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(54) **AEROSOL-GENERATING ARTICLE COMPRISING A HOLLOW TUBE SEGMENT COMPRISING POLYHYDROXYALKANOATE**

AEROSOLERZEUGENDER ARTIKEL MIT EINEM HOHLROHRSEGMENT MIT
POLYHYDROXYALKANOAT

ARTICLE DE GÉNÉRATION D'AÉROSOL COMPRENANT UN SEGMENT DE TUBE CREUX
COMPORTANT UN POLYHYDROXYALCANOATE

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Description

[0001] The present invention relates to an aerosol-generating article comprising a hollow tube segment. The present invention further relates to an aerosol-generating system comprising an aerosol-generating device and one such aerosol-generating article.

[0002] Conventional aerosol-generating articles, such as filter cigarettes, typically comprise a cylindrical rod of tobacco cut filler surrounded by a paper wrapper and a cylindrical filter axially aligned, most often in an abutting end-to-end relationship, with the wrapped tobacco rod. The cylindrical filter typically comprises one or more plugs of a fibrous filtration material, such as cellulose acetate tow, 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 an opaque paper material that circumscribes the entire length of the filter and an adjacent portion of the wrapped tobacco rod.

[0003] Aerosol-generating articles in which an aerosol-generating substrate, such as a tobacco-containing substrate, is heated rather than combusted, are also known in the art. Typically in such articles an aerosol is generated by the transfer of heat from a heat source to a physically separate aerosol-generating substrate or material.

[0004] By way of example, aerosol-generating articles have been proposed wherein an aerosol is generated by electrical heating of an aerosol-generating substrate. A number of prior art documents disclose aerosol-generating devices for consuming aerosol-generating articles. Such devices include, for example, electrically heated aerosol-generating devices in which an aerosol is generated by the transfer of heat from one or more electrical heater elements of the aerosol-generating device to the aerosol-generating substrate of a heated aerosol-generating article. As another example, aerosol-generating articles are also known wherein an aerosol is generated by the transfer of heat from a combustible fuel element or heat source to an aerosol-generating substrate. The combustible fuel element or heat source may be located in contact with, within, around, or downstream of the aerosol-generating substrate.

[0005] During use of one such aerosol-generating article, volatile compounds are released from the aerosol-generating substrate by heat transfer and are entrained in air drawn through the aerosol-generating article. As the released compounds cool, they condense to form an aerosol.

[0006] Typically, aerosol-generating articles of the types described may include a mouthpiece comprising a filter segment formed of porous filtration material such as cellulose acetate. In some known aerosol-generating articles a hollow tubular segment formed of a filtration material such as cellulose acetate is provided at a location between the aerosol-generating substrate and the mouth end of the article to impart structural strength to the article.

[0007] A number of aerosol-generating articles have also been described that comprise a hollow tube segment formed of fibrous filtration material. By way of example, aerosol-generating articles have been disclosed that, in addition to the rod of aerosol-generating substrate, comprise a support element in the form of a hollow acetate tube. In a particular embodiment, one such aerosol-generating article comprises, in linear sequential arrangement, a rod of aerosol-generating substrate, a hollow acetate tube located immediately downstream of the aerosol-generating substrate, an aerosol-cooling element located downstream of the hollow acetate tube, and an outer wrapper circumscribing the rod, the hollow acetate tube and the aerosol-cooling element.

[0008] Further, conventional aerosol-generating articles have been proposed wherein the filter comprises a hollow tube segment formed of fibrous filtration material, preferably in combination and in axial alignment with another non-hollow segment formed of fibrous filtration material. By way of example, filter cigarettes have been disclosed wherein one such hollow tube segment is arranged at the mouth end of the filter cigarette, such that the cavity internally defined by the hollow tube segment is open to the outer environment. Filter cigarettes have also been disclosed wherein one such hollow tube segment is arranged between non-hollow segments formed of fibrous filtration material. The cavity internally defined by the hollow tube segment and delimited at its ends by the two non-hollow segments may contain an aerosol-altering substance, such as a sorbent material, or a frangible flavour capsule, etc.

[0009] WO 2014/102095 A2 describes one such aerosol-generating article wherein a flow restrictor element is provided within a hollow tubular segment.

[0010] EP 3556230 A2 describes an aerosol-generating article including in sequential alignment a tobacco rod, a first filter segment, a cooling structure, and a second filter segment. The cooling structure is provided to cool aerosol generated as the heater heats the tobacco rod. The cooling structure may be fabricated by weaving at least a fibre bundle formed of a biodegradable polymeric material, such as one of polylactic acid (PLA), polyhydroxybutyrate (PHB), cellulose acetate, poly-epsilon-caprolactone (PCL), polyglycolic acid (PGA), polyhydroxyalkanoate (PHAs), and starch-based thermoplastic resins.

[0011] After an aerosol-generating article has been consumed and discarded, it may be desirable for any component of the article comprising filtration material to break down as quickly as possible. However, cellulose acetate, and many other commonly used filtration materials are not highly biodegradable.

[0012] US 2012/000480 A1 describes a mouth end filter element for an aerosol-generating article, the filter element comprising a fibrous tow filter material that incorporates a biodegradable material configured for increasing the rate of degradation of the filter material upon disposal. This may include non-fibrous biodegradable material incorporated within

the biodegradable tow. In an embodiment, the fibres have a core of a biodegradable material coated with cellulose acetate. US 2012/000480 A1 discloses a list of possible biodegradable polymers that can be used as the core material, including polyhydroxyalkanoates (PHA), polylactic acid (PLA), polycaprolactones, polybutylene succinate adipate, polyvinyl alcohol (PVA), starch, polyesteramide, regenerated cellulose (for example, rayon), and various aromatic copolyesters, and any combination of these polymers, blends of such biodegradable polymers, and non-biodegradable polymers such as starch-polyolefin mixtures.

[0013] However, alternative dispersible or biodegradable materials are often not able to provide an acceptable filtration efficiency and smoking experience for the consumer. Furthermore, many known dispersible and degradable materials are unsuitable for use in the existing manufacturing processes, and would require too significant a modification of the existing methods and equipment to make their use commercially feasible.

[0014] Further, cellulose acetate has been found to provide a relatively high level of adsorption and trapping of water from the mainstream smoke when used in conventional smoking articles. The mainstream smoke delivered to the consumer therefore has a significantly reduced moisture content and may, under certain conditions, be perceived as undesirably 'dry'. This may have an adverse effect on the overall smoking experience.

[0015] Thus, it would be desirable to provide a novel and improved aerosol-generating article that has enhanced biodegradation properties compared to known articles including conventional filtration materials such as cellulose acetate. It would also be desirable to provide a novel and improved aerosol-generating article that provides an acceptable smoking experience to the consumer, in particular, one that is capable of reducing the 'dry' smoke effect that is often found with articles comprising cellulose acetate as the filtration material.

[0016] It would be desirable to provide one such aerosol-generating article wherein the resistance to draw (RTD) of a filtration material segment can be adjusted so as to achieve an acceptable RTD of the article as a whole. Further, it would be desirable to provide such an aerosol-generating article that can effectively be produced in an automated, high-speed manufacturing process without requiring major modifications of existing equipment.

[0017] The present disclosure relates to an aerosol-generating article for producing an inhalable aerosol upon heating. The aerosol-generating article comprises a rod of aerosol-generating substrate and a hollow tube segment comprising fibrous filtration material. The hollow tube segment is arranged in longitudinal alignment with the rod. The fibrous filtration material comprises fibres comprising a polyhydroxyalkanoate (PHA) polymer or copolymer material.

[0018] In addition, the present disclosure relates to a system comprising an aerosol-generating device and an aerosol-generating article for use with the aerosol-generating device. The aerosol-generating article comprises a rod of aerosol-generating substrate and a hollow tube segment comprising fibrous filtration material. In the aerosol-generating device the hollow tube segment is arranged in longitudinal alignment with the rod. The fibrous filtration material comprises fibres comprising a polyhydroxyalkanoate (PHA) polymer or copolymer.

[0019] According to the present invention, there is provided an aerosol-generating article (10) for producing an inhalable aerosol upon heating, the aerosol-generating article comprising, in linear sequential arrangement: a first plug of filtration material; a rod (12) of aerosol-generating substrate, wherein the rod of the aerosol-generating substrate is located immediately downstream of the first plug of filtration material and comprises at least 12 percent by weight of an aerosol former, and wherein the rod of aerosol-generating substrate has a length of from 5 millimetres to 50 millimetres; a hollow tube segment (14) with a support function and comprising fibrous filtration material, the hollow tube segment located immediately downstream of the rod and in longitudinal alignment with the rod; a second plug (18) of filtration material located downstream of the hollow tube segment; and an outer wrapper circumscribing the first plug, the rod (12), the support element (14), and the second plug (18); wherein the fibrous filtration material comprises fibres comprising a polyhydroxyalkanoate (PHA) polymer or copolymer, the hollow tube segment comprising at least about 25 percent by weight of the PHA polymer or copolymer.

[0020] The term "aerosol-generating article" is used herein with reference to the invention to describe an article wherein an aerosol-generating substrate is heated to produce and deliver an aerosol to a consumer. As used herein, the term "aerosol-generating substrate" denotes a substrate capable of releasing volatile compounds upon heating to generate an aerosol.

[0021] A conventional cigarette is lit when a user applies a flame to one end of the cigarette and draws air through the other end. The localised heat provided by the flame and the oxygen in the air drawn through the cigarette causes the end of the cigarette to ignite, and the resulting combustion generates an inhalable smoke. By contrast, in heated aerosol-generating articles, an aerosol is generated by heating a flavour generating substrate, such as, for example, a tobacco-based substrate or a substrate containing an aerosol-former and a flavouring. Known heated aerosol-generating articles include, for example, electrically heated aerosol-generating articles and aerosol-generating articles in which an aerosol is generated by the transfer of heat from a combustible fuel element or heat source to a physically separate aerosol forming material.

[0022] As used herein, the term "longitudinal" refers to the direction corresponding to the main longitudinal axis of the aerosol-generating article, which extends between the upstream and downstream ends of the aerosol-generating article. As used herein, the terms "upstream" and "downstream" describe the relative positions of elements, or portions of

elements, of the aerosol-generating article in relation to the direction in which the aerosol is transported through the aerosol-generating article during use.

[0023] As described briefly above, in contrast with existing aerosol-generating articles, an article in accordance with the present invention comprises a hollow tube segment comprising fibrous filtration material, wherein the fibrous filtration material comprises fibres comprising a polyhydroxyalkanoate (PHA) polymer or copolymer.

[0024] Thus, in the hollow tube segment of an aerosol-generating article in accordance with the invention a PHA polymer or copolymer accounts for at least a portion of the fibrous filtration material. This means that the remainder of the fibrous filtration material may comprise a material other than a PHA polymer or copolymer. Further, this means that other components of the hollow tube segment - such as, for example, a plug wrapper circumscribing the fibrous filtration material, or an insert, a non-cutttable object, such as a flow restrictor or an additive delivery material, such as a breakable capsule, which may be provided at a location along the hollow tube segment may comprise a material other than a PHA polymer or copolymer.

[0025] Because fibres containing a PHA polymer or copolymer (in the following, also referred to as "PHA fibres") have a lower hydrophilicity compared with fibres of other filtration materials, such as cellulose acetate, of an equivalent weight, in aerosol-generating articles in accordance with the present invention the hollow tube segment has been found to have a significantly lower tendency to absorb water/steam. As a result, in those embodiments when the hollow tube segment is used as a component of a multi-segment filter in a conventional smoking article, the level of water in the mainstream smoke can advantageously be maintained at a higher level. This directly addresses the issue of "dry smoke" often encountered with conventional smoking articles, and provides an improved smoking experience for the consumer.

[0026] As PHA fibres have a much higher level of biodegradability compared with fibres of other filtration materials, such as cellulose acetate, articles in accordance with the present invention are more biodegradable as a whole. At the same time, as PHA fibres are obtained by means of a natural, fermentation process, aerosol-generating articles in accordance with the present invention also provide improved sustainability for the production process. Besides, a hollow tube segment has a greater exposed surface area compared with a cylindrical plug, and this may also further favour biodegradation.

[0027] By adjusting parameters such as the denier per filament, total denier, cross sectional shape, etc. it is possible to adjust the RTD of the filter segment to desirable ranges for any given filter length or filter design.

[0028] The term "denier per filament" (dpf) corresponds to the weight in grams of a single fibre or filament having a length of 9000 metres. In the present invention, the value of dpf therefore gives an indication of the thickness of each of the individual PHA fibres within the filter segment. The denier per filament is expressed in units of denier, where 1 denier corresponds to 1 gram per 9000 metres.

[0029] The "total denier" of the filtration material defines the total weight in grams of 9000 metres of the combined fibres forming the filtration material. The total denier for the filter segment therefore corresponds to the denier per filament multiplied by the total number of fibres in the filter segment.

[0030] In addition, the overall weight of the hollow tube segment may be advantageously controlled, and this may also contribute to help with biodegradation of the hollow tube segment and of the aerosol-generating article as a whole.

[0031] PHA properties also lead to good filter hardness, which can be further enhanced by circumscribing the hollow tube segment with a stiff plug wrap.

[0032] Aerosol-generating articles in accordance with the present invention comprise a rod of aerosol-generating substrate.

[0033] The rod of aerosol-generating substrate may be produced using randomly oriented shreds, strands, or strips of tobacco material. As an alternative, as has been proposed, for example in international patent application WO-A-2012/164009, the rod of aerosol-generating substrate may be formed from one or more gathered sheets of tobacco material. Alternative rods for aerosol-generating articles have also been proposed that are formed from strands of homogenised tobacco material, which may be formed by casting, rolling, calendering or extruding a mixture comprising particulate tobacco and at least one aerosol former to form a sheet of homogenised tobacco material. Further, a rod of aerosol-generating substrate may be formed from strands of homogenised tobacco material obtained by extruding a mixture comprising particulate tobacco and at least one aerosol former to form continuous lengths of homogenised tobacco material.

[0034] The rod of aerosol generating substrate preferably has an external diameter that is approximately equal to the external diameter of the aerosol generating article.

[0035] Preferably, the rod of aerosol generating substrate has an external diameter of at least 5 millimetres. The rod of aerosol generating substrate may have an external diameter of between about 5 millimetres and about 12 millimetres, for example of between about 5 millimetres and about 10 millimetres or of between about 6 millimetres and about 8 millimetres. In a preferred embodiment, the rod of aerosol generating substrate has an external diameter of 7.2 millimetres, to within 10 percent.

[0036] The rod of aerosol generating substrate may have a length of between about 5 millimetres and about 100 mm. Preferably, the rod of aerosol generating substrate has a length of at least about 5 millimetres, more preferably at least

about 7 millimetres. In addition, or as an alternative, the rod of aerosol generating substrate preferably has a length of less than about 80 millimetres, more preferably less than about 65 millimetres, even more preferably less than about 50 millimetres. In particularly preferred embodiments, the rod of aerosol generating substrate has a length of less than about 35 millimetres, more preferably less than 25 millimetres, even more preferably less than about 20 millimetres. In one embodiment, the rod of aerosol generating substrate may have a length of about 10 millimetres. In a preferred embodiment, the rod of aerosol generating substrate has a length of about 12 millimetres.

[0037] Preferably, the rod of aerosol generating substrate has a substantially uniform cross-section along the length of the rod. Particularly preferably, the rod of aerosol generating substrate has a substantially circular cross-section.

[0038] In preferred embodiments, the aerosol-generating substrate comprises one or more gathered sheets of homogenised tobacco material. Preferably the one or more sheets of homogenised tobacco material are textured. As used herein, the term 'textured sheet' denotes a sheet that has been crimped, embossed, debossed, perforated or otherwise deformed. Textured sheets of homogenised tobacco material for use in the invention may comprise a plurality of spaced-apart indentations, protrusions, perforations or a combination thereof. According to a particularly preferred embodiment of the invention, the rod of aerosol-generating substrate comprises a gathered crimped sheet of homogenised tobacco material circumscribed by a wrapper.

[0039] As used herein, the term 'crimped sheet' is intended to be synonymous with the term 'creped sheet' and denotes a sheet having a plurality of substantially parallel ridges or corrugations. Preferably, the crimped sheet of homogenised tobacco material has a plurality of ridges or corrugations substantially parallel to the cylindrical axis of the rod according to the invention. This advantageously facilitates gathering of the crimped sheet of homogenised tobacco material to form the rod. However, it will be appreciated that crimped sheets of homogenised tobacco material for use in the invention may alternatively or in addition have a plurality of substantially parallel ridges or corrugations disposed at an acute or obtuse angle to the cylindrical axis of the rod. In certain embodiments, sheets of homogenised tobacco material for use in the rod of the article of the invention may be substantially evenly textured over substantially their entire surface. For example, crimped sheets of homogenised tobacco material for use in the manufacture of a rod for use in an aerosol-generating article in accordance with the invention may comprise a plurality of substantially parallel ridges or corrugations that are substantially evenly spaced-apart across the width of the sheet.

[0040] Sheets or webs of homogenised tobacco material for use in the invention may have a tobacco content of at least about 40 percent by weight on a dry weight basis, more preferably of at least about 60 percent by weight on a dry weight basis, more preferably or at least about 70 percent by weight on a dry basis and most preferably at least about 90 percent by weight on a dry weight basis.

[0041] Sheets or webs of homogenised tobacco material for use in the aerosol-generating substrate may comprise one or more intrinsic binders, that is tobacco endogenous binders, one or more extrinsic binders, that is tobacco exogenous binders, or a combination thereof to help agglomerate the particulate tobacco. Alternatively, or in addition, sheets of homogenised tobacco material for use in the aerosol-generating substrate may comprise other additives including, but not limited to, tobacco and non-tobacco fibres, aerosol-formers, humectants, plasticisers, flavourants, fillers, aqueous and non-aqueous solvents and combinations thereof.

[0042] Suitable extrinsic binders for inclusion in sheets or webs of homogenised tobacco material for use in the aerosol-generating substrate are known in the art and include, but are not limited to: gums such as, for example, guar gum, xanthan gum, arabic gum and locust bean gum; cellulosic binders such as, for example, hydroxypropyl cellulose, carboxymethyl cellulose, hydroxyethyl cellulose, methyl cellulose and ethyl cellulose; polysaccharides such as, for example, starches, organic acids, such as alginic acid, conjugate base salts of organic acids, such as sodium-alginate, agar and pectins; and combinations thereof.

[0043] Suitable non-tobacco fibres for inclusion in sheets or webs of homogenised tobacco material for use in the aerosol-generating substrate are known in the art and include, but are not limited to: cellulose fibres; soft-wood fibres; hard-wood fibres; jute fibres and combinations thereof. Prior to inclusion in sheets of homogenised tobacco material for use in the aerosol-generating substrate, non-tobacco fibres may be treated by suitable processes known in the art including, but not limited to: mechanical pulping; refining; chemical pulping; bleaching; sulphate pulping; and combinations thereof.

[0044] Substrates for heated aerosol-generating articles typically comprise an "aerosol former", that is, a compound or mixture of compounds that, in use, facilitates formation of the aerosol, and that preferably is substantially resistant to thermal degradation at the operating temperature of the aerosol-generating article. Examples of suitable aerosol-formers include: polyhydric alcohols, such as propylene glycol, triethylene glycol, 1,3-butanediol and glycerin; esters of polyhydric alcohols, such as glycerol mono-, di- or triacetate; and aliphatic esters of mono-, di- or polycarboxylic acids, such as dimethyl dodecanedioate and dimethyl tetradecanedioate. Preferred aerosol formers are polyhydric alcohols or mixtures thereof, such as propylene glycol, triethylene glycol, 1,3-butanediol and, most preferred, glycerine.

[0045] Preferably, the aerosol-generating substrate comprises at least 10 percent by weight of an aerosol former, more preferably at least 12 percent by weight of an aerosol former, more preferably at least about 15 percent by weight of an aerosol former. Alternatively or in addition, the aerosol-generating substrate preferably comprises no more than

30 percent by weight of an aerosol former, more preferably no more than about 25 percent by weight of an aerosol former, more preferably no more than about 20 percent by weight of an aerosol former. For example, the aerosol-generating substrate may comprise between about 10 percent and about 30 percent by weight of an aerosol former, or between about 12 percent and about 25 percent by weight of an aerosol former, or between about 15 percent and about 20 percent by weight of an aerosol former. In a particularly preferred embodiment, the aerosol-generating substrate comprises around 18 percent by weight of an aerosol former.

[0046] In aerosol-generating articles in accordance with the present invention, the filter segment is formed of fibrous filtration material comprising fibres comprising a polyhydroxyalkanoate (PHA) polymer or copolymer. Preferably, the fibrous filtration material comprises at least about 85 percent by weight of fibres comprising a polyhydroxyalkanoate (PHA) polymer or copolymer.

[0047] PHAs are a family of polyhydroxyesters of 3-, 4-, 5- and 6-hydroxyalkanoic acids, which are produced by a variety of bacterial species under nutrient-limiting conditions with excess carbon and are found as discrete cytoplasmic inclusions in bacterial cells. Due to their excellent biocompatibility, PHAs have been proposed for use in a wide variety of biomedical applications, including drug delivery systems and tissue engineering scaffolds.

[0048] A PHA molecule is typically made up of 600 to 35,000 (R)-hydroxy fatty acid monomer units. Depending on the total number of carbon atoms within a PHA monomer, PHA can be classified as either short-chain length PHA (scl-PHA; 3 to 5 carbon atoms), medium-chain length PHA (mcl-PHA; 6 to 14 carbon atoms), or long-chain length PHA (lcl-PHA; 15 or more carbon atoms).

[0049] The first and most prevalent PHA is poly(β -hydroxybutyrate) (PHB). The next member of the PHA family, having a pendant ethyl group, is poly(3-hydroxyvalerate) or PHV. Having an ethyl group (HV unit) instead of the methyl group of PHB gives PHV more flexibility and less crystallinity than PHB.

[0050] In an aerosol-generating article in accordance with the invention the hollow tube segment comprises at least about 25 percent by weight of a PHA polymer or copolymer. More preferably, the hollow tube segment comprises at least about 50 percent by weight of a PHA polymer or copolymer. Even more preferably, the hollow tube segment comprises at least about 60 percent by weight of a PHA polymer or copolymer. In particularly preferred embodiments, the hollow tube segment comprises at least about 70 percent by weight of a PHA polymer or copolymer or even at least about 80 percent by weight of a PHA polymer or copolymer. In some highly preferred embodiments, the hollow tube segment comprises at least about 85 percent by weight of a PHA polymer or copolymer. More preferably, the PHA polymer or copolymer is one or more of polyhydroxypropionate, polyhydroxyvalerate, polyhydroxybutyrate, polyhydroxyhexanoate and polyhydroxyoctanoate. In a particularly preferred embodiment, the PHA compound is poly(3-hydroxybutyrate).

[0051] Even more preferably, the hollow tube segment comprises at least about 90 percent by weight of a PHA polymer or copolymer. Without wishing to be bound by theory, it is understood that higher contents of PHA in the hollow tube segment are generally associated with an improved biodegradability of the hollow tube segment and of the aerosol-generating article as a whole.

[0052] More preferably, the fibrous filtration material comprises at least about 91 percent by weight of a PHA polymer or copolymer or at least about 92 percent by weight of a PHA polymer or copolymer or at least about 93 percent by weight of a PHA polymer or copolymer or at least about 94 percent by weight of a PHA polymer or copolymer. In some particularly preferred embodiments, the fibrous filtration material comprises at least about 95 percent by weight of a PHA polymer or copolymer.

[0053] The remainder of the fibres within the PHA filter segment may comprise any suitable material. Suitable fibrous materials would be known to the skilled person and include but are not limited to polylactic acid (PLA) and cellulose acetate.

[0054] In some embodiments, the fibrous filtration material of the hollow tube segment may comprise some cellulose acetate. Without wishing to be bound by theory, it is understood that a certain amount of cellulose acetate in the hollow tube segment may impart desirable filtration properties and mechanical properties to the hollow tube segment as well as facilitating manufacture of the hollow tube segment.

[0055] In certain embodiments, the fibrous filtration material of the hollow tube segment comprises at least about 5 percent by weight of cellulose acetate. By way of example, the fibrous filtration material may comprise at least about 6 percent by weight of cellulose acetate or at least about 7 percent by weight of cellulose acetate or at least about 8 percent by weight of cellulose acetate or at least about 9 percent by weight of cellulose acetate. In some embodiments, the fibrous filtration material comprises at least about 10 percent by weight of cellulose acetate.

[0056] In aerosol-generating articles in accordance with the present invention, the fibrous filtration material preferably comprises less than about 15 percent by weight of cellulose acetate.

[0057] In some embodiments, the fibrous filtration material of the hollow tube segment comprises less than about 5 percent by weight of cellulose acetate, preferably less than 3 percent by weight of cellulose acetate, more preferably less than 1 percent by weight of cellulose acetate, even more preferably less than 0.1 percent by weight cellulose acetate. This may favourable further contribute to enhance biodegradability of the hollow tube segment and of the aerosol-generating article as a whole.

[0058] Preferably, an aerosol-generating article in accordance with the present invention comprises less than or equal to about 10 percent by weight of cellulose acetate measured with reference to the overall weight of the aerosol-generating article. More preferably, an aerosol-generating article in accordance with the present invention comprises less than or equal to about 7 percent by weight of cellulose acetate measured with reference to the overall weight of the aerosol-generating article. Even more preferably, an aerosol-generating article in accordance with the present invention comprises less than or equal to about 5 percent by weight of cellulose acetate measured with reference to the overall weight of the aerosol-generating article. This advantageously indicates that not only the hollow tube segment has a low or null content of cellulose acetate, but also that any other component of the article containing a fibrous filtration material contains little to no cellulose acetate. Embodiments of aerosol-generating articles in accordance with the invention having such low contents of cellulose acetate present particularly favourable biodegradability properties.

[0059] In some preferred embodiments, an aerosol-generating article in accordance with the present invention comprises less than or equal to about 3 percent by weight of cellulose acetate measured with reference to the overall weight of the aerosol-generating article. More preferably, an aerosol-generating article in accordance with the present invention comprises less than or equal to about 2 percent by weight of cellulose acetate measured with reference to the overall weight of the aerosol-generating article. Even more preferably, an aerosol-generating article in accordance with the present invention comprises less than or equal to about 1 percent by weight of cellulose acetate measured with reference to the overall weight of the aerosol-generating article.

[0060] In some highly preferred embodiments, an aerosol-generating article in accordance with the present invention is substantially free of cellulose acetate.

[0061] In some embodiments, the fibrous filtration material further comprises at least one biodegradable polymer selected from the group consisting of starch, polybutylene succinate (PBS), polybutyrate adipate terephthalate (PBAT), thermoplastic starch and thermoplastic starch blends (TPS), polycaprolactone (PCL), polyglycolide (PGA), polyvinyl alcohol (PVOH/PVA), viscose, regenerated cellulose, polysaccharides, cellulose acetate with a degree of substitution (DS) of less than 2.1, polyamides, protein-based biopolymers, chitosan-chitin based biopolymers, and combinations thereof.

[0062] The inventors have found that including one or more of these ingredients in the blend from which the fibrous material of the filter segment is formed further contributes to enhancing biodegradability of the filter segment and of the aerosol-generating article as a whole.

[0063] In addition, while it has previously been found to be technically challenging to manufacture PHA-containing filaments or fibres, using existing techniques and apparatus, the inventors have surprisingly found that it is possible to produce a filaments or fibres incorporating a high level of PHAs when the PHAs are combined in a blend as described above, as this makes it easier to form the filaments by a spinning technique.

[0064] In some embodiments, the fibrous filtration material comprises at least about 5 percent by weight of one such additional biodegradable polymer. In preferred embodiments, the fibrous filtration material comprises at least about 10 percent by weight of one such additional biodegradable polymer. More preferably, the fibrous filtration material comprises at least about 11 percent by weight or at least 12 percent by weight or at least 13 percent by weight or at least 14 percent by weight of the additional biodegradable polymer. Even more preferably, the fibrous filtration material comprises at least about 15 percent by weight of one such additional biodegradable polymer.

[0065] In particularly preferred embodiments, the at least one biodegradable polymer is one or more of PBAT, PCL and PBS. Without wishing to be bound by theory, the inventors have found that use of one or more of these selected biodegradable polymers contributes to improving the mechanical, thermal and morphological properties of the polymer mix. In particular, use of PBAT and PBS in combination has been found to provide especially well balanced mechanical properties, especially in terms of tensile strength and elongation.

[0066] In some embodiments, the fibrous filtration material comprises at least about 3 percent by weight of a plasticiser selected from triacetin, triethylene glycol diacetate (TEGDA), ethylene vinyl acetate, polyvinyl alcohol, starch or combinations thereof.

[0067] In some embodiments, the fibrous filtration material also further comprises a water based adhesive. This has the effect of structurally reinforcing the structure of the hollow tube segment. By way of example, compounds such as starch adhesive, methyl cellulose or polyvinyl acetate may be used to this purpose.

[0068] Preferably, the fibrous filtration material of the hollow tube segment comprises a plurality of fibres comprising a PHA polymer or copolymer and having a denier per filament of at least about 1. More preferably, the fibrous filtration material of the hollow tube segment comprises a plurality of fibres comprising a PHA polymer or copolymer and having a denier per filament of at least about 2. Even more preferably, the fibrous filtration material of the hollow tube segment comprises a plurality of fibres comprising a PHA polymer or copolymer and having a denier per filament of at least about 3.2.

[0069] In preferred embodiments, the fibrous filtration material of the hollow tube segment comprises a plurality of fibres comprising a PHA polymer or copolymer and having a denier per filament of less than or equal to about 10. More preferably, the fibrous filtration material of the hollow tube segment comprises a plurality of fibres comprising a PHA

polymer or copolymer and having a denier per filament of less than or equal to about 7.5. Even more preferably, the fibrous filtration material of the hollow tube segment comprises a plurality of fibres comprising a PHA polymer or copolymer and having a denier per filament of less than or equal to about 5.

[0070] In some embodiments, the fibrous filtration material of the hollow tube segment comprises a plurality of fibres comprising a PHA polymer or copolymer and having a denier per filament of from about 1 to about 10, more preferably from about 2 to about 10, even more preferably from about 3.2 to about 10. In other embodiments, the fibrous filtration material of the hollow tube segment comprises a plurality of fibres comprising a PHA polymer or copolymer and having a denier per filament of from about 1 to about 7.5, more preferably from about 2 to about 7.5, even more preferably from about 3.2 to about 7.5. In further embodiments, the fibrous filtration material of the hollow tube segment comprises a plurality of fibres comprising a PHA polymer or copolymer and having a denier per filament of from about 1 to about 5, more preferably from about 2 to about 5, even more preferably from about 3.2 to about 5.

[0071] Without wishing to be bound by theory, the inventors have found that when the hollow tube segment is formed from PHA fibres having a relatively low dpf of between 1.5 and 3.2, the hollow tube segment exhibits a particularly low RTD, which may be desirable for the design of certain aerosol-generating articles. One such low range of dpf also advantageously reduces the overall weight of the hollow tube segment, which further significantly improves the biodegradability of the aerosol-generating article.

[0072] Preferably, the fibres comprising a PHA polymer or copolymer of the filter segment are crimped.

[0073] The transverse cross-sectional shape of the PHA fibres may be varied, for example, in order to control the external surface area of the fibres within the hollow tube segment. By controlling the external surface area of the PHA fibres, the total surface area of the PHA fibres that is exposed to the aerosol as it passes through the hollow tube segment may also be controlled. This in turn will control to some extent the filtration properties of the PHA fibres, for example, the amount of water that is adsorbed by the fibres in conventional combustible smoking articles.

[0074] In some embodiments, the PHA fibres have a substantially round cross-section. In such embodiments, the total external surface area of the PHA fibres within the hollow tube segment is preferably between about 0.15 square metres per gram and about 0.30 square metres per gram.

[0075] In alternative embodiments, the PHA fibres have a Y-shaped cross-section. In such embodiments, the total external surface area of the PHA fibres within the hollow tube segment is preferably between about 0.15 square metres per gram and about 0.55 square metres per gram. More preferably, the total external surface area of the PHA fibres within the hollow tube segment is between about 0.2 square metres per gram and about 0.5 square metres per gram, even more preferably between about 0.25 square metres per gram and about 0.45 square metres per gram.

[0076] In some embodiments, the hollow tube segment may comprise one or more additive for reducing certain constituents in the mainstream smoke. By way of example, the filter segment preferably comprises an additive for the reduction of phenols and phenol derivatives. [...]

[0077] The combination of PHA with an additive such as PEG for the reduction of phenolic compounds from the mainstream smoke has been found to be particularly effective. PHA fibres generally provide a good filtration efficiency for undesirable smoke constituents but are less effective at the removal of phenolic compounds. By incorporating a compound that specifically reduces the level of phenolic compounds in the mainstream smoke, it is possible to further optimise the filtration capabilities of the hollow tube segment of an aerosol-generating article in accordance with the invention, in particular when a hollow tube segment as described above is used as a component of a multi-component filter in a combustible smoking article, such as a filter cigarette. This in turn improves the sensory characteristics of the aerosol delivered to the consumer.

[0078] In particularly preferred embodiments, the hollow tube segment further comprises at least about 5 percent by weight of polyethylene glycol, based on the total weight of the filtration material. Preferably, the hollow tube segment comprises no more than 10 percent by weight of polyethylene glycol, based on the total weight of the filtration material.

[0079] As described above, it has been found that PHA fibres absorb less water from the mainstream smoke than an equivalent amount of cellulose acetate fibres, due to the lower affinity of the PHA fibres to water. As demonstrated in the examples below, the amount of water absorbed by a PHA filter segment is significantly lower than the amount of water absorbed by a comparative filter segment formed of an equivalent weight of cellulose acetate fibres.

[0080] For example, when exposed to water in liquid form, the hollow tube segment of the aerosol-generating article of the present invention preferably absorbs less than half the amount of water that is absorbed under the same conditions by an equivalent hollow tube segment formed of cellulose acetate fibres.

[0081] The reduced absorption of water by the PHA fibres in the hollow tube segment of the present invention, compared to cellulose acetate results in a higher level of water in the mainstream smoke delivered from the aerosol-generating article during use.

[0082] For example, the amount of water in the mainstream smoke collected during the smoking of a combustible smoking article comprising a filter according to the invention with PHA fibres under ISO conditions was at least 10 percent higher and preferably at least 15 percent higher than the amount of water in the mainstream smoke collected during the smoking of an equivalent combustible smoking article having a filter segment of cellulose acetate tow under the same

conditions.

[0083] Aerosol-generating articles comprising a filter including a PHA hollow tube segment are therefore able to deliver a mainstream smoke having a higher moisture level, which is more sensorially acceptable to the consumer. In particular, the 'dry smoke' effect that may be experienced during smoking of an aerosol-generating article with a conventional cellulose acetate filter can advantageously be reduced.

[0084] The fibres comprising a PHA polymer or copolymer of the filter segment may be manufactured by one of several techniques, including melt spinning, gel spinning, and electrospinning. Preferably, the fibres comprising a PHA polymer or copolymer of the filter segment in aerosol-generating articles in accordance with the present invention are manufactured by melt spinning. Melt spinning is often regarded as the most economical process of spinning, since no solvent needs to be recovered or evaporated, as is by contrast the case with solution spinning. Further, the spinning rate with melt spinning is generally fairly high, which is advantageous in terms of overall productivity and manufacturing efficiency.

[0085] In this process, a viscous melt of polymer or of a polymer blend is extruded through a spinneret containing a number of holes into a chamber, where a blast of cold air or gas is directed onto the surface of filaments emanating from the spinneret. As the air strikes the filaments, the filaments are solidified and collected such as on a take-up wheel. The melt spinning process is advantageously characterised by defined filament cross-section geometries and affords a significant variety of fineness and filament count. By increasing the number of openings in the spinneret, a high spinning capacity can be achieved, which is difficult to match with other spinning processes.

[0086] Preferably, in an aerosol-generating article in accordance with the present invention the hollow tube segment does not substantially contribute to an overall RTD of the aerosol-generating article.

[0087] Thus, in aerosol-generating articles in accordance with the present invention the overall RTD of the article preferably depends essentially on the RTD of the rod and may further depend on the RTD of optional additional components, such as a mouthpiece or a filter segment, as a significant proportion of the overall volume of the hollow tube segment is substantially empty and, as such, the hollow tube segment only marginally contributes to the overall RTD.

[0088] In practice, the hollow tube segment may be adapted to generate a RTD in the range of approximately 0 millimetre H₂O (about 00 Pa) to approximately 20 millimetres H₂O (about 200 Pa). Preferably, the hollow tube segment is adapted to generate a RTD between approximately 0 millimetres H₂O (about 00 Pa) to approximately 10 millimetres H₂O (about 100 Pa).

[0089] The aerosol-generating article preferably has an overall RTD of less than about 90 millimetres H₂O (about 900 Pa). More preferably, the aerosol-generating article has an overall RTD of less than about 80 millimetres H₂O (about 800 Pa). Even more preferably, the aerosol-generating article has an overall RTD of less than about 70 millimetres H₂O (about 700 Pa).

[0090] Preferably, the aerosol-generating article has an overall RTD of at least about 30 millimetres H₂O (about 300 Pa). More preferably the aerosol-generating article has an overall RTD of at least about 40 millimetres H₂O (about 400 Pa). Even more preferably, the aerosol-generating article has an overall RTD of at least about 50 millimetres H₂O (about 500 Pa).

[0091] In some embodiments, the aerosol-generating article has an overall RTD from about 30 millimetres H₂O (about 300 Pa) to about 90 millimetres H₂O (about 900 Pa), preferably from about 40 millimetres H₂O (about 400 Pa) to about 90 millimetres H₂O (about 900 Pa), more preferably from about 50 millimetres H₂O (about 500 Pa) to about 90 millimetres H₂O (about 900 Pa). In other embodiments, the aerosol-generating article has an overall RTD from about 30 millimetres H₂O (about 300 Pa) to about 80 millimetres H₂O (about 800 Pa), preferably from about 40 millimetres H₂O (about 400 Pa) to about 80 millimetres H₂O (about 800 Pa), more preferably from about 50 millimetres H₂O (about 500 Pa) to about 80 millimetres H₂O (about 800 Pa). In further embodiments, the aerosol-generating article has an overall RTD from about 30 millimetres H₂O (about 300 Pa) to about 70 millimetres H₂O (about 700 Pa), preferably from about 40 millimetres H₂O (about 400 Pa) to about 70 millimetres H₂O (about 700 Pa), more preferably from about 50 millimetres H₂O (about 500 Pa) to about 70 millimetres H₂O (about 700 Pa).

[0092] The RTD of the aerosol-generating article may be assessed as the negative pressure that has to be applied, under test conditions as defined in ISO 3402, to downstream end of the article in order to sustain a steady volumetric flow of air of 17.5 ml/s through the article. The values of RTD listed above are intended to be measured on the aerosol-generating article on its own (that is, without inserting the article into an aerosol-generating device) and, if a ventilation zone is provided in the article, without blocking any perforations of the ventilation zone.

[0093] In other embodiments, the aerosol-generating article has an overall RTD of at least about 150 millimetres H₂O (about 1500 Pa), preferably at least about 200 millimetres H₂O (about 2000 Pa), more preferably at least about 250 millimetres H₂O (about 2500 Pa).

[0094] The hollow tube segment comprising PHA fibres in accordance with the present invention has additionally been found to provide a good stability in the RTD, which means that a high variability in the RTD can advantageously be avoided. For example, within a sample of 20 of the aerosol-generating articles according to the invention, there will typically be a standard deviation from the target RTD of between 2 percent and 10 percent, more preferably between 2 percent and 5 percent.

[0095] The hollow tube segment preferably has a wall thickness of at least about 0.3 millimetres. More preferably, the hollow tube segment has a wall thickness of at least about 0.4 millimetres. Even more preferably, the hollow tube segment has a wall thickness of at least about 0.5 millimetres.

[0096] Preferably, the hollow tube segment has a wall thickness of less than or equal to about 1.9 millimetres. More preferably, the hollow tube segment has a wall thickness of less than or equal to about 1.5 millimetres. Even more preferably, the hollow tube segment has a wall thickness of less than or equal to about 1.2 millimetres. Particularly preferably, the hollow tube segment has a wall thickness of less than or equal to about 0.9 millimetres.

[0097] In certain embodiments, the hollow tube segment has a wall thickness from about 0.3 millimetres to about 1.9 millimetres, preferably from about 0.4 millimetres to about 1.9 millimetres, more preferably from about 0.5 millimetres to about 1.9 millimetres. In some embodiments, the hollow tube segment has a wall thickness from about 0.3 millimetres to about 1.5 millimetres, preferably from about 0.4 millimetres to about 1.5 millimetres, more preferably from about 0.5 millimetres to about 1.5 millimetres. In other embodiments, the hollow tube segment has a wall thickness from about 0.3 millimetres to about 1.2 millimetres, preferably from about 0.4 millimetres to about 1.2 millimetres, more preferably from about 0.5 millimetres to about 1.2 millimetres. In further embodiments, the hollow tube segment has a wall thickness from about 0.3 millimetres to about 0.9 millimetres, preferably from about 0.4 millimetres to about 0.9 millimetres, more preferably from about 0.5 millimetres to about 0.9 millimetres. In a particularly preferred, exemplary embodiment, the hollow tube segment has a wall thickness of about 0.6 millimetres.

[0098] In some embodiments, the hollow tube segment may typically have a length of at least about 4 millimetres. Preferably, a length of the hollow tube segment is at least about 5 millimetres. More preferably, a length of the hollow tube segment is at least about 7 millimetres. Even more preferably, a length of the hollow tube segment is at least about 10 millimetres.

[0099] In certain embodiments, a length of the hollow tube segment is less than or equal to about 35 millimetres. Preferably, a length of the hollow tube segment is less than or equal to about 25 millimetres. More preferably, a length of the hollow tube segment is less than or equal to about 20 millimetres. Even more preferably, a length of the hollow tube segment is less than or equal to about 15 millimetres.

[0100] In preferred embodiments, a length of the hollow tube segment is from about 4 millimetres to about 35 millimetres. Preferably, a length of the hollow tube segment is from about 5 millimetres to about 35 millimetres. More preferably, a length of the hollow tube segment is from about 7 millimetres to about 35 millimetres. Even more preferably, a length of the hollow tube segment is from about 10 millimetres to about 35 millimetres.

[0101] In certain other embodiments, a length of the hollow tube segment is from about 4 millimetres to about 25 millimetres. Preferably, a length of the hollow tube segment is from about 5 millimetres to about 25 millimetres. More preferably, a length of the hollow tube segment is from about 7 millimetres to about 25 millimetres. Even more preferably, a length of the hollow tube segment is from about 10 millimetres to about 25 millimetres.

[0102] In other embodiments, a length of the hollow tube segment is from about 4 millimetres to about 20 millimetres. Preferably, a length of the hollow tube segment is from about 5 millimetres to about 20 millimetres. More preferably, a length of the hollow tube segment is from about 7 millimetres to about 20 millimetres. Even more preferably, a length of the hollow tube segment is from about 10 millimetres to about 20 millimetres.

[0103] In further embodiments, a length of the hollow tube segment is from about 4 millimetres to about 15 millimetres. Preferably, a length of the hollow tube segment is from about 5 millimetres to about 15 millimetres. More preferably, a length of the hollow tube segment is from about 7 millimetres to about 15 millimetres. Even more preferably, a length of the hollow tube segment is from about 10 millimetres to about 15 millimetres.

[0104] Preferably, in aerosol-generating articles in accordance with the present invention the hollow tube segment has an average radial hardness of at least about 80 percent, more preferably at least about 85 percent, even more preferably at least about 90 percent. The hollow tube segment is therefore able to provide a desirable level of hardness to the aerosol-generating article, which is comparable to that provided by a conventional cellulose acetate hollow tube segment.

[0105] If desired, the radial hardness of the hollow tube segment of aerosol-generating articles in accordance with the invention may be further increased by circumscribing the hollow tube segment by a stiff plug wrap, for example, a plug wrap having a basis weight of at least about 80 grams per square metre (gsm), or at least about 100 gsm, or at least about 110 gsm.

[0106] As used herein, the term "radial hardness" refers to resistance to compression in a direction transverse to a longitudinal axis of the hollow tube segment. Radial hardness of an aerosol-generating article around a hollow tube segment may be determined by applying a load across the article at the location of the hollow tube segment, transverse to the longitudinal axis of the article, and measuring the average (mean) depressed diameters of the articles. Radial hardness is given by:

$$\text{Radial hardness } (\%) = \frac{D_d}{D_s} * 100 \%$$

where D_s is the original (undepressed) diameter, and D_d is the depressed diameter after applying a set load for a set duration. The harder the material, the closer the hardness is to 100%.

[0107] To determine the hardness of a portion (such as a hollow tube segment) of an aerosol article, aerosol-generating articles should be aligned parallel in a plane and the same portion of each aerosol-generating article to be tested should be subjected to a set load for a set duration. This test is performed using a known DD60A Densimeter device (manufactured and made commercially available by Heinr Borgwaldt GmbH, Germany), which is fitted with a measuring head for aerosol-generating articles, such as cigarettes, and with an aerosol-generating article receptacle.

[0108] The load is applied using two load-applying cylindrical rods, which extend across the diameter of all of the aerosol-generating articles at once. According to the standard test method for this instrument, the test should be performed such that twenty contact points occur between the aerosol-generating articles and the load applying cylindrical rods. In some cases, the hollow tube segments to be tested may be long enough such that only ten aerosol-generating articles are needed to form twenty contact points, with each smoking article contacting both load applying rods (because they are long enough to extend between the rods). In other cases, if the hollow tube segments are too short to achieve this, then twenty aerosol-generating articles should be used to form the twenty contact points, with each aerosol-generating article contacting only one of the load applying rods, as further discussed below.

[0109] Two further stationary cylindrical rods are located underneath the aerosol-generating articles, to support the aerosol-generating articles and counteract the load applied by each of the load applying cylindrical rods.

[0110] For the standard operating procedure for such an apparatus, an overall load of 2 kg is applied for a duration of 20 seconds. After 20 seconds have elapsed (and with the load still being applied to the smoking articles), the depression in the load applying cylindrical rods is determined, and then used to calculate the hardness from the above equation.

The temperature is kept in the region of 22 degrees Centigrade \pm 2 degrees. The test described above is referred to as the DD60A Test. The standard way to measure the filter hardness is when the aerosol-generating article have not been consumed. Additional information regarding measurement of average radial hardness can be found in, for example, U.S. Published Patent Application Publication Number 2016/0128378.

[0111] An aerosol-generating article may comprise one or more further components that may be assembled with the rod of aerosol-generating substrate and with the hollow tube segment in a same wrapper.

[0112] Examples of such additional elements include a mouthpiece filtration segment, a cooling element adapted to favour cooling of the aerosol prior to reaching the mouthpiece, and so forth.

[0113] By way of example, the mouthpiece may comprise a filter segment, that is a plug of filtration material. The mouthpiece may, in particular, comprise a plug of a fibrous filtration material. Suitable filtration materials are known in the art and include, but are not limited to: fibrous filtration materials such as, for example, cellulose acetate tow, viscose fibres, polylactic acid (PLA) fibres and paper; adsorbents such as, for example, activated alumina, zeolites, molecular sieves and silica gel; and combinations thereof.

[0114] In some preferred embodiment, the fibrous filtration material used for forming the mouthpiece may be the same fibrous filtration material containing a PHA-containing polymer or copolymer described above for the hollow tube segment of the present invention. This may be particularly advantageous, as the desirable effects associated with a fibrous filtration material comprising a PHA-containing polymer or copolymer in terms of biodegradability and water-absorption properties extend also to the mouthpiece plug. As such, an aerosol-generating article may be provided that has especially advantageous properties.

[0115] In addition, the filter segment of the mouthpiece may further comprise one or more aerosol-modifying agent. Suitable aerosol-modifying agents are known in the art and include, but are not limited to, flavourants such as, for example, menthol.

[0116] In embodiments not according to the invention, the hollow tube segment may be used at the downstream end of aerosol-generating article, in axial alignment with the mouthpiece filter segment, preferably immediately adjacent to a downstream end of the mouthpiece filter segment. In such embodiments, the hollow tube segment defines a mouth end recess downstream of the plug of filtration material. Thus, the hollow tube segment forms a cavity at the mouth end that is open to the outer environment at the downstream end of aerosol-generating article.

[0117] In such embodiments, the filter segment of the mouthpiece may typically have a length of less than or equal to about 30 millimetres. Preferably, a length of the filter segment is less than or equal to about 27 millimetres. More preferably, a length of the filter segment is less than or equal to about 25 millimetres. Even more preferably a length of the filter segment it less than or equal to about 20 millimetres.

[0118] In such embodiments, a length of the filter segment is preferably from about 5 millimetres to about 30 millimetres, more preferably from about 10 millimetres to about 30 millimetres, even more preferably from about 15 millimetres to about 30 millimetres, most preferably from about 20 millimetres to about 30 millimetres. Alternatively, in such embodiments

a length of the filter segment may be from about 4 millimetres to about 27 millimetres, and preferably is from about 5 millimetres to about 27 millimetres, more preferably from about 10 millimetres to about 27 millimetres, even more preferably from about 15 millimetres to about 27 millimetres, most preferably from about 20 millimetres to about 27 millimetres. As a further alternative, in such embodiments, a length of the filter segment may be from about 4 millimetres to about 25 millimetres, and preferably is from about 5 millimetres to about 25 millimetres, more preferably from about 10 millimetres to about 25 millimetres, even more preferably from about 15 millimetres to about 30 millimetres, most preferably from about 20 millimetres to about 25 millimetres.

[0119] The filter segment preferably has an external diameter that is about equal to the external diameter of the aerosol-generating article. Preferably, the filter segment has an external diameter of at least 5 millimetres. The filter segment may have an external diameter of between about 5 millimetres and about 12 millimetres, for example of between about 5 millimetres and about 10 millimetres or of between about 6 millimetres and about 8 millimetres. In a preferred embodiment, the filter segment has an external diameter of 7.2 millimetres, to within 10 percent.

[0120] In some embodiments, the mouthpiece comprises a single filter segment as described above. In other embodiments, the aerosol-generating article may comprise one or more additional filter segments. In some preferred embodiments, each one of the filter segments of the mouthpiece comprising a PHA polymer or copolymer as described above.

[0121] As an alternative, a filter segment comprising a PHA polymer or copolymer may be combined with one or more axially aligned filter plugs formed of a fibrous filtration material not including PHA-containing fibres. Alternatively or in addition, a filter segment comprising a PHA polymer or copolymer may be combined with a tubular element formed of a cardboard tube.

[0122] The mouthpiece filter segment of aerosol-generating articles according to the invention may optionally comprise a flavourant. Flavourants can be incorporated using a variety of different means, which would be known to the skilled person. For example, a flavourant may be incorporated in the form of a capsule which may be provided in a filter segment comprising a PHA polymer or copolymer.

[0123] The aerosol-generating article comprises, in linear sequential arrangement, a first plug of filtration material, a rod of aerosol-generating substrate located immediately downstream of the first plug of filtration material, a hollow tube segment as described above with a support function located immediately downstream of the rod, a second plug of filtration material located downstream of the hollow tube segment, and an outer wrapper circumscribing the first plug, the rod, the support element, and the second plug.

[0124] The invention will now be further described with reference to the figures in which:

Figure 1 shows a schematic longitudinal cross-sectional view of an aerosol-generating article that is not according to the invention for use with an aerosol-generating device comprising a heater element;

Figure 2 shows a schematic longitudinal cross-sectional view of an aerosol-generating article that is not according to the invention comprising an integral heat source;

Figure 3 shows a schematic longitudinal cross-sectional view of an aerosol-generating article that is not according to the invention and

Figure 4 shows a schematic longitudinal cross-sectional view of an aerosol-generating system comprising an electrically operated aerosol-generating device and the aerosol-generating article shown in Figure 1.

[0125] The aerosol-generating article 10 shown in Figure 1 comprises a rod of aerosol-generating substrate 12, a support element provided as a hollow tubular element 14, a cooling element 16, and a mouth end filter segment 18. These four elements are arranged sequentially and in coaxial alignment and are circumscribed by a substrate wrapper 20 to form the aerosol-generating article 10. The aerosol-generating article 10 has a mouth end 22 and a distal end 24 located at the opposite end of the article to the mouth end 22. The aerosol-generating article 10 shown in Figure 1 is particularly suitable for use with an electrically operated aerosol-generating device comprising a heater for heating the rod of aerosol-generating substrate.

[0126] In use air is drawn through the aerosol-generating article by a user from the distal end 24 to the mouth end 22. The distal end 24 of the aerosol-generating article may also be described as the upstream end of the aerosol-generating article 10 and the mouth end 22 of the aerosol-generating article 10 may also be described as the downstream end of the aerosol-generating article 10. Elements of the aerosol-generating article 10 located between the mouth end 22 and the distal end 24 can be described as being upstream of the mouth end 22 or, alternatively, downstream of the distal end 24.

[0127] The aerosol-generating substrate 12 is located at the extreme distal or upstream end of the aerosol-generating article 10. In the embodiment illustrated in Figure 1, the aerosol-generating substrate 12 comprises a gathered sheet of crimped homogenised tobacco material circumscribed by a wrapper. The crimped sheet of homogenised tobacco material comprises glycerin as an aerosol former.

[0128] The support element 14 is located immediately downstream of the aerosol-generating substrate 12 and abuts the aerosol-generating substrate 12. In the embodiment shown in Figure 1, the support element is a hollow tube formed of a fibrous filtration material. The support element 14 locates the aerosol-generating substrate 12 at the extreme distal

end 24 of the aerosol-generating article 10 so that it can be penetrated by a heating element of an aerosol-generating device. In effect, the support element 14 acts to prevent the aerosol-generating substrate 16 from being forced downstream within the aerosol-generating article 10 towards the aerosol-cooling element 16 when a heating element of an aerosol-generating device is inserted into the aerosol-generating substrate 12. The support element 14 also acts as a spacer to space the aerosol-cooling element 16 of the aerosol-generating article 10 from the aerosol-generating substrate 12.

[0129] The aerosol-cooling element 16 is located immediately downstream of the support element 14 and abuts the support element 14. In use, volatile substances released from the aerosol-generating substrate 12 pass along the aerosol-cooling element 16 towards the mouth end 22 of the aerosol-generating article 10. The volatile substances may cool within the aerosol-cooling element 16 to form an aerosol that is inhaled by the user. In the embodiment illustrated in Figure 1, the aerosol-cooling element comprises a tubular element 20. The crimped and gathered sheet of polylactic acid defines a plurality of longitudinal channels that extend along the length of the aerosol-cooling element 40.

[0130] The filter segment 18 is located immediately downstream of the aerosol-cooling element 16 and abuts the aerosol-cooling element 16.

[0131] In the aerosol-generating article illustrated in Figure 1, the filter segment 18 comprises a single cylindrical plug of a fibrous filtration material formed of a plurality of PHA fibres having a denier per filament of approximately 3 and a total denier of approximately 27,000. The PHA fibres have a round cross-sectional shape and are substantially longitudinally aligned with each other along the length of the filter segment. The exposed surface area of the PHA fibres corresponds to about 0.16 square metres per gram. The PHA fibres have been formed by a melt spinning process and are crimped. The plug of fibrous filtration material is circumscribed by a plug wrap (not shown).

[0132] Further, the support element 14 is a hollow tube segment comprising fibrous filtration material formed of a plurality of PHA fibres having a denier per filament of approximately 3 and a total denier of approximately 27,000. The PHA fibres have a round cross-sectional shape and are substantially longitudinally aligned with each other along the length of the filter segment. The exposed surface area of the PHA fibres corresponds to about 0.16 square metres per gram. The PHA fibres have been formed by a melt spinning process and are crimped. In more detail, the fibres contain about 85 percent by weight of a PHA polymer or copolymer combined with 15 percent by weight of a PBAT/PBS blend with a 1:1 PBAT to PBS ratio.

[0133] The aerosol-generating article 100 shown in Figure 2 comprises a combustible heat source 112, a rod of aerosol-generating substrate 114, a transfer element 116, an aerosol-cooling element, 118, a spacer element 120 and a mouthpiece filter segment 122. These elements are arranged sequentially and in coaxial alignment and are circumscribed by a substrate wrapper to form the aerosol-generating article 100.

[0134] The combustible heat source 112 comprises a substantially circularly cylindrical body of carbonaceous material, having a length of about 10 millimetres. The combustible heat source 112 is a blind heat source. In other words, the combustible heat source 112 does not comprise any air channels extending therethrough.

[0135] The rod of aerosol-generating substrate 114 is arranged at a proximal end of the combustible heat source 112. The aerosol-generating substrate 114 comprises a substantially circularly cylindrical plug of tobacco material 124 circumscribed by filter plug wrap 126.

[0136] A non-combustible, substantially air impermeable first barrier 128 is arranged between the proximal end of the combustible heat source 112 and a distal end of the aerosol-generating substrate 114. The first barrier 128 comprises a disc of aluminium foil. The first barrier 128 also forms a heat-conducting member between the combustible heat source 112 and the aerosol-generating substrate 114, for conducting heat from the proximal face of the combustible heat source 112 to the distal face of the aerosol-generating substrate 114.

[0137] A heat-conducting element 130 circumscribes a proximal portion of the combustible heat source 112 and a distal portion of the aerosol-forming substrate 114. The heat-conducting element 130 comprises a tube of aluminium foil. The heat-conducting element 130 is in direct contact with the proximal portion of the combustible heat source 112 and the filter plug wrap 126 of the aerosol-generating substrate 114.

[0138] The mouthpiece filter 122 comprises a single cylindrical plug 126 of a fibrous filtration material formed of a plurality of PHA fibres having a denier per filament of approximately 3 and a total denier of approximately 27,000. The PHA fibres have a round cross-sectional shape and are substantially longitudinally aligned with each other along the length of the filter segment. The exposed surface area of the PHA fibres corresponds to about 0.16 square metres per gram. The PHA fibres have been formed by a melt spinning process and are crimped. The plug of fibrous filtration material is circumscribed by a plug wrap (not shown).

[0139] The spacer element 120 is provided as a hollow tube and comprises comprising fibrous filtration material formed of a plurality of PHA fibres having a denier per filament of approximately 3 and a total denier of approximately 27,000. The PHA fibres have a round cross-sectional shape and are substantially longitudinally aligned with each other along the length of the filter segment. The exposed surface area of the PHA fibres corresponds to about 0.16 square metres per gram. The PHA fibres have been formed by a melt spinning process and are crimped. In more detail, the hollow tube segment has an inner diameter of about 3.30 millimetres and an outer diameter of about 7.10 millimetres, which

corresponds to a wall thickness of about 1.90 millimetres.

[0140] The aerosol-generating article 310 shown in Figure 3 is a combustible smoking article comprising an aerosol-generating substrate 312 and a filter 314 arranged in coaxial alignment with each other. The aerosol-generating substrate 312 comprises a tobacco rod circumscribed by an outer wrapper (not shown). A tipping wrapper 316 circumscribes both the filter 314 and an end portion of the aerosol-generating substrate 312 and attaches the filter 314 to the aerosol-generating substrate 312.

[0141] The filter 314 comprises a cylindrical plug 318 of a fibrous filtration material formed of PHA fibres having a denier per filament of approximately 3 and a total denier of approximately 27,000. The PHA fibres have a round cross-sectional shape and are substantially longitudinally aligned with each other along the length of the filter segment. The exposed surface area of the PHA fibres corresponds to about 0.16 square metres per gram. The PHA fibres have been formed by a melt spinning process and are crimped. The plug of fibrous filtration material is circumscribed by a plug wrap (not shown).

[0142] In addition, the filter 314 comprises a hollow tube segment 320 arranged in axial alignment with the plug 318 and immediately downstream of the plug 318. The hollow tube segment 320 comprises a fibrous filtration material formed of PHA fibres having a denier per filament of approximately 3 and a total denier of approximately 27,000. The PHA fibres have a round cross-sectional shape and are substantially longitudinally aligned with each other along the length of the filter segment. The exposed surface area of the PHA fibres corresponds to about 0.16 square metres per gram. The PHA fibres have been formed by a melt spinning process and are crimped.

[0143] Figure 4 shows a portion of an electrically operated aerosol-generating system 200 that utilises a heater blade 210 to heat the rod of aerosol-generating substrate 12 of the aerosol-generating article 10 shown in Figure 1. The heater blade 210 is mounted within an aerosol-generating article chamber within a housing of an electrically operated aerosol-generating device 212. The aerosol-generating device 212 defines a plurality of air holes 214 for allowing air to flow to the aerosol-generating article 10, as illustrated by the arrows in Figure 4. The aerosol-generating device 212 comprises a power supply and electronics, which are not shown in Figure 4.

Comparative Example

[0144] A PHA filter segment according to the invention is prepared from PHA fibres, with the parameters shown in Table 1 below. The PHA fibres are formed using a melt spinning process, the fibres are then crimped and formed into a filter segment using standard filter making apparatus. For the purposes of comparison, a conventional cellulose acetate (CA) tow filter segment is prepared, with similar values of denier per filament (dpf) and total denier.

Table 1: parameters of PHA filter segment and cellulose acetate filter segment

Parameter	PHA filter segment	CA filter segment
Denier per filament	3.2	3
Total denier	27000	27000
Weight in filter segment (mg)	406.76	409.76
Exposed surface area (m ² /g)	0.161	0.329

[0145] In a first test, the water absorption by exposure to water of the PHA filter segment according to the invention and the CA filter segment are compared. For each filter segment, the plug wrap is removed and the filter segment is attached to the probe of a force tensiometer (KRUS force tensiometer, Model K100). The filter segment is moved down by the probe towards a container of water and automatically stopped when the filter segment makes contact with the water. The filter segment is retained in contact with the water for 300 seconds so that the filter material can absorb water and then the filter segment is weighed in order to determine the amount of water absorbed during the test period. For each of the PHA filter segment and the CA filter segment, this test is repeated three times and an average value of water absorption was calculated, as shown below in Table 2:

Table 2: Water absorption of the PHA and CA filter segments after exposure to water

	PHA filter segment	CA filter segment
Water absorption in 300 sec (g)	0.51	1.37

[0146] The amount of water absorbed by the PHA filter segment according to the invention during the test was therefore

less than 40 percent of the amount of water absorbed by the CA filter segment. This test therefore demonstrates the significantly reduced affinity of water of the PHA filter segment according to the invention compared to the conventional CA filter segment.

[0147] In a second test, the water absorption by exposure to moisture of the PHA filter segment according to the invention and the CA filter segment are compared. For each filter segment, the plug wrap is removed and the fibres forming the filter segment are placed in a petri dish and exposed to air at 22 degrees Celsius and 50 percent relative humidity for 70 hours. This is conducted in a vapour sorption analyser (ProUmid SPSx-1 μ). For each filter segment, the weight of the fibres is measured at the start of the test and the change in weight over time due to the absorption of water vapour by the fibres is measured. For each of the PHA filter segment and the CA filter segment, a value of the percentage difference in mass of the sample (%dm) is calculated, which expresses the increase in the weight of the sample as a percentage of the original weight. The values of %dm for each of the samples at the end of the 70 hour test are shown below in Table 3:

Table 3: Water absorption of the PHA and CA filter segments after exposure to moisture

	PHA filter segment	CA filter segment
% Difference in mass after 70 hours (% dm)	0.0133	0.6784

[0148] The results demonstrate that the amount of water vapour absorbed by the cellulose acetate fibres during the 70 hour test was more than 50 times greater than the amount of water vapour absorbed by the PHA fibres. The PHA fibres absorbed very little water vapour during the test. This further demonstrates the significantly reduced affinity of water of the PHA filter segment according to the invention compared to the conventional CA filter segment.

[0149] In a third test, the absorption of water from the mainstream smoke by a PHA filter segment according to the present invention and a conventional CA filter segment are compared. For each of the filter segments, a conventional smoking article is prepared as described above with reference to Figure 3, with a combustible tobacco rod and a single segment of the filtration material forming the filter. Each of the smoking articles is then smoked in a cigarette-smoking machine under ISO conditions as set out in ISO 3308:2000 (puff volume 35 ml; 2 second puff duration every 60 seconds) and an analysis of the resultant smoke is carried out.

[0150] For each of the filter segments, the amount of water in the mainstream smoke collected during the smoking test is measured, as shown in Table 4:

Table 4: Water in mainstream smoke generated during smoking test under ISO conditions

	PHA filter segment	CA filter segment
Water (mg per smoking article)	0.82	0.68

[0151] This demonstrates that when smoked under equivalent conditions, the smoking article incorporating the PHA filter segment produces a mainstream smoke having a water content that is approximately 20 percent higher than the water content of the mainstream smoke from the smoking article including the CA filter segment. This demonstrates that the PHA filter segment is absorbing less water from the mainstream smoke than the CA filter segment, thereby reducing the potential problem of dry smoke as described above.

Claims

1. An aerosol-generating article (10) for producing an inhalable aerosol upon heating, the aerosol-generating article comprising, in linear sequential arrangement:

a first plug of filtration material;

a rod (12) of aerosol-generating substrate, wherein the rod of the aerosol-generating substrate is located immediately downstream of the first plug of filtration material and comprises at least 12 percent by weight of an aerosol former, and wherein the rod of aerosol-generating substrate has a length of from 5 millimetres to 50 millimetres;

a hollow tube segment (14) with a support function and comprising fibrous filtration material, the hollow tube segment located immediately downstream of the rod and in longitudinal alignment with the rod;

a second plug (18) of filtration material located downstream of the hollow tube segment; and

an outer wrapper circumscribing the first plug, the rod (12), the support element (14), and the second plug (18);

wherein the fibrous filtration material comprises fibres comprising a polyhydroxyalkanoate (PHA) polymer or copolymer, the hollow tube segment comprising at least about 25 percent by weight of the PHA polymer or copolymer.

2. An aerosol-generating article according to claim 1 wherein the fibrous filtration material comprises at least about 85 percent by weight of fibres comprising a polyhydroxyalkanoate (PHA) polymer or copolymer.
3. An aerosol-generating article according to claim 1 or 2 wherein the fibrous filtration material comprises at least about 90 percent by weight of fibres comprising a polyhydroxyalkanoate (PHA) polymer or copolymer.
4. An aerosol-generating article according to any one of the preceding claims wherein the fibrous filtration material comprises at least about 5 percent of fibres comprising cellulose acetate.
5. An aerosol-generating article according to claim 4 wherein the fibrous filtration material comprises at least about 10 percent of fibres comprising cellulose acetate.
6. An aerosol-generating article according to any one of the preceding claims wherein the fibres comprising a polyhydroxyalkanoate (PHA) polymer or copolymer further comprise at least one biodegradable polymer selected from the group consisting of starch, polybutylene succinate (PBS), polybutyrate adipate terephthalate (PBAT), thermoplastic starch and thermoplastic starch blends (TPS), polycaprolactone (PCL), polyglycolide (PGA), polyvinyl alcohol (PVOH/PVA), viscose, regenerated cellulose, polysaccharides, cellulose acetate with a degree of substitution (DS) of less than 2.1, polyamides, protein-based biopolymers, chitosan-chitin based biopolymers, and combinations thereof.
7. An aerosol-generating article according to claim 6 wherein the at least one biodegradable polymer is one or more of PBAT, PCL and PBS.
8. An aerosol-generating article according to any one of the preceding claims wherein the fibrous filtration material comprises at least about 3 percent by weight of a plasticiser selected from triacetin, triethylene glycol diacetate (TEGDA), ethylene vinyl acetate, polyvinyl alcohol, starch or combinations thereof.
9. An aerosol-generating article according to any one of the preceding claims wherein the fibres comprising a polyhydroxyalkanoate (PHA) polymer or copolymer are of between 3.2 denier per filament and 5 denier per filament.
10. An aerosol-generating article according to any one of the preceding claims wherein the fibres comprising a polyhydroxyalkanoate (PHA) polymer or copolymer are crimped.
11. An aerosol-generating article according to any one of the preceding claims wherein an RTD of the hollow tube (14) segment is less than about 10 millimetres H₂O.
12. An aerosol-generating article according to any one of the preceding claims wherein the hollow tube segment (14) has a wall thickness of at least about 0.3 millimetres or a wall thickness of less than or equal to about 1.5 millimetres or both.
13. An aerosol-generating article according to any one of the preceding claims the hollow tube segment (14) has a length of at least about 4 millimetres.
14. An aerosol-generating article according to any one of the preceding claims wherein a dry radial hardness of the hollow tube segment (14) is at least about 90 percent.
15. A system comprising an aerosol-generating device and an aerosol-generating article according to any one of claims 1 to 14 for use with the aerosol-generating device, the aerosol-generating device being configured to heat rather than combust the aerosol-generating substrate.

Patentansprüche

1. Aerosolerzeugender Artikel (10) zum Erzeugen eines inhalierbaren Aerosols beim Erwärmen, wobei der aerosolerzeugende Artikel, in linearer sequenzieller Anordnung, umfasst:

einen ersten Einsatz aus Filtrationsmaterial;

einen Stock (12) aus aerosolerzeugendem Substrat, wobei der Stock des aerosolerzeugenden Substrats dem ersten Einsatz aus Filtrationsmaterial unmittelbar nachgelagert ist und wenigstens 12 Gewichtsprozent eines Aerosolbildners aufweist, und wobei der Stock aus aerosolerzeugendem Substrat eine Länge von 5 Millimeter bis 50 Millimeter aufweist;

ein hohles Rohrsegment (14) mit einer Auflagefunktion und umfassend Faserfiltrationsmaterial, wobei das hohle Rohrsegment dem Stock unmittelbar nachgelagert und in Längsausrichtung mit dem Stock ist;

einen zweiten Einsatz (18) aus Filtrationsmaterial, der dem hohlen Rohrsegment nachgelagert ist; und

eine äußere Umhüllung, die den ersten Einsatz, den Stock (12), das Auflageelement (14) und den zweiten Einsatz (18) umhüllt;

wobei das Faserfiltrationsmaterial Fasern umfasst, die ein Polyhydroxyalkanoat-(PHA-)Polymer oder -Copolymer umfassen, wobei das hohle Rohrsegment wenigstens etwa 25 Gewichtsprozent des PHA-Polymers oder -Copolymers umfasst.

2. Aerosolerzeugender Artikel nach Anspruch 1, wobei das Faserfiltrationsmaterial wenigstens etwa 85 Gewichtsprozent an Fasern umfasst, die ein Polyhydroxyalkanoat-(PHA-)Polymer oder -Copolymer umfassen.

3. Aerosolerzeugender Artikel nach Anspruch 1 oder 2, wobei das Faserfiltrationsmaterial wenigstens etwa 90 Gewichtsprozent an Fasern umfasst, die ein Polyhydroxyalkanoat-(PHA-)Polymer oder -Copolymer umfassen.

4. Aerosolerzeugender Artikel nach einem beliebigen der vorhergehenden Ansprüche, wobei das Faserfiltrationsmaterial wenigstens etwa 5 Prozent Fasern umfasst, die Celluloseacetat umfassen.

5. Aerosolerzeugender Artikel nach Anspruch 4, wobei das Faserfiltrationsmaterial wenigstens etwa 10 Prozent Fasern umfasst, die Celluloseacetat umfassen.

6. Aerosolerzeugender Artikel nach einem der vorhergehenden Ansprüche, wobei die Fasern ein Polyhydroxyalkanoat (PHA)-Polymer oder -Copolymer umfassen, das ferner wenigstens ein biologisch abbaubares Polymer aufweist, ausgewählt aus der Gruppe bestehend aus Stärke, Polybutylensuccinat (PBS), Polybutyrat-Adipat-Terephthalat (PBAT), thermoplastischer Stärke und thermoplastischen Stärkemischungen (TPS), Polycaprolacton (PCL), Polyglycolid (PGA), Polyvinylalkohol (PVOH/PVA), Viskose, regenerierter Cellulose, Polysacchariden, Celluloseacetat mit einem Substitutionsgrad (DS) von weniger als 2,1, Polyamide, Biopolymere auf Proteinbasis, Biopolymere auf Chitosan-Chitin-Basis und Kombinationen davon.

7. Aerosolerzeugender Artikel nach Anspruch 6, wobei das wenigstens eine biologisch abbaubare Polymer eines oder mehrere von PBAT, PCL und PBS ist.

8. Aerosolerzeugender Artikel nach einem der vorhergehenden Ansprüche, wobei das Faserfiltrationsmaterial wenigstens etwa 3 Gewichtsprozent eines Weichmachers umfasst, ausgewählt aus Triacetin, Triethylenglycoldiacetat (TEGDA), Ethylenvinylacetat, Polyvinylalkohol, Stärke oder Kombinationen davon.

9. Aerosolerzeugender Artikel nach einem der vorhergehenden Ansprüche, wobei die Fasern, die ein Polyhydroxyalkanoat-(PHA-)Polymer oder -Copolymer umfassen, zwischen 3,2 Denier pro Filament und 5 Denier pro Filament aufweisen.

10. Aerosolerzeugender Artikel nach einem der vorhergehenden Ansprüche, wobei die Fasern, die ein Polyhydroxyalkanoat-(PHA-)Polymer oder -Copolymer umfassen, gewellt sind.

11. Aerosolerzeugender Artikel nach einem der vorhergehenden Ansprüche, wobei ein RTD des hohlen Rohrsegments (14) weniger als etwa 10 Millimeter H₂O trägt.

12. Aerosolerzeugender Artikel nach einem der vorhergehenden Ansprüche, wobei das hohle Rohrsegment (14) eine Wandstärke von wenigstens etwa 0,3 Millimeter oder eine Wandstärke von weniger als oder gleich 1,5 Millimeter oder beides aufweist.

13. Aerosolerzeugender Artikel nach einem der vorhergehenden Ansprüche, wobei das hohle Rohrsegment (14) eine Länge von wenigstens etwa 4 Millimeter aufweist.

14. Aerosolerzeugender Artikel nach einem der vorhergehenden Ansprüche, wobei die radiale Trockenhärte des hohlen Rohrsegments (14) wenigstens etwa 90 Prozent beträgt.
15. System, umfassend eine Aerosolerzeugungsvorrichtung und einen aerosolerzeugenden Artikel nach einem der Ansprüche 1 bis 14 zum Gebrauch mit der Aerosolerzeugungsvorrichtung, wobei die Aerosolerzeugungsvorrichtung zum Erwärmen und nicht zum Verbrennen des aerosolerzeugenden Substrats ausgelegt ist.

Revendications

1. Article de génération d'aérosol (10) destiné à produire un aérosol inhalable lors du chauffage, l'article de génération d'aérosol comprenant, selon un agencement séquentiel linéaire :

un premier bout-filtre de matière de filtration ;

une tige (12) de substrat de génération d'aérosol, dans lequel la tige du substrat de génération d'aérosol est située immédiatement en aval du premier bout-filtre de matière de filtration et comprend au moins 12 pour cent en poids d'un agent de formation d'aérosol, et dans lequel la tige de substrat de génération d'aérosol a une longueur de 5 millimètres à 50 millimètres ;

un segment de tube creux (14) avec une fonction de support et comprenant une matière de filtration fibreuse, le segment de tube creux étant situé immédiatement en aval de la tige et en alignement longitudinal avec la tige ;

un deuxième bout-filtre (18) de matière de filtration situé en aval du segment de tube creux ; et

une enveloppe extérieure entourant le premier bout-filtre, la tige (12), l'élément de support (14) et le deuxième bout-filtre (18) ;

dans lequel la matière de filtration fibreuse comprend des fibres comprenant un polymère ou copolymère de polyhydroxyalcanoate (PHA), le segment de tube creux comprenant au moins environ 25 pour cent en poids du polymère ou copolymère PHA.

2. Article de génération d'aérosol selon la revendication 1 dans lequel la matière de filtration fibreuse comprend au moins environ 85 pour cent en poids de fibres comprenant un polymère ou un copolymère de polyhydroxyalcanoate (PHA).

3. Article de génération d'aérosol selon la revendication 1 ou 2 dans lequel la matière de filtration fibreuse comprend au moins environ 90 pour cent en poids de fibres comprenant un polymère ou un copolymère de polyhydroxyalcanoate (PHA).

4. Article de génération d'aérosol selon l'une quelconque des revendications précédentes, dans lequel la matière de filtration fibreuse comprend au moins environ 5 pour cent de fibres comprenant de l'acétate de cellulose.

5. Article de génération d'aérosol selon la revendication 4, dans lequel la matière de filtration fibreuse comprend au moins environ 10 pour cent de fibres comprenant de l'acétate de cellulose.

6. Article de génération d'aérosol selon l'une quelconque des revendications précédentes, dans lequel les fibres comprenant un polymère ou copolymère de polyhydroxyalcanoate (PHA) comprennent en outre au moins un polymère biodégradable choisi dans le groupe constitué par amidon, polybutylène succinate (PBS), téréphtalate d'adipate de polybutyrate (PBAT), amidon thermoplastique et mélanges d'amidon thermoplastique (TPS), polycaprolactone (PCL), polyglycolide (PGA), alcool polyvinylique (PVOH/PVA), viscose, cellulose régénérée, polysaccharides, acétate de cellulose avec un degré de substitution (DS) inférieur à 2.1, polyamides, biopolymères à base de protéines, biopolymères à base de chitosanechitine et des combinaisons de ceux-ci.

7. Article de génération d'aérosol selon la revendication 6, dans lequel l'au moins un polymère biodégradable est un ou plusieurs parmi PBAT, PCL et PBS.

8. Article de génération d'aérosol selon l'une quelconque des revendications précédentes, dans lequel la matière de filtration fibreuse comprend au moins environ 3 pour cent en poids d'un plastifiant sélectionné parmi la triacétine, le diacétate de triéthylène glycol (TEGDA), l'éthylène-acétate de vinyle, l'alcool polyvinylique, l'amidon ou des combinaisons de ceux-ci.

9. Article de génération d'aérosol selon l'une quelconque des revendications précédentes, dans lequel les fibres comprenant un polymère ou copolymère de polyhydroxyalcanoate (PHA) sont d'entre 3,2 denier par filament et environ 5 deniers par filament.

5 10. Article de génération d'aérosol selon l'une quelconque des revendications précédentes, dans lequel les fibres comprenant un polymère ou copolymère de polyhydroxyalcanoate (PHA) sont crêpées.

10 11. Article de génération d'aérosol selon l'une quelconque des revendications précédentes, dans lequel une RTD du segment de tube creux (14) est inférieure à environ 10 millimètres H₂O.

12. Article de génération d'aérosol selon l'une quelconque des revendications précédentes, dans lequel le segment de tube creux (14) a une épaisseur de paroi d'au moins environ 0,3 millimètre ou une épaisseur de paroi inférieure ou égale à environ 1,5 millimètre ou les deux.

15 13. Article de génération d'aérosol selon l'une quelconque des revendications précédentes, dans lequel le segment de tube creux (14) a une longueur d'au moins environ 4 millimètres.

20 14. Article de génération d'aérosol selon l'une quelconque des revendications précédentes, dans lequel une dureté radiale à sec du segment de tube creux (14) est d'au moins environ 90 pour cent.

25 15. Système comprenant un dispositif de génération d'aérosol et un article de génération d'aérosol selon l'une quelconque des revendications 1 à 14 destiné à être utilisé avec un dispositif de génération d'aérosol, le dispositif de génération d'aérosol étant configuré pour chauffer plutôt que mettre en combustion le substrat de génération d'aérosol.

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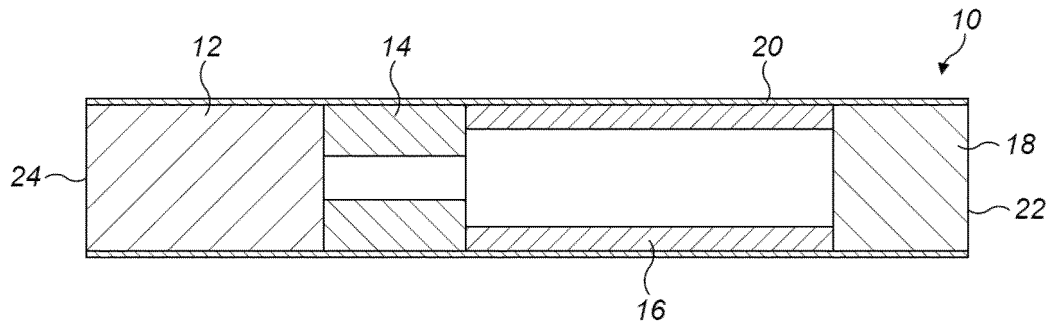


Figure 1

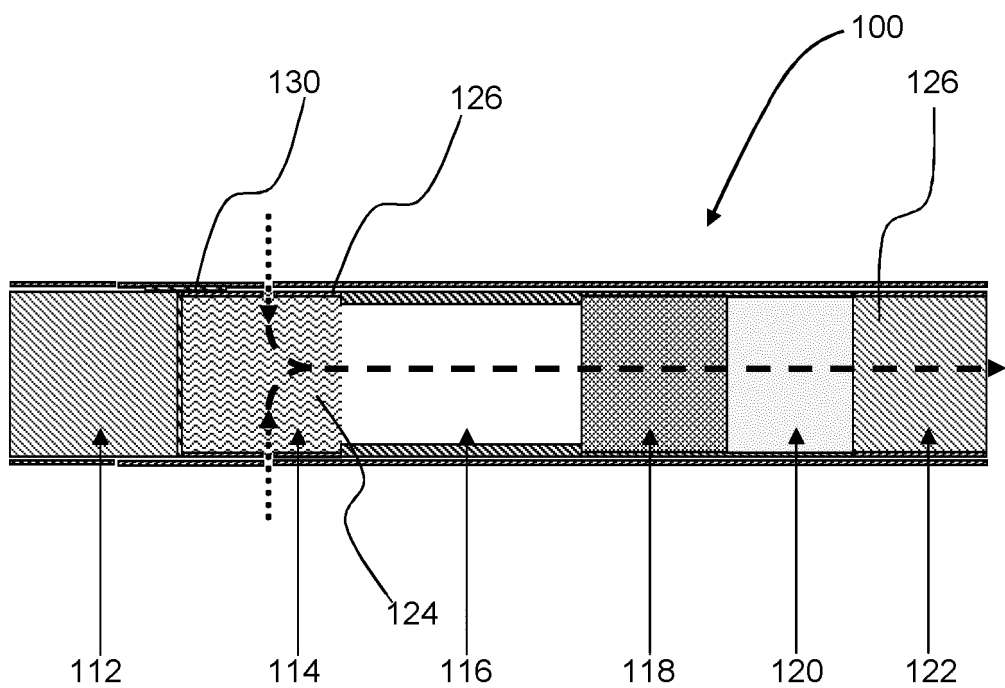


Figure 2

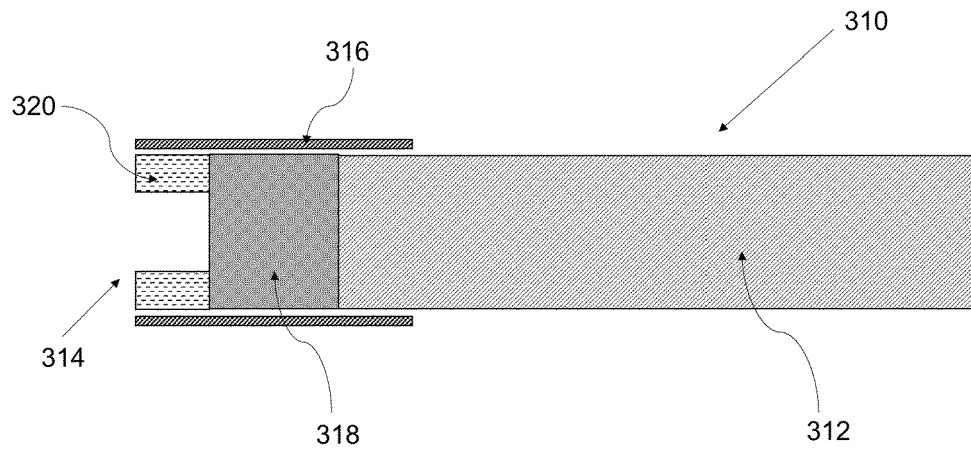


Figure 3

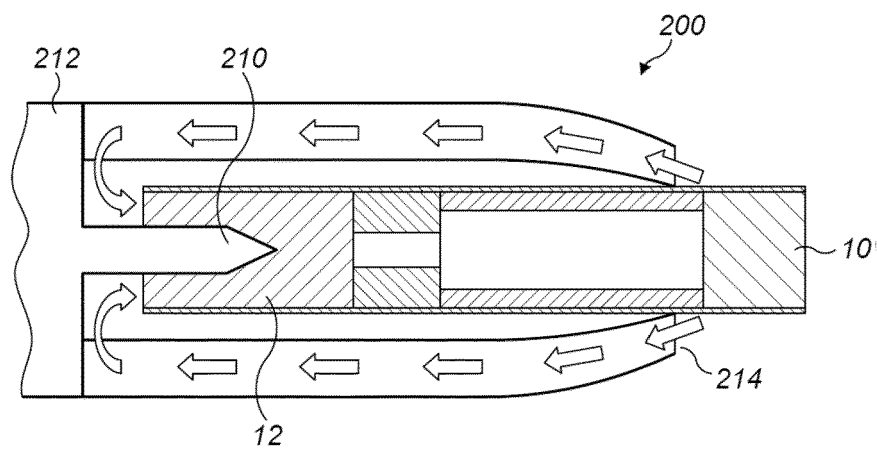


Figure 4

REFERENCES CITED IN THE DESCRIPTION

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