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(54) FIBER HAVING IMPROVED PROCESSING CHARACTERISTICS AND USE THEREOF

(57) The present invention relates to manmade cellulosic fibers having optimized processing characteristics in yarn spinning while improving yarn quality. Particularly, the invention relates to a manmade cellulosic fiber having improved running characteristics in the production of yarn, which in the finished state has a QPG value of 1.0 or more, preferably 1.0 to 3.0, more preferably 1.0 to 1.8, QPG being calculated as follows:

$$\text{QPG} = (\text{WHV x moisture x sinking time}) / (\text{DGW x FK x pH x crystallinity}).$$

Furthermore, the present invention relates to the use of this fiber for the production of a yarn by means of ring spinning, compact spinning, rotor spinning, or air-jet spinning.

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Description

[0001] The present invention relates to manmade cellulosic fibers having optimized processing characteristics in yarn spinning while improving yarn quality.

[0002] Manmade cellulosic fibers are fibers produced from a cellulosic raw material, particularly pulp, by dissolving it and subjecting it to a shaping process, particularly produced according to the viscose, modal, polynosic, lyocell, cupro, or carbamate processes. For the purposes of this invention, regenerated cellulosic fibers are meant to be such manmade cellulosic fibers during the production of which a cellulose derivative is formed as an intermediate product, particularly viscose, modal, polynosic, or carbamate fibers. For the purposes of the present invention, Lyocell fibers produced with the formation of a solution in aqueous amine oxide, particularly NMMO, or in ionic solvents shall not be considered as regenerated fibers. A modal fiber is a fiber that meets the BISFA definition of "modal". A viscose fiber is a fiber that meets the BISFA definition of "viscose", i.e., this does expressly not include fibers that meet the BISFA definition of modal fibers. A lyocell fiber is a fiber that meets the BISFA definition of "lyocell".

[0003] Generally, manmade cellulosic fibers are processed by using the same machines as for other fiber types, especially cotton. Industrial-scale spinning systems are designed for cotton, which is why the processing quality of manmade cellulosic fibers is not always ideal. Ever-increasing spinning velocities, in particular, cause the system to react with ever-increasing sensitivity to the specific fiber characteristics of manmade cellulosic fibers and the impact of the climate, which, in practical use, becomes noticeable in the form of reduced machine efficiency in the spinning process or reduced yarn quality, especially in the form of electrostatic charges, the formation of lapping, fly lint, etc.

[0004] In prior art, in order to avoid these problems, for example, the spinning machines are operated at reduced velocities, charges at the spinning machines are dissipated electrically, and spinning halls are air-conditioned to defined humidities and/or temperatures. Other possibilities include spraying with water or applying secondary finishes. Nevertheless, all these measures require additional investment and operating costs as compared to cotton processing.

Object

[0005] Therefore, it was the object to provide manmade cellulosic fibers having, without additional measures or a change of underlying conditions as compared to cotton, equivalent or even improved processing characteristics and permitting higher machine utilization efficiency levels in the spinning systems of ring spinning, compact spinning, rotor spinning, and air-jet spinning, similar to the cotton benchmark, particularly also in complicated external climatic conditions at the manufacturing site. All this was to be possible with yarn quality at least remaining the same, but ideally being improved.

Description of the invention

[0006] The four classic spinning systems, ring spinning, compact spinning, rotor spinning, and air-jet spinning, are optimized for cotton, which is why cotton processing characteristics are used as a benchmark for the manmade cellulosic fibers. In experiments, the factors were determined that influence fiber processability in the spinning process.

[0007] Surprisingly, it was found that not every characteristic of the manmade cellulosic fibers must be adapted directly to the respective cotton-typical parameters, but that it is sufficient to adjust one aggregate parameter for the sum of individual characteristics that represents a measure for processability quality. For the purposes of the present invention, this aggregate parameter shall be referred to as "Yarn Spinning Quality Parameter" or "QPG".

[0008] Therefore, it was possible to solve the above object with a manmade cellulosic fiber which has improved running characteristics during the production of yarn and which, in its finished state, has a QPG value of 1.0 or more, preferably 1.0 to 3.0, more preferably 1.0 to 1.8, QPG being calculated as follows:

$$\mathrm{QPG} = (\mathrm{WHV} \times \mathrm{moisture} \times \mathrm{sinking\ time}) / (\mathrm{DGW} \times \mathrm{FK} \times \mathrm{pH} \times \mathrm{crystallinity})$$

[0009] Therein, WHV denotes water holding capacity in [g/g], moisture (=water content in the fibers) denotes in [%(w/w)] and DGW denotes volume resistance in [GΩ]. The sinking time is measured in [seconds]. Crystallinity is specified as a degree of crystallinity in [%].

[0010] The fiber coefficient FK has an experimentally determined specific value for each fiber category. It was found that in the case of a modal fiber FK = 0.66, in the case of a viscose fiber FK = 0.90, and in the case of a lyocell fiber FK = 0.10.

[0011] It is assumed that the FK covers the fiber-specific impact of volume and surface (surface roughness and structure).

[0012] In a preferred embodiment, the manmade cellulosic fiber according to the invention is a staple fiber having a staple length between 18 and 120 mm. However, the principles of the present invention can also be applied analogously to continuous filaments produced according to the above-mentioned methods. Yet, here, the specific problems which occur in connection with yarn spinning are by nature not present to the same extent.

[0013] Preferably, the manmade cellulosic fiber is a regenerated cellulosic fiber, selected from the group containing modal and viscose fibers.

[0014] More preferably, the regenerated cellulosic fiber, selected from the group containing modal and viscose fibers, according to the invention has a volume resistance between 0 und 20 GΩ, more preferably between 2 and 20 GΩ. Such low volume resistances are unique, they have so far never been measured, and surprisingly it was found that fibers having such volume resistance values exhibit a greatly improved running behavior during yarn spinning. Particularly, it must be emphasized that, on the contrary, cotton, which is to be used as the benchmark, has a very high volume resistance of approx. 180 GΩ.

[0015] Even more preferably, the manmade cellulosic fiber according to the invention is a modal fiber.

[0016] In a further preferred embodiment of the present invention, the manmade cellulosic fiber is a lyocell fiber. More preferably, the lyocell fiber according to the invention has a volume resistance between 30 und 90 GΩ, more preferably between 35 and 60 GΩ. Even such low volume resistances are unique for lyocell fibers. They have so far never been measured for lyocell fibers, and surprisingly it was found that fibers having such volume resistance values exhibit a greatly improved running behavior during yarn spinning.

[0017] In the production of yarn, the fibers are moved across several machines where they are electrostatically charged. Particularly, charging takes place at the carding machine as well as during ring spinning on the sliver at the drawing machine and the flyer. It is known that the intensity of electrostatic charging during the production of yarn depends not only on the specific fiber characteristics and the soft finish, but also substantially on temperature and humidity. The lower the humidity, the harder it is to dissipate the charges from the sliver. In standard conditions (50% relative humidity, 23 °C), the fiber according to the invention achieves, for the first time, a reduction in charge by the factor > 100 to almost 0 mV, which leads to a greatly improved processability in the spinning process that surprisingly is maintained also in complicated climatic conditions (low humidity) as well as during fluctuations in climatic conditions. Also preferably, the inventive manmade cellulosic fiber therefore exhibits the following electrostatic charges of the sliver during yarn production, provided of course that the machines are operated at conditions usual in the industry for the commercial production of such yarns:

- carding machine 0.001-1.0 mV, preferably 0.001-0.5 mV, more preferably 0.001-0.1 mV

[0018] Another embodiment of the present invention is the use of the above-described fiber according to the invention for the production of yarn by means of ring spinning, compact spinning, rotor spinning, or air-jet spinning. Particularly, by the use according to the invention during spinning yarn breaks / 1000 Sh are reduced by at least 50% as compared to commercially available fiber types.

[0019] According to the invention, the following applies to the composition of the soft finish:

- Emulsifier: 40-90%, preferably 55-80%, more preferably 65-75%
- Lubricant: 0-40%, preferably 4-25%, more preferably 7-15%
- Antistatic agent: 5-50%, preferably 8-35%, more preferably 10-25%
- Additive: 0-20%, preferably 1-10%, more preferably 3-7%

[0020] In a preferred embodiment of the invention the soft finish consists of saturated components only.

[0021] Each of these components can consist of the following substance classes or substances, individually or also as mixtures:

Emulsifier:

[0022] For this component, the following substance classes or substances can be used:

- Monoesters and/or diesters of - preferably saturated - fatty acids, preferably C16 and/or C18 acids , branched or unbranched, esterified with polyethylene glycols and/or polypropylene glycols having a preferred molecular mass of 300 - 400 g/mol on average, with a terminal hydroxyl group and/or alkyl end-capped. For example: Alkyl-CO-$O(CH_2CH_2O)_n$-H, alkyl-CO-$O(CH_2CH_2O)_n$-alkyl, alkyl-CO-$O(CH_2CH_2O)_n$-CO-alkyl.

- Monoethers and/or diethers of polyethylene and/or polypropylene glycol with a preferred molecular mass of 300 - 400 g/mol on average and - preferably saturated - fatty alcohols, preferably being C16 and/or C18 alcohols, with a terminal hydroxyl group and/or alkyl end-capped. For example: Alkyl-$O(CH_2CH_2O)_n$-H, alkyl-$O(CH_2CH_2O)_n$-alkyl.

- Monoacylglycerols and/or diacylglycerols, preferably from saturated C16 and/or C18 fatty acids, preferably mono- or dipolyethoxylated and/or -polypropoxylated. For example: Alkyl-CO-OCH_2-CHOH-CH_2OH, alkyl-CO-OCH_2-CHOH-CH_2O-(CH_2CH_2O)$_n$-H.

- Polyglyceryl esters, preferably from saturated C16 and/or C18 fatty acids, optionally partially polyethoxylated and/or polypropoxylated. For example:. R_1-O(CH_2-CHOR_2-CH_2O)$_n$CH_2-CHOR_3-CH_2OR_4, where R_1...R_4 = H or acyl or PEG, where R_1...R_4 = at least 1 acyl.

- Alkyl polyglycosides, preferably alkylated with saturated C12 - C18 chains, optionally polyethoxylated and/or polypropoxylated. For example: H-($C_6H_{10}O_5$)$_n$O-alkyl.

- Fatty acids, preferably saturated, preferably C16 and/or C18 acids, preferably as a sodium or potassium salt. For example: C15-CO_2R, where R = H or Na or K.

Lubricant:

[0023] For this component, the following substance classes or substances can be used:

- Fatty alcohols, preferably saturated, preferably with a chain length of C16 and/or C18, for example stearyl alcohol.
- Sulfated - preferably saturated - fatty alcohols, preferably with a chain length of C16 and/or C18: R-OSO_3R', wherein R = alkyl, and R' = H, or R' = cation.
- Alkyl sulfonates, preferably saturated, preferably C16 and/or C18 chains: R-SO_3R', wherein R = alkyl, and R' = H, or R' = cation
- Fatty acids, preferably saturated, preferably C16 and/or C18 acids, preferably sodium or potassium salt. For example: C15-CO_2R, where R = H or Na or K.
- Fats/waxes. For example: CH_3-(CH_2)$_n$-CO-OCH_2CH(O-CO-(CH_2)$_n$-CH_3)-CH_2O-CO-(CH_2)$_n$-CH_3.

Antistatic agent:

[0024] For this component, the following substance classes or substances can be used:

- Phosphate mono-, di-, or triester, optionally polyethoxylated and/or polypropoxylated, preferably C6-C18, more preferably C10-C13, branched and/or unbranched, for example: R-OPO_3R', wherein R = alkyl, and R' = H or cation, R-(OCH_2CH_2)$_n$-OPO_3R', wherein R = alkyl, and R' = H or cation.

- Alkyl phosphonates, for example: R-POOR'OR", wherein R = alkyl, R' = alkyl, R" = H or cation.
- Sulfated - preferably saturated - fatty alcohols, preferably with a chain length of C16 and/or C18. For example: R-OSO_3R', wherein R = alkyl, and R' = H, or R' = cation.
- Alkyl sulfonates, preferably saturated, preferably C16 and/or C18: R-SO_3R', wherein R = alkyl, and R' = H, or R' = cation.
- Alkyl sarcosinates. For example: R-CO-NCH_3-CH_2-COOR', wherein R = alkyl and R' = H or cation
- Fatty acids, preferably saturated, preferably C16 and/or C18, preferably sodium or potassium salt. For example: C15-CO_2R, where R = H or Na or K.

Additives:

[0025] For this component, one, or in combination also several, of the following substance classes or substances generally known to those skilled in the art can be used:

- wetting agents, for example: Sulfosuccinates
- corrosion inhibitors, for example: Phosphonates
- Boundary additives: Polyethylene glycols, for example: H-(OCH_2CH_2)$_n$-OH and/or ethylene oxide propylene oxide copolymers, for example: HO-(CHCH_3CH2O)$_n$-(CH_2-CH_2O)$_m$-(CHCH_3-CH_2O)$_l$-H

[0026] Some of the substances listed above have more than only one of the functions needed in a soft finish and therefore can be used in more than one of the components according to the invention. This is why some of the substances mentioned above are listed in more than one of the groups of substances above.

[0027] The invention offers the following advantages over prior art:

- The fiber according to the invention has the 'inherently' improved processing characteristics in the spinning process, particularly in ring, compact, rotor, and air-jet spinning, such as reduced electrostatic charging, reduced fly lint, fewer lapping, etc.
- Machine utilization, i.e., productivity, can be increased.
- Yarn quality is improved.
- The characteristics according to the invention can be controlled via process management in the fiber production
- The fiber according to the invention is suitable for all spinning systems and all climatic conditions
- The improvement of the processing characteristics is stable during fluctuations of climatic conditions
- Economic efficiency is improved because no additional spraying or other machine-end measures are required.

[0028] Subsequently, the invention will be described with reference to examples. However, the invention is not expressly limited to the embodiments of these examples, but also comprises all other embodiments that are based on the same inventive concept.

Examples

[0029] The characteristics of the fibers described herein below were determined as follows:

Degree of crystallinity

[0030] For the measurements, a Bruker IFS66 with FRA106 Raman module was used, Nd:YAG laser 500 mW, laser wavelength 9394cm^{-1} (1064 nm), liq. N2 cooled Ge detector, 3500-100 cm^{-1}, resolution 4 cm^{-1} 100 scans, four measurements per sample. Two calibration methods were used: vector standardization at 3500-250 cm^{-1} and at 3500-100 cm^{-1}.

Determination of fiber pH

[0031] Fiber pH was determined based on the DIN 54275 standard as follows:

> The liquor ratio is 1:10, 3 g of fibers are placed in a 50 ml flask with a screw cap to which 30 ml of deionized water (ph 5 to 7), measured in a 50 ml type A measuring cylinder, are added.
> The suspension is shaken occasionally during a one-hour period, whereupon the fiber is squeezed out and the pH of the filtrate is determined using a pH meter.

Sinking time and water holding capacity ("WHV")

[0032] 5 g of carded, air-dried fibers are placed, evenly distributed, in the dry wire basket. The wire basket is structured as follows: weight 2.7 g +/- 0.3 g, height 80 mm, diameter 50 mm, the wire is an 0.4 mm thick copper or steel wire, the mesh width of the basket is 15 - 20 mm. A crystallization dish having a diameter of 19 cm and a height of 9 cm is filled with deionized water at 20 °C +/- 2 °C up to a height of 7 cm. The wire basket is, in a horizontal position, allowed to drop from a height of 10 mm +/- 3 mm to the surface of the deionized water. From that time on, the duration until the full sinking of the wire basket is measured using a stop watch. This measured value in seconds describes the sinking time. Then, the basket is lifted out of the water, held in a horizontal position for 30 seconds to drain the water and measured in a beaker with an accuracy of 0.1 g using a precision balance.

[0033] Water holding capacity WHV, which is understood as the ratio of mass of water to mass of fibers, is calculated as follows:

$$\text{WHV} = (\text{total mass after wetting} - \text{total mass}) / (\text{mass of fibers prior to wetting})$$

wherein total mass = mass of beaker + mass of basket + mass of fibers prior to wetting

Volume resistance ("DGW")

[0034] Volume resistance was determined based on the DIN 54345 standard as follows:
Prior to measuring, a 5 gram fiber sample is carded on a laboratory carding machine and then placed for at least 24 hours into an air-conditioned chamber (23 °C, 50% relative humidity).

Measuring arrangement for fiber samples:

[0035] 0.30 grams (weighed precisely with a precision balance) of a sample are placed into the PTFE ring of the resistance meter and weighed down with the measuring plunger. Then, the measuring electrode is put on, and the carded, weighted fiber material is measured.

Example 1:

[0036] A viscose containing 8.70% by weight of cellulose, 5.20% by weight of alkali, and 2.3% by weight of sulfur, with a ripening index of 15° Hottenroth and a falling ball viscosity of 75 seconds (determined according to the Zellcheming Technical Leaflet III/5/E), was spun into a regeneration bath containing 100 g/l of sulfuric acid, 310 g/l of sodium sulfate, and 15 g/l of zinc sulfate, by means of a spinneret. The spinneret had 1053 holes with a diameter of 50 μm. 0.5% by weight of a nitrogen-containing auxiliary agent were added to the viscose spinning solution. In order to achieve adequate fiber strength, stretching by approx. 75% is carried out in the secondary bath (92 C, 15 g/l H_2S0_4). The draw-off velocity is 50 m/min.

Example 2:

[0037] A modal viscose containing 6.0% by weight of cellulose, 6.20% by weight of alkali, and 1.8% by weight of sulfur, with a gamma value of 65 and a falling ball viscosity of 130 seconds (determined according to the Zellcheming Technical Leaflet III/5/E), was spun into a regeneration bath containing 72 g/l of sulfuric acid, 115 g/l of sodium sulfate, and 55 g/l of zinc sulfate, by means of a spinneret. The spinneret had 1053 holes with a diameter of 45 μm. 2.5% by weight of a nitrogen-containing auxiliary agent were added to the viscose spinning solution. In order to achieve adequate fiber strength, stretching by approx. 115% is carried out in the secondary bath (92 C, 15 g/l H_2S0_4). The draw-off velocity is 23 m/min.

Example 3:

[0038] A lyocell spinning solution containing 13,5% by weight of cellulose and 10,0% by weight of water, with a temperature of 130°C, was spun into an aqueous regeneration bath with a temperature of 20°C, by means of a spinneret. The spinneret holes had a diameter of 50 μm. The air gap had a length of 20 mm. The blowing air in the air gap had a velocity of 2 m/sec, a temperature of 30°C and a humidity of 10 g H_2O per kg air. In order to achieve adequate fiber strength, a stretch ratio of 2,96 was applied. The draw-off velocity was 40 m/min.

[0039] The fibers from Examples 1 to 3 were treated with a soft finish of the following composition (oil pick-up of 0.3% (w/w)):

Emulsifier: 65%(w/w)

Lubricant: 15%(w/w)

Antistatic agent: 14%(w/w)

Additive: 6%(w/w)

[0040] The fibers treated in this way featured the following properties; in each case, commercially available fibers of the same fiber category were used for comparison (Table 1):

Table 1:

Fiber type	**FK**	**QPG**	**Moisture**	**Fiber pH**	**Sinking time**	**WHV**	**Volume resistance**	**Crystallinity Raman**
LENZING™ Modal	0.66	**0.92**	10.06	7.3	18.3	20.6	29.64	29
Example 2	0.66	**1.08**	10.06	7.3	13.4	19.4	17.36	29
Market modal 1	0.66	**0.73**	10.90	6.7	17.8	21.0	42.28	30
Market modal 2	0.66	**0.45**	10.40	6.9	10.4	19.2	33.82	30

(continued)

Fiber type	**FK**	**QPG**	**Moisture**	**Fiber pH**	**Sinking time**	**WHV**	**Volume resistance**	**Crystallinity Raman**
LENZING™ Viscose	0.90	**0.14**	10.50	8.2	8.6	20.7	65.08	28
Example 1	0.90	**1.26**	10.50	8.2	5.8	20.5	4.79	28
Market viscose 1	0.90	**0.14**	11.10	6.3	4.8	20.0	47.74	28
Market viscose 2	0.90	**0.03**	11.10	6.8	2.7	20.6	118.94	28
Market viscose 3	0.90	**0.11**	11.10	7.1	3.3	20.5	37.06	28
Example 3	0.10	**1.40**	9.70	7.5	9.7	23.0	47.00	44
Market lyocell 1	0.10	**0.23**	12.80	7.1	3.1	21.0	131.00	39
Market lyocell 2	0.10	**0.25**	9.00	7.0	4.1	20.5	105.00	41
Market lyocell 3	0.10	**0.45**	10.00	6.6	6.0	21.7	101.00	44

Example 4:

[0041] 1.0 dtex / 39 mm LENZING™ Modal Micro fibers, from Example 2, bleached using a conventional bleaching method and treated with a soft finish containing 70%(w/w) polyethylene glycol esters with a mean molecular mass of 400 g/mol of stearic and palmitic acids, 12%(w/w) potassium stearyl phosphate, 13%(w/w) stearyl alcohol and 5%(w/w) polyethylene glycol with a mean molecular mass of 400 g/mol to provide an oil pickup of 0.3%(w/w) were processed into 120 Nm air-jet yarn on an industrial scale by means of a Rieter spinning machine.
The following table 2 shows the percentagewise improvement in yarn quality in a direct comparison with a conventional type of modal fiber.

Table 2:

	Classimat total nonconformities / 100 km [change in %]	Neps + 200% / km [change in %]	Yarn breaks / 1000 Sh [change in %]
LENZING™ Modal fiber according to Example 2 vs. comparison type	-25 %	-32 %	-71 %

Example 5:

[0042] 130 kg of 1.3 dtex / 38 mm LENZING™ Modal fibers from Example 2 and posttreated according to Example 4 were processed into 50 Nm ring yarn.
The amount of electrostatic charge was measured using a field strength measuring device on the slivers of carding machine. The measurements were conducted at a relative atmospheric humidity of 50% and a temperature of 23 °C.

[0043] The following table 3 shows the electrostatic charge measured on the sliver on LENZING™ Modal fibers as compared to a conventional fiber type.

Table 3:

Electrostatic charge measured on sliver of:	comparison type	LENZING™ Modal
carding machine [mV]	1.4	0.01

Example 6

[0044] 1.3 dtex / 38 mm LENZING™ Modal fibers (from Example 2 and posttreated according to Example 4) on which the volume resistance was determined.

[0045] The following table 4 shows the volume resistance of LENZING™ Modal fibers (according to Example 2 and posttreated according to Example 4) in direct comparison to a conventional LENZING™ Modal fiber and two competitor modal fibers.

Table 4:

Fiber	Volume Resistance [GΩ]
LENZING™ Modal, according to Example 2	17.36
LENZING™ Modal	29.64
Modal fiber - competitor 1	42.28
Modal fiber - competitor 2	33.82

Claims

1. A manmade cellulosic fiber having improved running characteristics in the production of yarn, **characterized in that**, in the finished state, it has a QPG value of 1.0 or more, preferably 1.0 to 3.0, more preferably 1.0 to 1.8, QPG being calculated as follows:

$$\text{QPG} = (\text{WHV} \times \text{moisture} \times \text{sinking time}) / (\text{DGW} \times \text{FK} \times \text{pH} \times \text{crystallinity})$$

and in the case of a modal fiber FK = 0.66, in the case of a viscose fiber FK = 0.90, and in the case of a lyocell fiber FK = 0.10.

2. The manmade cellulosic fiber as claimed in claim 1, wherein the fiber is a staple fiber having a staple length between 18 and 120 mm.

3. The manmade cellulosic fiber as claimed in claim 1, wherein the fiber is a regenerated cellulosic fiber selected from the group containing modal and viscose fibers.

4. The manmade cellulosic fiber as claimed in claim 3, wherein the fiber is a modal fiber.

5. The manmade cellulosic fiber as claimed in claim 3 or 4, wherein the fiber has a volume resistance between 0 and 20 GΩ, preferably between 2 and 20 GΩ.

6. The manmade cellulosic fiber as claimed in claim 1, wherein the fiber is a lyocell fiber.

7. The manmade cellulosic fiber as claimed in claim 6, wherein the fiber has a volume resistance between 30 and 90 GΩ, preferably between 35 and 60 GΩ.

8. The manmade cellulosic fiber as claimed in claim 1, wherein the fiber has a soft finish of the following composition:

a) emulsifier: 40-90%, preferably 55-80%, more preferably 65-75%
b) lubricant: 0-40%, preferably 4-25%, more preferably 7-15%
c) antistatic agent: 5-50%, preferably 8-35%, more preferably 10-25%
d) additive: 0-20%, preferably 1-10%, more preferably 3-7%

9. The manmade cellulosic fiber as claimed in claim 1, wherein, in the production of yarn, the fiber exhibits the following electrostatic charges of the sliver:

- carding machine 0.001-1.0 mV, preferably 0.001-0.5 mV, more preferably 0.001-0.1 mV

10. A use of a fiber as claimed in claim 1 for the production of a yarn by means of ring spinning, compact spinning, rotor spinning, or air-jet spinning.

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EUROPEAN SEARCH REPORT

Application Number
EP 18 21 0261

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 4 297 407 A (MANCA FRANCESCO) 27 October 1981 (1981-10-27) * column 2, line 1 - line 65 * * examples * -----	1-5,8-10 6,7	INV. D01F2/00 D01F2/06 D06M15/53 D06M13/188 D06M13/217 D06M13/144 D06M13/292 D01F11/02
X	JP 2015 206128 A (TAKEMOTO OIL & FAT CO LTD) 19 November 2015 (2015-11-19) * paragraph [0004] * * examples * * table 1 * -----	1-3,5, 8-10	
Y	WO 2008/153244 A1 (KOLON INC [KR]; MOON SANG-HYUN [KR] ET AL.) 18 December 2008 (2008-12-18) * page 3, line 10 - line 14 * * examples * -----	6,7	
T	JP H05 44115 A (KAO CORP) 23 February 1993 (1993-02-23) * paragraph [0002] * * paragraph [0009] * -----		

TECHNICAL FIELDS SEARCHED (IPC)

D01F
D06M
D02G

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	15 May 2019	Fiocco, Marco

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 18 21 0261

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