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(54) **METHOD AND SYSTEM FOR MANUFACTURING BIODEGRADABLE COLOURED NETTING FABRICS**

(57) The present invention describes a method and a system for manufacturing biodegradable, suitably coloured netting fabrics, in particular a biodegradable packaging system for fruit, vegetables and other articles which can be coloured to any desired colour to fit with the colour of the items in the package or with the colour scheme

used by the producer or to colour code the items in the package. Another embodiment of the present invention is a textile packaging material which has a colour fitting to the colour of the content of the textile package packed by it.

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Description

[0001] The present invention describes a method and a system for manufacturing biodegradable, suitably coloured netting fabrics, in particular a biodegradable packaging system for fruit, vegetables and other articles which can be coloured to any desired colour to fit with the colour of the items in the package or with the colour scheme used by the producer or to colour code the items in the package. Another embodiment of the present invention is a textile packaging material which has a colour fitting to the colour of the content of the textile package packed by it.

[0002] A net in the context of packaging is an open structure fabric with open spaces between the yarns. The open spaces are apertures that allow a clear view of the contents of the package made using the net while providing sufficient control of the contents to keep the package intact. The size of the apertures can vary widely according to the intended application. Netting used for retail display of fruit and vegetables will have an aperture size of 2mm to 15mm or more specifically of 4 mm to 8 mm.

[0003] Currently available net packaging systems are most commonly produced using continuous filament polypropylene or polyethylene yarn. The yarn is formed into a fabric most commonly by circular knitting or raschel knitting. Leno weaving is also sometimes used to produce the fabric.

[0004] Circular knitted fabric is produced as a tube of fabric in a variety of diameters. A cut length of the tube is sealed at one end and the articles to be packed are placed in the tube and the other end is sealed. Sealing may be by heat sealing or by the use of a mechanical closing device such as a metal or plastic clip or string.

[0005] Raschel knitted fabric is produced using a type of warp knitting which produces flat fabric. Similarly woven leno fabric is produced as a flat fabric. To use these fabrics for packaging, the fabric is first formed into a bag or sack by sewing together two edges of a folded rectangle of fabric. The articles to be packaged are placed in the bag and the open end is sealed by heat sealing or by the use of a mechanical closing device such as a metal or plastic clip or string.

[0006] It is normal practice to colour the yarn from which the netting is made prior to producing the fabric. With polypropylene and polyethylene yarns this is done during production of the yarn by adding pigments to the melt used to produce the yarn. The packager selects the colour best suited to the requirements of the product from a limited range of colours offered by the fibre producer.

[0007] A major problem with packaging made using synthetic polymers such as polypropylene and polyethylene is that they are not biodegraded if released into the environment. There is no mechanism in nature for breaking down these synthetic polymers into harmless by-products. As a result if they are disposed of in landfill sites, they will still be present many years later.

[0008] If they are released into oceans they may break

down by physical action, but the microparticles ultimately produced will similarly persist for many years and may enter the food chain.

[0009] A solution to this problem of non-biodegradability is the use of cellulosic fibres. Cellulose from trees is readily biodegradable in the environment.

[0010] Manmade cellulosic fibres have a high rate of biodegradation. They can be coloured during or after manufacturing and can be formed into circular knitted fabrics, raschel knitted fabrics or leno woven fabrics. The fibre family includes viscose, modal and lyocell.

[0011] The fibre may also be spun into yarn as white uncoloured fibre. The yarn may then be dyed by package dyeing. The yarn may be made into netting fabric by knitting or weaving and then dyed to the desired colour by conventional dyeing techniques.

Manmade cellulosic fibre manufacture

[0012] Viscose fibre is produced by extruding a solution of a cellulose derivative through very small spinneret holes and then precipitating by changing the pH value and by converting the derivative back to cellulose.

[0013] Cellulose as wood pulp is usually used as the starting material although other sources of cellulose such as bamboo and cotton linters are also used. The wood pulp is steeped in sodium hydroxide and then reacted with carbon disulphide to convert it to cellulose xanthate. The xanthate is dissolved in a sodium hydroxide solution to yield a viscous, golden coloured liquid which is commonly called viscose.

[0014] The viscose is de-aerated and filtered. It is then extruded through precious metal spinnerets into a spin-bath consisting of sulphuric acid, sodium sulphate and zinc sulphate. The acid reacts with the sodium hydroxide in the viscose to cause precipitation of the cellulose xanthate. The acid also reacts with the cellulose xanthate converting it back to cellulose.

[0015] While the newly formed fibre is still in a plastic state it is stretched to increase the orientation of the cellulose molecules with the axis of the fibre and encourage crystallisation. The fibre may then be cut into lengths to form staple fibre or it may be kept as continuous filament or tow depending on the design of the spinning machine and the product required.

[0016] In the remainder of the process the fibre is washed to remove non-cellulose products of the reaction such as sodium sulphate and hydrogen sulphide, finished with lubricants and anti-stats to aid downstream processing and dried. Modern viscose plants are designed to recover as much of the by-products of the process as possible. This is essential to avoid environmental pollution and to ensure the safety of the workforce and surrounding community. Better recovery and recycling of by-products can also give a positive economic benefit.

[0017] At the Lenzing plant in Austria, a pulp mill and the viscose production are linked together so that undried wood pulp is fed directly to the viscose making stage.

The non-cellulosic parts of the wood used in the pulp mill are incinerated and used to generate the power used by the pulp mill and most of the power for the viscose process. Further chemicals are recovered before incineration such as acetic acid, xylitol or wood sugar and furfural. Xylitol is used as a low calorie sweetener.

The Modal process

[0018] Modal fibre is a high wet modulus fibre produced using a modified version of the viscose process. An additive is mixed with the spinning solution which slows down the regeneration of the cellulose during spinning. Together with modified spinbath and viscose composition, the additive allows the fibre to be stretched to a much greater extent than normal viscose. This gives a fibre with a higher orientation which is stronger than viscose and has a modulus closer to that of cotton.

[0019] Modal fibre is often used in blend with cotton to give softer fabrics than would be made with cotton alone. It is used widely in knitted fabrics for lingerie and ladies apparel.

The Lyocell process

[0020] The newest of the three main manmade cellulosic fibres is lyocell. It is produced by a solvent spinning process. The solvent is an amine oxide, which is non-toxic. A slurry of cellulose in a mixture of amine oxide and water is prepared. Water is removed from the slurry by evaporation and as the water content decreases, the cellulose dissolves in the amine oxide producing a solution which is a viscous liquid above 80°C. The solution is extruded through spinneret holes into a water bath. The solvent is diluted by the water and the cellulose precipitates to form a fibre. In the remainder of the process, the fibre is washed to remove any amine oxide solvent, cut into staple fibre, finished with a lubricant and antistatic agent and then dried.

[0021] The amine oxide solvent is recycled in a closed loop in the factory. Recovery rates of greater than 99.5% are achieved. Recycling of the additive means that the effect of the process on the environment is very low. It is also essential for the economics of the process.

[0022] Lyocell is much stronger than viscose and is stronger than cotton in both the wet and the dry state. It is used in apparel, home furnishings, workwear and non-wovens. Over 90% of the world's lyocell production is produced by Lenzing AG and sold under the brand TEN-CEL®.

Description of the invention

[0023] Surprisingly it has been found that a functional net fabric for packaging fruit, vegetables and other articles can be produced using manmade cellulosic yarns.

[0024] In particular an embodiment of the present invention consists in a method for manufacturing a textile

packaging material which has a colour fitting to the colour of the content of the textile package wherein at least two compounds of the textile packaging material are chosen from a system consisting of a fixed set of compounds with different colours. Fitting means that the colour of the packaging material does not need to be of the identical colour, but which helps to present the content in an attractive, aesthetic way. The content can be of any kind, but the invention may be used mainly for contents like food, in particular vegetables and fruits. A system according to the invention means a setup which enables someone to perform the invention. In its most simple embodiment it is a collection of the compounds with different colours, contained e.g. in a warehouse, a storage container or the like.

[0025] Preferably the textile packaging material is a netting fabric.

[0026] According to a preferred embodiment of the invention the compounds of the system are fibrous moulded bodies, in particular staple fibers or filaments, mostly preferred staple fibers.

[0027] In particular the fibrous moulded bodies are manmade cellulosic moulded bodies, in particular made according to the viscose, modal or lyocell process. By using such manmade cellulosic moulded bodies a biodegradable packing material is obtained.

[0028] According to a preferred embodiment of the invention the system consists of bright, black, dark brown, beige, red and yellow coloured compounds. "Bright compounds" means compounds containing no colour nor any white pigments, e.g. no matting agents like TiO₂ pigments; according to the present invention not all 5 kinds of coloured compounds have to be used for manufacturing the same textile packaging material, but the inventive idea is to use at least two of them, in particular either two or three of them, in order to obtain an overall colour which fits to the content of the textile package.

[0029] Another embodiment of the present invention is a system suitable for manufacturing a textile packaging material wherein the system consists of bright, black, dark brown, beige, red and yellow coloured compounds. According to a preferred embodiment of the invention the compounds of the system are fibrous moulded bodies, in particular staple fibers or filaments, mostly preferred staple fibers.

[0030] In particular the fibrous moulded bodies are manmade cellulosic moulded bodies, in particular made according to the viscose, modal or lyocell process.

[0031] Another embodiment of the present invention is a textile packaging material which has a colour fitting to the colour of the content of the textile package packed by it, wherein at least two compounds of the textile packaging material are chosen from a system consisting of a fixed set of compounds with different colours. In a preferred embodiment the textile packaging material is a netting fabric.

[0032] In a preferred embodiment the compounds within the textile packaging material according to the in-

vention are fibrous moulded bodies, in particular staple fibers or filaments, mostly preferred staple fibers.

[0033] In a preferred embodiment the fibrous moulded bodies are manmade cellulosic moulded bodies, in particular made according to the viscose, modal or lyocell process.

[0034] In a preferred embodiment the compounds within the textile packaging material according to the invention are chosen from the group containing bright, black, dark brown, beige, red and yellow coloured compounds.

[0035] According to the invention any suitable kind of dyeing is possible to dye the moulded bodies: coloured pigments may be incorporated into the cellulose containing mass, e.g. the spinning solution, before moulding, to obtain spundyed moulded bodies. Alternatively after moulding the moulded bodies may be dyed by substantive dyes, reactive dyes, acid dyes or any other kind of dyes suitable to dye a cellulosic material. Preferably the applied colours must fulfil the requirements according to the use of the packing material, i.e. non-toxicity, light fastness, humidity fastness, abrasion resistance, etc..

[0036] In the case of staple fibre yarns, any desired colour of yarn can be produced by blending together the correct proportions of fibres which have been coloured to a small number of selected colours during or after fibre production. As an example an orange modal yarn suitable for producing a net that will match oranges to be packed in it can be produced by blending together 40% red modal fibre, 40% beige modal fibre and 20% yellow modal fibre. The modal fibre is coloured by the addition of pigments to the viscose during fibre manufacture. The blend produced is then spun into a yarn by ring spinning, open end spinning or other suitable yarn spinning method.

[0037] The fibre may also be coloured by dyeing as staple fibre by stock dyeing. The resultant coloured staple fibre can be blended in the same way as fibre produced by the addition of pigment during the spinning process. The fibre may also be coloured by sliver dyeing to give coloured slivers which can be blended together in the right proportions prior to spinning.

[0038] Continuous filament manmade cellulosic fibres may also be used to produce the product of the invention.

[0039] The manmade cellulosic yarns are made into fabric by a suitable method for producing an open net like structure. Suitable methods are those used to produce synthetic fibre netting which currently including circular knitting, raschel knitting and leno weaving.

[0040] It will be clear to those skilled in the art of textiles that the important aspects of this invention are that the netting is produced using a biodegradable manmade cellulosic fibre and that the netting can be coloured by blending together the correct proportions of producer coloured fibre or fibre coloured prior to spinning. Any appropriate yarn spinning method may be used. Any fabric forming method may be used.

Advantages of the invention

[0041] The invention allows the production of high quality, functional netting for retail presentation of fruit and vegetables without the use of fossil carbon based fibres. The netting produced will readily degrade by composting or landfill and so does not have a long term effect on the environment. Fig. 1 shows that after only 8 weeks in compost, the nets are completely disintegrated.

[0042] If the netting is disposed of incorrectly, for example into an ocean, it will readily biodegrade in a reasonable time.

[0043] The netting produced uses a process which is highly sustainable. The netting can be incinerated with no net increase in atmospheric carbon.

Applications of the invention

[0044] The primary use of the invention is for packaging of fruit and vegetables for retail presentation, storage and shipping. It may also be used for any packaging application where netting is an acceptable method. For example it may be used for packaging toys, small components and many other articles.

[0045] Customised colours of netting mean it can fit with a retailer's or brand's image. The colour can be matched to the article being packaged or it may be used to provide contrast and interest.

[0046] Customised colours also allow differentiation of products by using different colours of netting.

[0047] The use of a netting that has a proven low effect on the environment provides the basis of a major marketing claim for use of the brand or retailer in sustainability, ease of disposal and minimal effect on the environment.

[0048] The invention will now be illustrated by examples. These examples are not limiting the scope of the invention in any way. The invention includes also any other embodiments which are based on the same inventive concept.

Examples

Example 1

[0049] A range of five coloured modal fibres were produced by spun dyed technology. The colours were produced by injecting pigments into the dope prior to forcing the dope through the spinnerettes.

[0050] The five colours produced that gave the following colour co-ordinates (based on CIELab D65 measurements):

	L*	a*	b*
Black	19.4	-1.03	-0.55
Dark Brown	25.43	4.99	4.96

(continued)

	L*	a*	b*
Beige	69.29	7.11	28.50
Red	41.92	55.61	26.57
Yellow	82.01	13.66	84.01

Example 2

[0051] Fibres from Example 1 were blended to produce an orange colour.

[0052] The fibres were blended as bales prior to the yarn spinning process in the ratio:

40% Red, 40% Beige, 20% Yellow.

[0053] The fibres created a new bespoke colour with the following co-ordinates:

L* 44.32, a* 33.14, b* 62.74

[0054] The fibres were spun into yarn (Nm 34/1, Ring yarn)

[0055] The yarns were then knitted into nets on a Rius TC-300-TA-2 Multi circular knitting machine.

[0056] The nets so produced were suitable for use as a biodegradable net for the packaging of oranges at retail. The colour of the nets was sufficiently close to the average colour of the oranges contained within to give a visually pleasing result.

Example 3

[0057] Fibres from Example 1 were blended to produce a yellow colour.

[0058] The fibres were blended as bales prior to the yarn spinning process in the ratio:

94% Yellow, 6% Red.

[0059] The new co-ordinates of the blended fibres were:

L* 49.27, a* 36.31, b* 28.01

[0060] The fibres were spun into yarn.

[0061] The yarns were then knitted into nets on a circular knitting machine as in Example 2.

[0062] The nets so produced were suitable for use as a biodegradable net for the packaging of onions at retail. The colour of the nets was sufficiently close to the average colour of the onions contained within to give a visually pleasing result.

Claims

1. A method for manufacturing a textile packaging material which has a colour fitting to the colour of the content of the textile package, **characterised in that** at least two compounds of the textile packaging material are chosen from a system consisting of a fixed set of compounds with different colours.
2. A method according to claim 1 wherein the textile packaging material is a netting fabric.
3. A method according to claim 1 wherein the compounds of the system are fibrous moulded bodies, in particular staple fibers or filaments, mostly preferred staple fibers.
4. A method according to claim 3 wherein the fibrous moulded bodies are manmade cellulosic moulded bodies, in particular made according to the viscose, modal or lyocell process.
5. A method according to claim 1 wherein the system consists of bright, black, dark brown, beige, red and yellow coloured compounds.
6. A system suitable for manufacturing a textile packaging material **characterized in that** the system consists of bright, black, dark brown, beige, red and yellow coloured compounds
7. A system according to claim 6, wherein the compounds are fibrous moulded bodies, in particular staple fibers or filaments, mostly preferred staple fibers.
8. A system according to claim 7, wherein the fibrous moulded bodies are manmade cellulosic moulded bodies, in particular made according to the viscose, modal or lyocell process.
9. A textile packaging material which has a colour fitting to the colour of the content of the textile package packed by it, **characterised in that** at least two compounds of the textile packaging material are chosen from a system consisting of a fixed set of compounds with different colours.
10. A textile packaging material according to claim 9, which is a netting fabric.
11. A textile packaging material according to claim 10, wherein the compounds are fibrous moulded bodies, in particular staple fibers or filaments, mostly preferred staple fibers.
12. A textile packaging material according to claim 11, wherein the fibrous moulded bodies are manmade cellulosic moulded bodies, in particular made ac-

according to the viscose, modal or lyocell process.

13. A textile packaging material according to claim 10, wherein the compounds are chosen from the group containing bright, black, dark brown, beige, red and yellow coloured compounds. 5

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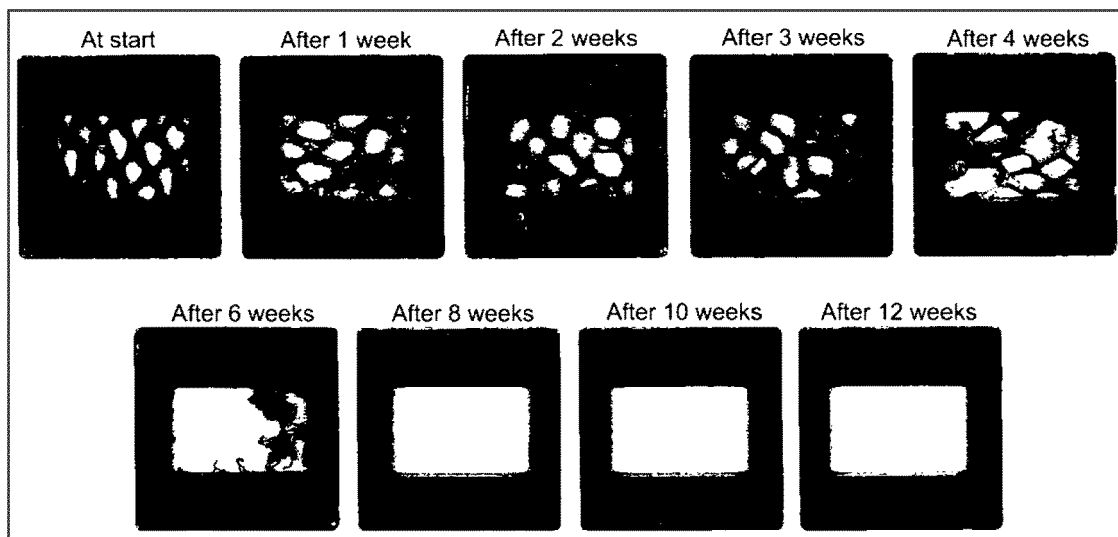
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Fig. 1:





EUROPEAN SEARCH REPORT

Application Number
EP 18 15 5193

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 19 July 2018	Examiner Pollet, Didier
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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Place of search Munich		Date of completion of the search 19 July 2018	Examiner Pollet, Didier
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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The members are as contained in the European Patent Office EDP file on
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