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(71) Applicant: **Philip Morris Products S.A.**
2000 Neuchâtel (CH)

(72) Inventors:
- **Rasouli, Firooz**
  Midlothian, Virginia 23113 (US)
- **Kadiric, Alen**
  2552 Orpund (CH)

(74) Representative: **Dowling, Ian**
Reddie & Grose LLP
16 Theobalds Road
London WC1X 8PL (GB)

(54) **Porous cigarette paper**

(57) A smoking article comprises a mouthpiece and an aerosol generating substrate wrapped in a cigarette paper. The cigarette paper is formed from a sheet material comprising a mixture of cellulosic fibres, a polymeric material and a filler. The polymeric material is present in an amount of at least 2 percent by weight of the sheet material and the filler is present in an amount of at least 30 percent by weight of the sheet material.

EP 2 888 956 A1

Description

[0001] The present invention relates to a smoking article comprising a cigarette paper formed from a sheet material with controlled permeability and diffusivity. The present invention also relates to a method of forming the sheet material.

[0002] Filter cigarettes typically comprise a cylindrical rod of tobacco cut filler surrounded by a paper wrapper, also known as a cigarette paper. A cylindrical filter is axially aligned in an abutting end-to-end relationship with the wrapped tobacco rod. The cylindrical filter typically comprises a filtration material circumscribed by a paper plug wrap. Conventionally, the wrapped tobacco rod and the filter are joined by a band of tipping wrapper, normally formed of a paper material that circumscribes the entire length of the filter and an adjacent portion of the wrapped tobacco rod.

[0003] A number of smoking articles in which an aerosol forming substrate, such as tobacco, is heated rather than combusted have also been proposed in the art. In heated smoking articles, the aerosol is generated by heating the aerosol forming substrate. Known heated smoking articles include, for example, smoking articles in which an aerosol is generated by electrical heating or by the transfer of heat from a combustible fuel element or heat source to an aerosol forming substrate. The aerosol generating substrate may be wrapped in a paper wrapper, such as a cigarette paper. During smoking, volatile compounds are released from the aerosol forming substrate by heat transfer from the heat source and entrained in air drawn through the smoking article. As the released compounds cool, they condense to form an aerosol that is inhaled by the consumer. Also known are smoking articles in which a nicotine-containing aerosol is generated from a tobacco material, tobacco extract, or other nicotine source, without combustion, and in some cases without heating, for example through a chemical reaction.

[0004] Two aspects of smoking article design that affect the composition of mainstream smoke delivered to a consumer are the permeability and the diffusivity of the cigarette paper used to wrap the aerosol generating substrate. The term "permeability" is used herein to mean the rate at which a gas flows through a substrate as a result of a pressure gradient across the substrate. The term "diffusivity" is used herein to mean the rate at which a gas flows through a substrate as a result of a concentration gradient across the substrate. The two mechanisms are not mutually exclusive and diffusion may still occur even when a pressure gradient is applied across the substrate. If the concentration gradient is in the opposite direction to the pressure gradient, the movement of gas across the substrate will be the net result of the two opposing mechanisms.

[0005] It would be desirable to provide a means of tailoring one or both of the permeability and the diffusivity of a cigarette paper to increase the retention of desirable molecules in mainstream smoke (nicotine, for example) while decreasing the retention of unwanted molecules (carbon monoxide, for example).

[0006] Accordingly, the present invention provides a smoking article comprising a mouthpiece and an aerosol generating substrate wrapped in a cigarette paper. The cigarette paper is formed from a sheet material comprising a mixture of cellulosic fibres, a polymeric material and a filler. The polymeric material is present in an amount of at least 2 percent by weight of the sheet material and the filler is present in an amount of at least 30 percent by weight of the sheet material.

[0007] The combination of a relatively large amount of filler with the polymeric material in cigarette papers according to the present invention increases the total pore volume by creating a larger number of smaller pores when compared with traditional cigarette paper. Therefore, cigarette papers in accordance with the present invention exhibit a larger total pore volume and a smaller average pore size when compared with traditional cigarette paper.

[0008] The present inventors have recognised that the permeability of a paper material is substantially independent of the molecular weight of the permeating gas, whereas the diffusivity of a paper material can vary according to the molecular weight of the diffusing gas. In particular, where the pore diameter is smaller than the mean free path of the diffusing gas molecules and the density of the gas is relatively low, the gas molecules collide with the pore walls more frequently than they do with each other, in a process known as Knudsen diffusion. The rate at which gas molecules diffuse via Knudsen diffusion is dependent on the molecular weight of the molecules in the diffusing gas.

[0009] Accordingly, the present inventors have recognised that the larger total pore volume and the smaller average pore size of cigarette papers in accordance with the present invention advantageously favours diffusion of smaller molecules, such as carbon monoxide, over larger molecules, such as nicotine. In other words, by forming a cigarette paper having a larger number of smaller pores, the increase in the diffusion rate of smaller molecules, such as carbon monoxide, is greater than the increase in the diffusion rate of larger molecules, such as nicotine. Therefore, by exhibiting a faster diffusion rate for smaller molecules compared to larger molecules, certain smaller molecules can be reduced in a larger proportion than certain larger molecules. For example, a smoking article according to the present invention can exhibit a smaller amount of carbon monoxide per milligram of nicotine delivered to the consumer when compared to the same smoking article constructed using traditional cigarette paper.

[0010] The polymeric material facilitates the incorporation of a relatively large amount of filler in the sheet material by helping to bind the filler and the cellulosic fibres together. Preferably, the polymeric material comprises a polysaccharide such as guar gum, starch, algi-

nate, or a mixture thereof. The polymeric material is preferably present in an amount of between about 2% and about 5% by weight of the sheet material.

[0011] The filler preferably comprises calcium carbonate. The filler is preferably present in an amount of between about 30% and about 50% by weight of the sheet material. In some embodiments, the filler comprises a particulate material, wherein the particulate material preferably has a number average particle size of between about 0.2 and about 5.0 micrometres.

[0012] The sheet material preferably has a permeability of between about 10 Coresta units and about 100 Coresta units measured in accordance with the Coresta Recommended Method No. 40. A permeability within this range can provide a desirable burn rate if the aerosol generating substrate is combusted during use, such as a wrapped tobacco rod in a filter cigarette.

[0013] Preferably, the sheet material has a diffusivity of between about 2.4 centimetres per second and about 3.5 centimetres per second for carbon dioxide, measured in accordance with the Coresta method CRM 77 and using an apparatus in line with requirements given in section 5 "apparatus" of CRM 77. The method measures diffusivity (diffusion capacity) by diffusion of CO_2 through a defined area of the sample into N_2 without any significant pressure differential across the sample. Suitable diffusivity meters are available from Hauni Sodim (France), Hauni Borgwalt (Germany) and Cerulean (United Kingdom), for example.

[0014] The cellulosic fibres in the sheet material may be randomly oriented staple fibres. Additionally, or alternatively, the cellulosic fibres are preferably any wood fibres or annual plant fibres.

[0015] Smoking articles according to the present invention may be filter cigarettes or other smoking articles in which a tobacco material is combusted to form smoke. Alternatively, smoking articles according to the present invention may be articles in which a tobacco material is heated to form an aerosol, rather than combusted. In one type of heated smoking article, a tobacco material is heated by one or more electrical heating elements to produce an aerosol. In another type of heated smoking article, an aerosol is produced by the transfer of heat from a combustible or chemical heat source to a physically separate tobacco material, which may be located within, around or downstream of the heat source. The present invention further encompasses smoking articles in which a nicotine-containing aerosol is generated from a tobacco material, tobacco extract, or other nicotine source, without combustion, and in some cases without heating, for example through a chemical reaction.

[0016] The present invention also extends to cigarette papers for use in smoking articles according to any of the embodiments described above. Therefore, the present invention also provides a cigarette paper formed from a sheet material comprising a mixture of cellulosic fibres, a polymeric material and a filler, wherein the polymeric material is present in an amount of at least 2 percent by weight of the sheet material, and wherein the filler is present in an amount of at least 30 percent by weight of the sheet material.

[0017] Preferably, the polymeric material comprises a polysaccharide such as guar gum, starch, alginate, or a mixture thereof. The polymeric material is preferably present in an amount of between about 2% and about 5% by weight of the sheet material.

[0018] The filler preferably comprises calcium carbonate. The filler is preferably present in an amount of between about 30% and about 50% by weight of the sheet material. In some embodiments, the filler comprises a particulate material, wherein the particulate material preferably has a number average particle size of between about 0.2 and about 5.0 micrometres.

[0019] The sheet material preferably has a permeability of between about 10 Coresta units and about 100 Coresta units measured in accordance with the Coresta Recommended Method No. 40. A permeability within this range can provide a desirable burn rate when the cigarette paper is used to wrap an aerosol generating substrate that is combusted during use, such as a wrapped tobacco rod in a filter cigarette.

[0020] Preferably, the sheet material has a diffusivity of between about 2.4 centimetres per second and about 3.5 centimetres per second for carbon dioxide, measured in accordance with the Coresta method CRM 77, as described above.

[0021] The cellulosic fibres in the sheet material may be randomly oriented staple fibres. Additionally, or alternatively, the cellulosic fibres are preferably any wood fibres or annual plant fibres.

[0022] The present invention also extends to a method of forming a sheet material for use as a cigarette paper in accordance with any of the embodiments described above. Therefore, the present invention provides a method of forming a sheet material for use as a cigarette paper, the method comprising a step of forming a pulp comprising a mixture of cellulosic fibres, a polymeric material and a filler. The pulp is deposited on a forming surface and dried to form a substantially continuous sheet material. The polymeric material is present in an amount of at least 2 percent by weight of the sheet material, and the filler is present in an amount of at least 30 percent by weight of the sheet material.

[0023] As described above, the polymeric material facilitates the incorporation of a relatively large amount of filler in the sheet material by helping to bind the filler and the cellulosic fibres together. Preferably, the polymeric material comprises guar gum, starch, alginate, or a mixture thereof. The polymeric material is preferably present in an amount of between about 2% and about 5% by weight of the sheet material.

[0024] The filler preferably comprises calcium carbonate. The filler is preferably present in an amount of between about 30% and about 50% by weight of the sheet material. In some embodiments, the filler comprises a particulate material, wherein the particulate material has

a number average particle size of between about 0.2 and about 0.5 micrometres.

[0025] The sheet material preferably has a permeability of between about 10 Coresta units and about 100 Coresta units for carbon dioxide, measured in accordance with the Coresta Recommended Method No. 40. A permeability within this range can provide a desirable burn rate when the sheet material is used as a cigarette paper to wrap an aerosol generating substrate that is combusted during use, such as a wrapped tobacco rod in a filter cigarette.

[0026] Preferably, the sheet material has a diffusivity of between about 2.4 centimetres per second and about 3.5 centimetres per second for carbon dioxide, measured in accordance with the Coresta method CRM 77, as described above.

[0027] The cellulosic fibres in the sheet material may be randomly oriented staple fibres. Additionally, or alternatively, the cellulosic fibres are preferably any wood fibres or annual plant fibres.

[0028] The present invention also extends to the use of a sheet material to form a cigarette paper, the sheet material comprising a mixture of cellulosic fibres, a polymeric material and a filler, wherein the polymeric material is present in an amount of at least 2 percent by weight of the sheet material, and wherein the filler is present in an amount of at least 35 percent by weight of the sheet material.

Examples

[0029] To demonstrate the change in porosity caused by the incorporation of a polymeric material and a relatively large amount of filler when compared to a traditional cigarette paper, several test papers were formed and the resulting pore size distribution was measured for each paper. The results are shown in the four graphs in Figure 1.

[0030] As can be seen from the first and third graphs in Figure 1, increasing the amount of calcium carbonate filler from 10 percent by weight of the paper (which is more typical of a conventional cigarette paper) to 45 percent by weight of the paper results in an increase in the number of smaller pores at the 1 micrometre size, and therefore reduces the average pore size of the paper. As discussed above, an increased number of smaller pores results in a greater increase in the diffusion rate of smaller molecules, such as carbon monoxide, when compared to the increase in the diffusion rate of larger molecules, such as nicotine.

[0031] Adding guar gum in an amount of 5 percent by weight of the paper binds the filler together and therefore facilitates the incorporation of a relatively large amount of filler, at levels of at least 30 percent by weight of the paper. As can be seen by comparing graphs three and four in Figure 1, adding the guar gum also results in a further reduction in the average pore size by increasing the number of smaller pores at the 1 micrometre size.

Claims

1. A smoking article comprising:

   a mouthpiece; and
   an aerosol generating substrate wrapped in a cigarette paper, the cigarette paper formed from a sheet material comprising a mixture of cellulosic fibres, a polymeric material and a filler, wherein the polymeric material is present in an amount of at least 2 percent by weight of the sheet material, and wherein the filler is present in an amount of at least 30 percent by weight of the sheet material.

2. A smoking article according to claim 1, wherein the polymeric material comprises guar gum, starch, alginate, or a mixture thereof.

3. A smoking article according to claim 1 or 2, wherein the polymeric material is present in an amount of between 2% and 5% by weight of the sheet material.

4. A smoking article according to any preceding claim, wherein the filler comprises calcium carbonate.

5. A smoking article according to any preceding claim, wherein the filler is present in an amount of between 30% and 50% by weight of the sheet material.

6. A smoking article according to any preceding claim, wherein the filler comprises a particulate material.

7. A smoking article according to claim 6, wherein the particulate material has a number average particle size of between 0.2 and 0.5 micrometres

8. A smoking article according to any preceding claim, wherein the sheet material has a permeability of between 10 Coresta units and 100 Coresta units for carbon dioxide.

9. A smoking article according to any preceding claim, wherein the sheet material has a diffusivity of between 2.4 centimetres per second and 3.5 centimetres per second for carbon dioxide.

10. A cigarette paper, the cigarette paper formed from a sheet material comprising a mixture of cellulosic fibres, a polymeric material and a filler, wherein the polymeric material is present in an amount of at least 2 percent by weight of the sheet material, and wherein the filler is present in an amount of at least 30 percent by weight of the sheet material.

11. A method of forming a sheet material for use as a cigarette paper, the method comprising:

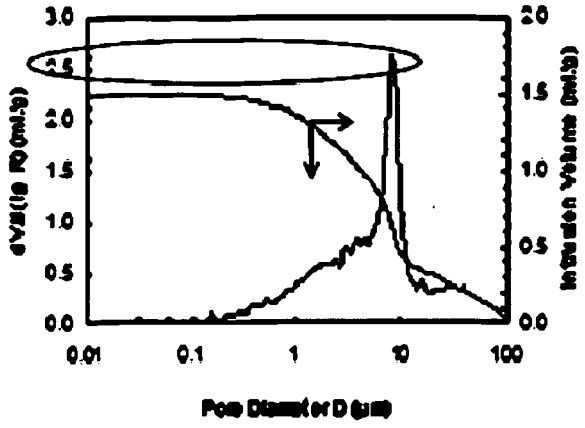
forming a pulp comprising a mixture of cellulosic fibres, a polymeric material and a filler;
depositing the pulp on a forming surface; and
drying the pulp to form a substantially continuous sheet material, wherein the polymeric material is present in an amount of at least 2 percent by weight of the sheet material, and wherein the filler is present in an amount of at least 30 percent by weight of the sheet material.

12. A method according to claim 11, wherein the polymeric material comprises guar gum, starch, alginate, or a mixture thereof.

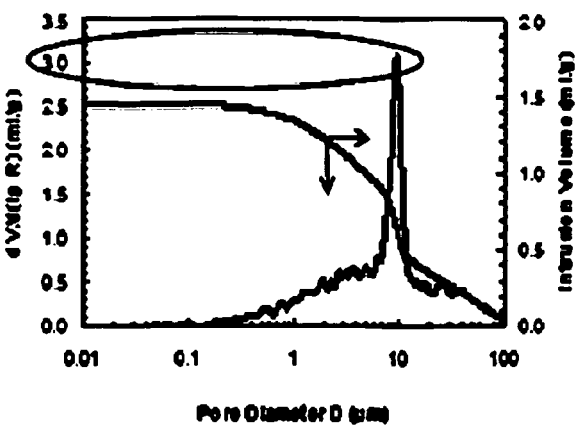
13. A method according to claim 11 or 12, wherein the sheet material has a permeability of between 10 Coresta units and 100 Coresta units for carbon dioxide.

14. A method according to claim 11, 12 or 13, wherein the sheet material has a diffusivity of between 2.4 centimetres per second and 3.5 centimetres per second for carbon dioxide.

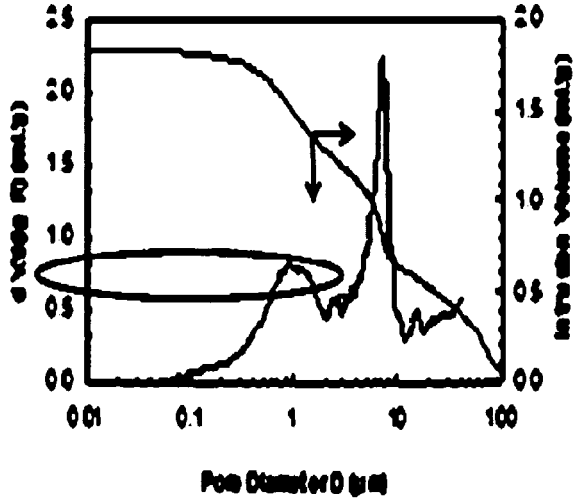
15. Use of a sheet material to form a cigarette paper, the sheet material comprising a mixture of cellulosic fibres, a polymeric material and a filler, wherein the polymeric material is present in an amount of at least 2 percent by weight of the sheet material, and wherein the filler is present in an amount of at least 30 percent by weight of the sheet material.



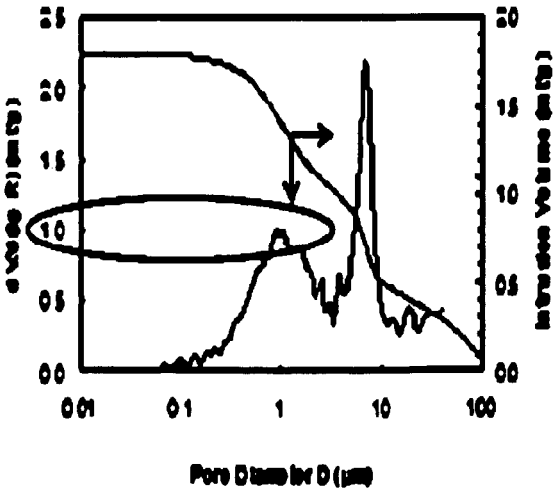
10% Carbonate, 0% Guar



10% Carbonate, 5% Guar



45% Carbonate, 0% Guar



45% Carbonate, 5% Guar

Figure 1

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EUROPEAN SEARCH REPORT

Application Number
EP 13 19 9597

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

A24D
A24B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 April 2014	Dimoula, Kerasina

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 19 9597

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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