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• **SWM Holdco Luxembourg**  
**5326 Contern (LU)**

(72) Inventors:  
• **NIEDERHUBER, Armin**  
**83052 BRUCKMÜHL (DE)**  
• **LEON, Romuald**  
**72700 SPAY (FR)**

(71) Applicants:  
• **Neenah Gessner GmbH**  
**83052 Bruckmühl (DE)**

(74) Representative: **Plasseraud IP**  
**104 Rue de Richelieu**  
**CS92104**  
**75080 Paris Cedex 02 (FR)**

(54) **FILTER COMPRISING A PAPER SUBSTRATE COMPRISING A MONOLAYER BASE WEB WITH DIFFERENT FIBROUS PORTIONS**

(57) The invention relates to a filter comprising a paper substrate as filter media, in particular a filter for a smoking or vaping article

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**Description****Technical Field**

- 5   **[0001]** The invention relates to the filter comprising a paper substrate as filter media, in particular the filter for a smoking or vaping article.

**Background Art**

- 10   **[0002]** A filter for a smoking or vaping article has a right circular cylindrical shape and generally comprises an outer envelope of plug wrap paper and a substrate located within the outer envelope. The filter for a smoking or vaping article, by virtue of the substrate, makes it possible to prevent the user from inhaling tobacco particles and allows retention of the harmful particulate substances contained in the smoke or the aerosol, such as tar.

- 15   **[0003]** Conventional filters comprise cellulose acetate tow. Said conventional filters are also known as cellulose acetate filters. The cellulose acetate filters have a nicotine retention capacity such that the user's perception of the filtered smoke is satisfactory. However, the cellulose acetate filters degrade very slowly and have negative impact on the environment. Indeed, the filter is not consumed during the smoking/vaping of a smoking/vaping article and is regularly found in the environment. Cellulose acetate filters thus have a significant environmental impact.

- 20   **[0004]** To limit the environmental impact of cellulose acetate filters, it has been proposed to replace the cellulose acetate tow with a paper substrate obtained by a wetlaid process. As the paper substrates are biodegradable, the filters comprising a paper substrate degrade rapidly. However, the filters comprising a paper substrate have higher filtration efficiency, in particular higher nicotine retention capacity, and lower hardness than cellulose acetate filters. Since the nicotine retention capacity is higher, then the perception of the filtered smoke by the user may not be satisfactory. Accordingly, the user experience provided by the filters comprising a paper substrate is not as satisfactory as the user experience provided by  
25 the cellulose acetate filters.

**Technical problem**

- 30   **[0005]** There is therefore a need for a paper substrate which can be used as a filter media and enables the manufacture of a filter for a smoking article or a vaping article and which has a nicotine retention capacity which tends towards the nicotine retention capacity of a cellulose acetate filter. In other words, there is a need for a paper substrate which provides to the user of a smoking or vaping article a satisfactory experience.

- 35   **[0006]** It is thus to the credit of the inventors to have found that it was possible to meet this need by means of a paper substrate comprising a monolayer base web with different fibrous portions.

**Summary**

- 40   **[0007]** It is proposed a filter comprising a paper substrate as a filter media, said paper substrate comprising a monolayer base web having a first portion and a second portion, the first portion and the second portion being disposed next to each other along a thickness direction of the monolayer base web,

- 45       wherein the fibers of the first portion are intermeshed with the fibers of the second portion in a transition zone, wherein the second portion comprises more fibers, in terms of mass per unit area, than the first portion, wherein the density of the paper substrate is from 200 mg/cm<sup>3</sup> to 300 mg/cm<sup>3</sup>, in particular from 220 mg/cm<sup>3</sup> to 270 mg/cm<sup>3</sup>, more particularly from 230 mg/cm<sup>3</sup> to 260 mg/cm<sup>3</sup>.

- [0008]** Unexpectedly, in comparison to a standard paper filter, the nicotine retention capacity of the filter of the invention is advantageously improved as it tends towards the nicotine retention capacity of a cellulose acetate filter.

- 50   **[0009]** Moreover, the difference between the hardness of the filter of the invention and the hardness of a cellulose acetate filter is unexpectedly lower than the difference between the hardness of a standard paper filter and the hardness of cellulose acetate filter.

- [0010]** Without wishing bound to any theory, the inventors are of the opinion that these two improvements may be due to the density of the paper substrate since said density is lower than the density of a conventional paper substrate used in the standard paper filters, i.e. about 429 mg/cm<sup>3</sup>.

- 55   **[0011]** Indeed, the probability that nicotine of the smoke or aerosol interacts with the fibers decreases as the density decreases.

- [0012]** Moreover, a lower density requires to more compact the paper substrate to manufacture filters having the same weight as the conventional cellulose acetate filters, thereby increasing the hardness of the filters.

**[0013]** According to another aspect, it is proposed a process for producing a paper substrate as defined above, comprising the following steps:

- a1) forming a monolayer base web on a substrate, and
- b1) removing the monolayer base web from the substrate to produce the paper substrate.

**[0014]** According to another aspect, it is proposed a process for producing a filter as defined above for a smoking article or vaping article, comprising the following steps:

- a2) forming a rod from the paper substrate produced by the process for producing a paper substrate as defined above,
- b2) wrapping the rod with a sheet of plug wrap paper, and
- c2) depositing an adhesive line at the junction of the sheet of plug wrap paper to obtain a rod of filtering material, and
- d2) cutting the rod of filtering material to produce the filter.

**[0015]** The process for producing the filter of the invention is advantageously cost-effective since it does not require the addition of other component than a starting material to produce a base web in order to obtain its nicotine retention capacity.

### Description of Embodiments

**[0016]** It is proposed a filter comprising a paper substrate as a filter media, said paper substrate comprising a monolayer base web having a first portion and a second portion, the first portion and the second portion being disposed next to each other along a thickness direction of the monolayer base web,

wherein the fibers of the first portion are intermeshed with the fibers of the second portion in a transition zone, wherein the second portion comprises more fibers, in terms of mass per unit area, than the first portion, wherein the density of the paper substrate is from 200 mg/cm<sup>3</sup> to 300 mg/cm<sup>3</sup>, in particular from 220 mg/cm<sup>3</sup> to 270 mg/cm<sup>3</sup>, more particularly from 230 mg/cm<sup>3</sup> to 260 mg/cm<sup>3</sup>.

**[0017]** The term "monolayer base web" is used herein to mean a fibrous sheet made of a single layer.

**[0018]** The monolayer base web has a first portion and a second portion, and the first portion and second portions are disposed next to each other along a thickness direction of the monolayer base web. The first portion and second portion may be lamellar, i.e. having first and second dimensions that are both larger than a third dimension (i.e. a thickness direction), and typically overlie one another and occupy the same area of the monolayer base web. The thickness direction is from one face of the monolayer base web to the other face of the monolayer base web, and is typically the shortest distance from opposing faces of the monolayer base web. The fibers from the first portion are intermeshed with the fibers from the second portion - this may be from forming first and second portion together, e.g. by wet laying both first and second portion together, as described herein, to allow intermeshing of the fibers. Accordingly, at the point where the first and second portions meet in the layer, fibers from the first portion intermesh with the second portion, binding first and second portions together. This allows a continuum of the intermeshed fibrous structure through the thickness of the monolayer base web and therefore a continuum of voids through the thickness of the monolayer base web, and avoids an abrupt interface as would be seen when two separately-formed fibrous layers are contacted together.

**[0019]** The first and second portion formed may be as described herein, e.g. wherein the weight ratio of the fibers in the first portion to the fibers in the second portion is n:1, wherein n is >1, and wherein the monolayer base web comprises two different types of cellulosic fiber and the second portion comprises more synthetic fibers, in terms of mass per unit area, than the first portion.

**[0020]** The weight ratio of fibers of the first portion to the fibers of the second portion may be from 20:80 to 40:60, in particular from 25:75 to 35:65.

**[0021]** The fibers of the first portion may be curled fibers and the fibers of the second portion may be uncurled fibers.

**[0022]** In contrary to the uncurled fibers, the curled fibers are fibers having a shape of spiral or helix. Moreover, the curled fibers differ from the uncurled by the air permeability. Indeed, the air permeability of the curled fibers is at least 20% higher than uncurled fibers.

**[0023]** The density of the monolayer base web of the filter of the present invention may be reached thanks to the curled fibers and the uncurled fibers.

**[0024]** Independently from each other, the fibers of the first portion and the fibers of the second portion may be wood fibers, natural fibers or combinations thereof.

**[0025]** Wood fibers may be hardwood pulp, bleached hardwood pulp, softwood pulp, bleached softwood pulp, softwood fluff pulp, lyocell fibers (cellulose fibers which are ground and dissolved in N-methylmorpholine N-oxide monohydrate for the purpose of obtaining fibers with a cross section of variable shape (round, oval, cross-shaped, circular, lamellar cross

section) with calibrated length and mass per unit length, which the person skilled in the art can choose depending on their needs), viscose fibers (fibers obtained by dissolving cellulose by means of modification of its hydroxyl groups by carbon disulfide (CS<sub>2</sub>) and then precipitating it in the presence of sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) for the purpose of obtaining fibers with a cross section of variable shape (round, oval, cross-shaped, circular, lamellar cross section) with calibrated length and mass per unit length, which the person skilled in the art can choose depending on their needs) or mixtures thereof, in particular bleached softwood pulp, softwood pulp, softwood fluff pulp, lyocell fibers, viscose fibers or mixtures thereof, more particularly bleached softwood pulp, softwood pulp, softwood fluff pulp or mixtures thereof.

**[0026]** Natural fibers such as leaf fibers, fruit fibers, seed fibers, bast fibers, stalk fibers, reed fibers or mixtures thereof, in particular leaf fibers, seed fibers, bast fibers or mixtures thereof, more particularly bast fibers.

**[0027]** For the purposes of the present application, "bast fiber" denotes a plant fiber contained in the bast of the plants.

**[0028]** The bast fibers may be abaca fibers, hemp fiber, Indian hemp fiber, jute fiber, kenaf fiber, kudzu fiber, coin vine fiber, flax fiber, okra fiber, nettle fiber, papyrus fiber, ramie fiber, sisal fiber, esparto fiber or mixtures thereof, in particular hemp fiber, flax fiber, sisal fiber or mixtures thereof, more particularly flax fiber, sisal fiber, or mixtures thereof.

**[0029]** For the purposes of the present application, "seed fiber" denotes a fiber obtained from seeds of a plant. The seed fibers may be cotton fiber, kapok fiber, luffa fiber, milkweed fiber or mixtures thereof.

**[0030]** The air permeability of the paper substrate may be higher than 4000 CORESTA Unit (CU), in particular from 6000 CU to 12000 CU, more particularly from 9000 CU to 11000 CU.

**[0031]** An air permeability in these ranges is advantageously higher than the air permeability of a paper substrate used in the standard paper filters, i.e. about 3300 CU. This higher air permeability can explain the better nicotine retention capacity of the filter of the present invention than the nicotine retention capacity of the standard paper filters.

**[0032]** The air permeability of the paper substrate can be determined by ISO 2965:2009. The paper substrate can be conditioned for at least 30 min at 23°C and 50% humidity before the measurement.

**[0033]** The thickness of the paper substrate may be from 100 μm to 200 μm, in particular from 120 μm to 180 μm, more particularly from 130 μm to 170 μm.

**[0034]** The basis weight of the paper substrate may be from 25 g/m<sup>2</sup> to 55 g/m<sup>2</sup>, in particular from 30 g/m<sup>2</sup> to 50 g/m<sup>2</sup>, more particularly from 35 g/m<sup>2</sup> to 45 g/m<sup>2</sup> measured as per ISO 536:2012.

**[0035]** The skilled person knows how to adapt the basis weight and the thickness of the paper substrate to reach the required density since the density of the paper substrate is calculated by dividing its basis weight by its thickness.

**[0036]** The standard ISO 534:2011 can be used to determine the thickness of paper substrate. The paper substrate can be conditioned for at least 30 min at 23°C and 50% humidity before the measurement.

**[0037]** The standard ISO 536:2012 can be used to determine the basis weight of the paper substrate. The paper substrate can be conditioned for at least 30 min at 23°C and 50% humidity before the measurement.

**[0038]** The tensile strength ratio MD/CD of the paper substrate may be from 2.0 to 3.2, in particular from 2.1 to 2.8, more particularly from 2.2 to 2.7.

**[0039]** These ranges of tensile strength ratio ensures that the mechanical properties of the paper substrate are sufficient to produce the filter of the present invention.

**[0040]** The tensile strength ratio is obtained by dividing tensile strength values measured in machine direction (MD) by tensile strength values measured in cross direction (CD). The tensile strength values in machine direction (MD) and the tensile strength values in cross direction (CD) may be measured at 15 mm band size as per ISO 1924-2 2009-05.

**[0041]** The elongation at break in machine direction (MD) of the paper substrate may be from 1.4% to 2.5%, in particular from 1.5% to 2.4%, more particularly from 1.6% to 2.2 %.

**[0042]** The elongation at break in cross direction (CD) of the paper substrate may be from 3.0% to 5.5%, in particular from 3.2% to 5.2%, more particularly from 3.5% to 5.0%.

**[0043]** The elongation at break in machine direction (MD) and the elongation at break in cross direction (CD) may be measured at 15 mm band size as per ISO 1924-2 2009-05.

**[0044]** The specific volume of the paper substrate may be from 4.5 cm<sup>3</sup>/g to 9 cm<sup>3</sup>/g, in particular from 5 cm<sup>3</sup>/g to 7 cm<sup>3</sup>/g, more particularly from 5.5 cm<sup>3</sup>/g to 6.5 cm<sup>3</sup>/g.

**[0045]** The specific volume, V<sub>sp</sub>, is obtained by the following formula :

$$V_{sp} = (\text{thickness} \cdot 1000) / \text{grammage}$$

**[0046]** In one embodiment, the weight ratio of the fibers of the first portion to the fibers of the second portion may be from 20:80 to 40:60, the thickness of the of the paper substrate may be from 100 μm to 200 μm, the tensile strength ratio MD/CD of the paper substrate may be from 2 to 3.2, the fibers of the first portion and of the second portion may be wood fibers, the fibers of the first portion may be curled fibers and the fibers of the second portion may be uncurled fibers, and the specific volume of the paper substrate may be from 4.5 cm<sup>3</sup>/g to 9 cm<sup>3</sup>/g.

**[0047]** In one embodiment, the weight ratio of the fibers of the first portion to the fibers of the second portion may be from

20:80 to 40:60, the thickness of the of the paper substrate may be from 100  $\mu\text{m}$  to 200  $\mu\text{m}$ , the tensile strength ratio MD/CD of the paper substrate may be from 2.2 to 2.7, the fibers of the first portion and of the second portion may be wood fibers, the fibers of the first portion may be curled fibers and the fibers of the second portion may be uncurled fibers, and the specific volume of the paper substrate may be from 5.5  $\text{cm}^3/\text{g}$  to 6.5  $\text{cm}^3/\text{g}$ .

**[0048]** The filter of the present invention may be a filter for a smoking article or a vaping article.

**[0049]** For the purposes of the present application, "smoking article" denotes an article comprising tobacco and/or any other plant intended to be smoked. For example, the smoking article may be a machine-manufactured cigarette, a roll-your-own cigarette or a make-your-own cigarette.

**[0050]** Typically, the filter for a smoking article has a right circular cylindrical shape and comprises an outer envelope of plug wrap paper for a smoking article, in particular for a cigarette, and the paper substrate as defined above located within the outer envelope.

**[0051]** For the purposes of the present application, "vaping article" denotes an article comprising tobacco and/or any other plant intended to be vaped, which is intended to be inserted into a device which heats the tobacco and/or the plant without burning said tobacco/plant and which enables delivery of an aerosol to a user. For example, the vaping article can be a tobacco stick.

**[0052]** Typically, the filter for a vaping article has a right circular cylindrical shape and comprises an outer envelope of plug wrap paper for a vaping article, in particular for a tobacco stick, and the paper substrate as defined above located within the outer envelope.

**[0053]** The filter of the invention can comprise:

- an outer envelope of plug wrap paper for a filter for a smoking or vaping article, and
- the paper substrate within the outer envelope.

**[0054]** The filter of the invention can have a right circular cylindrical shape.

**[0055]** According to another aspect, the present invention also relates to a smoking article comprising a filter as defined above.

**[0056]** According to another aspect, the present invention also relates to a vaping article comprising a filter as defined above.

**[0057]** According to another aspect, it is proposed a process for producing a paper substrate as defined above, comprising the following steps:

- a1) forming a monolayer base web on a substrate, and
- b1) removing the monolayer base web from the substrate to produce the paper substrate.

**[0058]** The monolayer base web may be made using any suitable technique that allows intermeshing of fibers, including, but not limited to, wet laying, air laying and foam forming or laying of fibers. Wet laying is preferred, since it typically results in a thinner fibrous layer than, for example, air laying.

**[0059]** For example, step a1) may comprise the following sub-steps:

- a111) wet laying the first portion on the substrate by disposing a first slurry containing fibers on the substrate and, while the first portion is still wet, wet laying the second portion on the first portion, to allow intermeshing of the fibers in the first portion with the second portion, and then
- a112) removing liquid from the first and second portions to form the monolayer base web.

**[0060]** Alternatively, step a1) may comprise the following sub-steps:

- a121) wet laying the second portion on the substrate by disposing a second slurry containing fibers on the substrate and, while the second portion is still wet, wet laying the first portion on the second portion, to allow intermeshing of the fibers in the first portion with the second portion, and then
- a122) removing liquid from the first and second portions to form the monolayer base web.

**[0061]** The first and second slurries may be wet laid using a paper making machine, such as a fourdrinier or a rotoformer. The paper making machine preferably has a dual channel headbox, i.e. allowing two different slurries to be laid on top of one another.

**[0062]** The substrate may be a porous substrate, such as a wire mesh or porous screen, that allows liquid from the slurries to flow through, but not the fibers from the slurries to flow through. The liquid may be removed by vacuum, e.g. by reducing the pressure below the porous substrate, to effect a flow of liquid through the substrate.

**[0063]** The first slurry and second slurry as applied to the substrate may, respectively, contain the the same or different

types and proportions of fibers to form the monolayer base web. The concentrations of the different types of fibers within the first and second slurries and the relative volumes of first and second slurries applied to the substrate can be adjusted by the skilled person to reflect the desired relative amounts of fibers within the first and second portions. For example, the weight ratio of the fibers in the first portion to the fibers in the second portion is  $n:1$ , wherein  $n$  is  $>1$ . Accordingly, to achieve this with first and second slurries with the same total concentration of fibers as one another, a greater volume of the first slurry is laid down on a substrate (to form the first portion) in a wet laying technique, than the volume of the second slurry laid down on the first portion; similarly, where the first and second slurries have same total concentration of fibers then the relative volumes of first and second slurries laid down on the substrate (or, in the case of the second slurry, on the first portion formed by the first slurry), i.e. volume of first slurry:volume of second slurry, may be  $n:1$ , e.g. wherein  $n$  is 2 to 10, optionally 3 to 5, optionally 3.5 to 4.5 optionally about 4. If the total concentration of fibers in first and second slurries is different, then the volume of the slurry laid down on the substrate can be adjusted accordingly by the skilled person, to ensure that the weight ratio of the fibers in the first portion to the fibers in the second portion is  $n:1$ , wherein  $n$  is  $>1$ .

**[0064]** According to another aspect, it is proposed a process for producing a filter as defined above for a smoking article or vaping article, comprising the following steps:

- a2) forming a rod from the paper substrate produced by the process for producing a paper substrate as defined above,
- b2) wrapping the rod with a sheet of plug wrap paper, and
- c2) depositing an adhesive line at the junction of the sheet of plug wrap paper to obtain a rod of filtering material, and
- d2) cutting the rod of filtering material to produce the filter.

**[0065]** Steps b2) to d2) are steps well known to the skilled person. The skilled person knows how to adapt the parameters of these processes to produce the filter of the invention.

**[0066]** The paper substrate involved in step a2) can be shaped.

**[0067]** The process may comprise, before step a2), a step of shaping the paper substrate by crimping, embossing, folding, compression or combinations thereof.

## Examples

### Example 1: Paper substrate manufacturing

**[0068]** The paper substrate was produced as follows:

A slurry comprising softwood fibers and hardwood fibers with a weight ratio of 90:10 is introduced into first head-box of a wetlaid process. A slurry comprising only softwood fibers as fibers is introduced into a second headbox of a wetlaid process.

A first portion is wet layed on a porous substrate from the first-head box, then while the first portion is still wet, the second portion is wet layed on the first portion from the second-head box.

The liquid is removed from the first and second portions are dried to remove to form a monolayer base web.

The monolayer base web is then removed from the porous substrate to obtain the paper substrate.

**[0069]** The ratio of the fibers of the first portion to the fibers of the second portion is 70:30 respectively.

**[0070]** The paper substrate Obtained paper has a density of  $245 \text{ mg/cm}^3$ , a basis weight of  $40 \text{ g/m}^2$ , a thickness of  $161 \mu\text{m}$  and a permeability of 10930 CU.

**[0071]** The properties of the manufactured paper substrate (referred as paper substrate of Example 1 below) and of a conventional paper substrate (referred as conventional paper substrate below) used in standard paper filters are presented in Table 1.

[Table 1]

|                                    | conventional paper substrate | Paper substrate of Example 1 |
|------------------------------------|------------------------------|------------------------------|
| Density ( $\text{mg/cm}^3$ )       | 429                          | 245                          |
| Basis weight ( $\text{g.m}^{-2}$ ) | 36                           | 40                           |
| Thickness ( $\mu\text{m}$ )        | 84                           | 161                          |
| Permeability (CU)                  | 3300                         | 10931                        |

**Example 2: Filter manufacturing**

[0072] A filter rod for a smoking article was manufactured with a nonporous plug wrap paper having a basis weight of 23.5 g/m<sup>2</sup> as an outer envelope and the paper substrate of Example 1.

[0073] A filter rod for a smoking article was manufactured with a nonporous plug wrap paper having a basis weight of 23.5 g/m<sup>2</sup> as an outer envelope and the conventional paper substrate.

[0074] The properties of these two filter rods were compared with the properties of a commercial cellulose acetate filter rod from Marlboro Red France™.

[0075] The filter rod hardness was measured by a standard method by use a Filtrona DHT200 equipment. Results are expressed at % of crushing versus initial diameter of filter.

[0076] The characteristics of the filters are given in Table 2 below.

[0077] Table 2 demonstrates that the filters according to the invention have:

- higher hardness than hardness of the conventional paper filter, and
- hardness of the same magnitude of order or higher than the hardness of the commercial cellulose acetate filter.

[Table 2]

|                            | Commercial cellulose<br>acetate filter | Comparative paper filter | Filter with Paper substrate<br>of Example 1 |
|----------------------------|----------------------------------------|--------------------------|---------------------------------------------|
| Filter rod weight (mg)     | n.d.                                   | 232                      | 229                                         |
| Hardness of filter rod (%) | 95%                                    | 92%                      | 96%                                         |

**Example 3: Manufacture and characterization of cigarettes**

[0078] Cigarettes were prepared using the filters rods described in Example 2. The filters were cut to 21 mm length. To form the cigarettes, the rods of tobacco were assembled with the cut filters using nonporous 35g/m<sup>2</sup> tipping paper. A commercial "American blend" tobacco was used to form the rods of tobacco. The cigarettes were prepared with a pressure difference similar to that of the commercial cigarette. The ventilation of the cigarettes was blocked.

[0079] The cigarettes prepared were smoked on a Borgwaldt RM20 smoking machine in accordance with the standard ISO 3308:2000. The pressure drop was measured in accordance with the standard ISO 6565:2002. The nicotine content in the smoke was measured in accordance with the standard ISO 10315:2000. The smoking results are given in Table 3 below.

[0080] Table 3 demonstrates that, with an equivalent pressure drop, the difference between the nicotine retention of the cigarettes with the filter according to the invention and the nicotine retention of the cigarettes with the commercial cellulose acetate filter is lower than the difference between the nicotine retention of the cigarette with the conventional paper filter and the nicotine retention of the cigarettes with the commercial cellulose acetate filter.

[Table 3]

|                                                  | Commercial cellulose<br>acetate filter | Comparative<br>paper filter | Filter with Paper substrate<br>of Example 1 |
|--------------------------------------------------|----------------------------------------|-----------------------------|---------------------------------------------|
| Cigarette pressure drop (mmWg)                   | 104                                    | 116                         | 116                                         |
| Nicotine retention in smoke vs cellulose acetate | 0%                                     | -41%                        | -31%                                        |

**Claims**

1. Filter comprising a paper substrate as a filter media, said paper substrate comprising a monolayer base web having a first portion and a second portion, the first portion and the second portion being disposed next to each other along a thickness direction of the monolayer base web,

wherein the fibers of the first portion are intermeshed with the fibers of the second portion in a transition zone, wherein the second portion comprises more fibers, in terms of mass per unit area, than the first portion,

wherein the density of the paper substrate is from 200 mg/cm<sup>3</sup> to 300 mg/cm<sup>3</sup>.

2. Filter according to claim 1, wherein the air permeability of the paper substrate is higher than 4000 Coresta Unit (CU).

3. Filter according to claim 1 or claim 2, wherein the thickness of the paper substrate is from 100 μm to 200 μm.

4. Filter according to any of claims 1 to 3, wherein the basis weight of the paper substrate is from 25 to 55 g/m<sup>2</sup>.

5. Filter according to any of claims 1 to 4, wherein the tensile strength ratio MD/CD of the paper substrate is from 2 to 3.2.

6. Filter according to any of claims 1 to 5, wherein the fibers of the first portion are curled fibers and the fibers of the second portion are uncurled fibers.

7. Filter according to any of claims 1 to 6, wherein the fibers of the first portion and the fibers of the second portion are, independently from each other, wood fibers, natural fibers or combinations thereof.

8. Filter according to any one of Claims 1 to 7 for a smoking article or a vaping article.

9. Smoking article comprising a filter as defined in Claim 8.

10. Vaping article comprising a filter as defined in Claim 8.

11. Process for producing a paper substrate as defined in any one of claims 1 to 7, comprising the following steps:

- a1) forming a monolayer base web on a substrate, and
- b1) removing the monolayer base web from the substrate to produce the paper substrate.

12. Process according to claim 11, wherein step a1) comprises the following sub-steps:

- a111) wet laying the first portion on the substrate by disposing a first slurry containing fibers on the substrate and, while the first portion is still wet, wet laying the second portion on the first portion, to allow intermeshing of the fibers in the first portion with the second portion, and then
- a112) removing liquid from the first and second portions to form the monolayer base web.

13. Process according to claim 11, wherein step a1) comprises the following sub-steps:

- a121) wet laying the second portion on the substrate by disposing a second slurry containing fibers on the substrate and, while the second portion is still wet, wet laying the first portion on the second portion, to allow intermeshing of the fibers in the first portion with the second portion, and then
- a122) removing liquid from the first and second portions to form the monolayer base web.

14. Process for producing a filter as defined in claim 8 for a smoking article or vaping article, comprising the following steps:

- a2) forming a rod from the paper substrate produced by the process for producing a paper substrate as defined in claim 11 or claim 12,
- b2) wrapping the rod with a sheet of plug wrap paper, and
- c2) depositing an adhesive line at the junction of the sheet of plug wrap paper to obtain a rod of filtering material, and
- d2) cutting the rod of filtering material to produce the filter.





## EUROPEAN SEARCH REPORT

Application Number

EP 24 30 6871

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category                                                                                                                                                                                                                                                                              | Citation of document with indication, where appropriate, of relevant passages                                                                     | Relevant to claim                | CLASSIFICATION OF THE APPLICATION (IPC)              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------------------------------|
| A                                                                                                                                                                                                                                                                                     | GB 795 666 A (OLIN MATHIESON)<br>28 May 1958 (1958-05-28)<br>* page 1, lines 15-35,57-69 *<br>* claims; figures *                                 | 1-14                             | INV.<br>A24D3/02<br>A24D3/04<br>A24D3/06<br>A24D3/10 |
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