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(54) Title: METHOD FOR MANUFACTURING A PRODUCT COMRPISING RECYCLED FIBERS BY FILTRATION AND ACID TREATMENT OF A VISCOSE DOPE

Abstract

There is provided a method for manufacturing a material, the method comprising the sequential steps of: i) providing a viscose dope comprising cellulose xanthate and undissolved non-cellulosic fibres, and filtering the viscose dope to obtain a material comprising at least a part of the undissolved non-cellulosic fibres, ii) pressing the material obtained in step i), so that the amount of undissolved non-cellulosic fibers in the material after the pressing is at least 40 wt%, iii) contacting the material with an acid solution so that the cellulose xanthate is at least partially converted to cellulose, and iv) washing the material in an aqueous solution. The manufactured material is a product, which can be used for various purposes. Advantages of the invention include that it is possible to use remaining non-cellulosic fibers instead of discarding them when manufacturing viscose from textile waste.

METHOD FOR MANUFACTURING A PRODUCT COMRPISING RECYCLED FIBERS

Technical Field

The invention relates to chemical recycling of textile comprising cellulosic fibers and non-cellulosic fibers and in particular the manufacture of a new material.

Background

Despite its environmental impact, the textile industry is growing fast. The textile industry is a contributor to pollution, including CO_2 emissions. It is desirable to reduce the environmental impact of the textile industry by increasing the recycling of textiles.

Textiles can for instance be reused, chemically recycled or mechanically recycled. Chemical recycling of textiles can be made in various ways, producing multiple products depending on the textile source. Chemical recycling involves some kind of chemical reaction of the material, which is the case in the viscose process.

One example of a chemical recycling is using recycled pulp material in the viscose process, where fibers of regenerated cellulose are produced. The viscose process is a well-known multistep process to produce a regenerated textile fiber. The exact partition and labeling of the process step varies, however, the chemistry remains the same. The overall objective of the process is to first increase the reactivity and accessibility of the cellulose fiber followed by solubilization of the cellulose by xanthation. The solubilized cellulose (cellulose xanthate) is later regenerated in acid, and viscose fibers are spun.

A schematic overview of a typical viscose process is shown in fig 1.

Dissolving pulp (also called dissolving cellulose), is often used to produce viscose. Dissolving pulp is for instance made through the sulfite process or made through the sulfate process (also known as kraft pulping or kraft process) with a prehydrolysis step to remove hemicelluloses. The sulfite process produces pulp with a α-cellulose content up to 92 percent. It can use ammonium, calcium, magnesium or sodium as a base. The sulfate process with a prehydrolysis step produces pulp with a α-cellulose content up to 96 percent. Special alkaline purification treatments can yield even higher α-cellulose levels. The pulp can be produced form several different cellulose sources, the most common one is wood and another cellulose source is cotton linters. The purity is of importance as other polysaccharides such as hemicelluloses and extractives can interfere with the viscose process.

The cellulose is converted to alkali cellulose by immersing the pulp into a mixture comprising sodium hydroxide in the steeping step. This soda treatment can, in addition to deprotonate cellulose, remove any potential remaining unwanted material, such as hemicelluloses, that is left in the pulp. The fibers will swell during the treatment, enabling the soda and other compounds to penetrate the fiber wall further. The concentration and temperature of the soda treatment determines the extent of both conversion and swelling, an optimization is required to reach the most preferable outcome.

The alkali cellulose mixture is pressed to remove excess of soda. The excess of soda can be filtered to remove fines and other particles and then reused in the prior steeping step.

The alkali cellulose mixture is then shredded to further enhance the reaction in both the mercerization and xanthation steps, respectively. This is a mechanical pretreatment that increases the active surface, enable accessibility for upcoming treatment with sodium hydroxide and carbon disulphide.

The shredded alkali cellulose is stored for instance in silos during the mercerization, pre-ageing, step where an oxidative depolymerization reaction takes place. The degree of polymerization, DP, is reduced to achieve a sufficiently low viscosity of the viscose dope. However, to maintain a good tensile strength of the viscose fiber, it is of importance not to lower the DP excessively. Generally, a DP of 250 - 300 is suitable for alkali cellulose prior to xanthation. The degree of polymerization (DP) is expressed as the limiting viscosity number and measured according to ISO 5351:2010.

During the xanthation, carbon disulphide (CS_2) reacts with the alkali cellulose producing the dissolved product cellulose xanthate. All three hydroxyl groups of the glucose unit are possible sites for the substitution reaction. It is sufficient with a degree of substitution of 0.5 for a fiber free solution, however, the value varies between 0.5 and 0.7 at technical conditions.

The alkali cellulose xanthate solution (viscose dope) is often diluted with a sodium hydroxide solution. The alkali cellulose xanthate at least partily dissolved in the viscose dope. The concentration of the sodium hydroxide solution is set to result in predetermined concentrations of both the alkali and the cellulose in the viscose dope. After the at least partial dissolution the viscose dope is placed in a ripening vessel for e.g. 16-17 hours. In the ripening vessel the number of xanthate groups on each glucose unit reduces and distributes evenly throughout the chain to enable an acceptable coagulation in the later spin bath.

The viscose dope is normally filtered, for instance in order to avoid clogging and other problems. The reject from the filtration typically comprises undissolved fibers, cellulose xanthate gel, dirt particles and so on. Often a cut off size of 15-20 µm is used for the filtration. The reject is normally processed and recycled to the viscose process. When using reclaimed textiles as raw material the amount of reject in the filtration of the viscose dope increases since the reclaimed textiles comprise a mixture of different fibers such as for instance cellulose fibers and polyester fibers as well as other synthetic fibers.

The filtrate (liquid which has passed through the filter) may be de-aerated and then filtered again. By removing air bubbles, the risk of breakage or uneven streams in the jet rays during the spinning decreases.

The viscose dope is pushed out in jet rays directly into an acid bath containing e.g. sulphuric acid, sodium sulfate and zinc sulfate. The alkali cellulose xanthate will, in contact with the acid, quickly regenerate into cellulose, forming filaments and later staple fibers.

Chemical pretreatments to improve the accessibility and reactivity of cellulose can be performed. Some pretreatments swell the cellulose fiber and thus breaking some of the hydrogen bonds that are linking the cellulose chains together. Mechanical treatment can also be used, whereby the active surface of the cellulose fibers is increased by beating and thereby results in an improvement of the cellulose accessibility.

The starting materials for recycling of textiles, including but not limited to post consumer textiles, often comprise both cellulosic and non-cellulosic fibers etc. These may not be dissolved in the viscose process and are normally removed to an extent, which is necessary in the mentioned filtering step.

EP 3868929 describes producing a molded body comprising cellulose, in particular by means of a lyocell process or a viscose process, based on a starting material in such a way that the regenerated cellulosic molded body has at least part of the synthetic plastic of the starting material incorporated in the cellulose. Some synthetic plastic is contained in the molded body, some synthetic plastic may also be removed.

EP 3511451 describes a process where cellulose-containing material is recycled and used to manufacture a cellulose-containing body, where a part of the non-cellulosic material in the starting material is present in the final product. The depleted material can be mixed with starting material to contain some of the non-cellulosic material and achieve desired properties. Alternatively, the non-cellulosic impurities can be selectively depleted from the cellulose such that at least one predefined synthetic plastic remains at least partially in the depleted starting material.

It is a problem that the reject from the filtration of the cellulose dope is not taken care of in a suitable way. In particular when using reclaimed textiles as raw material for the viscose production the amount of reject can become a problem.

Summary

It is an object of the invention to obviate at least some of the problems in the prior art and provide a method which makes use of at least some of the materials in reclaimed textile. It is another object of the present invention to provide final products with desired properties.

In a first aspect there is provided a method for manufacturing a material, the method comprising the sequential steps of:

i) providing a viscose dope comprising cellulose xanthate and undissolved non-cellulosic fibres, and filtering the viscose dope to obtain a material comprising at least a part of the undissolved non-cellulosic fibres,

ii) pressing the material obtained in step i), so that the amount of undissolved non-cellulosic fibers in the material after the pressing is at least 40 wt%,

iii) contacting the material with an acid solution so that the cellulose xanthate is at least partially converted to cellulose, and

iv) washing the material in an aquaeous solution.

In a second aspect there is provided a product comprising

a) at least 40 wt% of non-cellulosic fibers, and

b) regenerated cellulose,

wherein at least some of the regenerated cellulose is incorporated between the non-cellulosic fibers.

In a third aspect there is provided use of the product as at least one selected from padding and lining.

An advantage of the invention is the recycling of as much of the starting material as possible by making both the usually desired filtered viscose dope of a viscose process, while at the same time making use of the removed material (filter reject). This has the advantage of improving the recycling process of textiles since the non-cellulosic fibers in reclaimed textiles can be utilized in an economic way.

The new material has unique and desired properties. It is for example more elastic than films made out of pure regenerated cellulose.

Brief description of the drawings

Figure 1 shows a schematic overview of a typical viscose process.

Detailed description

The following detailed description discloses by way of examples details and embodiments by which the invention may be practised.

It is to be understood that the terminology employed herein is used for the purpose of describing particular embodiments only and is not intended to be limiting since the scope of the present invention is limited by the appended claims.

The term "non-cellulosic fibers" as used throughout the description and the claims denotes fibers which are not cellulose, and may be other natural fibers or synthetic fibers.

The term "recycling" as used throughout the description and the claims denotes a process of converting waste materials into new materials.

The term "regenerated cellulose fibers" as used throughout the description and the claims denotes cellulose fibers, where the cellulose fibers have undergone a process where the cellulose fibers are processed into a pulp and subsequently extruded to a fiber. Examples include but are not limited to viscose. Such fibers are produced by regeneration of dissolved forms of cellulose.

The term “synthetic fibers” as used throughout the description and the claims denotes fibers made by humans through chemical synthesis, as opposed to natural fibers that are directly derived from living organisms, such as plants (like cotton) or fur from animals. Examples of synthetic fibers are nylon, and polyester.

The terms “textile” and “textile material” as used throughout the description and the claims denote a flexible material made by creating an interlocking bundles of yarns or threads, which are produced by spinning fibers into long and twisted lengths. Textiles are then formed by weaving, knitting, crocheting, knotting, tatting, felting, bonding or braiding these yarns together.

The term “viscose dope” as used throughout the description and the claims denotes a mixture comprising cellulose xanthate formed during a viscose process by reacting carbon disulphide with alkali cellulose. Depending on the origin of the cellulose the mixture may comprise additional fibers, for instance if the cellulose comes from recycled textiles, the viscose dope may comprise additional fibers which are not cellulose fibers. Altough the viscose dope comprises dissolved cellulose xanthate it is typically a mixture since it comprises additional undissolved fibers.

The term “undissolved” as used throughout the description and the claims denotes that some matter for instance a fiber is not dissolved in the surrounding liquid medium and hence a solution is not formed by the fiber. In case of a fiber in a liquid medium the undissolved fiber is in soled state.

If nothing else is defined, any terms and scientific terminology used herein are intended to have the meanings commonly understood by those of skill in the art to which this invention pertains.

All percentages and ratios are calculated by weight unless otherwise stated.

In the first aspect there is provided a method for manufacturing a material, the method comprising the sequential steps of:

i) providing a viscose dope comprising cellulose xanthate and undissolved non-cellulosic fibres, and filtering the viscose dope to obtain a material comprising at least a part of the undissolved non-cellulosic fibres,

ii) pressing the material obtained in step i), so that the amount of undissolved non-cellulosic fibers in the material after the pressing is at least 40 wt%,

iii) contacting the material with an acid solution so that the cellulose xanthate is at least partially converted to cellulose, and

iv) washing the material in an aquaeous solution.

It is understood that the material manufactured in the first aspect is the same as the product which is described in the second aspect.

In one embodiment, the amount of undissolved non-cellulosic fibers in the material after the pressing is at least 40 wt%. In one embodiment, the amount of undissolved non-cellulosic fibers in the material after the pressing is at least 50 wt%. In one embodiment, the amount of undissolved non-cellulosic fibers in the material after the pressing is at least 60 wt%. In one embodiment, the amount of undissolved non-cellulosic fibers in the material after the pressing is at least 70 wt%. In one embodiment, the amount of undissolved non-cellulosic fibers in the material after the pressing is at least 80 wt%.

The viscose dope in a viscose process is filtered at least once. In this step, undissolved non-cellulosic fibres, xanthate gel and other unwanted particles of a certain size are removed. The cut-off depends on the filter and is determined by selecting a suitable filter with an appropriate cut-off. Such a filtering step is performed at least once at a point in the viscose process after the xanthation, but before the cellulose xanthate is converted back to cellulose. Here, such a filtering step is present in step i).

The filter reject (material which has not passed through the filter, i.e. non-liquid material which is too large to pass the filter) may be obtained through e.g. scraping or backwashing of the filters and is usually thrown out or worked up and returned into the process to an earlier step. In the present invention, the filter reject is collected and treated further according to the method of the invention. The filter reject is thus the material which is treated further in the next step.

In one embodiment, the viscose dope is made from at least one textile material. The problem with non-cellulosic fibers and cellulose fibers which are mixed together typically occurs when textiles are used and are processed to be used as a starting material in the viscose process. The processing of textiles such as pre and post consumer textiles is described as a whole or in part for instance in WO 2018/073177, WO 2018/104330, WO 2020/127453, and WO 2021/185704. Textiles can be recycled by processing them and then the processed material can be used for viscose process. In such cases a complete separation of cellulose fibers and non-cellulosic fibers may not always be necessary. Instead the non-cellulosic fibers can be filtered away during the viscose process and the non-cellulosic fibers together with cellulose can be turned into a useful new material.

In one embodiment, the undissolved non-cellulosic fibers comprise synthetic fibers. Synthetic fibers are made from synthesized polymers of small molecules. In one embodiment the synthetic fibers comprise at least one selected from polyester, acryl, polyamide, polyurethane, polyether, nylon, and elastane.

In one embodiment, the filtering in step i) is performed using at least one filter selected from the group consisting a filter with a sintered metal sheet, a frame filter press, a polymer filter, and a centrifugal discharge pressure leaf filter.

In one embodiment, the filtering in step i) is followed by backwashing to obtain the material. In another embodiment, the material is recovered by mechanically removing the material from the filter for instance by scraping.

In one embodiment, particles larger that 15 µm are retained in the filtering mentioned in step i), wherein the particle size is measured according to ISO 13320:2020. Particles with a size larger than 15 µm are retained in the filter, whereas particles with a size smaller than 15 µm are not retained in the filter. In another embodiment particles larger that 20 µm are retained in the filtering mentioned in step i), wherein the particle size is measured according to ISO 13320:2020. In another embodiment particles larger that 5 µm are retained in the filtering mentioned in step i), wherein the particle size is measured according to ISO 13320:2020. In another embodiment particles larger that 40 µm are retained in the filtering mentioned in step i), wherein the particle size is measured according to ISO 13320:2020. If a stronger viscose fiber is desired in the viscose process a smaller cut off value should be selected for the filtration in the viscose process. If a finer titer or stronger fibers are desired in the viscose process, then a finer cut-off should be used in the viscose process.

In one embodiment the material is stored in a first storage compartment after step i) and before step ii). In one embodiment the material is stored in a second storage compartment after step ii) and before step iii). This has the advantage of providing the possibility to accumulate material when the viscose process is run and then make a production run of the new material.

In one embodiment, the pressing in step ii) is performed using at least one press selected from the group consisting of a screw press and a tube press.

In one embodiment, filtered viscose dope from step i) (i.e. the material which passes through the filter) is returned to the viscose process. In one embodiment the pressing in step ii) provides further viscose dope, which is returne to the viscose process. This gives an improved process economy so that material is not wasted.

In one embodiment, the material obtained after step ii) is shaped into a desired shape before step iii). When the material is contacted with the acid, the remaning cellulose xanthate turns into cellulose. The material also comprises a number of non-cellulosic fibers. When the material is shaped to a certain shape before contacting with the acid, that shape will be retained after the treatment with acid. The formed cellulose and the non-cellulosic fibers in the material will form a material where the non-cellulosic fibers are embedded in the cellulose. In one embodiment the material is shaped into a desired shape during heat treatment. In one embodiment the material is shaped into a desired shape during heat treatment at or above the glass-transition temperature (Tg) of the synthetic fibers.

In one embodiment, the material obtained after step ii) is rolled before step iii). This creates a sheet of material which is easy to contact with acid and easy to handle. In one embodiment the material is rolled to a thickness in the range 0.05-1 mm before step iii). This thickness gives a suitable treatment time in acid and makes the final material possible to handle in an easy way. It is however possible to make the material thicker or thinner.

In one embodiment the acid solution in step iii) comprises at least one acid selected from the group consisting of sulphuric acid, sodium sulfate and zinc sulfate. The acid solution is comparable with the acid solution used in the viscose process to react the cellulose xanthate to cellulose. In one embodiment the same acid solution is used for step iii) as for the viscose process. This setup can simplify the process when performed in or near a viscose factory.

CS_2 is released during step iii) and in one embodiment this is returned into the viscose process. This recycling makes the process more economical.

In a second aspect there is provided a product comprising

a) at least 40 wt% of non-cellulosic fibers, and

b) regenerated celloluse,

wherein the non-cellulosic fibers are embedded in the regenerated cellulose.

The manufacturing method gives a product where the non-cellulosic fibers are embedded in cellulose. The non-cellulosic fibers constitute a fairly high fraction of the material (at least 40 wt%). When the material is contacted with the acid solution, then the cellulose xanthate is regenerated to cellulose and then the non-cellulosic fibers become embedded in cellulose. The non-cellulosic fibers can be viewed as reinforcement in the regenerated cellulose. The non-cellulosic fibers contributes strongly to the mechanical properties of the material. Due to the in-situ regeneration of the cellulose xanthate the adhesion between the non-cellulosic fibers and the regenerated cellulose becomes high, which further contribute to the mechanical properties of the finished material.

In one embodiment, the product comprises at least 40 wt% of non-cellulosic fibers. In one embodiment, the product comprises at least 50 wt%, at least 60 wt%, at least 70 wt% or at least 80 wt% of non-cellulosic fibers.

In one embodiment the non-cellulosic fibers are at least one selected from polyester, acryl, polyamide, polyurethane, polyether, nylon, and elastane. The non-cellulosic fibers as well as the cellulosic fibers typically come from post consumer or pre-consumber textiles to be recycled. Textiles often comprise cellulosic fibers such as for instance cotton mixed with one or more of the above mentioned non-cellulosic fibers.

In one embodiment, the product has a thickness in the inverval 0.05-1 mm. It is an advantage that the process can be scaled up and in a large scale it is an advantage to be able to roll the material. The material can be rolled to a certain thickness and it has turned out that a thickness in the interval 0.1-1 mm gives suitable properties with respect to handling of the material and other properties. In one embodiment the width of the material is in the interval 100-1500 mm. This is a suitable width with respect to handling of the material in a factory.

The invention is not limited to rolled material and other shapes can easily be manufactured. The material is typically shaped right before and/or in the very beginning of the treatment with the acid solution. Due to the properties of the material the shape will last when the cellulose xanthate has been converted to cellulose.

In a third aspect there is provided use of the product as at least one selected from padding and lining. The finished material is a useful product and can be used in many different applications. Such applications include but are not limited to padding and lining.

In one embodiment, there are at least 2 filter systems used in the viscose process. In one embodiment, there are at least 3 filter systems used in the viscose process. In one embodiment there are at least 4 filter used systems in the viscose process. In at least one of the filters, i.e. filter systems in the viscose process, the solid matter over a certain size is retained and recovered. The filters used are filters which are normally used in the viscose process to filter the viscose dope. The recovered solid non-cellulosic fibers are typically together with cellulose xanthate in liquid form and cellulose xanthate in gel form, particles and other impurities. The recovered solid non-cellulosic fibers together with some remaining cellulose as well as remaining liquid viscose dope is the filter reject and is often discarded, but the present invention makes it possible to use it.

In one embodiment, the filter is backwashed to recover the filter reject, which is then the material comprising undissolved fibres obtained by filtering of viscose dope in a viscose process provided in step i). The undissolved fibers comprise non-cellulosic fibers as well as some undissolved cellulosic fibers and solid particles such as impurities and gel of cellulose xanthate. In one embodiment, the filter is scraped to obtain the filter reject.

The reject may be stored in a container before step ii) and/or before step iii). The storage allows a better planning of the process in large scale. It is also possible to transport the reject to another geographical location to prepare it further there.

In one embodiment, the acid solution comprises at least one selected from sulphuric acid, sodium sulfate and zinc sulfate. The acid solution is typically an acid solution which is commonly used for viscose manufacturing. In one embodiment, the acid solution comprises 100-150 g/l, for example about 130 g/l, of sulphuric acid (H_2SO_4). In one embodiment, the acid solution comprises 200-400 g/l, for example about 310 g/l, of sodium sulfate (Na_2SO_4). In one embodiment, the acid solution comprises 5-20 g/l, for example about 9.5 g/l, of zinc sulfate ($ZnSO_4$).

The concentration of the acid solution is set to result in the regeneration of cellulose.

The step iv) of washing removes acid from the material and ceases chemical reactions.

After step iv), the material may be rolled up on a cylinder or a spool if the material is made as a sheet or in another shape which can be rolled.

The resulting final product is a synthetic fiber-reinforced cellulose-containing material. It can be used for various purposes including but not limited to padding or lining.

An advantage of the method is thereby making use of the filter reject of a viscose process and providing an additional final product with a high content of fibers of the type that were not dissolved in the viscose process. This includes non-cellulosic fibres such as synthetic fibres such as at least one selected from polyester, acryl, polyamide, polyurethane, polyether, nylon, and elastane. The final product will also have a content of regenerated cellulose fibers. As these fibers are regenerated in the presence of the exsisting undissolved fibers, they are to some extent intertwined with the undissolved fibers, providing a material with desirable properties.The material may for example have a good elasticity. The properties will be slightly different dependent on the type of synthetic fiber present. At the same time, the relatively pure viscose dope obtained after step i) and the filtering can for example be further processed as usual in the viscose process. The pure viscose dope desired for use in the spinning process and the resulting viscose end product of the viscose process is thereby not compromised.

In one embodiment, CS_2 gas is released and obtained during step iii). The obtained CS_2 gas can be used for multiple purposes. In one embodiment, the obtained CS_2 gas is returned into the viscose process and used in the xanthation step.

In the second aspect, there is provided a product comprising.
- at least 40% of non-cellulosic fibers and
- regenerated celloluse,
wherein at least some of the regenerated cellulose is incorporated between the non-cellulosic fibers.

In one embodiment of the product, the non-cellulosic fibers are at least one selected from polyester, polyacrylonitrile, polyamide, polyurethane, and polyether. In one embodiment of the product, the non-cellulosic fibers are at least one selected from nylon and elastane.

In one embodiment, the product is a cloth being 0.05-1 mm thick and 100-1500 mm broad.

In a third aspect, there is provided the use of such a product for padding or lining.

The celluloses recycled from textiles through the viscose process usually have different properties than natural cellulosic fibers. They may for example have a relatively short chain length. In this product, non-cellulosic fibers such as synthetic fibers are present in an unusually high proportion and the cellulosic fraction are at least to some extent incorporated into the undissolved non-cellulosic (e.g. synthetic) fibers as they are regenerated in the presence of the existing undissolved fibers. This provides a material with desirable properties. For example, the material can have a relatively high elasticity.

It is conceived that the present method is intended to be carried out together with additional steps and stages in the regeneration of reclaimed cellulose, such as an initial collection of textiles to be recycled, and also subsequent steps such as a subsequent viscose process or other use of the material. Additional stages are known in the art and can easily be combined with the steps according to the invention by a skilled person. A number of additional steps are suitably performed in the regeneration of reclaimed cellulose as described in the prior art.

In one embodiment, the starting material originate from pre-consumer textile waste. Pre-consumer textile waste includes but is not limited to combing waste and cuttings. In one embodiment, the starting material originate from post-consumer textiles. Post-consumer cellulose containing waste includes but is not limited to laundry waste and used clothes.

Claims

1. A method for manufacturing a material, the method comprising the sequential steps of:

i) providing a viscose dope comprising cellulose xanthate and undissolved non-cellulosic fibres, and filtering the viscose dope to obtain a material comprising at least a part of the undissolved non-cellulosic fibres,

ii) pressing the material obtained in step i), so that the amount of undissolved non-cellulosic fibers in the material after the pressing is at least 40 wt%,

iii) contacting the material with an acid solution so that the cellulose xanthate is at least partially converted to cellulose, and

iv) washing the material in an aquaeous solution.

2. The method according to claim 1, wherein the viscose dope is made from at least one textile material.

3. The method according to any of claims 1-2, wherein the undissolved non-cellulosic fibers comprise synthetic fibers.

4. The method according to claim 3, wherein the synthetic fibers comprise at least one selected from the group consisting of polyester, polyacrylonitrile, polyamide, polyurethane, and polyether.

5. The method according to claim 4, wherein the synthetic fibers comprise at least one selected from the group consisting of nylon and elastane.

6. The method according to any of claims 1-5, wherein the filtering in step i) is performed using at least one filter selected from the group consisting a filter with a sintered metal sheet, a frame filter press, a polymer filter, and a centrifugal discharge pressure leaf filter.

7. The method according to any one of claims 1-6, wherein the filtering in step i) comprises a backwash to obtain the material.

8. The method according to any of claims 1-7, wherein particles larger that 15 µm are retained in the filtering mentioned in step i), wherein the particle size is measured according to ISO 13320:2020.

9. The method according to any of claims 1-8, wherein the material is stored in a first storage compartment before step ii).

10. The method according to any of claims 1-9, wherein the material is stored in a second storage compartment before step iii).

11. The method according to any of claims 1-10, wherein the pressing in step ii) is performed using at least one press selected from the group consisting of a screw press and a tube press.

12. The method according to any of claims 1-11, wherein filtered viscose dope from step i) is returned to a viscose process.

13. The method according to any of claims 1-12, wherein the pressing in step ii) gives viscose dope, which is returned to a viscose process.

14. The method according to any of claims 1-13, wherein the material obtained after step ii) is shaped into a desired shape before step iii).

15. The method according to any of claims 1-14, wherein the material obtained after step ii) is rolled before step iii).

16. The method according to claim 15, wherein the material is rolled to a thickness in the range 0.1-1 mm before step iii).

17. The method according to any of claims 1-16, wherein the acid solution in step iii) comprises at least one acid selected from the group consisting of sulphuric acid, sodium sulfate and zinc sulfate.

18. The method according to any of claims 1-17, wherein CS_2 is released during step iii) and which is returned into a viscose process.

19. The method according to any of claims 1-18, wherein the material is shaped into a desired shape during heat treatment, preferably at or above the glass-transition temperature (Tg) of the synthetic fibers.

20. A product comprising

a) at least 40 wt% of non-cellulosic fibers, and

b) regenerated celloluse,

wherein at least some of the regenerated cellulose is incorporated between the non-cellulosic fibers.

21. The product according to claim 20, wherein the non-cellulosic fibers comprise at least one selected from

the group consisting of polyester, polyacrylonitrile, polyamide, polyurethane, and polyether.

22. The product according to any of claims 20-21, wherein the product has a thickness in the inverval 0.1-1 mm.

23. Use of the product according to any of claims 20-22 as at least one selected from the group consisting of padding and lining.

Ansökningsnummer / Patent application No: 2251160-4

I följande bilaga finns patentkraven på svenska. Observera att det är patentkravens slutliga lydelse på engelska som gäller.

Enclosed are the patent claims in Swedish. Please note that only the granted English claims have legal effect.

Patentkrav

1. Förfarande för tillverkning av ett material, varvid förfarandet innefattar de sekventiella stegen av:
i) tillhandahållande av en viskos-dop innefattande cellulosaxantat och olösta icke-cellulosahaltiga fibrer, och filtrering av viskos-dopet för att erhålla ett material som omfattar åtminstone en del av de olösta icke-cellulosahaltiga fibrerna,
ii) pressa materialet som erhållits i steg i), så att mängden olösta icke-cellulosafibrer i materialet efter pressningen är minst 40 viktprocent,
iii) bringa materialet i kontakt med en sur lösning så att cellulosaxantatet åtminstone delvis omvandlas till cellulosa, och
iv) tvätta materialet i en vattenlösning.

2. Förfarande enligt krav 1, kännetecknat därav, att viskosmassan (1) är gjord av åtminstone ett textilmaterial.

3. Förfarande enligt något av kraven 1-2, varvid de olösta icke-cellulosafibrerna innefattar syntetiska fibrer.

4. Förfarande enligt krav 3, kännetecknat av att de syntetiska fibrerna innefattar åtminstone en vald från gruppen bestående av polyester, polyakrylnitril, polyamid, polyuretan och polyeter.

5. Förfarande enligt krav 4, kännetecknat av att de syntetiska fibrerna innefattar åtminstone en vald från gruppen bestående av nylon och elastan.

6. Förfarande enligt något av kraven 1-5, varvid filtreringen i steg i) utförs med användning av minst ett

filter valt från gruppen bestående av ett filter med en sintrad metallplåt, en ramfilterpress, ett polymerfilter och ett centrifugalt utloppstryckbladfilter.

7. Förfarande enligt något av kraven 1-6, varvid filtreringen i steg i) innefattar en backspolning för att erhålla materialet.

8. Förfarande enligt något av kraven 1-7, varvid partiklar större än 15 µm hålls kvar i den filtrering som nämns i steg i), varvid partikelstorleken mäts enligt ISO 13320:2020.

9. Förfarande enligt något av kraven 1-8, varvid materialet förvaras i ett första lagringsutrymme före steg ii).

10. Förfarande enligt något av kraven 1-9, varvid materialet förvaras i ett andra lagringsutrymme före steg iii).

11. Förfarande enligt något av kraven 1-10, varvid pressningen i steg ii) utförs med användning av minst en press vald från gruppen bestående av en skruvpress och en rörpress.

12. Förfarande enligt något av kraven 1-11, varvid filtrerad viskosmassa från steg i) återförs till en viskosprocess.

13. Förfarande enligt något av kraven 1-12, varvid pressningen i steg ii) ger viskosdop, som återförs till en viskosprocess.

14. Förfarande enligt något av kraven 1-13, varvid materialet erhållet efter steg ii) formas till en önskad form före steg iii).

15. Förfarande enligt något av kraven 1-14, varvid materialet erhållet efter steg ii) valsas före steg iii).

16. Förfarande enligt krav 15, varvid materialet valsas till en tjocklek i området 0,1-1 mm före steg iii).

17. Förfarande enligt något av kraven 1-16, varvid syralösningen i steg iii) innefattar minst en syra vald från gruppen bestående av svavelsyra, natriumsulfat och zinksulfat.

18. Förfarande enligt något av kraven 1-17, varvid CS2 frigörs under steg iii) och som återförs till en viskosprocess.

19. Förfarande enligt något av kraven 1-18, varvid materialet formas till en önskad form under värmebehandling, företrädesvis vid eller över glasövergångstemperaturen (Tg) för de syntetiska fibrerna.

Drawings

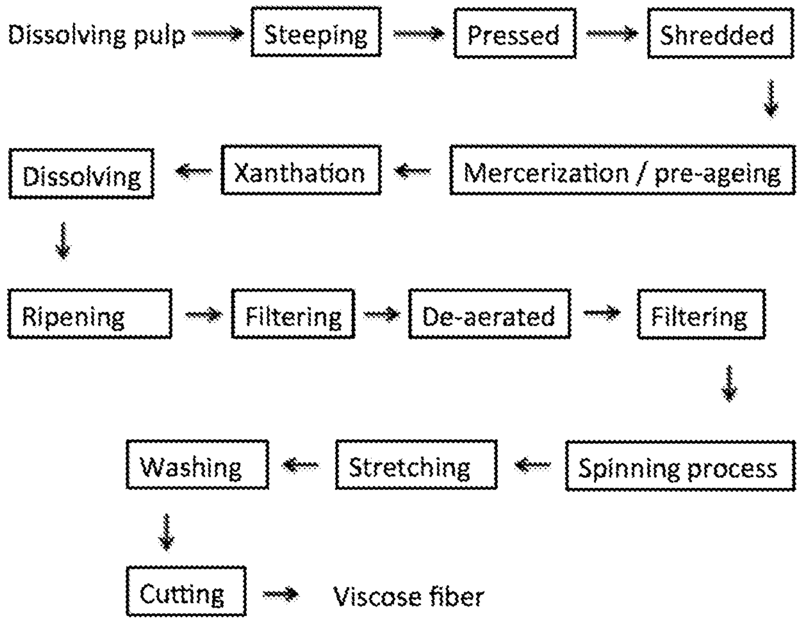

Fig 1