation was 99.38%.

[0094] The features disclosed in the above description, the figures and the claims might be significant for the realization of the invention in its different embodiments individually as in any combination.

Reference signs:

[0095]

1	filament, textile substrate
3	biodegradability enhancing additive
5	biodegradability enhancing composition
7	textile composite
9	yarn, textile substrate
11	staple fiber, textile substrate
13	sheath, textile substrate
15	woven fabric, textile substrate
17	weft yarns, textile substrate
19	warp yarns, textile substrate
21	warp of warp yarns, textile substrate
23	basin
25	immersion drum
27	rotation axis of immersion drum
29	guiding drum
31	coating drum
33	spray device, nozzle

Claims

1. A textile composite (7) comprising

- a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer and cotton, and
- a composition (5) for enhancing the biodegradability of the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), wherein the composition (5) is absorbed by the cotton.

2. The textile composite (7) according to claim 1, wherein the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) is a yarn comprising a plurality of cotton fibers, which comprise the cotton, and at least one synthetic fiber, which comprise the synthetic polymer, in particular wherein the at least one synthetic fiber comprises a plurality of synthetic staple fibers being intermixed with the cotton fibers and/or at least one synthetic filament being surrounded by a sheath comprising the cotton fibers and optionally additional synthetic fibers.

3. The textile composite (7) according to claim 1 or 2, wherein the textile substrate (1, 9, 11, 13, 15, 17, 19,

21) is a yarn (9) comprising the synthetic polymer in a weight content of between 10 and 30%, in particular between 15 and 25 %, and/or cotton in a weight content between 90 and 70 %, in particular between 85 and 75 %, in particular wherein the cotton carries, in particular absorbs, the composition (5).

4. The textile composite (7) according to claim 1, wherein the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) is a fabric (15), in particular a woven fabric, comprising a plurality of yarns, wherein at least a part of the yarns comprise at least one synthetic fiber, which comprise the synthetic polymer, and cotton fibers, which comprise the cotton, in particular wherein this part of the yarns is realized according to the textile composite (7) of claim 2 or 3.

5. A textile composite (7), in particular according to one of the preceding claims, comprising

- a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer and indigo, and
- a composition (5), which is disposed on the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), for enhancing the biodegradability of the textile substrate (1, 9, 11, 13, 15, 17, 19, 21).

6. The textile composite (7) according to claim 5, wherein the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) is a fabric (15) comprising yarns (9), in particular a woven fabric comprising warp yarns (19) and weft yarns (17), wherein

- at least a part of the yarns (17, 19) is indigo dyed, and wherein
- at least a part of the yarns (17, 19) comprises the synthetic polymer, and wherein
- the composition (5) is disposed at least on the yarns (17, 19) which comprise the synthetic polymer, in particular is only disposed on the yarns which comprise the synthetic polymers, on all yarns having the same orientation as the yarns comprising the synthetic polymers, or on an all yarns of the fabric.

7. The textile composite (7) according to claim 6, wherein

- the yarns which comprise the synthetic polymer are the indigo dyed yarns, preferably wherein the indigo dyed yarns comprise cotton by which the composition (5) is at least partially absorbed, or
- wherein the yarns which comprise the synthetic polymer are other yarns than the yarns being indigo dyed, preferably in that the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) is a woven fabric (15), wherein the warp yarns (19) are indigo dyed and wherein the composition (5) is disposed on the weft yarns (17), which comprise the synthetic polymer, or vice versa.

8. The textile composite (7) according to one of the claims 6 to 7, wherein the fabric comprises (15) cotton in a weigh content between 90 and 98 % and the synthetic polymer in a weight content between 10 and 2 %, in particular wherein the fabric (15) is a woven fabric comprising warp yarns (19) and weft yarns (17), wherein the warp yarns and/or the weft yarns are textile composites (7) according to one of the claim 1 to 3.

9. A textile composite (7), in particular according to one of the preceding claims, comprising

- a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer, and
- a composition (5), which is disposed on the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), for enhancing the anaerobic biodegradability of the textile substrate (1, 9, 11, 13, 15, 17, 19, 21).

10. A textile composite (7), in particular according to one of the preceding claims, comprising

- a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer, and
- a composition (5), which is disposed on the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), wherein

the composition (5) comprises starch (3) in a weight content between 0,5 and 10 %.

11. The textile composite (7) according to claim 10, wherein composition (5) comprises the starch (3) in a weight content of at least 1 %, 2 %, 3 % or 5 % and/or maximally 9 %, 8 %, 7 % or 6 %, preferably between 2 and 10 %, particularly preferred between 3 and 8%, most preferably between 4 and 6 %.

12. The textile composite (7) according to claim 10 or 11, wherein the composition (5) comprises 2-hydroxy-3-(trimethylammonio)propyl ether, in particular wherein

- the composition (5) comprises the 2-hydroxy-3-(trimethylammonio)propyl ether in a weight content of at least 0,1 %, 0,3%, 0,5 %, 0,6 % or 0,8 % and/or of maximally 4 %, 3 %, 2 % or 1 %, preferably between 0,3 and 3 %, particularly preferred between 0,5 and 2%, most preferably between 0,6 and 1 %, and/or in particular wherein
- the composition (5) comprises starch (3) in a

weight content of between 2 and 15 times, preferably between 3 and 12 times, more preferably between 4 and 10 times, most preferably between 5 and 8 times, the weight content of 2-hydroxy-3-(trimethylammonio)propyl ether.

13. A textile composite (7), in particular according to one of the preceding claims, comprising

- a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer, and
- a composition (5), which is disposed on the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), for enhancing the biodegradability of the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), wherein the composition (5) comprises a deaerating agent.

14. The textile composite (7) according to claim 13, wherein

- the composition (5) comprises the deaerating agent in a weight content of at least 3 %, 5 %, 6 %, 7 % or 8 % and/or of maximally 18 %, 16 %, 14 %, 12 % or 10 %, preferably between 3 and 16 %, particularly preferred between 5 and 12 %, most preferably between 7 and 10 %.

15. A textile composite (7), in particular according to one of the preceding claims, comprising

- a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer, and
- a composition (5), which is disposed on the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), for enhancing the biodegradability of the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), wherein the composition (5) comprises an emulsifier.

16. The textile composite (7) according to claim 15, wherein

- the emulsifier comprises alkyl polyglycol ethers, especially alkyl polyglycol ethers with 10-11 ethylene oxide units, and/or wherein
- the composition (5) comprises the emulsifier in a weight content of at least 4 %, 6 %, 8 %, 10 % or 12 % and/or of maximally 24 %, 20 %, 16 % or 14 %, preferably between 6 and 20 %, particularly preferred between 8 and 16 %, most preferably between 10 and 14 %.

17. A textile composite (7), in particular according to one of the preceding claims, comprising

- a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer, and
- a composition (5), which is disposed on the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), for enhancing the biodegradability of the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), wherein the composition (5) comprises a crosslinking agent.

18. The textile composite (7) according to claim 17, wherein

- the crosslinking agent is a self-crosslinking polyurethan, and/or wherein
- the composition (5) comprises the crosslinking agent in weight content of at least 20 %, 30 %, 50 %, 65 %, 70 % or 72,5 % and/or of maximally 90 %, 80 % or 75 %, preferably between 50 and 90 %, particularly preferred between 65 and 80 %, most preferably between 70 and 75 %.

19. A textile composite (7), in particular according to one of the preceding claims, comprising

- a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer, and
- a composition (5), which is disposed on the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), for enhancing the biodegradability of the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), wherein the composition (5) comprises an organic acid, in particular carboxylic acid, with less than ten carbon atoms.

20. The textile composite (7) according to claim 19, wherein

- the organic acid is selected from the group consisting of acetic acid, citric acid, tartaric acid, maleic acid, lactic acid, and oxalic acid, most preferred acetic acid, and/or wherein
- the composition (5) comprises the organic acid in a weight content of at least 0,3 %, 0,5 %, 0,8 %, 1,0 % or 1,2 % and/or maximally 5 %, 3 %, 2 % or 1 %, preferably between 0,5 and 3 %, particularly preferred between 0,8 and 2 %, most preferably between 1 and 1,5 %.

21. The textile composite (7) according to one of the preceding claims, wherein the biodegradability is measured according to ASTM D 5511, in particular wherein the textile composite (7) comprises the synthetic polymer in a weight content of at least 2 %, preferably at least 3%, 4%, 5% or 6 %, and biodegrades to at least 95 %, preferably at least 96 %, 97%, 98% or 99 %, within 150 days.

22. The textile composite (7) according to one of the claims 9 to 21, wherein

- the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) is a synthetic fiber (1), which comprises the synthetic polymer, in particular wherein the com-

position (5) is disposed on the synthetic fiber, or wherein
- the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) is a yarn (9) comprising at least one synthetic fiber, which comprises the synthetic polymer, in particular wherein the composition (5) is disposed at least in parts on the at least one synthetic fiber and/or on additional natural fibers, in particular cotton fibers, or wherein
- the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) is a fabric (15), in particular a woven, non-woven or knitted fabric, comprising synthetic fibers or yarns comprising synthetic fibers, which fibers comprise the synthetic polymer, in particular wherein the composition (5) is disposed at least in parts on the synthetic fibers.

23. The textile composite (7) according to one of the preceding claims, wherein the textile composite (7) comprises the composition (5) in a weight content between 0,5 and 25 %, preferably between 1 and 20 %, more preferably between 2 and 15 %, most preferably between 3 and 10 %.

24. The textile composite (7) according to one of the preceding claims, wherein the synthetic polymer is selected from the group consisting of a polyester, a polyethylene, a polypropylene, polystyrene, a polyamid, a polyaramid, a polyoxymethylene, a polytetrafluorethylene, a polyetheretherketone, a polyphenylenesulfid, polyalkyleneterepthalate, preferably a polybutyleneterephthalate, a polytrimethyleneterephthalate, a polyethyleneterephthalate, a polyurethane, apolyvinylalkohol, a copolymer of two or more thereof or a mixture of two or more thereof, preferably a polyester, polyethylene, polypropylene, polystyrene, polyethylenterephthalate, polyamide, polybutyleneterephthalate, polyurethane, polyvinylalkohol or a mixture of two or more thereof, most preferred is a polyester.

25. A method for providing a textile composite (7) according to one of the preceding claims, comprising the steps of:

a) providing a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer;
b) providing a composition (5) for enhancing the biodegradability of the textile substrate (1, 9, 11, 13, 15, 17, 19, 21); and
c) disposing the composition (5) on the the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) to obtain the textile composite (7).

26. A method, in particular according to claim 25, for providing a denim fabric, which comprises a synthetic polymer, with enhanced biodegradability, comprising the steps of:

a) providing a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer;
b) providing a composition (5) for enhancing the biodegradability of the textile substrate;
c) disposing the composition (5) on the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) to obtain a textile composite (7),

wherein the textile substrate in step c) is a denim fabric (15) or
wherein the textile substrate in step c) is a filament (1), a yarn (9) or a warp of yarns (21), which is processed into a denim fabric (15) after carrying out step c).

27. Use of starch (3) in a composition (5) for enhancing the biodegradability of a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer, wherein the composition (5) is disposed on the textile substrate (1, 9, 11, 13, 15, 17, 19, 21).

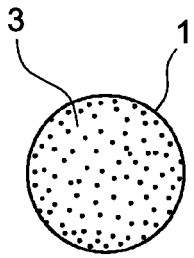

Fig. 1a
Prior Art

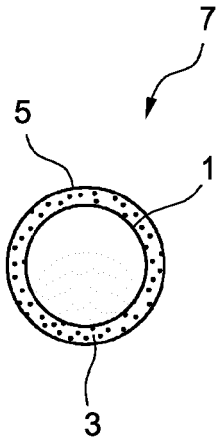

Fig. 1b

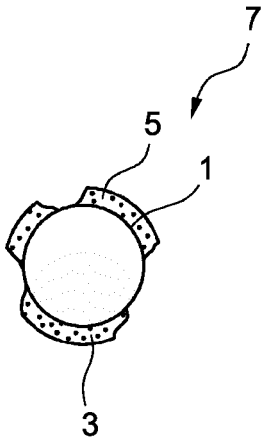

Fig. 1c

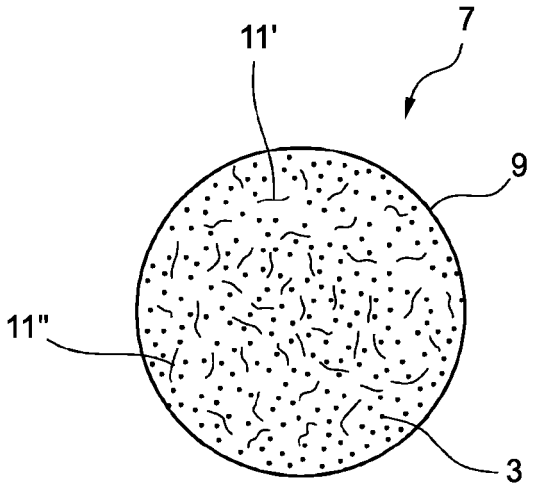

Fig. 2a

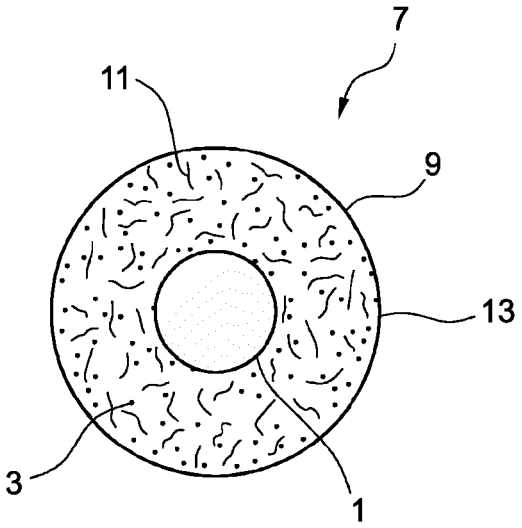

Fig. 2b

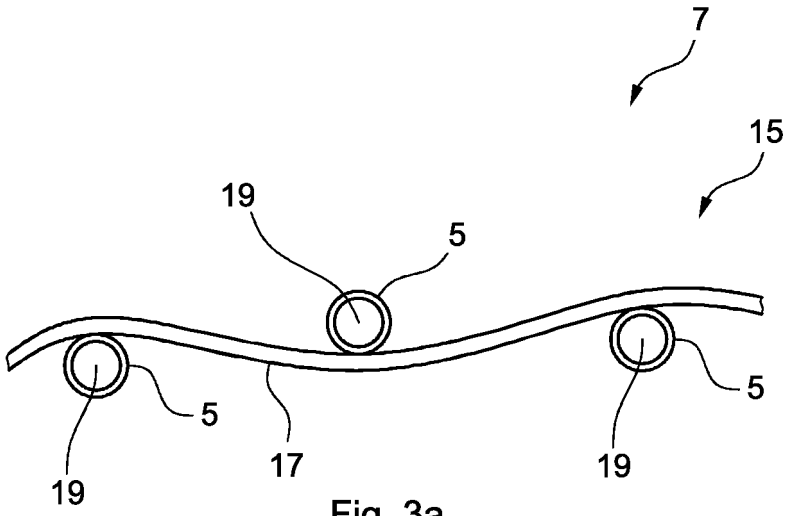

Fig. 3a

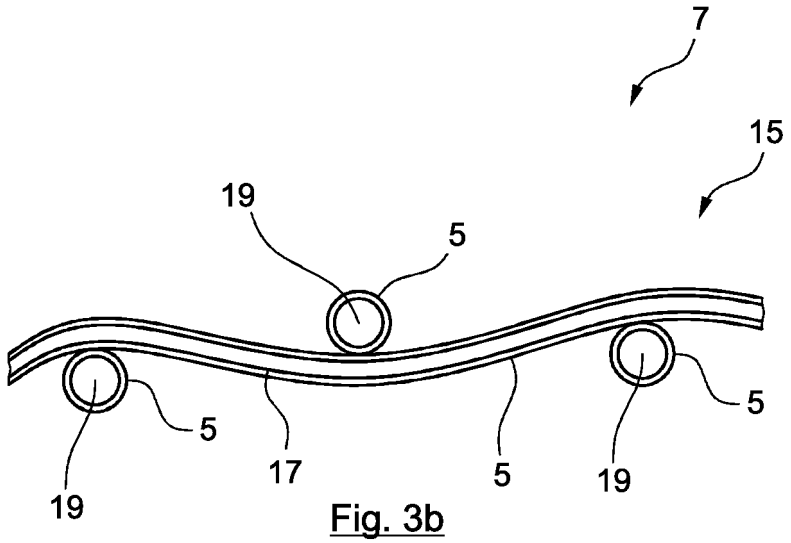

Fig. 3b

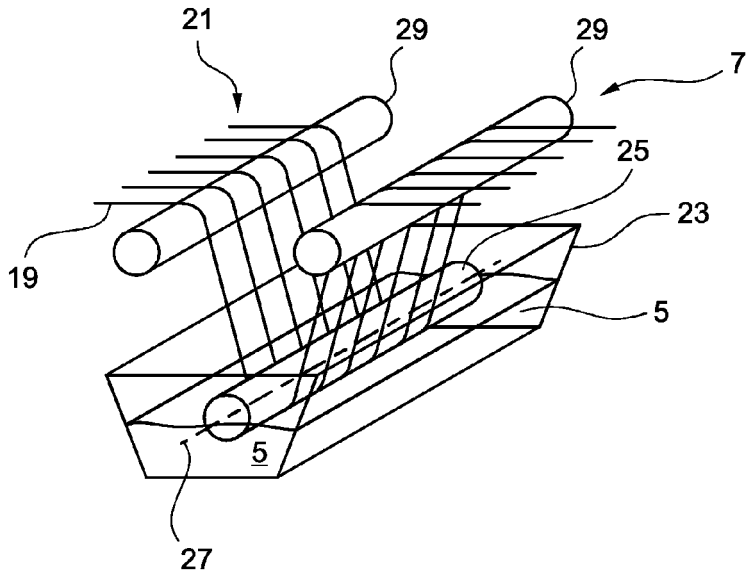

Fig. 4a

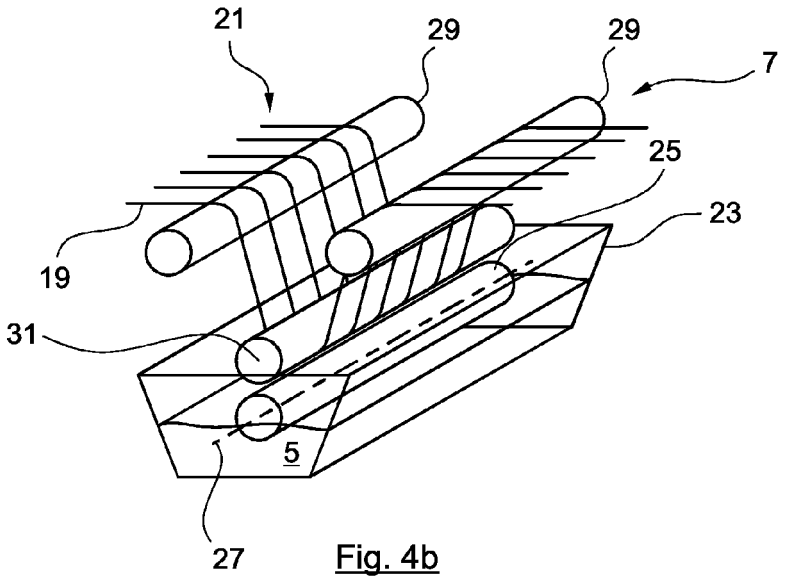

Fig. 4b

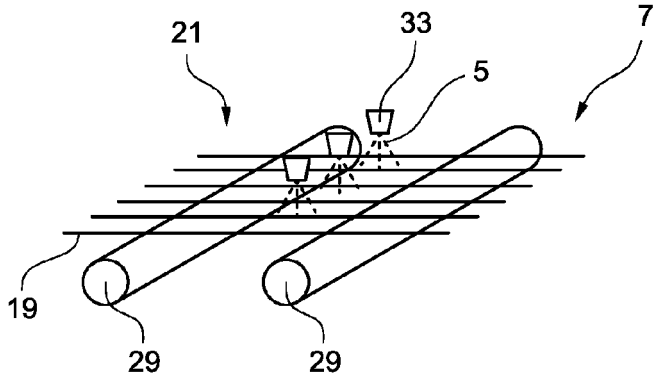

Fig. 4c

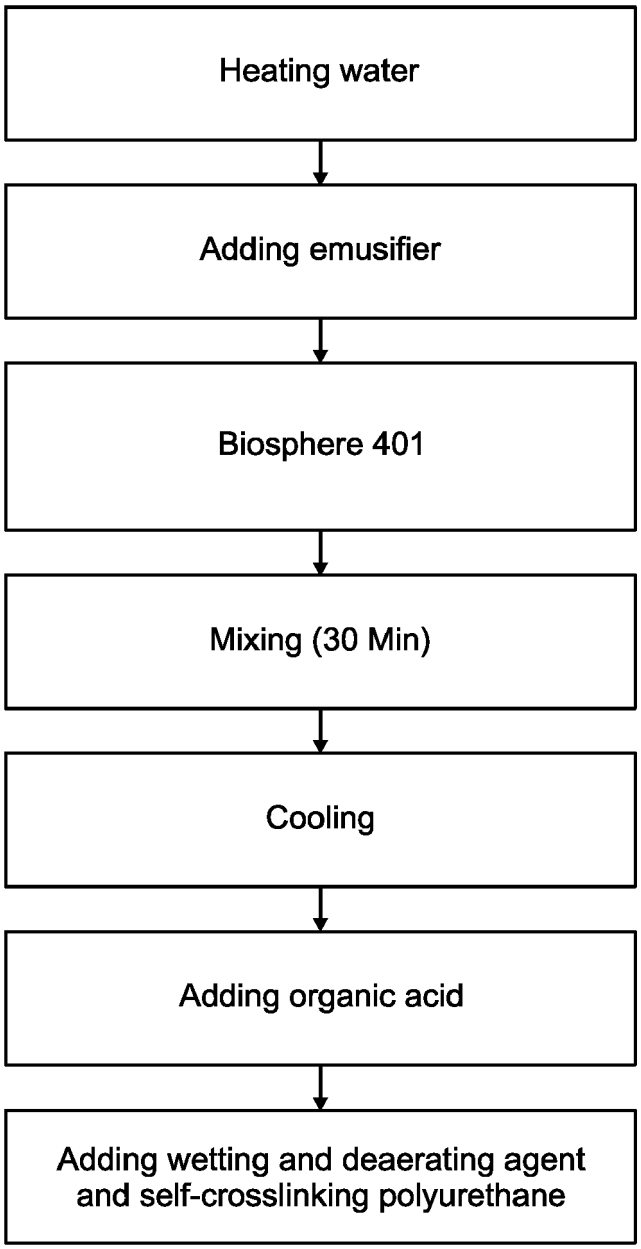
Heating water
Adding emusifier
Biosphere 401
Mixing (30 Min)
Cooling
Adding organic acid
Adding wetting and deaerating agent and self-crosslinking polyurethane

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 1638

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
The Hague	14 June 2022	Barathe, Rainier

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 1638

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)

~~The present search report has been drawn up for all claims~~

1

Place of search	Date of completion of the search	Examiner
The Hague	14 June 2022	Barathe, Rainier

CATEGORY OF CITED DOCUMENTS

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D : document cited in the application
L : document cited for other reasons

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Application Number
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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-4, 21-24(completely); 5-20, 25, 26(partially)

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 22 15 1638

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-4, 21-24(completely); 5-20, 25, 26(partially)

- A textile composite (7) comprising
- a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer and cotton, and
- a composition (5) for enhancing the biodegradability of the textile substrate (1, 9, 11, 13, 15, 17, 19, 21), wherein the composition (5) is absorbed by the cotton.
- A method for providing a textile composite (7) according to one of the preceding claims, comprising the steps of:
a) providing a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer AND COTTON;
b) providing a composition (5) for enhancing the biodegradability of the textile substrate (1, 9, 11, 13, 15, 17, 19, 21); and
c) disposing the composition (5) on the the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) to obtain the textile composite (7).
- A method according to claim 25, for providing a denim fabric, which comprises a synthetic polymer, with enhanced biodegradability, comprising the steps of:
a) providing a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer AND COTTON;
b) providing a composition (5) for enhancing the biodegradability of the textile substrate;
c) disposing the composition (5) on the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) to obtain a textile composite (7),
wherein the textile substrate in step c) is a denim fabric (15)
or
wherein the textile substrate in step c) is a filament (1), a yarn (9) or a warp of yarns (21), which is processed into a denim fabric (15) after carrying out step c).

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2. claims: 27(completely); 5-20, 25, 26(partially)

- A method for providing a textile composite (7) comprising the steps of:
a) providing a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer;
b) providing a composition (5) for enhancing the biodegradability of the textile substrate (1, 9, 11, 13, 15, 17, 19, 21); and
c) disposing the composition (5) on the the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) to obtain the textile composite (7).
- Use of starch (3) in a composition (5) for enhancing the biodegradability of a textile substrate (1, 9, 11, 13, 15, 17,19, 21), which comprises a synthetic polymer, wherein the

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 22 15 1638

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

composition (5) is disposed on the textile substrate (1, 9, 11, 13, 15, 17, 19, 21).

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3. claim: 26(partially)

A method for providing a denim fabric, which comprises a synthetic polymer, with enhanced biodegradability, comprising the steps of:
a) providing a textile substrate (1, 9, 11, 13, 15, 17, 19, 21), which comprises a synthetic polymer;
b) providing a composition (5) for enhancing the biodegradability of the textile substrate;
c) disposing the composition (5) on the textile substrate (1, 9, 11, 13, 15, 17, 19, 21) to obtain a textile composite (7),
wherein the textile substrate in step c) is a denim fabric (15)

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REFERENCES CITED IN THE DESCRIPTION

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