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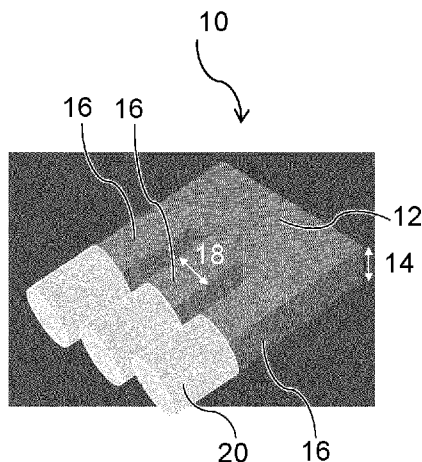
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(54) Title: AEROSOL-GENERATING ARTICLE WITH FOAMED CELLULOSIC FILTER ELEMENT

Fig. 2



(57) Abstract: The invention relates to an aerosol-generating article for use in an aerosol-generating device. The aerosol-generating article comprises a filter element (22). The filter element comprises a filtration material. The filtration material comprises a foamed cellulosic material (12). The aerosol-generating article comprises an aerosol-forming substrate.



AEROSOL-GENERATING ARTICLE WITH FOAMED CELLULOSIC FILTER ELEMENT

The present invention relates to an aerosol-generating article. The present invention relates to an aerosol-generating system. The present invention relates to a method of manufacturing a filter element for the aerosol-generating article. The present invention relates to a method for manufacturing the aerosol-generating article.

It is known to provide an aerosol-generating device for generating an inhalable vapor. Such devices may heat aerosol-forming substrate to a temperature at which one or more components of the aerosol-forming substrate are volatilised without burning the aerosol-forming substrate. Aerosol-forming substrate may be provided as part of an aerosol-generating article. The aerosol-generating article may have a rod shape for insertion of the aerosol-generating article into a cavity, such as a heating chamber, of the aerosol-generating device. A heating element may be arranged in or around the heating chamber for heating the aerosol-forming substrate once the aerosol-generating article is inserted into the heating chamber of the aerosol-generating device. The article may comprise a filter element. The filter element may be made from a plastic material.

It would be desirable to provide an aerosol-generating article with improved sustainability. It would be desirable to provide an aerosol-generating article with a biodegradable filter element. It would be desirable to provide an aerosol-generating article with a recyclable filter element. It would be desirable to provide an aerosol-generating article with a plastic-free filter element. It would be desirable to provide a method for manufacturing a filter element with improved sustainability. It would be desirable to provide a method for manufacturing a biodegradable filter element. It would be desirable to provide a method for manufacturing a plastic-free filter element. It would be desirable to provide a method for manufacturing a recyclable filter element.

According to an embodiment of the invention there is provided an aerosol-generating article for use in an aerosol-generating device. The aerosol-generating article may comprise a filter element. The filter element may comprise a filtration material. The filtration material may comprise a foamed cellulosic material. The aerosol-generating article may comprise an aerosol-forming substrate.

According to an embodiment of the invention there is provided an aerosol-generating article for use in an aerosol-generating device. The aerosol-generating article comprises a filter element. The filter element comprises a filtration material. The filtration material comprises a foamed cellulosic material. The aerosol-generating article comprises an aerosol-forming substrate.

The aerosol-generating article may provide an improved sustainability. The filter element of the aerosol-generating article may be a biodegradable filter element. The filter

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element of the aerosol-generating article may be a recyclable filter element. The filter element of the aerosol-generating article may be a plastic-free filter element. The filter element may be manufactured with improved sustainability. The method described herein may provide a biodegradable filter element. The method described herein may provide a plastic-free filter element. The method described herein may provide a recyclable filter element.

The filter element described herein may replace existing non-biodegradable filter elements at a comparable performance. The filter element described herein may replace existing plastic filter elements at a comparable performance. The filter element described herein may replace existing cellulose acetate filter elements at a comparable performance.

The foamed cellulosic material may be porous. The foamed cellulosic material may be a foam of cellulosic material. The foamed cellulosic material may be a dry foam of cellulosic material. The foamed cellulosic material may be a solid foam of cellulosic material. The foamed cellulosic material may be a foam of cellulosic material. The foamed cellulosic material may be a dry foamed cellulosic material. The foamed cellulosic material may be a solid foamed cellulosic material. The foam of cellulosic material may be porous.

A dry foam may refer to a material formed from pockets of air or other gas in a solid. A dry foam may refer to a material that has been formed from a wet foam by drying the wet foam.

A wet foam may refer to a material formed from pockets of air or other gas in a liquid.

A material having an open-cell structure may refer to a material comprising fluidly interconnected pockets of air or other gas in a solid.

The foamed cellulosic material may be produced by preparing a wet foam from a dispersion of cellulosic material and removing the liquid dispersion medium. The wet foam may be produced from the dispersion by agitating the dispersion or otherwise introducing bubbles of air into the dispersion.

Foaming of the cellulosic material may result in a material of lowered density. Foaming of the cellulosic material may result in a material of increased porosity. Foaming of the cellulosic material may result in a porous cellulosic material. The density may be determined at about 23 degrees Celsius and 50 percent relative humidity.

The consistency may be the percentage, by weight, of dry fiber to the total weight of a suspension of cellulosic material. The consistency of the suspension of cellulosic material may be of between 2.5 percent and 10 percent.

The filtration material may consist of the foamed cellulosic material.

The foamed cellulosic material in the filter element may be a portion of a sheet of the foamed cellulosic material. The portion may be obtained by separating the portion from a sheet of the foamed cellulosic material. "A portion of the sheet of the foamed cellulosic material" in the filter element may refer to a portion of the sheet which has been obtained by separating

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the portion from the sheet of the foamed cellulosic material. The portion may be obtained by cutting off the portion from a sheet of the foamed cellulosic material. The foamed cellulosic material in the filter element may be a separated portion of a sheet of the foamed cellulosic material. The cutting may be performed using a water jet cutter.

5 The foamed cellulosic material in the filter element may be a crimped and gathered sheet of the foamed cellulosic material. The foamed cellulosic material in the filter element may be a portion of a crimped and gathered sheet of the foamed cellulosic material. The portion may be obtained by separating the portion from a crimped and gathered sheet of the foamed cellulosic material. The portion may be obtained by cutting off the portion from a crimped and
10 gathered sheet of the foamed cellulosic material.

 The filter element may comprise a core formed from the filtration material. The core formed from the filtration material may be circumscribed by a filter element wrapper discussed below. The shape of the core may be defined by the filter element wrapper discussed below. The filter element may comprise a core formed from the foamed cellulosic material. The core
15 formed from the foamed cellulosic material may be circumscribed by a filter element wrapper discussed below. The core may be formed from a continuous body of the foamed cellulosic material. The core may be formed from a single continuous body of the foamed cellulosic material. The core may be formed from a continuous portion of a sheet of the foamed cellulosic material. The core may be formed from a crimped and gathered sheet of the foamed cellulosic
20 material. The core may be formed from a portion of a crimped and gathered sheet of the foamed cellulosic material.

 The cellulosic material may comprise cellulose. The cellulosic material may comprise cellulose fibers. The cellulosic material may be cellulose. The cellulosic material may be cellulose fibers. The cellulosic material may consist of cellulose. The cellulosic material may
25 consist of cellulose fibers. The cellulosic material may not comprise cellulose acetate. The cellulosic material may be free of cellulose acetate.

 The foamed cellulosic material may comprise cellulose. The foamed cellulosic material may comprise cellulose fibers. The foamed cellulosic material may not comprise cellulose acetate.

30 The foamed cellulosic material may be a foam of cellulosic material. The foamed cellulosic material may be a cellulosic foam. The foamed cellulosic material may be a cellulose foam. The foamed cellulosic material may be a foam of cellulose fibers. The foamed cellulosic material may be a foam of natural cellulose fibers.

 The foamed cellulosic material may be prepared from pulp. The foamed cellulosic
35 material may be prepared from wood pulp. The foamed cellulosic material may be prepared from cellulose fibers. The foamed cellulosic material may be prepared from a suspension of

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cellulose fibers. The cellulosic material may be derived from pulp. The cellulosic material may be derived from wood pulp.

The foamed cellulosic material may comprise foamed cellulose. The foamed cellulosic material may comprise foamed cellulose fibres. The foamed cellulosic material may comprise
5 foamed natural cellulose fibers. The cellulosic material may comprise foamed pulp. The foamed cellulosic material may comprise foamed wood pulp.

The foamed cellulosic material may be based on cellulose. The foamed cellulosic material may be based on cellulosic fibres. The foamed cellulosic material may be based on pulp. The foamed cellulosic material may be based on a wood pulp.

10 The foamed cellulosic material may have an open-cell structure. The foamed cellulosic material may be an open-cell foam of cellulosic material. The foamed cellulosic material may be a solid foam. The foamed cellulosic material may be a dry foam. The foamed cellulosic material may comprise a porous network of cellulosic fibers. The foamed cellulosic material may comprise a dry porous network of cellulosic fibers.

15 The filter element may comprise a proximal end. The filter element may comprise a distal end. The filtration material may be arranged between the proximal end of the filter element and the distal end of the filter element. The proximal end of the filter element and the distal end of the filter element may be fluidly connected via the filtration material. The proximal end of the filter element and the distal end of the filter element may be fluidly connected via
20 the foamed cellulosic material. The filtration material may extend between the proximal end of the filter element and the distal end of the filter element. The foamed cellulosic material may extend between the proximal end of the filter element and the distal end of the filter element.

"Porosity" may refer to the volume fraction of void space in a material or component. "Porosity" may refer to the volume fraction of void space in the foamed cellulosic material. For
25 example, if 60% of a volume of the foamed cellulosic material were unfilled by cellulosic material, the foamed cellulosic material would a porosity of 0.6. "Porosity" may refer to the volume fraction of void space in filter element. "Porosity" may refer to the volume fraction of void space in a volume of a crimped and gathered sheet of the foamed cellulosic material. The foamed cellulosic material may have a porosity of between 0.7 and 0.95, preferably of between
30 0.8 and 0.95.

Porosity, pore size distribution, median pore diameter and mean pore diameter of the foamed cellulosic material may be determined by x-ray micro tomography imaging. A piece of the foamed cellulosic material (approximately 1 centimeter x 1 centimeter x 0.7 to 1 centimeter) may be used for imaging.

35 "Pore" may refer to a pocket filled with air or other gas which is defined by a wall at least partially surrounding the pocket.

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The median pore diameter may be of between 100 micrometers and 250 micrometers. The mean pore diameter may be of between 130 micrometers and 330 micrometers.

The filter element may have a cylindrical shape. The filter element may have a solid cylindrical shape. The filter element may be a rod. The filter element may comprise a rod of the filtration material. The filter element may comprise a rod of the foamed cellulosic material. The filter element may have a substantially circular cross-section. The filter element may have a skewed circular cross-section. The foamed cellulosic material may have a substantially circular cross-section. The foamed cellulosic material may have a skewed circular cross-section. The core formed from the foamed cellulosic material may be a rod. The core formed from the foamed cellulosic material may have a substantially circular cross-section. The core formed from the foamed cellulosic material may have a skewed circular cross-section. The filter element may have a hollow tubular shape. The foamed cellulosic material in the filter element may have a hollow tubular shape.

The filter element may have a cuboid shape. The foamed cellulosic material may have a cuboid shape. The filter element may have a rectangular cross-section. The foamed cellulosic material may have a rectangular cross-section. The core formed from the foamed cellulosic material may be cuboid-shaped.

The filter element may comprise at least a portion of a sheet of the foamed cellulosic material. The filter element may be made from at least a portion of the sheet of the foamed cellulosic material.

The foamed cellulosic material may be derived from one of bleached softwood pulp, unbleached softwood pulp, bleached eucalyptus pulp and bleached cotton linter pulp, or any combinations thereof. The foamed cellulosic material may be derived from bleached chemi-thermomechanical pulp. The bleached softwood pulp may comprise fibres of two different lengths. The bleached softwood pulp may be Bleached Softwood Kraft Pulp (BSKP) from Metsä Fibre. The bleached softwood pulp may comprise cellulosic fibers from Nordic pine (*pinus silvestris*) and spruce (*picea abies*). The bleached softwood pulp may consist of cellulosic fibers of Nordic pine (*pinus silvestris*) and spruce (*picea abies*). The Bleached Softwood Kraft Pulp (BSKP) may be refined with a low-consistency pulper. The Bleached Softwood Kraft Pulp (BSKP) may have a Schopper-Riegler (SR) value of between 15 and 40, more preferably of between 20 and 30. The refining energy for Bleached Softwood Kraft Pulp (BSKP) to achieve a Schopper-Riegler (SR) value of 20 may be 80 kWh/t. The bleached eucalyptus pulp may be Bleached Eucalyptus Kraft Pulp (BEKP). The Bleached Eucalyptus Kraft Pulp (BEKP) may be refined with a low-consistency pulper. The Bleached Eucalyptus Kraft Pulp (BEKP) may have a Schopper-Riegler (SR) value of between 15 and 40, more preferably of 20 and 30, most preferably of about 25. The refining energy for Bleached

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Eucalyptus Kraft Pulp (BEKP) to achieve a Schopper-Riegler (SR) value of 39 may be 40 kWh/t.

The Schopper-Riegler (SR) value may be determined according to EN ISO 5267 - 1:2000. The Schopper-Riegler (SR) value may be a measure of drainability of pulp. The Schopper-Riegler (SR) value may be determined by measuring the amount of water that is drained when 0.2 weight percent pulp freely is let to drain through a wire. A lower Schopper-Riegler (SR) value indicates faster drainage of water.

Bleached softwood pulp and bleached eucalyptus pulp may be more readily available. Unbleached pulp and thermomechanical pulp grades may be cost effective.

The foamed cellulosic material may be essentially free of cellulose acetate. The foamed cellulosic material may be free of cellulose acetate. The foamed cellulosic material may be free of plastic.

The filtration material may be essentially free of cellulose acetate. The filtration material may be free of cellulose acetate. The filtration material may be free of plastic.

The filter element may be essentially free of cellulose acetate. The filter element may be free of cellulose acetate. The filter element may be free of plastic.

The foamed cellulosic material may comprise at least 98 weight-% of cellulose fibers, preferably at least 99 weight-% of cellulose fibers.

The filtration material may consist of the foamed cellulosic material.

The filter element may comprise a filter element wrapper. The filter element wrapper may be made from a paper material. The filter element wrapper may be arranged to at least partially circumscribe the filtration material. The filter element wrapper may be arranged to fully circumscribe the filtration material. The filter element wrapper may be configured to at least partially surround the filtration material. The filter element wrapper may be configured to fully surround the filtration material. The filter element wrapper may be configured to at least partially circumscribe the foamed cellulosic material. The filter element wrapper may be configured to fully circumscribe the foamed cellulosic material. The filter element wrapper may be configured to at least partially surround the foamed cellulosic material. The filter element wrapper may be configured to fully surround the foamed cellulosic material.

The filter element wrapper may be configured to at least partially circumscribe a portion of the sheet of the foamed cellulosic material. The filter element wrapper may be configured to fully circumscribe a portion of the sheet of the foamed cellulosic material.

The filter element wrapper may be configured to be wrapped around the filtration material. The filter element wrapper may be configured to be wrapped around the foamed cellulosic material. The filter element wrapper may be configured to be wrapped around a portion of the sheet of the foamed cellulosic material.

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The filter element wrapper may be configured to define the shape of the filter element. The filter element wrapper may be configured to define the shape of the foamed cellulosic material in the filter element. The filter element wrapper may be configured to define a cylindrical shape of the filter element. The filter element wrapper may be configured to define a cuboid shape of the filter element. The filter element wrapper may be tightened around the foamed cellulosic material.

The filter element wrapper may be configured to be wrapped around the foamed cellulosic material, such as to facilitate a cylindrical shape of the foamed cellulosic material.

The filter element may have a diameter of less than 10 millimetres, more preferably of between 1 millimeter and 10 millimeters, and even more preferably of about 7 millimeters. The diameter of the filter element may be defined by the filter element wrapper. The diameter of the foamed cellulosic material in the filter element may be defined by the filter element wrapper. The diameter of the foamed cellulosic material in the filter element may substantially correspond to the diameter of the filter element. The diameter of the foamed cellulosic material in the filter element may be smaller than the diameter of the filter element.

The filter element wrapper may be configured to stabilise the filtration material. The filter element wrapper may be configured to protect the filtration material. The filter element wrapper may be configured to stabilize the body of foamed cellulosic material. The filter element wrapper may be configured to hold the foamed cellulosic material in the desired arrangement. The filter element wrapper may be configured to stabilize the arrangement of the foamed cellulosic material.

The filtration material may be arranged on a longitudinal axis of the filter element. The filter element wrapper may be coaxially arranged around the filtration material. The filter element wrapper may be coaxially arranged around the foamed cellulosic material.

The filter element wrapper may be permanently attached to the filtration material. The filter element wrapper may be glued to the filtration material by a starch glue.

The filter element wrapper may have a permeability of between 3500 Coresta Units and 12000 Coresta Units.

The filter element wrapper may have a thickness of between 0.2 micrometers and 0.4 micrometers.

The filter element wrapper may have a basis weight of between 10 g/m and 30 g/m, preferably of between 17 g/m and 21 g/m.

The filter element wrapper may be made from a paper material. The filter element wrapper may be biodegradable. The filter element wrapper may be recyclable.

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The filtration material may comprise a crimped and gathered sheet of the foamed cellulosic material. The filtration material may consist of a crimped and gathered sheet of the foamed cellulosic material.

5 Crimping and gathering of the sheet of foamed cellulosic material may improve the resistance-to-draw of the filter element. Crimping and gathering of the sheet of foamed cellulosic material may improve the resistance-to-draw of the aerosol-generating article. Crimping and gathering of the sheet of foamed cellulosic material may improve the homogeneity of the resistance-to-draw of the filter element. Crimping and gathering of the sheet of foamed cellulosic material may improve the homogeneity of the resistance-to-draw of
10 the aerosol-generating article.

The filtration material may comprise a crimped sheet of the foamed cellulosic material. The filtration material may consist of a crimped sheet of the foamed cellulosic material. The filtration material may comprise a crimped and gathered sheet of the foamed cellulosic material. The filtration material may consist of a crimped and gathered sheet of the foamed
15 cellulosic material.

The foamed cellulosic material may be provided in the form of a sheet. The sheet of the foamed cellulosic material may be divided into portions. The sheet of the foamed cellulosic material may be cut into portions. The sheet of the foamed cellulosic material may be cuboid-shaped. The portions of the sheet of foamed cellulosic material may be cuboid-shaped. The
20 filter element may comprise the sheet of the foamed cellulosic material. The filter element may comprise a portion of the sheet of the foamed cellulosic material. The filtration material may comprise the sheet of the foamed cellulosic material. The filtration material may consist of the sheet of the foamed cellulosic material. The filtration material may comprise a portion of the sheet of the foamed cellulosic material. The filtration material may consist of a portion of the
25 sheet of the foamed cellulosic material.

The sheet of the foamed cellulosic material may be crimped and gathered. The filter element may comprise the crimped and gathered sheet of the foamed cellulosic material. The filter element may comprise a portion of the crimped and gathered sheet of the foamed cellulosic material. The filtration material may comprise the crimped and gathered sheet of the
30 foamed cellulosic material. The filtration material may consist of the crimped and gathered sheet of the foamed cellulosic material. The filtration material may comprise a portion of the crimped and gathered sheet of the foamed cellulosic material. The filtration material may consist of a portion of the crimped and gathered sheet of the foamed cellulosic material.

The filter element may comprise a crimped and gathered sheet of the filtration material.
35 The filter element may consist of a crimped and gathered sheet of the filtration material. Crimping and gathering of the sheet of the filtration material may improve the resistance-to-

draw of the filter element. Crimping and gathering of the sheet of the filtration material may improve the resistance-to-draw of the aerosol-generating article. Crimping and gathering of the sheet of the filtration material may improve the homogeneity of the resistance-to-draw of the filter element. Crimping and gathering of the sheet of the filtration material may improve the homogeneity of the resistance-to-draw of the aerosol-generating article.

The filter element wrapper may be configured to at least partially circumscribe the crimped and gathered sheet of the foamed cellulosic material. The filter element wrapper may be configured to fully circumscribe the crimped and gathered sheet of the foamed cellulosic material. The filter element wrapper may be configured to fully circumscribe at least a portion of the crimped and gathered sheet of the foamed cellulosic material. The filter element wrapper may be configured to be wrapped around the crimped and gathered sheet of the foamed cellulosic material. The filter element wrapper may be configured to define the diameter of the crimped and gathered sheet in the filter element.

As used herein, the term 'crimped sheet' may denote a sheet having a plurality of substantially parallel ridges or corrugations. The crimped sheet of the foamed cellulosic material may be gathered. The crimped and gathered sheet may be surrounded by a filter element wrapper. The filter element wrapper may hold the crimped and gathered sheet in a desired shape. The crimped sheet may be gathered into a rod. The crimped sheet may be gathered into a cube. A sheet of foamed cellulosic material may first be crimped and then be gathered.

When the aerosol-generating article has been assembled, the substantially parallel ridges or corrugations may extend along or parallel to the longitudinal axis of the aerosol-generating article. This may facilitate gathering of the crimped sheet of the foamed cellulosic material to form the filter element. However, it will be appreciated that crimped sheets of the foamed cellulosic material for inclusion in the aerosol-generating article may alternatively or in addition have a plurality of substantially parallel ridges or corrugations that are disposed at an acute or obtuse angle to the longitudinal axis of the aerosol-generating article when the aerosol-generating article has been assembled. In certain embodiments, the filter element may comprise a gathered sheet of the foamed cellulosic material that is substantially evenly textured over substantially its entire surface. For example, the filter element may comprise a crimped and gathered sheet of the foamed cellulosic material comprising a plurality of substantially parallel ridges or corrugations that are substantially evenly spaced-apart across the width of the sheet.

The sheet of the foamed cellulosic material may have a thickness of between 50 micrometers and 1000 micrometers. The sheet of the foamed cellulosic material may have a thickness of between 50 micrometers and 1000 micrometers before crimping. The sheet of the

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foamed cellulosic material having a thickness of between 50 micrometers and 1000 micrometers may be crimped. The sheet of the foamed cellulosic material having a thickness of between 50 micrometers and 1000 micrometers may be crimped and gathered. The sheet having a thickness of between 50 micrometers and 1000 micrometers may be crimped and gathered to form the filtration material.

The sheet of the foamed cellulosic material may have a volume of about 350 mm³.

The sheet of the foamed cellulosic material may have a grammage of between 20 g/m² and 200 g/m². The grammage of the foamed cellulosic material may be determined according to the standard method ISO 536:2012. The grammage of the foamed cellulosic material may be determined at 23 degrees Celsius and 50 percent relative humidity.

The foamed cellulosic material may have a density of between 10 kg/m³ and 100 kg/m³.

Thickness, density, and specific volume of the foamed cellulosic material may be determined with Lorentzen & Wettre micrometer 51 according to the standard test method ISO 534:2012.

The filtration material may comprise a continuous body of the foamed cellulosic material. The filtration material may consist of a continuous body of the foamed cellulosic material.

The continuous body of the foamed cellulosic material may be a portion of a sheet of the foamed cellulosic material. The continuous body of the foamed cellulosic material may be a single unit of foamed cellulosic material. The continuous body of the foamed cellulosic material may not be crimped and gathered.

The filter element wrapper may be configured to at least partially circumscribe the continuous body of the foamed cellulosic material. The filter element wrapper may be configured to fully circumscribe the continuous body of the foamed cellulosic material. The filter element wrapper may be configured to at least partially surround the continuous body of the foamed cellulosic material. The filter element wrapper may be configured to fully surround the continuous body of the foamed cellulosic material. The filter element wrapper may be configured to be wrapped around the continuous body of the foamed cellulosic material.

The filter element wrapper may be configured to at least partially compress the foamed cellulosic material. The filter element wrapper may be configured to compress the foamed cellulosic material. The filter element wrapper may be configured to compress at least a peripheral portion of the foamed cellulosic material.

The filter element wrapper may be configured to at least partially compress the continuous body of the foamed cellulosic material. The filter element wrapper may be configured to compress the continuous body of the foamed cellulosic material. The filter element wrapper may be configured to at least partially compress a cuboid-shaped continuous

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body of the foamed cellulosic material into a rod to form the filter element. The filter element wrapper may be configured to be wrapped around a cuboid-shaped continuous body of the foamed cellulosic material to form the cuboid-shaped continuous body into a rod. The filter element wrapper may be configured to define the shape of the continuous body of the foamed
5 cellulosic material in the filter element.

The filter element wrapper may be wrapped around a cuboid-shaped continuous body of the foamed cellulosic material having a thickness of 7 millimeters and a width of 7 millimeters. The filter element wrapper may be configured to compress a cuboid-shaped continuous body of the foamed cellulosic material having a thickness of 7 millimeters and a
10 width of 7 millimeters into a rod shape to form the filter element.

The foamed cellulosic material may have a diameter of less than 10 millimeters, more preferably of between 1 millimeter and 10 millimeters, and even more preferably of about 7 millimeters.

The foamed cellulosic material may be arranged in the filter element in the shape of a
15 solid cylindrical rod. The foamed cellulosic material arranged in the shape of the solid cylindrical rod may have a circular cross-section. The diameter of the foamed cellulosic material may refer to a diameter of the cross-section of the foamed cellulosic material arranged in the shape of the solid cylindrical rod in the filter element.

The filter element may have a solid cylindrical shape. The filter element may have a
20 rod shape.

The filter element may be arranged downstream of the aerosol-forming substrate.

The article may comprise an outer article wrapper. The outer article wrapper may be made of paper. The outer article wrapper may be configured to at least partially circumscribe the aerosol-forming substrate and the filter element. The outer article wrapper may be
25 configured to fully circumscribe the aerosol-forming substrate and the filter element.

The resistance-to-draw of the filter element may be of between 35 mm H₂O and 50 mm H₂O.

The foamed cellulosic material may comprise one or more additives.

The foamed cellulosic material may comprise the additive in an amount of less than 2
30 weight-%, preferably in an amount of less than 1 weight-%.

The additive may be selected from one or more of a foaming agent, a hydrophobizing agent and a strength additive.

The foamed cellulosic material may comprise a foaming agent. The foaming agent may be a surfactant. The foaming agent may comprise an anionic surfactant. The foaming agent
35 may comprise a non-ionic surfactant. The foaming agent may be configured to stabilize the foam. The foaming agent may be configured to facilitate the formation of the foam.

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The foaming agent may be selected from one or more of sodium dodecyl sulphate (SDS) and polyoxyethylene (20) sorbitan monolaurate. Polyoxyethylene (20) sorbitan monolaurate may be Tween 20. The foaming agent may comprise about 80 mol-% of sodium dodecyl sulphate and 20 mol-% of polyoxyethylene (20) sorbitan monolaurate. The foaming agent may consist of about 80 mol-% of sodium dodecyl sulphate and 20 mol-% of polyoxyethylene (20) sorbitan monolaurate. The foaming agent may be a mixture consisting of of sodium dodecyl sulphate in an amount of about 80 mol-% and of polyoxyethylene (20) sorbitan monolaurate in an amount of about 20 mol-%.

The foaming agent may be sodium dodecyl sulphate (SDS). The foaming agent may be polyoxyethylene (20) sorbitan monolaurate (Tween 20). The foaming agent may be a mixture comprising SDS and Tween 20. The foaming agent may be a mixture consisting of SDS and Tween 20.

SDS (active content ≥ 90 weight percent) and Tween 20 may be obtained from Sigma-Aldrich.

The hydrophobizing agent may be alkyl ketene dimer (AKD). The alkyl ketene dimer may be Fennosize KD 364 M. The foamed cellulosic material may comprise about 1 weight-% of alkyl ketene dimer.

The hydrophobizing agent may be configured to hydrophobize the cellulosic material. The hydrophobizing agent may be configured to hydrophobize the cellulose fibres.

Alkyl ketene dimer (Fennosize KD 364 M) may be obtained from Kemira (active content: 15 weight percent).

The strength additive may be selected from one or more of sodium carboxymethylcellulose (CMC), microfibrillated cellulose, and cellulose nanofibrils.

Sodium carboxymethylcellulose (CMC) (Finnfix 4000 G) may be obtained from Nouryon. Microfibrillated cellulose, highly fibrillated (Celova M250R-G) may be obtained from Weidmann (active content: 3.04 %, determined dry matter content). Cellulose nanofibrils may be obtained from UMaine PDC (active content: 3.50 %, determined dry matter content).

The strength additive may increase the tensile strength of the foamed cellulosic material. The strength additive may stabilize the foamed cellulosic material. The strength additive may increase the stiffness of the foamed cellulosic material. The foamed cellulosic material may comprise about 0.5 weight-% of the strength additive.

Tensile strength, energy to break and strain at break may be determined according to the standard method ISO 1924-2:2008 (for paper and board) using a Lloyd LS5 tensile testing machine.

The tensile strength of the foamed cellulosic material may be of between 165 N/m and 3820 N/m.

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The foamed cellulosic material may be obtained from a suspension comprising cellulosic material, foaming agent and hydrophobizing agent. The foamed cellulosic material may be obtained from a suspension comprising cellulosic material, foaming agent, hydrophobizing agent and strength additive.

5 The aerosol-generating article may have a cylindrical shape. The aerosol-generating article may be rod. The aerosol-generating article may have a substantially circular cross-section. The aerosol-generating article may have a skewed circular cross-section. The aerosol generating article may be cuboid-shaped. The aerosol-generating article may have a rectangular cross-section.

10 The filter element may comprise triacetin.

The foamed cellulosic material may comprise a phenol scavenger. The phenol scavenger may be triacetin. The foamed cellulosic material may be impregnated with the phenol scavenger. The foamed cellulosic material may be impregnated with triacetin. The phenol scavenger may retain phenolic compounds. The phenol scavenger may absorb
15 phenolic compounds from the aerosol flowing through the filter element.

The foamed cellulosic material may be derived from one or more of bleached softwood pulp, unbleached softwood pulp, blead eucalyptus pulp and blead cotton linter pulp. The cellulosic material may be derived from one or more of bleached softwood pulp, unbleached softwood pulp, blead eucalyptus pulp and blead cotton linter pulp. The cellulosic material may
20 be based from one or more of bleached softwood pulp, unbleached softwood pulp, blead eucalyptus pulp and blead cotton linter pulp.

The foamed cellulosic material may have a density of below 200 kg/m^3 . The foamed cellulosic material may have a density of below 100 kg/m^3 . The foamed cellulosic material may have a density of between 50 kg/m^3 and 200 kg/m^3 . The foamed cellulosic material may have
25 a density of between 50 kg/m^3 and 100 kg/m^3 . The foamed cellulosic material may have a density of about 50 kg/m^3 . The foamed cellulosic material may have a density of about 75 kg/m^3 . The foamed cellulosic material may have a density of about 100 kg/m^3 . The continuous body of foamed cellulosic material may have a density of between 45 kg/m^3 and 105 kg/m^3 , preferably of between 48 kg/m^3 and 98 kg/m^3 . The crimped and gathered sheet of foamed
30 cellulosic material may have a density of between 50 kg/m^3 and 200 kg/m^3 , preferably of between 78 kg/m^3 and 168 kg/m^3 .

The grammage of the continuous body of foamed cellulosic material may be of between 350 g/m^2 and 1500 g/m^2 , preferably of between 372 g/m^2 and 1479 g/m^2 . The grammage of the crimped and gathered sheet of foamed cellulosic material may be of between 20 g/m^2 and
35 55 g/m^2 , preferably of between 22.8 g/m^2 and 52.3 g/m^2 .

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The filter element may have a length of between 5 millimeters and 21 millimeters, preferably of between 7 millimeters and 11 millimeters.

The filter element may have an outer diameter of between 3 millimeters and 10 millimeters, preferably of between 4 millimeters and 9 millimeters.

5 In a preferred embodiment of the invention, the filter element comprises the crimped and gathered sheet of the foamed cellulosic material and the filter element wrapper circumscribing the crimped and gathered sheet of the foamed cellulosic material. The sheet may have a thickness of between 50 micrometers and 1000 micrometers. The crimped and gathered sheet may be obtained by first crimping and then gathering a sheet of foamed
10 cellulosic material having a thickness of between 50 micrometers and 1000 micrometers. The filter element may be configured as a rod of substantially circular cross-section.

In another preferred embodiment of the invention, the filter element may comprise the continuous body of the foamed cellulosic material. The foamed cellulosic material may be a foam of cellulosic material. The continuous body of the foam of cellulosic material may be
15 circumscribed by the filter element wrapper. The filter element may be configured as a rod of substantially circular cross-section. The continuous body of the foam of cellulosic material may have a diameter of about 7 millimeters. Preferably, the filter element wrapper is configured to compress a cuboid-shaped continuous body of the foam of cellulosic material into a rod of substantially circular cross-section. Preferably, cuboid-shaped continuous body of the foam
20 may have a thickness of about 7 millimeters and a width of about 7 millimeters.

The invention further relates to an aerosol-generating system which may comprise an aerosol-generating device and an aerosol-generating article as described herein.

The invention further relates to an aerosol-generating system comprising an aerosol-generating device and an aerosol-generating article as described herein.

25 The invention further relates to a method of manufacturing a filter element for an aerosol-generating article which may comprise the following steps:

- a) preparing a filtration material comprising a sheet of a foamed cellulosic material,
- b) adjusting a thickness of the sheet of foamed cellulosic material,
- c) drying the sheet of the foamed cellulosic material,
- 30 d) shaping at least a portion of the sheet of cellulosic material to form the filter element.

The invention relates to a method of manufacturing a filter element for an aerosol-generating article comprising the following steps:

- a) preparing a filtration material comprising a sheet of a foamed cellulosic material,
- 35 b) adjusting a thickness of the sheet of foamed cellulosic material,
- c) drying the sheet of the foamed cellulosic material,

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d) shaping at least a portion of the sheet of cellulosic material to form the filter element.

In step d) the sheet of the cellulosic material may be shaped to form the filter element.

In step a), the sheet of the foamed cellulosic material may be prepared from pulp.

5 In step a), the sheet of the foamed cellulosic material may be prepared from cellulose fibers. In step a), the sheet of the foamed cellulosic material may be prepared from wood pulp.

In step a), the pulp may be refined. Refining the pulp may increase the tensile strength of the foamed cellulosic material.

10 In step a), the conductivity of the pulp may be adjusted to 1000 $\mu\text{S}/\text{cm}$. In step a), the conductivity of the pulp may be adjusted to 1000 $\mu\text{S}/\text{cm}$ by the addition of sodium chloride.

In step a), the pH of the pulp may be adjusted to about 8. In step a), the pH of the pulp may be adjusted to about 8 by the addition of sodium hydroxide.

15 In step a), a strength additive may be added to the pulp. In step a), a strength additive, selected from one or more of sodium carboxymethylcellulose (CMC), microfibrillated cellulose and cellulose nanofibrils may be added to the pulp.

20 In step a), a foaming agent may be added to the pulp. In step a), a foaming agent, selected from one or more of sodium dodecyl sulphate (SDS) and polyoxyethylene (20) sorbitan monolaurate may be added to the pulp. In step a), a mixture comprising sodium dodecyl sulphate (SDS) in an amount of 80 mol-% and polyoxyethylene (20) sorbitan monolaurate in an amount of 20 mol-%, may be added to the pulp.

In step a), a hydrophobizing agent may be added to the pulp. The hydrophobizing agent may be alkyl ketene dimer (AKD).

In step a), the pulp may be mixed to form a foam. In step a), the pulp may be agitated to form a foam.

25 In step b), the sheet of foamed cellulosic material may be adjusted to a thickness of between 50 micrometers and 1000 micrometers.

30 In step d), at least of portion of the sheet may be crimped and subsequently gathered to form the filter element. In step d), the sheet of the foamed cellulosic material may be crimped and subsequently gathered to form the filter element. In step d), at least of portion of the sheet may be crimped and subsequently gathered. In step d), the sheet may be crimped and subsequently gathered. The crimped and gathered portion of the sheet may be wrapped by the filter element wrapper to form the filter element. The portion may be cut off the sheet of the foamed cellulosic material. The crimped and gathered sheet may be wrapped by the filter element wrapper to form the filter element.

35 In step b), the sheet of foamed cellulosic material may be adjusted to a thickness of between 1 millimeter and 10 millimeters.

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In step d), at least of portion of the sheet may be circumscribed by a filter element wrapper to form the filter element. In step d), a continuous body of the foamed cellulosic material may be circumscribed by a filter element wrapper to form the filter element. In step d), at least a portion of the sheet may be circumscribed by a filter element wrapper to form the filter element. The filter element wrapper may define the shape of the foamed cellulosic material in the filter element. The portion may be cut off the sheet of the foamed cellulosic material. The continuous body of the foamed cellulosic material may be cut off the sheet of the foamed cellulosic material.

Prior to step b), a fabric may be applied to a top surface of the sheet of the foamed cellulosic material. The fabric may be a wire fabric.

Prior to step b), the sheet of the foamed cellulosic material may be dewatered, dried, and rewetted by the addition of water. In the rewetting, the moisture content may 50 percent.

The invention further relates to a method for manufacturing an aerosol-generating article which may comprise the following steps:

a) preparing a filter element using the method of manufacturing a filter element for an aerosol-generating article described above

b) combining the filter element with an aerosol-forming substrate.

The invention further relates to a method for manufacturing an aerosol-generating article comprising the following steps:

a) preparing a filter element using the method of manufacturing a filter element for an aerosol-generating article described above

b) combining the filter element with an aerosol-forming substrate.

The invention further relates to a method of manufacturing a sheet of foamed cellulosic material which may comprise the following steps:

a) preparing a suspension of cellulosic material, wherein the suspension comprises a foaming agent,

b) agitating the suspension of cellulosic material and, optionally, adding hydrophobizing agent to the suspension of cellulosic material to obtain a wet foam of cellulosic material,

c) preparing a sheet of the wet foam of cellulosic material and dewatering the sheet of wet foam of cellulose material,

d) drying the sheet of wet foam of cellulosic material,

e) rewetting the sheet of foam

f) adjusting a thickness of the sheet of foam, and

g) drying of the foam.

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The method may yield a sheet of dry foamed cellulosic material. The method may yield a sheet of dry foam of cellulosic material. The method may yield the foamed cellulosic material of the filter element of the invention.

5 The suspension of cellulosic material may be a suspension of pulp. The suspension of cellulosic material may be a suspension of wood pulp. The suspension of cellulosic material may be a suspension of cellulose. The suspension of cellulosic material may be a suspension of refined cellulose. The suspension of cellulosic material may be a suspension of cellulosic fibers. The suspension of cellulosic material may be a suspension of cellulose fibers.

10 The cellulosic material may be cellulose. The cellulosic material may be cellulosic fibers. The cellulosic material may be cellulose fibers. The cellulosic material may comprise cellulose. The cellulosic material may comprise cellulosic fibers. The cellulosic material may comprise cellulose fibers. The cellulosic material may be free of cellulose acetate.

15 The cellulosic material may be based on one of bleached softwood pulp, unbleached softwood pulp, bleached eucalyptus pulp and bleached cotton linter pulp, or any combinations thereof. The cellulosic material may be derived from one of bleached softwood pulp, unbleached softwood pulp, bleached eucalyptus pulp and bleached cotton linter pulp, or any combinations thereof.

20 The foaming agent may comprise one or more surfactants. Preferably, the foaming agent may be a mixture comprising sodium dodecyl sulphate (SDS) in an amount of about 80 mol-% and polyoxyethylene (20) sorbitan monolaurate in an amount of about 20 mol-%.

Preferably, the hydrophobizing agent may be alkyl ketene dimer (AKD). The hydrophobizing agent may be added to the suspension of cellulosic material at an amount of about 1 weight-% of the suspension.

25 In step a), the cellulosic material may be refined to between 2 percent and 3 percent. In step a), the conductivity of the suspension of cellulosic material may be adjusted to 1000 $\mu\text{S}/\text{cm}$ by adding sodium chloride. In step a), the pH of the suspension of cellulosic material may be adjusted to about 8 by adding sodium hydroxide. In step a), a strength additive may be added to the suspension of cellulosic material. The strength additive may be selected from one or more of sodium carboxymethylcellulose (CMC), microfibrillated cellulose and cellulose
30 nanofibrils.

In step c), the wet foam of cellulosic material may be poured on a hand sheet mould. In step c), the sheet of wet foam of cellulosic material may be drained by gravity. In step c), the dewatering may not be performed using a vacuum. In step c), a fabric may be arranged on top of the foam to stabilize the foam. In step d) the drying may be performed in an oven at 70 degrees Celsius.

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In step e), the foam may be rewetted to 50 percent moisture content. In step e), the sheet of foam may be rewetted by exposing the sheet to an atmosphere having 50 % moisture content for 4 hours.

In step g), the foam may be dried in an oven at 70 degrees Celsius. In step g), the foam
5 may be cured at about 80 degrees Celsius for 2 hours to ensure complete reaction of AKD.

The foamed cellulosic material may be a foam of cellulosic material. The foamed cellulosic material may be a dry foam of cellulosic material. The foamed cellulosic material may be a solid foam of cellulosic material. The foamed cellulosic material may be an open-cell foam. The foamed cellulosic material may be free of cellulose acetate. The foamed cellulosic material
10 may be porous. A density of the foam of cellulosic material may be of between 45 kg/m³ and 105 kg/m³.

Exemplary preparation of a filter element comprising the crimped and gathered sheet of the foamed cellulosic material:

15 In a first step, a cellulose fiber suspension was produced. The pulp was disintegrated in tap water to a desired consistency to form a cellulose fiber slurry. Preferably, the pulp was bleached softwood Kraft Pulp (BSKP). Preferably, the consistency was of about 2 percent to 3 percent (20 to 30 g/l). The consistency may be the percentage, by weight, of dry fiber to the total weight of the cellulose fiber slurry. The conductivity of the cellulose fiber slurry was
20 increased to 1000 µS/cm by adding sodium chloride. The pH of the cellulose fiber slurry was adjusted to about 8 by adding sodium hydroxide. A foaming agent was added to the cellulose fiber slurry. Preferably, the foaming agent was a mixture of sodium dodecyl sulphate (SDS) (80 mol-%) and polyoxyethylene (20) sorbitan monolaurate (Tween 20) (20 mol-%). A strength additive may be added to the cellulose fiber slurry. The cellulose fiber suspension was
25 obtained.

In a second step, the cellulose fiber suspension was foamed. The cellulose fiber suspension was transferred to a foaming vessel. Foam was generated by aerating the cellulose fiber suspension using a Netzsch Shearmaster mixer. A bend disc type of mixing plate (having diameter of 83 millimeters) was used. The mixing plate was placed just below
30 the surface of the cellulose fiber suspension. The mixing rate was 3650 revolutions per minute. The mixing time was from between 2.5 minutes to 6.5 minutes. A hydrophobizing agent was added. Preferably, the hydrophobizing agent was alkyl ketene dimer (AKD) (1 weight-%).

After foaming, the foam was poured on a hand sheet mould. A funnel directed the foam to one side of the mould. The foam was spread evenly onto a fabric. The funnel was removed.
35 A plastic cover was placed on top of the foam to create a seal for the vacuum. Water was removed by applying a vacuum. The plastic cover was carefully removed. The obtained wet

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sheet was carefully detached from the fabric and dried using a KRK rotary dryer (Kumagai Riki Kogyo Co., Ltd.). The drying temperature was about 105 degrees Celsius. Wet pressing was not performed before drying. Finally, the dried samples were cured in an oven at about 80 degrees Celsius for 2 hours to ensure a complete reaction of alkyl ketene dimer. A sheet of foamed cellulosic material was obtained. The obtained sheets had a thickness of between 50 micrometers and 1000 micrometers.

The sheet of foamed cellulosic material was crimped, gathered and wrapped with a filter element wrapper to form the filter element as described herein.

Further exemplary preparation of a filter element comprising the crimped and gathered sheet of the foamed cellulosic material

A filter element of the aerosol-generating article of the present invention was manufactured. The filter element comprises the crimped and gathered sheet of the foamed cellulosic material. The filter element is shown in below discussed Fig. 6.

In a first step, a cellulose fiber suspension was produced. The foamed cellulosic material was prepared from refined Bleached Softwood Kraft Pulp (BSKP) (Metsä Fibre). The BSKP was disintegrated in tap water to a desired consistency to form a cellulose fiber slurry. The consistency was of 2 percent to 3 percent (20 to 30 g/l). The conductivity of the cellulose fiber slurry was increased to 1000 $\mu\text{S}/\text{cm}$ by adding sodium chloride. The pH of the cellulose fiber slurry was adjusted to about 8 by adding sodium hydroxide. A mixture of sodium dodecyl sulphate (SDS) (80 mol-%) and polyoxyethylene (20) sorbitan monolaurate (Tween 20) (20 mol-%) was added. A strength additive was added to the cellulose fiber slurry. The cellulose fiber suspension was obtained.

In a second step, the cellulose fiber suspension was foamed. The cellulose fiber suspension was transferred to a foaming vessel. Foam was generated by aerating the cellulose fiber suspension using a Netzsch Shearmaster mixer. A bend disc type of mixing plate (having diameter of 83 millimeters) was used. The mixing plate was placed just below the surface of the cellulose fiber suspension. The mixing rate was 3650 revolutions per minute. The mixing time was from between 2.5 minutes to 6.5 minutes. Alkyl ketene dimer (AKD) (3 weight-%) was added.

After foaming, the foam was poured on a hand sheet mould. A funnel directed the foam to one side of the mould. The foam was spread evenly onto a fabric. The funnel was removed. A plastic cover was placed on top of the foam to create a seal for the vacuum. Water was removed by applying a vacuum. The plastic cover was carefully removed. The obtained wet sheet was carefully detached from the fabric and dried using a KRK rotary dryer (Kumagai Riki Kogyo Co., Ltd.). The drying temperature was about 105 degrees Celsius. Wet pressing was

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not performed before drying. Finally, the dried samples were cured in an oven at about 80 degrees Celsius for 2 hours to ensure a complete reaction of alkyl ketene dimer. A sheet of foamed cellulosic material was obtained. The obtained sheets had a thickness of between 50 micrometers and 1000 micrometers.

The sheet of foamed cellulosic material had a width of 15 centimetres. The sheet of foamed cellulosic material was crimped. The sheet of foamed cellulosic material was passed between two rollers. The crimping was carried out using a PLA crimping rollers. A crimping depth of 445 micrometres was used. The crimped sheet of foamed cellulosic material was gathered to obtain the filter element of the aerosol-generating article of the invention as shown in below discussed Fig. 6. The resulting filter element had characteristics described in the below table.

	Weight (mg)	Diameter (mm)	Ovality (mm)	Resistance-to-draw (mm H ₂ O)
Average	1514.6	7.21	0.56	219
Standard deviation	17.44	0.01	0.09	21.76
Coefficient of variation (CV)	1.15	0.18	16.42	9.93

The resulting filter elements showed a desirable resistance-to-draw with a low coefficient of variation. Accordingly, the crimping and gathering of the sheet of foamed cellulosic material provides filter elements having a desired resistance-to-draw at improved uniformity.

In an alternative crimping of the sheet of foamed cellulosic material, CU rollers (Koerber) were used. The sheet of foamed cellulosic material had a width of 12 centimetres. A crimping depth of 600 micrometres was used. The crimped sheet of foamed cellulosic material was gathered to obtain the filter element of the aerosol-generating article of the invention. The resulting filter element had a resistance-to-draw of 240.5 mm H₂O at a coefficient of variation (CV) of 4.39. The filter element had a diameter of about 7.2 millimetres. Accordingly, the crimping and gathering of the sheet of foamed cellulosic material provides a filter element having a desired resistance-to-draw at improved uniformity.

Exemplary preparation of a filter element comprising the continuous body of the foamed cellulosic material

In a first step, a cellulose fiber suspension was produced. The pulp was disintegrated in tap water to a desired consistency to form a cellulose fiber slurry. Preferably, the pulp was

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bleached softwood Kraft Pulp (BSKP) or Bleached Eucalyptus Kraft Pulp (BEKP). Preferably, the consistency was of about 2 percent to 3 percent (20 to 30 g/l). The conductivity of the cellulose fiber slurry was increased to 1000 $\mu\text{S}/\text{cm}$ by adding sodium chloride. The pH of the cellulose fiber slurry was adjusted to about 8 by adding sodium hydroxide. A foaming agent mixture was added to the cellulose fiber slurry. Preferably, the foaming agent was a mixture of sodium dodecyl sulphate (SDS) (80 mol-%) and polyoxyethylene (20) sorbitan monolaurate (Tween 20) (20 mol-%). A strength additive may be added to the cellulose fiber slurry. The cellulose fiber suspension was obtained.

In a second step, the cellulose fiber suspension was foamed. The cellulose fiber suspension was transferred to a foaming vessel. Foam was generated by aerating the cellulose fiber suspension by using a Netzsch ShearMaster mixer. A bend disc type of mixing plate (having diameter of 83 millimeters) was used. The mixing plate was placed just below the surface of the cellulose fiber suspension. The mixing rate was 3800 revolutions per minute. The mixing time is from between 2.5 minutes to 6.5 minutes. A hydrophobizing agent was added. Preferably, the hydrophobizing agent was alkyl ketene dimer (AKD) (1 weight-%).

After foaming, the foam was poured onto a hand sheet mould. A fabric was placed on top of the foam. The foam was let to dewater for about 20 minutes. No vacuum was used to assist water removal. The water was let to drain by the influence of gravity. The purpose of fabric on top of the foam was to prevent the foam from collapsing. The portion of the foam contacting the fabric adhered to the wire fabric during dewatering. Subsequently, the wet foam was transferred to a convection oven and dried at about 70 degrees Celsius overnight. After drying, the sheets of foam were pressed to the target thickness of about 7 millimeters. The sheets of foam were rewetted by spraying them with tap water to 50 percent moisture content. The sheets of foam were placed in sealed plastic bags for 4 hours. Such treatment softens the material before pressing. After rewetting, the sheets were pressed to a desired thickness by placing the sheets between metal plates with spacers having the desired thickness arranged between the metal plates. Preferably, the desired thickness was about 7 millimeters. The sheets of the foamed cellulosic material between the metal plates were placed into an oven and dried again at 70 degrees Celsius overnight. Pressed dry samples were cured in an oven at 80 degrees Celsius for 2 hours to ensure a complete reaction of AKD. A sheet of foamed cellulosic material was obtained. The sheet had a thickness of about 7 millimeters.

The resulting sheet of the foamed cellulosic material was trimmed into a plurality of continuous bodies having a thickness of about 7 millimeters and a width of about 7 millimeters. A filter element wrapper was wrapped around each continuous body of foamed cellulosic material to form a filter element of the invention.

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The invention further relates to an aerosol-generating article comprising the filter element produced by the method of manufacturing a filter element as described herein.

The invention further relates to a filter element as described herein for an aerosol-generating article.

5 As used herein, the terms 'proximal', 'distal', 'downstream' and 'upstream' may be used to describe the relative positions of components, or portions of components, of the aerosol-generating article in relation to the direction in which a user draws on the aerosol-generating article during use thereof.

10 The aerosol-generating article may comprise a mouth end through which in use an aerosol exits the aerosol-generating article and is delivered to a user. The mouth end may also be referred to as the proximal end. In use, a user may draw on the proximal or mouth end of the aerosol-generating article in order to inhale an aerosol generated by the aerosol-generating article. The aerosol-generating article comprises a distal end opposed to the proximal or mouth end. The proximal or mouth end of the aerosol-generating article may also be referred to as
15 the downstream end and the distal end of the aerosol-generating article may also be referred to as the upstream end. Components, or portions of components, of the aerosol-generating article may be described as being upstream or downstream of one another based on their relative positions between the proximal, downstream or mouth end and the distal or upstream end of the aerosol-generating article.

20 The aerosol-generating article may be inserted into a cavity of an aerosol-generating device. A user may directly draw on an aerosol-generating article inserted into an opening at the proximal end of the aerosol-generating device. The terms 'proximal', 'distal', 'downstream' and 'upstream' may be used to describe the relative positions of components, or portions of components, of the aerosol-generating device in relation to the direction in which a user draws
25 on the aerosol-generating device during use thereof.

 As used herein, an 'aerosol-generating device' may relate to a device that interacts with an aerosol-forming substrate to generate an aerosol. The aerosol-forming substrate may be part of an aerosol-generating article. An aerosol-generating device may be a smoking device that interacts with an aerosol-forming substrate of an aerosol-generating article to
30 generate an aerosol that is directly inhalable into a user's lungs thorough the user's mouth. An aerosol-generating device may be a holder. The device may be an electrically heated smoking device. The aerosol-generating device may comprise a housing, electric circuitry, a power supply, a heating chamber and a heating element.

 The aerosol-generating device may comprise electric circuitry. The electric circuitry
35 may comprise a microprocessor, which may be a programmable microprocessor. The microprocessor may be part of a controller. The electric circuitry may comprise further

electronic components. The electric circuitry may be configured to regulate a supply of power to the heating element. Power may be supplied to the heating element continuously following activation of the aerosol-generating device or may be supplied intermittently, such as on a puff-by-puff basis. The power may be supplied to the heating element in the form of pulses of electrical current. The electric circuitry may be configured to monitor the electrical resistance of the heating element, and preferably to control the supply of power to the heating element dependent on the electrical resistance of the heating element.

The aerosol-generating device may comprise a power supply, typically a battery, within a main body of the aerosol-generating device. In one embodiment, the power supply is a Lithium-ion battery. Alternatively, the power supply may be a Nickel-metal hydride battery, a Nickel cadmium battery, or a Lithium based battery, for example a Lithium-Cobalt, a Lithium-Iron-Phosphate, Lithium Titanate or a Lithium-Polymer battery. As an alternative, the power supply may be another form of charge storage device such as a capacitor. The power supply may require recharging and may have a capacity that enables to store enough energy for one or more usage experiences; for example, the power supply may have sufficient capacity to continuously generate aerosol for a period of around six minutes or for a period of a multiple of six minutes. In another example, the power supply may have sufficient capacity to provide a predetermined number of puffs or discrete activations of the heating element.

The cavity of the aerosol-generating device may have an open end into which the aerosol-generating article is inserted. The open end may be a proximal end. The cavity may have a closed end opposite the open end. The closed end may be the base of the cavity. The closed end may be closed except for the provision of air apertures arranged in the base. The base of the cavity may be flat. The base of the cavity may be circular. The base of the cavity may be arranged upstream of the cavity. The open end may be arranged downstream of the cavity. The cavity may have an elongate extension. The cavity may have a longitudinal central axis. A longitudinal direction may be the direction extending between the open and closed ends along the longitudinal central axis. The longitudinal central axis of the cavity may be parallel to the longitudinal axis of the aerosol-generating device

The cavity may be configured as a heating chamber. The cavity may have a cylindrical shape. The cavity may have a hollow cylindrical shape. The cavity may have a cube shape. The cavity may have a shape corresponding to the shape of the aerosol-generating article to be received in the cavity. The cavity may have a circular cross-section. The cavity may have an elliptical or rectangular cross-section. The cavity may have a rectangular cross-section. The cavity may have an inner diameter corresponding to the outer diameter of the aerosol-generating article.

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An airflow channel may run through the cavity. Ambient air may be drawn into the aerosol-generating device, into the cavity and towards the user through the airflow channel. Downstream of the cavity, a mouthpiece may be arranged or a user may directly draw on the aerosol-generating article. The airflow channel may extend through the mouthpiece.

5 In any of the aspects of the disclosure, the heating element may comprise an electrically resistive material. Suitable electrically resistive materials include but are not limited to: semiconductors such as doped ceramics, electrically "conductive" ceramics (such as, for example, molybdenum disilicide), carbon, graphite, metals, metal alloys and composite materials made of a ceramic material and a metallic material. Such composite materials may
10 comprise doped or undoped ceramics. Examples of suitable doped ceramics include doped silicon carbides. Examples of suitable metals include titanium, zirconium, tantalum platinum, gold and silver. Examples of suitable metal alloys include stainless steel, nickel-, cobalt-, chromium-, aluminium- titanium- zirconium-, hafnium-, niobium-, molybdenum-, tantalum-, tungsten-, tin-, gallium-, manganese-, gold- and iron-containing alloys, and super-alloys based
15 on nickel, iron, cobalt, stainless steel, Timetal® and iron-manganese-aluminium based alloys. In composite materials, the electrically resistive material may optionally be embedded in, encapsulated or coated with an insulating material or vice-versa, depending on the kinetics of energy transfer and the external physicochemical properties required.

As described, in any of the aspects of the disclosure, the heating element may be part
20 of an aerosol-generating device. The aerosol-generating device may comprise an internal heating element or an external heating element, or both internal and external heating elements, where "internal" and "external" may refer to the aerosol-forming substrate. An internal heating element may take any suitable form. For example, an internal heating element may take the form of a heating blade. Alternatively, the internal heater
25 may take the form of a casing or substrate having different electro-conductive portions, or an electrically resistive metallic tube. Alternatively, the internal heating element may be one or more heating needles or rods that run through the center of the aerosol-forming substrate. Other alternatives include a heating wire or filament, for example a Ni-Cr (Nickel-Chromium), platinum, tungsten or alloy wire or a heating plate. Optionally, the internal heating element may
30 be deposited in or on a rigid carrier material. In one such embodiment, the electrically resistive heating element may be formed using a metal having a defined relationship between temperature and resistivity. In such an exemplary device, the metal may be formed as a track on a suitable insulating material, such as ceramic material, and then sandwiched in another insulating material, such as a glass. Heaters formed in this manner may be used to
35 both heat and monitor the temperature of the heating elements during operation.

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An external heating element may take any suitable form. For example, an external heating element may take the form of one or more flexible heating foils on a dielectric substrate, such as polyimide. The flexible heating foils can be shaped to conform to the perimeter of the substrate receiving cavity. Alternatively, an external heating element may take the form of a metallic grid or grids, a flexible printed circuit board, a molded interconnect device (MID), ceramic heater, flexible carbon fibre heater or may be formed using a coating technique, such as plasma vapour deposition, on a suitable shaped substrate. An external heating element may also be formed using a metal having a defined relationship between temperature and resistivity. In such an exemplary device, the metal may be formed as a track between two layers of suitable insulating materials. An external heating element formed in this manner may be used to both heat and monitor the temperature of the external heating element during operation.

As an alternative to an electrically resistive heating element, the heating element may be configured as an induction heating element. The induction heating element may comprise an induction coil and a susceptor. In general, a susceptor is a material that is capable of generating heat, when penetrated by an alternating magnetic field. When located in an alternating magnetic field. If the susceptor is conductive, then typically eddy currents are induced by the alternating magnetic field. If the susceptor is magnetic, then typically another effect that contributes to the heating is commonly referred to hysteresis losses. Hysteresis losses occur mainly due to the movement of the magnetic domain blocks within the susceptor, because the magnetic orientation of these will align with the magnetic induction field, which alternates. Another effect contributing to the hysteresis loss is when the magnetic domains will grow or shrink within the susceptor. Commonly all these changes in the susceptor that happen on a nano-scale or below are referred to as "hysteresis losses", because they produce heat in the susceptor. Hence, if the susceptor is both magnetic and electrically conductive, both hysteresis losses and the generation of eddy currents will contribute to the heating of the susceptor. If the susceptor is magnetic, but not conductive, then hysteresis losses will be the only means by which the susceptor will heat, when penetrated by an alternating magnetic field. According to the invention, the susceptor may be electrically conductive or magnetic or both electrically conductive and magnetic. An alternating magnetic field generated by one or several induction coils heat the susceptor, which then transfers the heat to the aerosol-forming substrate, such that an aerosol is formed. The heat transfer may be mainly by conduction of heat. Such a transfer of heat is best, if the susceptor is in close thermal contact with the aerosol-forming substrate.

As used herein, the term 'aerosol-generating article' may refer to an article comprising an aerosol-forming substrate that is capable of releasing volatile compounds that can form an

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aerosol. For example, an aerosol-generating article may be a smoking article that generates an aerosol that is directly inhalable into a user's lungs through the user's mouth. An aerosol-generating article may be disposable. The aerosol-generating article may be a combustible cigarette. The aerosol-generating article may be a stand alone combustible cigarette. The aerosol-generating article may comprise a rod of tobacco and the filter element described herein. The tobacco may be burnt. A user may light the cigarette to burn the tobacco.

As used herein, the term 'aerosol-forming substrate' may relate to a substrate capable of releasing one or more volatile compounds that can form an aerosol. Such volatile compounds may be released by heating the aerosol-forming substrate. An aerosol-forming substrate may conveniently be part of an aerosol-generating article or smoking article. The aerosol-forming substrate may comprise a tobacco substrate. The aerosol-forming substrate may comprise a tobacco rod.

The aerosol-forming substrate may be a solid aerosol-forming substrate. The aerosol-forming substrate may comprise both solid and liquid components. The aerosol-forming substrate may comprise a tobacco-containing material containing volatile tobacco flavour compounds which are released from the substrate upon heating. The aerosol-forming substrate may comprise a non-tobacco material. The aerosol-forming substrate may comprise an aerosol former that facilitates the formation of a dense and stable aerosol. Examples of suitable aerosol formers are glycerine and propylene glycol.

The aerosol-generating substrate preferably comprises homogenised tobacco material, an aerosol-former and water. Providing homogenised tobacco material may improve aerosol generation, the nicotine content and the flavour profile of the aerosol generated during heating of the aerosol-generating article. Specifically, the process of making homogenised tobacco involves grinding tobacco leaf, which more effectively enables the release of nicotine and flavours upon heating.

Below, there is provided a non-exhaustive list of non-limiting examples. Any one or more of the features of these examples may be combined with any one or more features of another example, embodiment, or aspect described herein.

Example 1: An aerosol-generating article for use in an aerosol-generating device, wherein the aerosol-generating article comprises:

- a filter element comprising a filtration material, wherein the filtration material comprises a foamed cellulosic material; and
- an aerosol-forming substrate.

Example 2: The aerosol-generating article according to example 1, wherein the foamed cellulosic material is essentially free of cellulose acetate.

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Example 3: The aerosol-generating article according to example 1 or example 2, wherein filtration material is essentially free of cellulose acetate.

Example 4: The aerosol-generating article according to any of the preceding examples, wherein the foamed cellulosic material comprises at least 98 weight-% of cellulose fibers, preferably at least 99 weight-% of cellulose fibers.

Example 5: The aerosol-generating article according to any of the preceding examples, wherein the filtration material consists of the foamed cellulosic material.

Example 6: The aerosol-generating article according to any of the preceding examples, wherein the filter element comprises a filter element wrapper, preferably made from a paper material, wherein the filter element wrapper is arranged to at least partially circumscribe the filtration material.

Example 7: The aerosol-generating article according to example 6, wherein the filter element wrapper is configured to be wrapped around the foamed cellulosic material, such as to facilitate a cylindrical shape of the foamed cellulosic material.

Example 8: The aerosol-generating article according to any of the preceding examples, wherein the filter element has a solid cylindrical shape, preferably wherein the filter element has a rod shape.

Example 9: The aerosol-generating article according to any of the preceding examples, wherein the filter element has a diameter of less than 10 millimetres, more preferably of between 1 millimeter and 10 millimeters, and even more preferably of about 7 millimeters.

Example 10: The aerosol-generating article according to any of the preceding examples, wherein the filtration material comprises, preferably consists of a crimped and gathered sheet of the foamed cellulosic material.

Example 11: The aerosol-generating article according to example 10, wherein the sheet of the foamed cellulosic material has a thickness of between 50 micrometers and 1000 micrometers.

Example 12: The aerosol-generating article according to example 10 or example 11, wherein the sheet of the foamed cellulosic material has a grammage of between 20 g/m² and 200 g/m².

Example 13: The aerosol-generating article according to any of examples 1 to 9, wherein the filtration material comprises, preferably consists of a continuous body of the foamed cellulosic material.

Example 14: The aerosol-generating article according to example 13, wherein the filter element wrapper is configured to at least partially compress the foamed cellulosic material.

Example 15: The aerosol-generating article according to example 13 or example 14, wherein the foamed cellulosic material has a diameter of less than 10 millimetres, more

preferably of between 1 millimeter and 10 millimeters, and even more preferably of about 7 millimeters.

Example 16: The aerosol-generating article according to any of the preceding examples, wherein the filter element is arranged downstream of the aerosol-forming substrate.

5 Example 17: The aerosol-generating article according to any of the preceding examples, wherein the article comprises an outer article wrapper, preferably made of paper, wherein the outer article wrapper is configured to at least partially circumscribe the aerosol-forming substrate and the filter element.

10 Example 18: The aerosol-generating article according to any of the preceding examples, wherein the resistance-to-draw of the filter element is of between 35 mm H₂O and 50 mm H₂O.

Example 19: The aerosol-generating article according to any of the preceding examples, wherein the foamed cellulosic material comprises one or more additives.

15 Example 20: The aerosol-generating article according to example 19, wherein the foamed cellulosic material comprises the additive in an amount of less than 2 weight-%, preferably in an amount of less than 1 weight-%.

Example 21: The aerosol-generating article according to example 19 or example 20, wherein the additive is selected from one or more of a foaming agent, a hydrophobizing agent and a strength additive.

20 Example 22: The aerosol-generating article according to example 21, wherein the foaming agent is selected from one or more of sodium dodecyl sulphate (SDS) and polyoxyethylene (20) sorbitan monolaurate, such as Tween 20, preferably wherein the foaming agent comprises about 80 mol-% of sodium dodecyl sulphate and 20 mol-% of polyoxyethylene (20) sorbitan monolaurate.

25 Example 23: The aerosol-generating article according to example 21 or example 22, wherein the hydrophobizing agent is alkyl ketene dimer (AKD), such as FennoSize KD 364 M.

Example 24: The aerosol-generating article according to any of examples 21 to 23, wherein the strength additive is selected from one or more of sodium carboxymethylcellulose (CMC), microfibrillated cellulose and cellulose nanofibrils.

30 Example 25: The aerosol-generating article according to any of the preceding examples, wherein the filter element comprises triacetin.

Example 26: The aerosol-generating article according to any of the preceding examples, wherein the foamed cellulosic material is derived from one or more of bleached softwood pulp, unbleached softwood pulp, blead eucalyptus pulp and blead cotton linter pulp.

35 Example 27: An aerosol-generating system comprising an aerosol-generating device and an aerosol-generating article according to any of examples 1 to 26.

Example 28: A method of manufacturing a filter element for an aerosol-generating article comprising the following steps:

- a) preparing a filtration material comprising a sheet of a foamed cellulosic material,
- b) adjusting a thickness of the sheet of foamed cellulosic material,
- 5 c) drying the sheet of the foamed cellulosic material,
- d) shaping at least a portion of the sheet of cellulosic material to form the filter element.

Example 29: The method according to example 28, wherein prior to step d), the sheet of foamed cellulosic material is divided into a plurality of portions, and in step d) each portion is at least partially circumscribed by a filter element wrapper to form the filter element or each
10 portion is crimped and subsequently gathered to form the filter element. The portion may be a continuous body of the foamed cellulosic material.

Example 30: The method according to example 28 or example 29, wherein in step a), the sheet of the foamed cellulosic material is prepared from pulp.

Example 31: The method according to any of examples 28 to 30, wherein in step a),
15 the conductivity of the pulp is adjusted to 1000 $\mu\text{S}/\text{cm}$, preferably by the addition of sodium chloride.

Example 32: The method according to any of examples 28 to 31, wherein in step a), the pH of the pulp is adjusted to about 8, preferably by the addition of sodium hydroxide.

Example 33: The method according to any of examples 28 to 32, wherein in step a), a
20 strength additive, preferably selected from one or more of sodium carboxymethylcellulose (CMC), microfibrillated cellulose and cellulose nanofibrils is added to the pulp.

Example 34: The method according to any of examples 28 to 33, wherein in step a), a foaming agent, preferably selected from one or more of sodium dodecyl sulphate (SDS) and polyoxyethylene (20) sorbitan monolaurate, more preferably a mixture comprising sodium
25 dodecyl sulphate (SDS) in an amount of 80 mol-% and polyoxyethylene (20) sorbitan monolaurate in an amount of 20 mol-%, is added to the pulp.

Example 35: The method according to any of examples 28 to 34. wherein in step a), a hydrophobizing agent, preferably alkyl ketene dimer (AKD) is added to the pulp.

Example 36: The method according to any of examples 28 to 35, wherein in step a),
30 the pulp is mixed to form a foam.

Example 37: The method according to any of examples 28 to 36, wherein in step b), the sheet of foamed cellulosic material is adjusted to a thickness of between 50 micrometers and 1000 micrometers.

Example 38: The method according to example 37, wherein in step d), at least of
35 portion of the sheet is crimped and subsequently gathered to form the filter element.

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Example 39: The method according to any of examples 28 to 36, wherein in step b), the sheet of foamed cellulosic material is adjusted to a thickness of between 1 millimeter and 10 millimeters.

5 Example 40: The method according to example 39, wherein in step d), at least of portion of the sheet is circumscribed by a filter element wrapper to form the filter element.

Example 41: The method according to example 39 or example 40, wherein prior to step b), a fabric, preferably a wire fabric, is applied to a top surface of the sheet of the foamed cellulosic material.

10 Example 42: The method according to any of examples 39 to 41, wherein prior to step b), the sheet of the foamed cellulosic material is dewatered, dried, and rewetted by the addition of water.

Example 43: A method for manufacturing an aerosol-generating article comprising the following steps:

- 15 a) preparing a filter element using the method according to any of examples 28 to 42
b) combining the filter element with an aerosol-forming substrate.

Example 44: A method of manufacturing a sheet of foamed cellulosic material comprising the following steps:

- 20 a) preparing a suspension of cellulosic material, wherein the suspension comprises a foaming agent,
b) agitating the suspension of cellulosic material and, optionally, adding hydrophobizing agent to the suspension of cellulosic material to obtain a wet foam of cellulosic material,
c) preparing a sheet of the wet foam of cellulosic material and dewatering the sheet of wet foam of cellulosic material,
25 d) drying the sheet of wet foam of cellulosic material,
e) rewetting the sheet of foam
f) adjusting a thickness of the sheet of foam, and
g) drying the foam.

30 Below, there is provided a non-exhaustive list of non-limiting examples. Any one or more of the features of these examples may be combined with any one or more features of another example, embodiment, or aspect described herein.

Features described in relation to one embodiment may equally be applied to other embodiments of the invention.

The invention will be further described, by way of example only, with reference to the accompanying drawings in which:

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Fig. 1 shows a stack of three sheets of foamed cellulosic material;

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Fig. 2 shows portions of the sheet of the film of cellulosic material with filter element wrappers;

Fig. 3 shows a filter element produced from the sheet shown in Fig. 2;

Fig. 4 shows a flow diagram of the method to manufacture of the sheets of film of
5 cellulosic material shown in Figs. 1 and 2;

Fig. 5 shows the filter element comprising a crimped and gathered sheet of the foamed cellulosic material; and

Fig. 6 shows the filter element comprising the crimped and gathered sheet of the foamed cellulosic material obtained in the above further exemplary preparation of a filter
10 element comprising the crimped and gathered sheet of the foamed cellulosic material.

Fig. 1 shows a stack of three sheets 10 of a foamed cellulosic material 12 of the invention. The foamed cellulosic material 12 is a foam of cellulosic material. Each sheet has a thickness 14 of about 7 millimeters. The foamed cellulosic material comprises cellulose fibers.

As shown in Fig. 2, filter elements of the invention may be produced from the sheet 10
15 of the foam of cellulosic material 12. The sheet 10 of the foam of cellulosic material 12 is cut into portions 16. The example shown in Fig. 2 shows three of such portions 16. The portions have a width 18 of about 7 millimeters. The portions 16 have a thickness 14 of about 7 millimeters. The portions 16 are cuboid-shaped. Each portion may be wrapped with a filter
20 element wrapper 20. The filter element wrapper 20 may compress the periphery of the cuboid-shaped portion of the foamed cellulosic material 12 to form the portion of the form of cellulosic material into a rod. The portion of the foamed cellulosic material 12 wrapped by the filter element wrapper 20 may be a cut off the sheet 10 of the foam of cellulosic material 12 to form
25 a filter element 22 of the invention shown in Fig. 3. Alternatively, the portion may be cut off the sheet of the foamed cellulosic material 12 before the portion is wrapped with the filter element wrapper 20. The portions wrapped by the filter element wrapper 20 are continuous bodies of the foamed cellulosic material 12.

In the embodiment shown in Figs. 2 and 3, the thickness of the sheet of the foamed cellulosic material 12 corresponds substantially to the diameter of the filter element. In the
30 embodiment shown in Figs. 2 and 3, the thickness of the sheet of the foamed cellulosic material 12 may be slightly larger than the diameter of the filter element 22 as the filter element wrapper 20 may slightly compresses the foam of cellulosic material 12 in the filter element. In the embodiment shown in Fig. 2 and 3, the filter element 22 comprises a continuous rod-shaped core of the foam of cellulosic material 12 circumscribed by the filter element wrapper 20.

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Fig. 4 shows a flow diagram of the method to manufacture of the sheets of foam of cellulosic material 12 shown in Figs. 1 and 2. At the right-hand side of Fig. 4, photographs illustrating the corresponding manufacturing step are shown.

In a first step, a wet sheet of foamed cellulosic materials is produced. Cellulose fibres are suspended in water. One or more additives, such as foaming agents, strength additives or hydrophobizing agents may be added to the cellulose fibres. The cellulose fiber suspension is agitated in a mixer such that a wet foam of cellulose fibres is formed. The wet foam of cellulose fibres is inserted into a cuboid-shaped container to form a sheet of wet foam cellulose fibres. In a second step, the wet foam of cellulose fibres is dewatered. In a third step, the dewatered sheet is dried. In a fourth step, the sheet is rewetted by the addition of water (50 percent relative humidity). In a final step, the thickness of the sheet is adjusted and the sheet is dried. The sheet is placed between two metal plates held apart by spacers by a distance corresponding to the desired thickness of the final sheet of foam. For example, for the sheet 10 shown in Fig. 1, the metal plates are held apart by about 7 millimeters. A compression force is exerted on the metal plates such that the thickness of the sheet 10 is adjusted according to the thickness of the spaces arranged between the metal plates.

Fig. 5 shows a plurality of the filter element 22 comprising a crimped and gathered sheet of the foamed cellulosic material. The filter element 22 comprises a core formed from the crimped and gathered sheet of the foamed cellulosic material 12. The core of the filter element 22 is wrapped with filter element wrapper 20.

The filter element 22 comprising the crimped and gathered sheet 24 of the foamed cellulosic material 12 is produced from a sheet of the foamed cellulosic material 12 having a thickness of between 50 micrometers and 1000 micrometers. In a first step, the sheet is crimped. In a second step, the sheet is gathered into the desired shape of the filter element 22 and wrapped by the filter element wrapper 20. The filter element wrapper 20 circumscribes the crimped and gathered sheet 24. The filter element wrapper 20 holds the crimped and gathered sheet 24 in the desired shape of the filter element 22. The filter element 22 shown in Fig. 5 has a rod shape.

Fig. 6 shows the filter element 22 comprising the crimped and gathered sheet 24 of the foamed cellulosic material 12 obtained in the above further exemplary preparation of a filter element comprising the crimped and gathered sheet of the foamed cellulosic material.

CLAIMS

1. An aerosol-generating article for use in an aerosol-generating device, wherein the aerosol-generating article comprises:

5 a filter element comprising a filtration material, wherein the filtration material comprises a foamed cellulosic material, wherein the filtration material comprises a crimped and gathered sheet of the foamed cellulosic material; and

an aerosol-forming substrate.

10 2. The aerosol-generating article according to claim 1, wherein filtration material is free of cellulose acetate.

3. The aerosol-generating article according to claim 1 or claim 2, wherein the foamed cellulosic material comprises at least 98 weight-% of cellulose fibers, preferably at
15 least 99 weight-% of cellulose fibers.

4. The aerosol-generating article according to any of the preceding claims, wherein the filter element comprises a filter element wrapper, preferably made from a paper material, wherein the filter element wrapper is arranged to at least partially circumscribe the
20 filtration material.

5. The aerosol-generating article according to any of the preceding claims, wherein the filter element has a solid cylindrical shape, preferably wherein the filter element has a rod shape.
25

6. The aerosol-generating article according to any of the preceding claims, wherein the filter element has a diameter of less than 10 millimetres, more preferably of between 1 millimeter and 10 millimeters, and even more preferably of about 7 millimeters.

30 7. The aerosol-generating article according to any of the preceding claims, wherein the filtration material consists of the crimped and gathered sheet of the foamed cellulosic material.

8. The aerosol-generating article according to claim 7, wherein the sheet of the
35 foamed cellulosic material has a thickness of between 50 micrometers and 1000 micrometers.

9. The aerosol-generating article according to any of claims 1 to 6, wherein the filtration material comprises, preferably consists of a continuous body of the foamed cellulosic material.

10. The aerosol-generating article according to claim 9, wherein the foamed cellulosic material has a diameter of less than 10 millimetres, more preferably of between 1 millimeter and 10 millimeters, and even more preferably of about 7 millimeters.

11. The aerosol-generating article according to any of the preceding claims, wherein the foamed cellulosic material comprises an additive, wherein the additive is selected from one or more of a foaming agent, a hydrophobizing agent and a strength additive.

12. An aerosol-generating system comprising an aerosol-generating device and an aerosol-generating article according to any of claims 1 to 11.

13. A method of manufacturing a filter element for an aerosol-generating article comprising the following steps:

- a) preparing a filtration material comprising a sheet of a foamed cellulosic material,
- b) adjusting a thickness of the sheet of foamed cellulosic material,
- c) drying the sheet of the foamed cellulosic material,
- d) shaping at least a portion of the sheet of cellulosic material to form the filter element, wherein the sheet of foamed cellulosic material is crimped and gathered.

14. The method according to claim 13, wherein prior to step d), the sheet of foamed cellulosic material is divided into a plurality of portions, and in step d) each portion is at least partially circumscribed by a filter element wrapper to form the filter element or each portion is crimped and subsequently gathered to form the filter element.

15. The method according to claim 13 or claim 14, wherein in step a), the sheet of the foamed cellulosic material is prepared from pulp.

Fig. 1

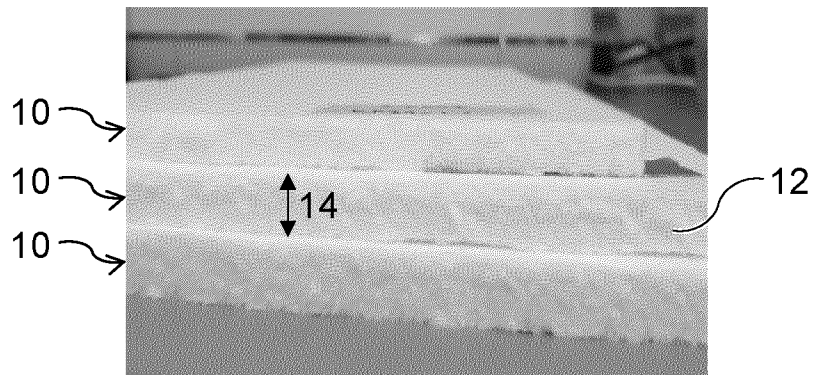


Fig. 2

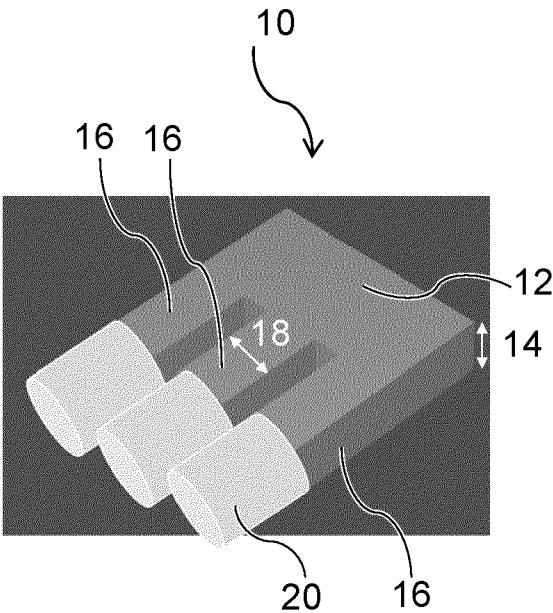
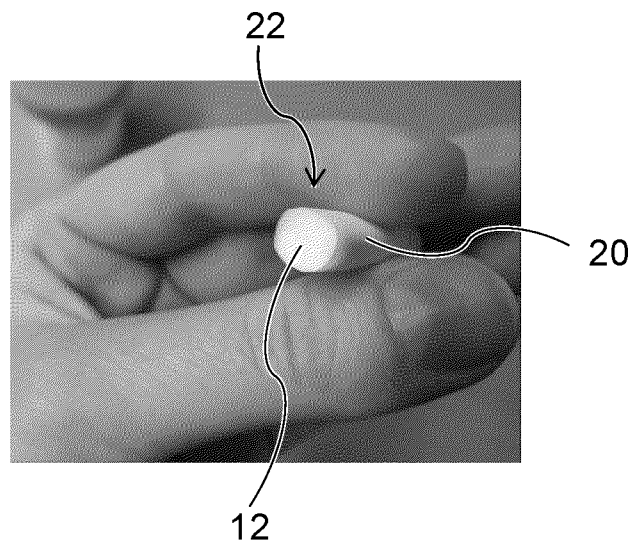


Fig. 3



-4/6-

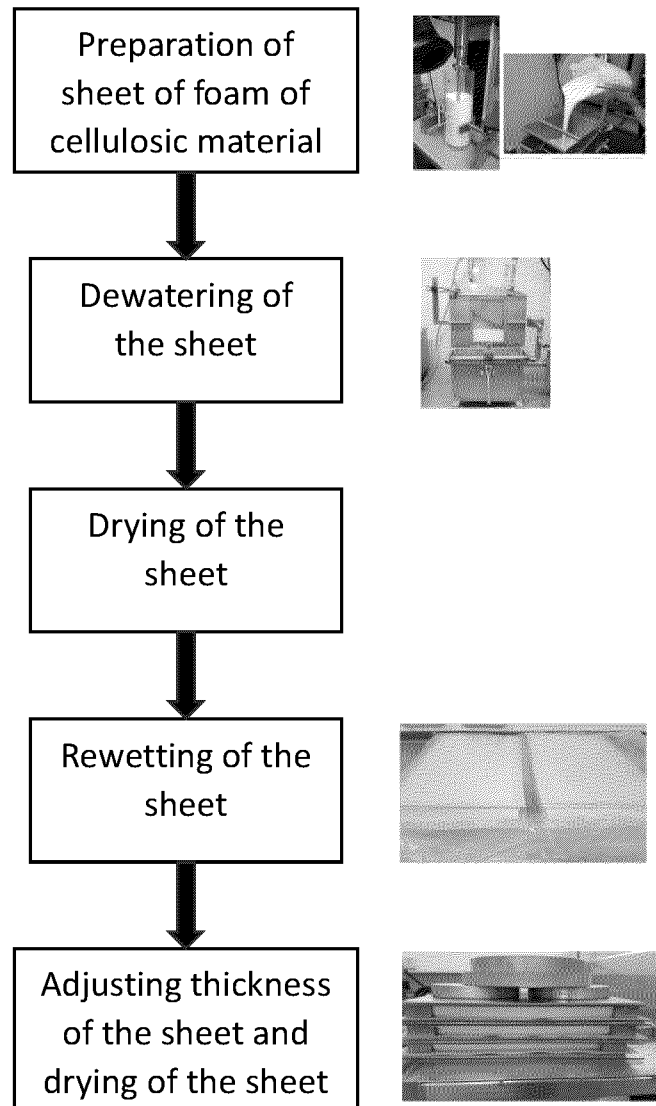
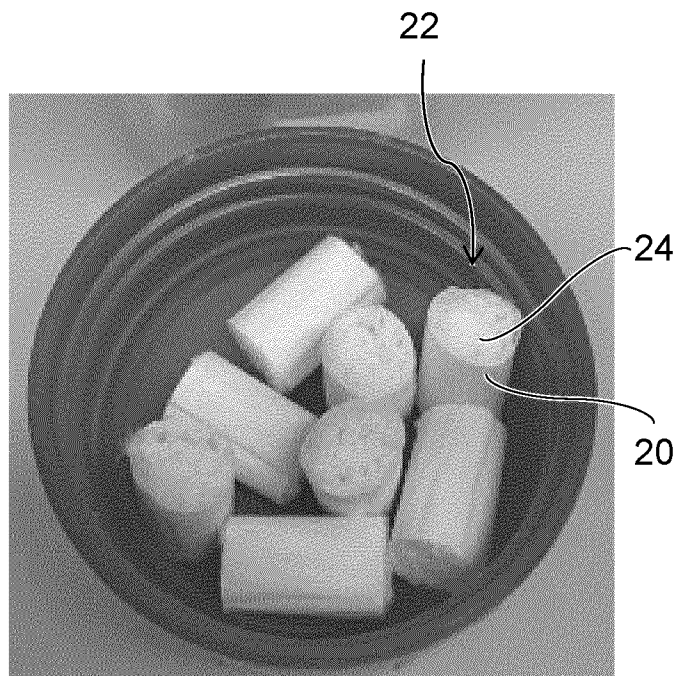
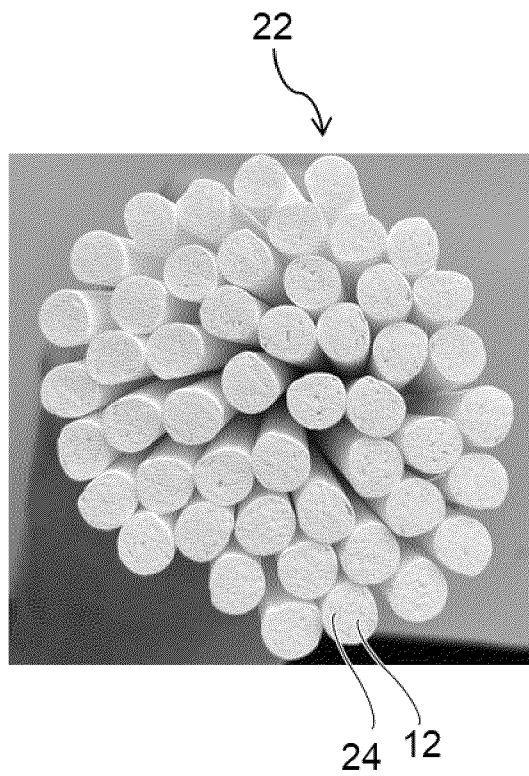
Fig. 4

Fig. 5



-6/6-

Fig. 6



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/080035

A. CLASSIFICATION OF SUBJECT MATTER		
INV.	A24D3/02	A24D3/17 A24D1/20
ADD.	A24F40/20	A24D3/04
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) A24D A24F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CA 865 462 A (JAMISON SAUNDERS E; EPSTEIN MARTIN E) 9 March 1971 (1971-03-09) page 2, line 22 page 5, lines 10-14 page 8, line 13 - page 9, line 12 -----	1 - 15
A	US 3 554 202 A (JAMISON SAUNDERS E ET AL) 12 January 1971 (1971-01-12) column 1, line 28 - column 2, line 50 column 2, line 72 -----	1 - 15
A	CA 813 648 A (BUCKEYE CELLULOSE CORP) 27 May 1969 (1969-05-27) page 5, line 15 - page 6, line 33; figures 1,2 ----- - / - -	1 - 15
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 20 December 2024		Date of mailing of the international search report 13/01/2025
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Caballero Martínez

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2024/080035

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2023/243105 A1 (HANSSON SUSANNE [SE] ET AL) 3 August 2023 (2023-08-03) claims -----	1 - 15
A	US 8 424 539 B2 (BRAUNSHTEYN MICHAEL [US]; LI SAN [US] ET AL.) 23 April 2013 (2013-04-23) column 2, lines 15-24 column 2, lines 50-67 -----	1 - 15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2024/080035

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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US 3554202	A	12-01-1971	NONE	
CA 813648	A	27-05-1969	NONE	
US 2023243105	A1	03-08-2023	CA 3186605 A1 CN 115917083 A EP 4172412 A1 KR 20230026353 A SE 2050753 A1 US 2023243105 A1 WO 2021260606 A1	30-12-2021 04-04-2023 03-05-2023 24-02-2023 25-12-2021 03-08-2023 30-12-2021
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