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(54) **A COOLING ELEMENT**

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(57) **ABSTRACT**

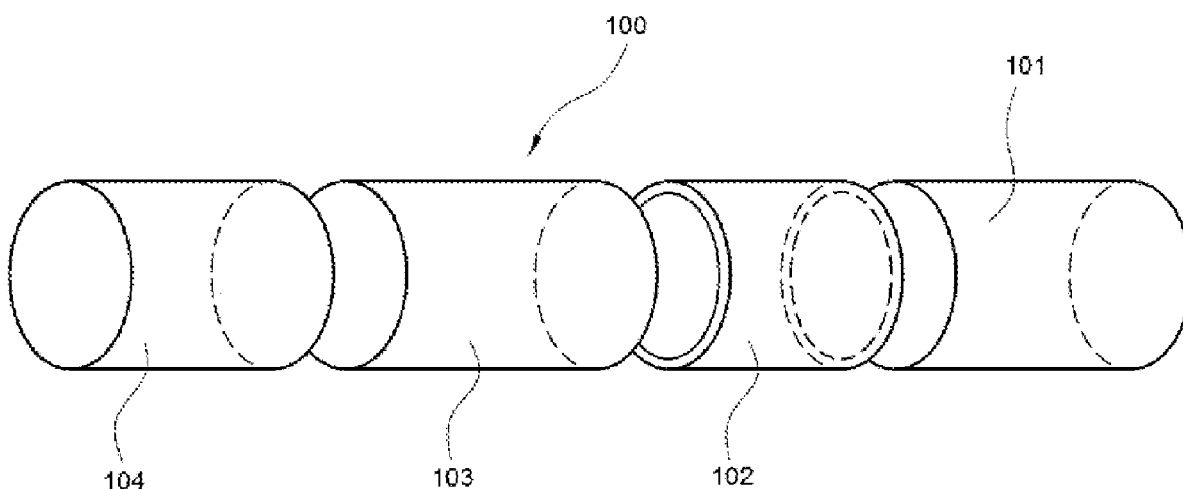
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A cooling element comprising a longitudinally extending substrate, the longitudinally extending substrate including an additive in an amount from 3% to 12% by total weight of the substrate, wherein the additive is selected from (i) propylene glycol, (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide.



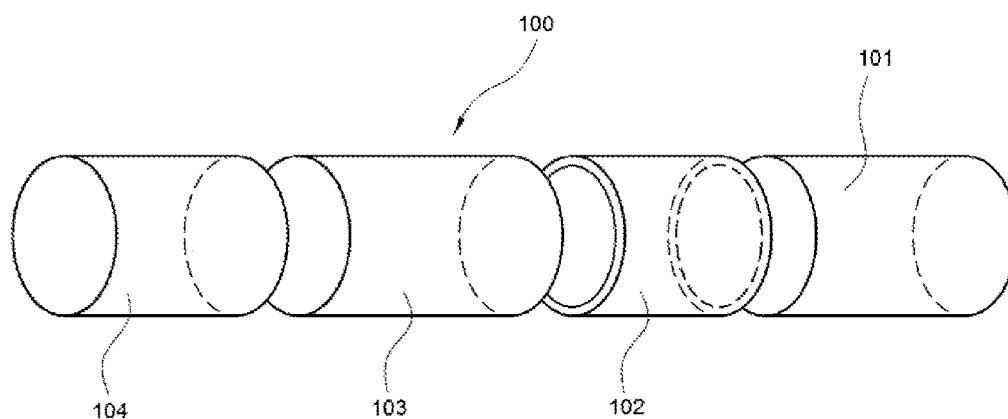


Figure 1

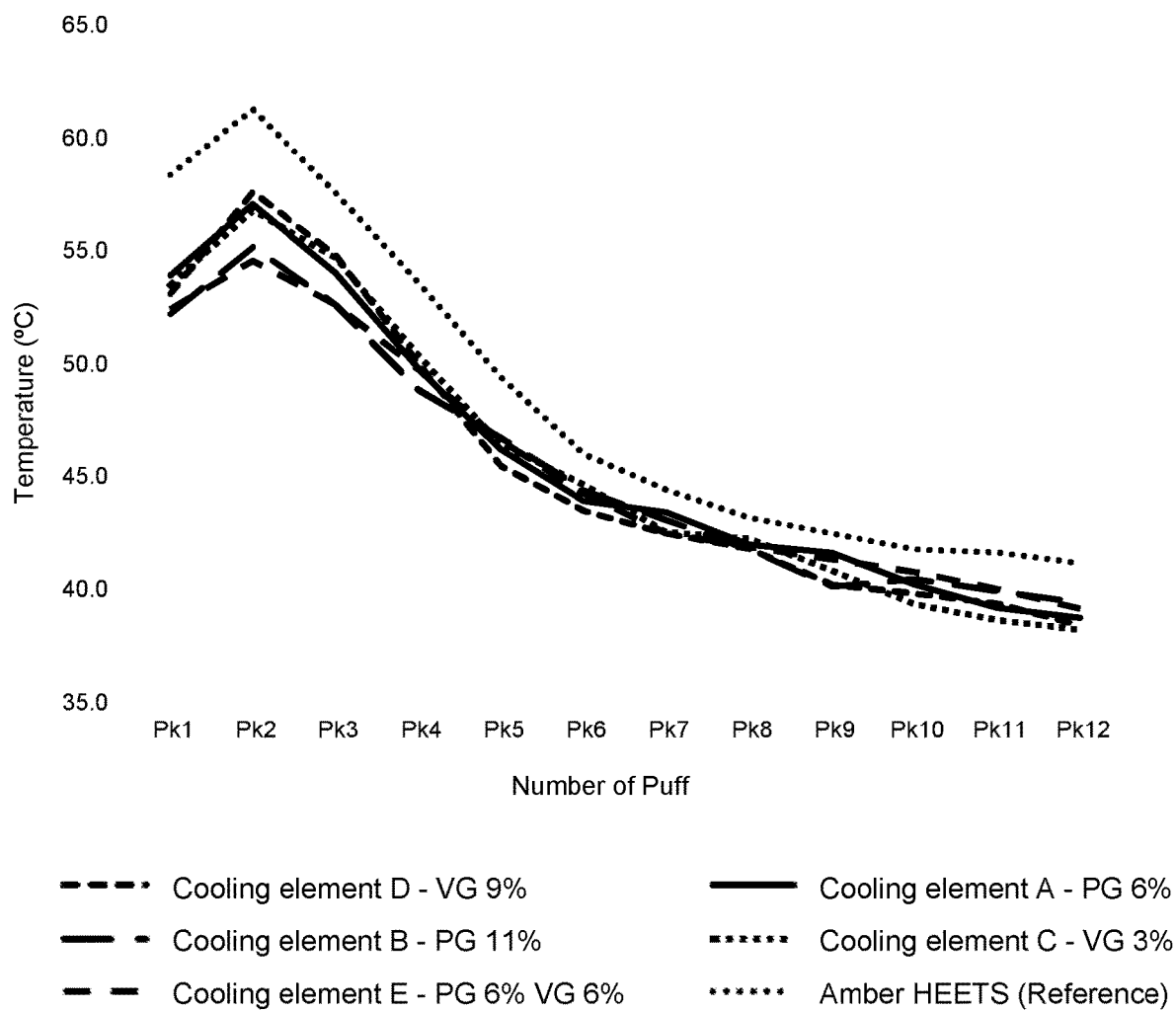


Figure 2

A COOLING ELEMENT

INTRODUCTION

[0001] The present invention provides a cooling element for use with a smoking article such as a tobacco heating product or a heat-not-burn product.

BACKGROUND

[0002] Tobacco heating products or heat-not-burn (HNB) products are well known. The idea of a tobacco heating product is that the tobacco is heated to a specific temperature (such as 350° C.) without burning. This delivers a vapour containing nicotine but it is believed that heating without burning avoids creation of combustion products that are harmful to the consumer.

[0003] Tobacco heating products or HNB products may include a plug of modified tobacco and other mouthpiece components which are wrapped in a paper plugwrap so as to provide a cigarette-like appearance. In one such product a reconstituted tobacco plug, a wrapped hollow acetate tube, a wrapped plug of PLA [poly (lactic acid)] and a conventional wrapped acetate segment are wrapped in a white paper. The product may then be inserted into a heating element which heats the tobacco so the product can then be “smoked” by the consumer. The function of the “filter” in these products is very different from that of a cigarette filter; the main functions are to provide the look and feel of a cigarette and also to cool the vapour down to an acceptable temperature for the consumer.

[0004] However, existing tobacco heating products or HNB products have drawbacks in terms of their filtration properties (particularly in relation to phenols) and their ability to cool vapour down to an acceptable or predictable level.

[0005] Consequently, there is a need for components of a HNB product (e.g., a cooling element) that provide acceptable cooling of the vapour in a HNB product and acceptable filtration properties (particularly in relation to phenols). It is also desirable for the HNB product to have a consistent and/or predictable cooling effect to provide the required temperature reduction of the vapour.

SUMMARY OF THE INVENTION

[0006] According to the present invention in a first aspect there is provided a cooling element (e.g., a cooling element for a tobacco heating product and/or HNB product) comprising a longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper), the longitudinally extending substrate including an additive in an amount from 3% to 12% (e.g., from 6% to 10.5%) by total weight of the substrate, wherein the additive is selected from (i) propylene glycol (e.g., PEG 400), (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutylamide.

[0007] It will be appreciated that the term “cooling element” as used herein refers to a discrete segment which provides a significant cooling function i.e., lowering the temperature of the vapour as it passes along the length of the element. The cooling element may also provide a significant filtering function i.e., filtering the vapour as it passes along the length of the element.

[0008] The amount of additive in the cooling element is calculated as a percentage of the total weight of the substrate and additive via the general equation presented below. An example calculation has been presented in Example 1 wherein the substrate includes an amount of additive which is 9% vegetable glycerin by total weight of the substrate and additive.

Percentage of additive % =

$$\frac{\text{amount of additive (g)}}{\text{amount of additive (g) + amount of substrate (g)}} \times 100$$

[0009] The applicants have found that a cooling element which comprises a longitudinally extending substrate including an additive can provide superior cooling of the vapour. The applicants have found that by including an additive and varying the amount of additive they are able tailor the cooling effect to provide the required temperature reduction and acceptable filtration properties (e.g., particularly in relation to phenols).

[0010] In one example, the cooling element has an amount of additive present that is from 3% to 12% by total weight of the substrate. In another example, the cooling element has an amount of additive present that is from 6% to 10.5% by total weight of the substrate.

[0011] In one example, the temperature of the vapour may be lowered by more than 10° C. as it is drawn through a cooling element according to the invention. In another example, the temperature of the vapour may be lowered by more than 20° C. as it is drawn through a cooling element according to the invention.

[0012] In one example, phenols (e.g., phenolic compounds) may be removed (e.g., adsorbed) from the vapour by the cooling element as it is drawn through the cooling element.

[0013] The applicants have found that the inclusion of an additive may provide optimal cooling characteristics and may increase the filtration efficiency (e.g., in relation to phenols) whilst delivering nicotine in an acceptable amount for the consumer.

[0014] The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate may be made from natural or synthetic filamentary tow (e.g., cotton, e.g., plastics such as polyethylene or polypropylene or cellulose acetate). The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate may be made from natural or synthetic staple fibres, cotton wool, non-woven materials or web material such as paper (e.g., creped paper, e.g., cellulose based embossed paper).

[0015] Preferably the longitudinally extending (e.g., cylindrical, e.g., tubular) substrate is made from cellulose acetate (e.g., crimped cellulose acetate fibres, e.g., a mono-acetate filter). Preferably the longitudinally extending (e.g., cylindrical, e.g., tubular) substrate is thermoformed from cellulose acetate. The cellulose acetate may further comprise plasticiser (e.g., triacetin, triethyleneglycol diacetate (TEGDA) or polyethylene glycol (PEG) or other plasticiser, or a mixture of plasticisers).

[0016] Preferably the length of the cooling element is from 5 to 50 mm (e.g., from 10 to 30 mm, e.g., 8 to 24 mm, e.g., 15 to 20 mm, e.g., 18 mm).

[0017] Preferably the circumference of the cooling element is from 12 to 30 mm (e.g., 15 to 28 mm), more preferably from 17 to 25 mm (e.g., 18 to 25 mm, e.g., 20 to 24 mm, e.g., 22 to 24 mm, e.g., 23 mm, e.g., 22 mm).

[0018] Preferably the longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper) is of uniform axial cross section (e.g., circular, e.g., annular).

[0019] Preferably the cooling element (e.g., a cooling element for a tobacco heating product and/or HNB product) has a substantially circular cross section meaning the cooling element is substantially cylindrical in shape. However, the cooling element of the present invention may be any shape. For example, the cooling element may have an annular cross section or an oval cross section or a square cross section or a rectangular cross section.

[0020] The cooling element (e.g., a cooling element for a tobacco heating product and/or HNB product) may further comprise an outer wrapper engaged around the longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper). The outer wrapper may be a paper (e.g., plugwrap), preferably a paper (e.g., plugwrap) of basis weight 20 to 160 gsm, for example a paper (e.g., plugwrap) of basis weight 24 to 150 gsm, for example a paper (e.g., plugwrap) of basis weight 70 to 150 gsm, for example a paper (e.g., plugwrap) of basis weight 70 to 140 gsm.

[0021] The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper) may have one, or a plurality of, longitudinally extending bore(s) (or hole(s)). The one or plurality of longitudinally extending bore(s) (or hole(s)) may extend longitudinally through the full length of the longitudinally extending substrate (and may be open at one or both ends of the substrate).

[0022] The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper) may have a profiled outer surface including a plurality of (e.g., longitudinally extending) (e.g., C-shaped or U-shaped) grooves or channels. The plurality of (e.g., longitudinally extending) (e.g., C-shaped or U-shaped) grooves or channels may extend the full length of the (outer surface of the) longitudinally extending substrate. The plurality of (e.g., longitudinally extending) (e.g., C-shaped or U-shaped) grooves or channels may not extend the full length of the (outer surface of the) longitudinally extending substrate.

[0023] The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper) may have one, or a plurality of, longitudinally extending bore(s) (or hole(s)) and may have a profiled outer surface including a plurality of (e.g., longitudinally extending) (e.g., C-shaped or U-shaped) grooves or channels.

[0024] According to the present invention in a second aspect there is provided a cooling element (e.g., a cooling element for a tobacco heating product and/or HNB product) comprising a longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper), the longitudinally extending substrate including a cooling additive in an amount from 3% to 12% (e.g., from 6% to 10.5%) by total weight of the substrate.

[0025] As used herein, the term “cooling additive” refers to an additive (e.g., a cooling agent) which performs a

significant cooling function i.e., lowering the temperature of the vapour as it passes along the length of the element.

[0026] The amount of cooling additive in the cooling element is calculated as a percentage of the total weight of the substrate and cooling additive by total weight of the substrate. It will be appreciated that the same equation for calculating the amount of additive in the cooling element (as set out above) can be used to calculate the amount of cooling additive in the cooling element.

[0027] The applicants have found that a cooling element which comprises a longitudinally extending substrate including an additive can provide superior cooling of the vapour. The applicants have found that by including an additive and varying the amount of additive they are able tailor the cooling effect to provide the required temperature reduction and acceptable filtration properties (e.g., particularly in relation to phenols).

[0028] In one example, the temperature of the vapour may be lowered by more than 10° C. as it is drawn through a cooling element according to the invention. In another example, the temperature of the vapour may be lowered by more than 20° C. as it is drawn through a cooling element according to the invention.

[0029] In one example, phenols (e.g., phenolic compounds) may be removed (e.g., adsorbed) from the vapour by the cooling element as it is drawn through the cooling element.

[0030] The applicants have found that the inclusion of an additive may provide optimal cooling characteristics and may increase the filtration efficiency (e.g., in relation to phenols) whilst delivering nicotine in an acceptable amount to the consumer.

[0031] The cooling additive may be selected from (i) propylene glycol (e.g., PEG 400), (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide.

[0032] In one example, the cooling element has an amount of cooling additive present that is from 3% to 12% by total weight of the substrate. In another example, the cooling element has an amount of cooling additive present that is from 6% to 10.5% by total weight of the substrate.

[0033] The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate may be made from natural or synthetic filamentary tow (e.g., cotton, e.g., plastics such as polyethylene or polypropylene or cellulose acetate). The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate may be made from natural or synthetic staple fibres, cotton wool, non-woven materials or web material such as paper (e.g., creped paper, e.g., cellulose based embossed paper).

[0034] Preferably the longitudinally extending (e.g., cylindrical, e.g., tubular) substrate is made from cellulose acetate (e.g., crimped cellulose acetate fibres, e.g., a mono-acetate filter). Preferably the longitudinally extending (e.g., cylindrical, e.g., tubular) substrate is thermoformed from cellulose acetate. The cellulose acetate may further comprise plasticiser (e.g., triacetin, triethyleneglycol diacetate (TEGDA) or polyethylene glycol (PEG) or other plasticiser, or a mixture of plasticisers).

[0035] Preferably the length of the cooling element is from 5 to 50 mm (e.g., from 10 to 30 mm, e.g., 8 to 24 mm, e.g., 15 to 20 mm, e.g., 18 mm).

[0036] Preferably the circumference of the cooling element is from 12 to 30 mm (e.g., 15 to 28 mm), more

preferably from 17 to 25 mm, (e.g., 18 to 25 mm, e.g., 20 to 24 mm, e.g., 22 to 24 mm, e.g., 23 mm, e.g., 22 mm).

[0037] Preferably the longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper) is of uniform axial cross section (e.g., circular, e.g., annular).

[0038] Preferably the cooling element (e.g., a cooling element for a tobacco heating product and/or HNB product) has a substantially circular cross section meaning the cooling element is substantially cylindrical in shape. However, the cooling element of the present invention may be any shape. For example, the cooling element may have an annular cross section or an oval cross section or a square cross section or a rectangular cross section.

[0039] The cooling element (e.g., a cooling element for a tobacco heating product and/or HNB product) may further comprise an outer wrapper engaged around the longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper). The outer wrapper may be a paper (e.g., plugwrap), preferably a paper (e.g., plugwrap) of basis weight 20 to 160 gsm, for example a paper (e.g., plugwrap) of basis weight 24 to 150 gsm, for example a paper (e.g., plugwrap) of basis weight 70 to 150 gsm, for example a paper (e.g., plugwrap) of basis weight 70 to 140 gsm.

[0040] The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper) may have one, or a plurality of, longitudinally extending bore(s) (or hole(s)). The one or plurality of longitudinally extending bore(s) (or hole(s)) may extend longitudinally through the full length of the longitudinally extending substrate (and may be open at one or both ends of the substrate).

[0041] The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper) may have a profiled outer surface including a plurality of (e.g., longitudinally extending) (e.g., C-shaped or U-shaped) grooves or channels. The plurality of (e.g., longitudinally extending) (e.g., C-shaped or U-shaped) grooves or channels may extend the full length of the (outer surface of the) longitudinally extending substrate. The plurality of (e.g., longitudinally extending) (e.g., C-shaped or U-shaped) grooves or channels may not extend the full length of the (outer surface of the) longitudinally extending substrate.

[0042] The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper) may have one, or a plurality of, longitudinally extending bore(s) (or hole(s)) and may have a profiled outer surface including a plurality of (e.g., longitudinally extending) (e.g., C-shaped or U-shaped) grooves or channels.

[0043] According to the present invention in a third aspect there is provided a cooling element (e.g., a cooling element for a tobacco heating product and/or HNB product) comprising a longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper), the longitudinally extending substrate including an additive, wherein the additive is selected from (i) propylene glycol (e.g., PEG 400), (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutylamide.

[0044] The amount of additive in the cooling element may be from 3% to 12% by total weight of the substrate (e.g.,

from 6% to 10.5% by total weight of the substrate). The amount of additive in the cooling element is calculated as a percentage of the total weight of the substrate by total weight of the substrate. It will be appreciated that the same equation for calculating the amount of additive in the substrate (as set out above) can be used to calculate the amount of cooling additive in the substrate.

[0045] The applicants have found that a cooling element which comprises a longitudinally extending substrate including an additive can provide superior cooling of the vapour. The applicants have found that by including an additive and varying the amount of additive they are able tailor the cooling effect to provide the required temperature reduction and acceptable filtration properties (e.g., particularly in relation to phenols).

[0046] In one example, the cooling element has an amount of additive present that is from 3% to 12% by total weight of the substrate. In another example, the cooling element has an amount of additive present that is from 6% to 10.5% by total weight of the substrate.

[0047] In one example, the temperature of the vapour may be lowered by more than 10° C. as it is drawn through a cooling element according to the invention. In another example, the temperature of the vapour may be lowered by more than 20° C. as it is drawn through a cooling element according to the invention.

[0048] In one example, phenols (e.g., phenolic compounds) may be removed (e.g., adsorbed) from the vapour by the cooling element as it is drawn through the cooling element.

[0049] The applicants have found that the inclusion of an additive may provide optimal cooling characteristics and may increase the filtration efficiency (e.g., in relation to phenols) whilst delivering nicotine in an acceptable amount to the consumer.

[0050] The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate may be made from natural or synthetic filamentary tow (e.g., cotton, e.g., plastics such as polyethylene or polypropylene or cellulose acetate). The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate may be made from natural or synthetic staple fibres, cotton wool, non-woven materials or web material such as paper (e.g., creped paper, e.g., cellulose based embossed paper).

[0051] Preferably the longitudinally extending (e.g., cylindrical, e.g., tubular) substrate is made from cellulose acetate (e.g., crimped cellulose acetate fibres, e.g., a mono-acetate filter). Preferably the longitudinally extending (e.g., cylindrical, e.g., tubular) substrate is thermoformed from cellulose acetate. The cellulose acetate may further comprise plasticiser (e.g., triacetin, triethyleneglycol diacetate (TEGDA) or polyethylene glycol (PEG) or other plasticiser, or a mixture of plasticisers).

[0052] Preferably the length of the cooling element is from 5 to 50 mm (e.g., from 10 to 30 mm, e.g., 8 to 24 mm, e.g., 15 to 20 mm, e.g., 18 mm).

[0053] Preferably the circumference of the cooling element is from 12 to 30 mm (e.g., 15 to 28 mm), more preferably from 17 to 25 mm, (e.g., 18 to 25 mm, e.g., 20 to 24 mm, e.g., 22 to 24 mm, e.g., 23 mm, e.g., 22 mm).

[0054] Preferably the longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper) is of uniform axial cross section (e.g., circular, e.g., annular).

[0055] Preferably the cooling element (e.g., a cooling element for a tobacco heating product and/or HNB product) has a substantially circular cross section meaning the cooling element is substantially cylindrical in shape. However, the cooling element of the present invention may be any shape. For example, the cooling element may have an annular cross section or an oval cross section or a square cross section or a rectangular cross section.

[0056] The cooling element (e.g., a cooling element for a tobacco heating product and/or HNB product) may further comprise an outer wrapper engaged around the longitudinally extending (e.g., cylindrical, e.g., tubular) (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper). The outer wrapper may be a paper (e.g., plugwrap), preferably a paper (e.g., plugwrap) of basis weight 20 to 160 gsm, for example a paper (e.g., plugwrap) of basis weight 24 to 150 gsm, for example a paper (e.g., plugwrap) of basis weight 70 to 150 gsm, for example a paper (e.g., plugwrap) of basis weight 70 to 140 gsm.

[0057] The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper) may have one, or a plurality of, longitudinally extending bore(s) (or hole(s)). The one or plurality of longitudinally extending bore(s) (or hole(s)) may extend longitudinally through the full length of the longitudinally extending substrate (and may be open at one or both ends of the substrate).

[0058] The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper) may have a profiled outer surface including a plurality of (e.g., longitudinally extending) (e.g., C-shaped or U-shaped) grooves or channels. The plurality of (e.g., longitudinally extending) (e.g., C-shaped or U-shaped) grooves or channels may extend the full length of the (outer surface of the) longitudinally extending substrate. The plurality of (e.g., longitudinally extending) (e.g., C-shaped or U-shaped) grooves or channels may not extend the full length of the (outer surface of the) longitudinally extending substrate.

[0059] The longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper) may have one, or a plurality of, longitudinally extending bore(s) (or hole(s)) and may have a profiled outer surface including a plurality of (e.g., longitudinally extending) (e.g., C-shaped or U-shaped) grooves or channels.

[0060] According to the present invention in a further aspect there is provided a cooling element for a tobacco heating product and/or HNB product comprising a longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper), the longitudinally extending substrate including an additive in an amount from 3% to 12% (e.g., from 6% to 10.5%) by total weight of the substrate, wherein the additive is selected from (i) propylene glycol (e.g., PEG 400), (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide.

[0061] According to the present invention in a further aspect there is provided a cooling element for a tobacco heating product and/or HNB product comprising a longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper), the longitudinally extending substrate including a

cooling additive in an amount from 3% to 12% (e.g., from 6% to 10.5%) by total weight of the substrate.

[0062] According to the present invention in a further aspect there is provided a cooling element for a tobacco heating product and/or HNB product comprising a longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper), the longitudinally extending substrate including an additive, wherein the additive is selected from (i) propylene glycol (e.g., PEG 400), (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide.

[0063] It will be appreciated that the cooling element may be used in any multi-segment filter or consumable. The filter construction could be two, three, four or more discrete segments. The discrete further segments may be (e.g., cylindrical) plugs of tobacco smoke filtering material (e.g., cellulose acetate tow) and/or a hollow (e.g., acetate) tube and/or a wrapped (e.g., cylindrical) plug of PLA. The filter may be attached to a tobacco rod (which can be made from any form of tobacco (including reconstituted)). The filter may include other segments that include capsules, carbon, CPS, tubes, acetate, paper, menthol etc.

[0064] According to the present invention there is provided a smoking article (e.g., tobacco heating product, HNB product) comprising a cooling element as herein described and claimed below.

[0065] It will be appreciated that the smoking article (e.g. tobacco heating product, HNB product) may comprise one or more discrete further segments (e.g., of a HNB mouthpiece). The discrete further segments may be (e.g., cylindrical) plugs of tobacco smoke filtering material (e.g., cellulose acetate tow), a (e.g., cylindrical) rod of tobacco (e.g., any form of tobacco (including reconstituted tobacco)), a wrapped (e.g., cylindrical) plug of PLA, a hollow (e.g., acetate) tube etc.

[0066] According to the present invention in a further aspect there is provided a tobacco heating product and/or HNB product comprising a cooling element comprising a longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper), the longitudinally extending substrate including an additive in an amount from 3% to 12% (e.g., from 6% to 10.5%) by total weight of the substrate, wherein the additive is selected from (i) propylene glycol (e.g., PEG 400), (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide.

[0067] According to the present invention in a further aspect there is provided a tobacco heating product and/or HNB product comprising a cooling element comprising a longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper), the longitudinally extending substrate including a cooling additive in an amount from 3% to 12% (e.g., from 6% to 10.5%) by total weight of the substrate.

[0068] According to the present invention in a further aspect there is provided a tobacco heating product and/or HNB product comprising a cooling element comprising a longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper), the longitudinally extending substrate including an additive, wherein the additive is selected from (i) propylene glycol (e.g. PEG 400), (ii) vegetable glycerin, (iii)

propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide.

[0069] Preferably the tobacco heating product and/or HNB product according to the present invention further comprises one or more discrete further segments (e.g., of a HNB mouthpiece). The discrete further segments may be (e.g., cylindrical) plugs of tobacco smoke filtering material (e.g., cellulose acetate tow), a (e.g., cylindrical) rod of tobacco (e.g., any form of tobacco (including reconstituted tobacco)), a wrapped (e.g., cylindrical) plug of PLA, a hollow (e.g., acetate) tube etc.

[0070] The applicants have found that a cooling element which comprises a longitudinally extending substrate including an additive, optionally together with other components (e.g., other discrete segments) of a HNB mouthpiece, can provide superior cooling of the vapour. The applicants have found that by including an additive and varying the amount of additive they are able tailor the cooling effect to provide the required temperature reduction and acceptable filtration properties (e.g., particularly in relation to phenols). The applicants have found that the inclusion of an additive may provide optimal cooling characteristics and may increase the filtration efficiency (e.g., in relation to phenols) whilst delivering nicotine in an acceptable amount to the consumer.

[0071] According to the present invention in a further aspect there is provided the use, in a tobacco heating product and/or HNB product, of a cooling element comprising a longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper), the longitudinally extending substrate including an additive in an amount from 3% to 12% (e.g., from 6% to 10.5%) by total weight of the substrate, wherein the additive is selected from (i) propylene glycol (e.g., PEG 400), (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide.

[0072] According to the present invention in a further aspect there is provided the use, in a tobacco heating product and/or HNB product, of a cooling element comprising a longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper), the longitudinally extending substrate including a cooling additive in an amount from 3% to 12% (e.g., from 6% to 10.5%) by total weight of the substrate.

[0073] According to the present invention in a further aspect there is provided the use, in a tobacco heating product and/or HNB product, of a cooling element comprising a longitudinally extending (e.g., cylindrical, e.g., tubular) substrate (e.g., cellulose acetate, e.g., a non-woven material, e.g., paper), the longitudinally extending substrate including an additive, wherein the additive is selected from (i) propylene glycol (e.g., PEG 400), (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide.

[0074] Preferably the tobacco heating product and/or HNB product according to the present invention further comprises one or more discrete further segments (e.g., of a HNB mouthpiece). The discrete further segments may be (e.g., cylindrical) plugs of tobacco smoke filtering material (e.g., cellulose acetate tow), a (e.g., cylindrical) rod of tobacco (e.g., any form of tobacco (including reconstituted tobacco)), a wrapped (e.g., cylindrical) plug of PLA, a hollow (e.g., acetate) tube etc.

[0075] It will be appreciated that the cooling element may be used in any multi-segment filter or consumable. The filter construction could be two, three, four or more discrete segments. The discrete further segments may be (e.g., cylindrical) plugs of tobacco smoke filtering material (e.g., cellulose acetate tow) and/or a hollow (e.g., acetate) tube and/or a wrapped (e.g., cylindrical) plug of PLA. The filter may be attached to a tobacco rod (which can be made from any form of tobacco (including reconstituted)). The filter may include other segments that include capsules, carbon, CPS, tubes, acetate, paper, menthol etc.

[0076] The applicants have found that a cooling element which comprises a longitudinally extending substrate including an additive, optionally together with other components (e.g., other discrete segments) of a HNB mouthpiece, can provide superior cooling of the vapour. The applicants have found that by including an additive and varying the amount of additive they are able tailor the cooling effect to provide the required temperature reduction and acceptable filtration properties (e.g., particularly in relation to phenols). The applicants have found that the inclusion of an additive may provide optimal cooling characteristics and may increase the filtration efficiency (e.g., in relation to phenols) whilst delivering nicotine in an acceptable amount to the consumer.

[0077] In cooling elements, smoking articles, tobacco heating products, HNB products, and their uses according to the invention or aspects thereof as herein described and claimed, the additive or cooling additive may be selected from (i) propylene glycol (e.g., PEG 400), (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide. For example, the additive or cooling additive may be (e.g. a mixture of) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide. The additive or cooling additive may be (e.g. a mixture of) 70% by weight propylene glycol and 30% by weight 2-isopropyl-N,2,3-trimethylbutyramide.

[0078] The present invention will now be discussed in further detail with reference to the attached Figures in which:

[0079] FIG. 1 shows a schematic view of a HNB product according to the invention which includes a cooling element according to an embodiment of the invention;

[0080] FIG. 2 is a graphical representation of how the temperature at the mouth end of a HNB product varies as puffs are taken when the HNB product contains cooling elements A, B, C, D and E in comparison with a reference HNB product, Amber HEETS.

[0081] FIG. 1 illustrates a schematic view of a cylindrical HNB product **100**. The HNB product **100** comprises four segments: a cylindrical plug **101** of reconstituted tobacco; a hollow acetate tube **102**; a wrapped cylindrical plug of PLA **103** and a cylindrical cooling element **104** according to an embodiment of the present invention. Plug **101** of reconstituted tobacco is 12 mm long and has a circumference of 22 mm, and forms one end of the HNB product **100**. This is the end inserted in a HNB device. Such plugs of reconstituted tobacco are well known in the art. This plug is heated in use by a heating device (HNB device) to produce a vapour, as is well known in the art. The plug **101** of reconstituted tobacco is abutted at one end to a 8 mm long hollow acetate tube **102** which is also of circumference 22 mm and has wall thickness 1.3 mm. The end of the hollow acetate tube **102** opposite to the plug of reconstituted tobacco **101** is abutted

to a 18 mm long wrapped cylindrical plug of PLA **103**. A cylindrical cooling element **104** according to an embodiment of the present invention is abutted to the opposite end of the wrapped cylindrical plug of PLA **103** such that cylindrical cooling element **104** is positioned at the mouth end of the HNB product. The cylindrical cooling element **104** is made of cellulose acetate and includes 9% vegetable glycerin (not shown) applied by methods well known in the art (e.g., by spraying the fibres). The cylindrical cooling element **104** is of length 7 mm and circumference 22 mm.

[0082] The cylindrical plug of reconstituted tobacco **101**, hollow acetate tube **102**, wrapped cylindrical plug of PLA **103** and cylindrical cooling element **104** are further wrapped with a plugwrap (not shown) of conventional plugwrap paper (that is known in the art). This provides an external appearance similar to that of a conventional cigarette.

[0083] During use, the cylindrical plug of reconstituted tobacco **101** of the HNB product **100** is inserted into a HNB device. The HNB device heats the reconstituted tobacco in the manner conventional for HNB devices. This produces a hot vapour which is first drawn through the hollow acetate tube **102** and then through the wrapped cylindrical plug of PLA **103** and then finally through cylindrical cooling element **104** to the smoker's mouth (i.e., the mouth end). It is believed that drawing this hot vapour through the cooling element **104** cools the vapour down to a temperature that is acceptable for the user. The applicants have found that the inclusion of additives in the cooling element provides a particularly effective level of cooling, and also a remarkable extraction of phenols from the vapour. Such superior effects have not been achieved with previous cooling elements.

Example 1

[0084] In FIG. 1, cylindrical cooling element **104** of length 7 mm and circumference 22 mm is made of cellulose acetate which includes 9% vegetable glycerin (not shown) by total weight of the cellulose acetate and vegetable glycerin. The cellulose acetate used for cooling element **104** weighs 0.6 mg and contains 0.06 mg of vegetable glycerin. The percentage of vegetable glycerin present by total weight of the cellulose acetate and vegetable glycerin is 9%. This has been calculated using the general equation presented earlier, to give the result below.

$$\text{Percentage of additive \%} = \frac{0.06}{0.6 + 0.06} \times 100 = 9\%$$

Experiment

[0085] Cooling elements A, B, C, D and E of the invention were made according to methods known in the art.

[0086] Cooling element A comprises a longitudinally extending cylindrical substrate of cellulose acetate including 6% propylene glycol (6% PG) by total weight of the cellulose acetate and propylene glycol and is of length 7 mm and circumference 22 mm.

[0087] Cooling element B comprises a longitudinally extending cylindrical substrate of cellulose acetate including 11% propylene glycol (11% PG) by total weight of the cellulose acetate and propylene glycol and is of length 7 mm and circumference 22 mm.

[0088] Cooling element C comprises a longitudinally extending cylindrical substrate of cellulose acetate including 3% vegetable glycerin (3% VG) by total weight of the cellulose acetate and vegetable glycerin and is of length 7 mm and circumference 22 mm.

[0089] Cooling element D comprises a longitudinally extending cylindrical substrate of cellulose acetate including 9% vegetable glycerin (9% VG) by total weight of the cellulose acetate and vegetable glycerin and is of length 7 mm and circumference 22 mm.

[0090] Cooling element E comprises a longitudinally extending cylindrical substrate of cellulose acetate including 6% propylene glycol and 6% vegetable glycerin (6% PG 6% VG) by total weight of the cellulose acetate, vegetable glycerin and propylene glycol and is of length 7 mm and circumference 22 mm.

[0091] Five HNB products, according to FIG. 1, were assembled for testing, each including one of cooling elements of the invention A, B, C, D and E. Cooling elements A, B, C, D and E were used with a wrapped cylindrical plug of PLA (**103** in FIG. 1) of length 18 mm and circumference 22 mm, a hollow acetate tube (**102** in FIG. 1) of length 8 mm, circumference 22 mm and wall thickness 1.3 mm and a plug of reconstituted tobacco (**101** in FIG. 1) of length 12 mm and circumference 22 mm. The reference HNB product Amber HEETS includes a plug of reconstituted tobacco, a hollow acetate tube, a wrapped cylindrical plug of PLA and a cylindrical plug of cellulose acetate tow in an analogous arrangement to that shown in FIG. 1.

[0092] The HNB products including one of the cooling elements A, B, C, D and E, and the reference HNB product Amber HEETS were tested in conventional heating devices (HNB devices).

[0093] Each HNB product was inserted into a heating device. The mouth end of the HNB product was inserted into a smoking machine which is configured to smoke the HNB product. An IR camera was used to analyse the temperature at the mouth end of the HNB product while it is being smoked. The smoking machine was configured to take a puff on the HNB product every 30 seconds, each puff being 2 seconds long. The temperature at the mouth end of the HNB product was measured for each puff. The experiment was performed at standard room temperature and humidity. The experiment was repeated for each HNB product including one of the cooling elements A, B, C, D, E and the reference HNB product Amber HEETS.

[0094] FIG. 2 illustrates the temperature at the mouth end for each puff for the HNB products comprising cooling elements A, B, C, D and E in comparison with the reference HNB product Amber HEETS. The Figure shows that cooling elements A, B, C, D and E of the present invention are capable of providing a cooling effect that is better than the reference HNB product Amber HEETS, while providing an number of additional benefits e.g., reducing phenol yield, e.g., delivering nicotine in an acceptable amount to the consumer. This indicates cooling elements including propylene glycol and vegetable glycerin can provide improved cooling of the vapour.

[0095] In particular, FIG. 2 illustrates that the mouth end temperature of a HNB product comprising a cooling element including 9% vegetable glycerin is significantly lower than the mouth end temperature than the reference HNB product Amber HEETS for each puff. The highest temperature reduction is seen with cooling elements including vegetable

glycerin. However, FIG. 2 shows that cooling elements including propylene glycol, including cooling elements including propylene glycol and vegetable glycerin, also demonstrate a significant reduction in mouth end temperature with each puff compared to the conventional cooling element in the reference HNB product Amber HEETS. Further data are shown in Table 1 below.

[0096] Thus cooling elements of the present invention have a consistent and/or predictable cooling effect to provide the required temperature reduction.

[0097] The phenol and nicotine yields of the HNB products comprising one of the cooling elements A, B, C, D and E, and the reference HNB product Amber HEETS in conventional heating devices (HNB devices) were measured by methods well known in the art (ISO 23904:2020—Cigarettes—Determination of selected phenolic compounds in cigarette mainstream smoke with an intense smoking regime using HPLC-FLD and ISO 3308:2012 Routine analytical cigarette-smoking machine—Definitions and standard conditions). The results are illustrated in Table 1.

TABLE 1

	HNB Product					Amber HEETS
	Cooling element A	Cooling element B	Cooling element C	Cooling element D	Cooling element E	
PD (mmWG)	54	54	52	55	56	59
1st Puff Temp (° C.)	53	54	52	51	54	58
12 th Puff Temp (° C.)	38	39	39	38	38	41
AT (° C.)	15	15	13	13	16	17
Nicotine yield (mg)	1.03	1.18	1.00	1.08	1.16	1.05
Water (mg)	22.88	26.64	24.26	25.39	25.41	19.74
Phenol yield (µg)	0.49	0.77	0.55	0.41	0.67	0.83

[0098] Table 1 shows the phenol yields for the HNB products comprising cooling elements A, B, C, D and E are lower than the phenol yield for the reference HNB product Amber HEETS. In particular, Table 1 shows that the phenol yield of a HNB product comprising a cooling element including 9% vegetable glycerin is less than half the phenol yield of the reference HNB product Amber HEETS. Further, the phenol yield of a HNB product comprising a cooling element including 3% vegetable glycerin is significantly lower than the phenol yield for the reference HNB product Amber HEETS. This indicates that cooling elements including vegetable glycerin, in addition to providing superior cooling of the vapour, are particularly effective at removing (e.g., adsorbing) phenols (e.g., phenolic compounds) from the vapour as it is drawn through the cooling element.

[0099] Table 1 also shows cooling elements including 6% propylene glycol demonstrate a significant reduction in phenol yield compared to the reference HNB product Amber HEETS. Thus, cooling elements including propylene glycol are also effective at removing (e.g., adsorbing) phenols (e.g., phenolic compounds) from the vapour as it is drawn through the cooling element.

[0100] The lower phenol yields for the HNB products comprising cooling elements A, B, C, D and E compared to

the reference HNB product Amber HEETS are seen without a reduction in the nicotine yield. Table 1 shows cooling elements A, B, C, D and E of the present invention are capable of providing the same (or at least similar) nicotine yield of the reference HNB product Amber HEETS.

[0101] This indicates cooling elements of the present invention are capable of providing acceptable cooling of the vapour in a HNB product and acceptable filtration properties. In particular, cooling elements of the present invention are capable of reducing phenol yield whilst delivering an acceptable amount of nicotine to the consumer.

1. A cooling element comprising a longitudinally extending substrate, the longitudinally extending substrate including an additive in an amount from 3% to 12% by total weight of the substrate, wherein the additive is selected from (i) propylene glycol, (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide.

2-25. (canceled)

26. The cooling element according to claim 1, wherein the additive is in an amount from 6% to 10.5% by total weight of the substrate.

27. The cooling element according to claim 1, wherein the longitudinally extending substrate is made of cellulose acetate or paper (e.g., cellulose based embossed paper) or a non-woven material.

28. The cooling element according to claim 27, wherein the longitudinally extending substrate is thermoformed from cellulose acetate.

29. The cooling element according to claim 1, wherein the length of the cooling element is from 5 to 50 mm, e.g., 10 to 30 mm, e.g., 8 to 24 mm, e.g., 15 to 20 mm, e.g., 18 mm.

30. The cooling element according to claim 1, wherein the circumference of the cooling element is from 12 mm to 30 mm, e.g., 15 mm to 28 mm, e.g., 17 mm to 25 mm.

31. The cooling element according to claim 1, wherein the longitudinally extending substrate has one, or a plurality of, longitudinally extending bore(s).

32. The cooling element according to claim 1, wherein the longitudinally extending substrate has a profiled outer surface including a plurality of grooves or channels.

33. The cooling element according to claim 1, wherein the longitudinally extending substrate has a profiled outer surface including a plurality of grooves or channels and has one, or a plurality of, longitudinally extending bore(s).

34. A cooling element for a tobacco heating product and/or HNB product comprising a longitudinally extending substrate, the longitudinally extending substrate including an additive in an amount from 3% to 12% by total weight of the substrate, wherein the additive is selected from (i) propylene glycol, (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide.

35. A smoking article (e.g., tobacco heating product, HNB product) comprising the cooling element according to claim 1 and optionally one or more discrete further segments.

36. A tobacco heating product and/or HNB product comprising a cooling element comprising a longitudinally extending substrate, the longitudinally extending substrate including an additive in an amount from 3% to 12% by total weight of the substrate, wherein the additive is selected from (i) propylene glycol, (ii) vegetable glycerin, (iii) propylene glycol and vegetable glycerin or (iv) propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide.

37. The cooling element according to claim 1, wherein the additive or cooling additive is propylene glycol and 2-isopropyl-N,2,3-trimethylbutyramide, optionally wherein the additive or cooling additive is 70% by weight propylene glycol and 30% by weight 2-isopropyl-N,2,3-trimethylbutyramide.

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