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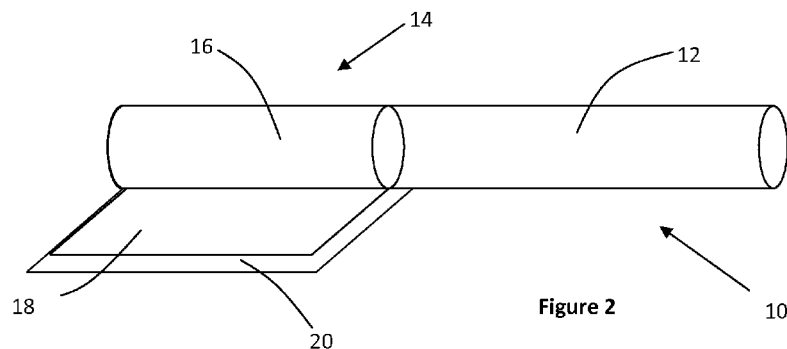
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(54) Title: SMOKING ARTICLE HAVING DISSOLVABLE POLYMERIC FILM WRAP



(57) Abstract: A smoking article (10; 30) comprises an aerosol generating substrate (12; 32) and a mouthpiece (14; 34) secured in axial alignment with the aerosol generating substrate. The mouthpiece comprises one or more segments (16; 36, 38, 40) and at least one dissolvable plug wrap (18; 37, 39, 41, 42) consisting of a sheet of polymeric film circumscribing at least one of the segments. The polymeric film comprises starch in an amount of less than 30% by weight of the polymeric film and at least one additional water-soluble polymer. A tipping wrapper (20; 44) circumscribes at least a portion of the mouthpiece, the tipping wrapper connecting the mouthpiece to the aerosol generating substrate.



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SMOKING ARTICLE HAVING DISSOLVABLE POLYMERIC FILM WRAP

The present invention relates to a smoking article having a mouthpiece comprising at least one segment circumscribed by a dissolvable plug wrap consisting of a sheet of polymeric film, wherein the polymeric film comprises starch in an amount of less than 30% by weight of the polymeric film and at least one additional water-soluble polymer. The present invention also relates to a method for producing such a smoking article.

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

A number of smoking articles in which tobacco is heated rather than combusted have also been proposed in the art. In heated smoking articles, an aerosol is generated by heating a flavour generating substrate, such as tobacco. Known heated smoking articles include, for example, electrically heated smoking articles and smoking articles in which an aerosol is generated by the transfer of heat from a combustible fuel element or heat source to a physically separate aerosol forming material. During smoking, volatile compounds are released from the aerosol forming substrate by heat transfer from the fuel element and entrained in air drawn through the smoking article. As the released compounds cool they condense to form an aerosol that is inhaled by the consumer. Smoking articles in which a nicotine-containing aerosol is generated from a tobacco material, tobacco extract or other nicotine source, without combustion or heating, are also known.

After a smoking article has been smoked and the remainder of the article has been discarded, the filter section should break open as quickly as possible so that the filtration material can degrade more quickly. It would be desirable to provide a smoking article which facilitates such degradation.

According to the present invention, there is provided a smoking article comprising an aerosol generating substrate and a mouthpiece secured in axial alignment with the aerosol generating substrate. The mouthpiece comprises one or more segments and at least one dissolvable plug wrap consisting of a sheet of polymeric film circumscribing at least one of the segments. The polymeric film comprises starch in an amount of less than 30% by weight of the polymeric film and at least one additional water-soluble polymer. A tipping wrapper circumscribes at least a portion of the mouthpiece, the tipping wrapper connecting the mouthpiece to the aerosol generating substrate.

The term "dissolvable" is used herein to mean that the plug wrap is capable of dissolving into a solution with a water solvent. This is achieved through the use of starch and one or more additional water soluble materials to form the polymeric film. The film may be made entirely of starch and one additional water-soluble polymer or it may additionally include other polymers or inert components, such as inert inorganic fillers, which may or may not be dissolvable. Therefore, in some embodiments the polymeric film comprises starch and the one or more additional water-soluble polymers in a total amount of at least about 25% by weight of the film, preferably at least about 60% by weight of the film. Preferably the starch and the one or more additional water-soluble polymers are present in a total amount of less than about 95% by weight of the film, more preferably less than about 80% by weight of the film.

The term "plug wrap" is used herein to define a wrap which circumscribes only the mouthpiece or a portion of the mouthpiece. Where the mouthpiece is formed of a single segment, such as a single segment of filtration material, the plug wrap will circumscribe the single segment and will generally be the only material between the underlying segment and the tipping wrapper. Where the mouthpiece is formed of a set of multiple segments, the term "plug wrap" can refer to segment plug wraps which each circumscribe only a single segment or a subset of the segments, or the term can refer to a combining plug wrap which circumscribes all of the segments and any segment plug wraps.

Advantageously, smoking articles in accordance with the present invention expedite the dispersion and degradation of the remainder of a smoked article by providing a dissolvable plug wrap which will dissolve upon contact with water so as to expose the underlying mouthpiece segments to the environment. Additionally, by providing the dissolvable material between the mouthpiece segment and the tipping wrapper (i.e. not on the outer surface of the smoking article), the dissolvable material will not dissolve in the consumer's mouth during smoking of the article.

In addition to increasing the water-solubility of the polymeric film, the inclusion of starch also advantageously reduces the stretchability of the polymeric film, thus facilitating processing of the polymeric film on high speed manufacturing equipment. Furthermore, where the polymeric film is formed as a transparent film, restricting the starch content to an amount of less than about 30% by weight of the polymeric film prevents an undesirable decrease in the transparency of the film. Where the starch used is not nanocrystalline starch, the starch is preferably present in an amount of less than about 20% by weight of the polymeric film. The starch may be present in an amount of less than about 15% by weight of the polymeric film, or less than about 10% by weight of the polymeric film. The starch is preferably present in an amount of at least about 1% by weight of the polymeric film.

Another advantage of the polymeric film used in the present invention is that the film can be formed such that it inherently possesses any required physical properties, such as low gas permeability, thus eliminating the need for any further processing steps during manufacture. Furthermore, where it is desirable to provide a transparent plug wrap, the polymeric film can be more easily formed as transparent than a paper plug wrap.

Preferably, the sheet of polymeric film dissolves in less than 72 hours when placed in water at a temperature of 22°C. More preferably the sheet of polymeric film dissolves in less than 48 hours in water at 22°C, most preferably less than 24 hours.

To determine the time required for a particular polymeric film to dissolve in water at 22°C, any of the three Dissolution Tests described in detail below can be used. Dissolution Test A can be used where a sample of the polymeric film is available in isolation from the other components of the smoking article. Where the polymeric film is only available for testing from an already assembled smoking article, Dissolution Test B can be used where the polymeric film and the tipping wrapper can be separated from the underlying filtration material. Dissolution Test C can be used where the components of the mouthpiece and the tipping wrapper cannot be separated prior to testing.

The dissolution times recorded for a particular sample will be substantially the same when tested under any of Dissolution Tests A, B and C. This is at least partly due to the relatively short time taken for the tipping wrapper and any filtration material present to open up and separate from the polymeric film when tested using Dissolution Test B or C. Therefore, for those embodiments in which the polymeric film dissolves in less than 72 hours, it is sufficient that the polymeric film dissolves in less than 72 hours under the conditions of any one of Dissolution Test A, B and C.

As well as being dissolvable, the plug wrap may also be biodegradable.

The polymeric film may be single-layered or multi-layered. Where the film comprises multiple layers, the layers may be formed from the same polymeric materials or they may be formed from different polymeric materials. Where they are formed from different polymeric materials, each layer may comprise at least one water-soluble polymer.

In a first set of embodiments, the mouthpiece comprises a segment of filtration material, the sheet of polymeric film having a first surface in direct contact with the filtration material and a second surface in direct contact with the tipping wrapper. In other words, the only layer between the filtration material and the tipping wrapper is the polymeric film. This provides a simple and cost-effective smoking article by reducing the plug wrap to a single sheet of polymeric film, wherein the polymeric film comprises at least one water-soluble polymer.

In a second set of embodiments, the mouthpiece comprises a plurality of segments, wherein each segment is individually wrapped in a segment plug wrap. The mouthpiece also

includes a combining plug wrap which circumscribes the plurality of segments and the segment plug wraps so as to combine the segments into a single mouthpiece. In these embodiments, the dissolvable plug wrap can form the combining plug wrap, such that the sheet of polymeric film has a first surface in direct contact with the segment plug wraps and a second surface in direct contact with the tipping wrapper. Alternatively, or in addition, at least one of the segments can comprise a filtration material, wherein the segment plug wrap circumscribing the segment of filtration material comprises a dissolvable plug wrap, the sheet of polymeric film having a first surface in direct contact with the filtration material and a second surface in direct contact with the combining plug wrap. In one embodiment, both the segment plug wraps and the combining plug wraps are each formed from a sheet of polymeric film each comprising at least one water-soluble polymer, such that each of the plug wraps is a dissolvable plug wrap in accordance with the present invention.

As mentioned above, it is sometimes desirable to provide a transparent plug wrap such that the consumer can view the underlying filtration material, e.g. to observe the effectiveness of the filter. Therefore, the polymeric film used to form the dissolvable plug wrap can be substantially transparent, preferably wherein the polymeric film has a haze of less than about 2.15, more preferably less than about 2.10, when measured using the method of ASTM D1003.

The term "substantially transparent" is used herein to describe a material which allows at least a significant proportion of incident light to pass through it, so that it is possible to see through the material. In accordance with embodiments of the present invention comprising a substantially transparent plug wrap, the substantially transparent plug wrap allows sufficient light to pass through it so that the underlying mouthpiece segment is visible through the plug wrap. The substantially transparent film may be completely transparent, or the film may have a lower level of transparency whilst still transmitting sufficient light such that the mouthpiece segment is visible through the plug wrap.

In embodiments comprising a substantially transparent plug wrap, any underlying or overlying layers such as the tipping wrapper are preferably transparent, have a transparent window or have a cut-out such that the consumer can observe the mouthpiece segment through all of the overlying layers.

To facilitate large-scale manufacture of smoking articles in accordance with the present invention, the polymeric film preferably has sufficient mechanical properties to withstand processing on high-speed manufacturing equipment. Therefore, the polymeric film preferably has a strain at break of less than about 30% and a tensile strength of greater than about 15 N / 15 mm, both measured according to the method of ISO 1924-2.

In addition to starch, the skilled person will appreciate that the polymeric film can include a number of different polymeric materials. Exemplary water-soluble materials include, but are

not limited to, polyvinyl alcohol, hydroxypropyl methylcellulose, carboxymethyl cellulose and combinations thereof. The polymeric film can be formed from a single layer or can comprise a laminate formed from multiple layers. Where the film is formed as a laminate, the layers can comprise the same water-soluble polymers or different water-soluble polymers. Laminate films can advantageously have improved elongation and tensile strength properties when compared to single layer films, which facilitate processing of the film on high-speed manufacturing equipment, as discussed above.

Preferably, the one or more additional water-soluble polymers is polyvinyl alcohol, which has a high rate of dissolution in water, thus optimising the dispersion of the plug wrap and the exposure of the underlying segment after the remainder of the smoked article has been discarded. The polyvinyl alcohol preferably has a number average molecular weight of less than about 80000 kg/kmol, preferably less than about 55000 kg/kmol, which reduces the elongation properties of the film, thus providing a strain at break of less than 100 %.

As discussed above, polymeric films are generally very stretchable, which can be undesirable when processing polymeric films on high speed manufacturing equipment. In addition to the inclusion of starch, another means for improving the strain at break of the polymeric film is to incorporate a plasticising agent into the film. Suitable plasticising agents include polyethylene glycol, glycerol, propylene glycol and combinations thereof. For example, the polymeric film can include polyethylene glycol, wherein the polyethylene glycol has a number average molecular weight of more than about 900 kg/kmol, preferably more than about 1200 kg/kmol. Where the plasticising agent comprises polyethylene glycol, the polyethylene glycol may be present in an amount of less than about 50% by weight of the polymeric film. Preferably the polyethylene glycol is present in an amount of at least about 30% by weight of the polymeric film, more preferably at least about 40% by weight of the polymeric film.

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

In certain preferred embodiments of the present invention, the aerosol generating substrate of the smoking article comprises a tobacco rod and the mouthpiece comprises a filter including one or more filter segments.

Where the smoking article includes one or more filter segments, the filtration material within the filter segment is preferably a plug of fibrous filtration material, such as cellulose acetate tow or paper. A filter plasticiser may be applied to the fibrous filtration material in a conventional manner, by spraying it onto the separated fibres, preferably before applying any particulate material to the filtration material. Smoking articles according to the present invention may include a variety of different types of filter segments or combinations of filter segments that would be known to the skilled person, including restrictors and segments that are used for adjusting the resistance to draw (RTD).

The present invention further provides a method of producing a smoking article according to the invention, as described above, the method comprising: providing one or more segments of material for forming a mouthpiece; providing a sheet of polymeric film, the polymeric film comprising starch in an amount of less than 30% by weight of the polymeric film and at least one additional water-soluble polymer; wrapping the sheet of polymeric film around at least one of the segments to form a mouthpiece, the mouthpiece comprising the one or more segments of material and a dissolvable plug wrap consisting of the sheet of polymeric film; and securing the mouthpiece in axial alignment with an aerosol generating substrate with a tipping wrapper circumscribing at least a portion of the mouthpiece. Preferably, the sheet of polymeric film dissolves in less than 72 hours when placed in water at a temperature of 22°C. As discussed above, the dissolution time of a particular polymeric film can be tested using any of Dissolution Tests A, B and C described in detail below.

The present invention also extends to the use of a sheet material consisting of a polymeric film as a plug wrap in a smoking article, wherein the polymeric film comprises starch in an amount of less than 30% by weight of the polymeric film and at least one additional water-soluble polymer. Preferably, the polymeric film dissolves in less than 72 hours when placed in water at a temperature of 22°C. As discussed above, the dissolution time of a particular polymeric film can be tested using any of Dissolution Tests A, B and C described in detail below.

Test procedures

For ease of reference, the test procedures mentioned above are described in detail below.

5 *Dissolution Test A*

As a measure of how quickly a polymeric film used in a smoking article in accordance with the present invention will dissolve in water, the following dissolution test can be used:

- 10 • Cut a 5 mm by 5 mm square sample of the polymeric film.
- At T = 0 seconds, place the square sample in a container of 25 ml of distilled water at a temperature of 22°C. The container should be sized such that the depth of water is sufficient to submerge the sample (although the buoyancy of the sample may be such that it floats on the surface of the water during the test).
- 15 • Note the time required for the polymeric film to dissolve such that the water soluble material from the polymeric film is no longer visible to the naked eye. The time at which this occurs is the dissolution time according to Dissolution Test A.

Dissolution Test B

- 20 As a measure of how quickly a polymeric film from a smoking article in accordance with the present invention will dissolve in water, the following dissolution test can be used:
- 25 • Make a longitudinal cut along one side of a mouthpiece of a smoking article and peel the combination of the tipping paper and the plug wrap from the underlying filtration material.
- Cut a 5 mm by 5 mm square sample from the combined tipping paper and plug wrap.
- At T = 0 seconds, place the square sample in a container of 25 ml of distilled water at a temperature of 22°C. The container should be sized such that the depth of water is sufficient to submerge the sample (although the buoyancy of the sample may be such that it floats on the surface of the water during the test).
- 30 • Note the time required for the dissolvable plug wrap to dissolve such that the water soluble material from the plug wrap is no longer visible to the naked eye. The time at which this occurs is the dissolution time according to Dissolution Test B.

Dissolution Test C

As a measure of how quickly a dissolvable plug wrap in a smoking article according to the present invention will dissolve in water, the following dissolution test can be used:

- 5
- Cut 5 mm long lengths of the mouthpiece from the portion of the mouthpiece with the dissolvable plug wrap, resulting in samples having the filtration material with the plug wrap outside of the filtration material and the tipping paper outside of the plug wrap. This step can be repeated on one or more identical smoking articles to produce
- 10 as many samples as is required.
- at T = 0 seconds, place each sample in a separate container, each container having 25 ml of distilled water at a temperature of 22°C. The containers should be sized such that the depth of water is sufficient to submerge each sample (although the buoyancy of the samples may be such that they float on the surface of the water during the test).
- 15
- After 30 minutes, observe whether any of the water-soluble material from the dissolvable plug wrap remains. If the filter has not opened by itself, remove one sample from the water and cut open to make the observation.
 - Repeat above step at 30 minute intervals until a sample is obtained for which no remaining water soluble material is visible to the naked eye - the time at which such a
- 20 sample is obtained is the dissolution time according to Dissolution Test C

ISO 1924-2

- 25 ISO 1924-2 specifies a method for measuring the tensile strength, strain at break and tensile energy absorption of paper and board, using a testing machine operating at a constant rate of elongation (20 mm/min).

ASTM D1003

- 30 ASTM D1003 - 11e1 Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics

- 35 In summary, luminous transmittance is obtained by placing a clear specimen at some distance from the entrance port of the integrating sphere. However, when the specimen is hazy, the total hemispherical luminous transmittance must be measured by placing the specimen at the

entrance port of the sphere. The measured total hemispherical luminous transmittance will be greater than the regular luminous transmittance, depending on the optical properties of the sample. With this test method, the specimen is necessarily placed at the entrance port of the sphere in order to measure haze and total hemispherical luminous transmittance.

5

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

Figure 1 shows a smoking article in accordance with a first embodiment of the present invention;

Figure 2 shows the smoking article of Figure 1 with the filter unwrapped; and

Figure 3 shows a smoking article in accordance with a second embodiment of the present invention with the filter unwrapped.

The filter cigarette 10 shown in Figures 1 and 2 comprises a wrapped rod 12 of tobacco cut filler which is attached at one end to an axially aligned filter 14 comprising a single filter segment 16 formed of cellulose acetate tow which has been wrapped with a dissolvable plug wrap 18 in accordance with the present invention. The dissolvable plug wrap 18 consists of a polymeric film, which may comprise a single layer or a multi-layered structure. The polymeric film comprises starch in an amount of less than 30% by weight of the polymeric film and at least one additional water-soluble polymer. The wrapped tobacco rod 12 and the filter 14 are joined by an outer wrapper 20 formed of tipping paper, which circumscribes the entire length of the filter 14 and an adjacent portion of the tobacco rod 12.

Figure 3 shows a filter cigarette 30 in accordance with a second embodiment of the present invention. The filter cigarette 30 comprises a wrapped rod 32 of tobacco cut filler which is attached to an axially aligned filter 34 comprising three filter segments in abutting end-to-end relationship: a mouth end segment 36, distant from the wrapped tobacco rod 32; a flavour release segment 38, located upstream of the mouth end segment 36; and a rod end segment 40 adjacent to and abutting the wrapped tobacco rod 32 and located upstream of the first flavour release segment 38.

The mouth end segment 36 comprises a plug of cellulose acetate tow of low filtration efficiency. The flavour release segment 38 comprises a plug of cellulose acetate tow through which particles of a suitable flavourant have been dispersed, such as cut peppermint leaf. The rod end segment 40 comprises a plug of cellulose acetate tow of medium to low filtration efficiency loaded with an additive, such as activated carbon. The mouth end segment 36, the flavour release segment 38 and the rod end segment 40 are each wrapped with a segment plug

wrap 37, 39, 41. The combined filter segments are wrapped with a combining plug wrap 42 which circumscribes the entire length of the filter 34. The wrapped tobacco rod 32 and the wrapped filter 34 are joined by an outer wrapper 44 formed of tipping paper, which circumscribes the entire length of the filter 34 and an adjacent portion of the tobacco rod 32. At least one of the segment plug wraps 37, 39, 41 and the combining plug wrap 42 is dissolvable and consists of a single layer or multi-layered polymer film. The polymer film comprises starch in an amount of less than 30% by weight of the polymer film and at least one additional water-soluble polymer. Preferably, all of the segment plug wraps and the combining plug wrap are dissolvable and formed from such a material.

It will be appreciated that whilst the specific embodiments described above relate to conventional smoking articles comprising a filter and a tobacco rod, a similar arrangement of the dissolvable plug wrap in accordance with the present invention could also be used on a distillation-based smoking article or an electrically heated smoking article.

Claims

1. A smoking article comprising:

an aerosol generating substrate;

a mouthpiece secured in axial alignment with the aerosol generating substrate, the mouthpiece comprising one or more segments and at least one dissolvable plug wrap consisting of a sheet of polymeric film circumscribing at least one of the segments, the sheet of polymeric film comprising starch in an amount of less than 30% by weight of the polymeric film and at least one additional water soluble polymer; and

a tipping wrapper circumscribing at least a portion of the mouthpiece, the tipping wrapper connecting the mouthpiece to the aerosol generating substrate.

2. The smoking article of claim 1, wherein the sheet of polymeric film dissolves in less than 72 hours when placed in water at a temperature of 22°C.

3. The smoking article of claim 1 or 2, wherein the polymeric film comprises starch and the at least one additional water-soluble polymer in a total amount of at least 25% by weight of the film, preferably at least 60% by weight of the film.

4. The smoking article of any preceding claim, wherein the mouthpiece comprises a segment of filtration material, the sheet of polymeric film having a first surface in direct contact with the filtration material and a second surface in direct contact with the tipping wrapper.

5. The smoking article of claim 1, 2 or 3, wherein the mouthpiece comprises a plurality of segments and a plurality of segment plug wraps each circumscribing only one of the segments, wherein the at least one dissolvable plug wrap is a combining plug wrap circumscribing the plurality of segments and the plurality of segment plug wraps, and wherein the sheet of polymeric film has a first surface in direct contact with the segment plug wraps and a second surface in direct contact with the tipping wrapper.

6. The smoking article of claim 1, 2 or 3, wherein the mouthpiece comprises:

a plurality of segments and a plurality of segment plug wraps each circumscribing only one of the segments, wherein at least one of the segments comprises a filtration material; and

a combining plug wrap circumscribing the plurality of segments and the plurality of segment plug wraps;

wherein the segment plug wrap circumscribing the segment of filtration material comprises the dissolvable plug wrap, the sheet of polymeric film having a first surface in direct contact with the filtration material and a second surface in direct contact with the combining plug wrap.

5 7. The smoking article of claim 6, wherein the combining plug wrap also comprises a dissolvable plug wrap, the sheet of polymeric film forming the combining plug wrap having a first surface in direct contact with the segment plug wraps and a second surface in direct contact with the tipping wrapper.

10 8. The smoking article of any preceding claim, wherein the polymeric film has a strain at break of less than 30% and a tensile strength of greater than 15 N / 15 mm, both measured according to the method of ISO 1924-2.

15 9. The smoking article of any preceding claim, wherein the polymeric film includes a plasticising agent comprising at least one of polyethylene glycol, glycerol and propylene glycol.

10. The smoking article of claim 9, wherein the plasticising agent comprises polyethylene glycol having a number average molecular weight of more than 900 kg/kmol, preferably more
20 than 1200 kg/kmol.

11. The smoking article of claim 9 or 10, wherein the plasticising agent comprises polyethylene glycol present in an amount of less than 50% by weight of the polymeric film.

25 12. The smoking article of any preceding claim, wherein the starch is nanocrystalline starch.

13. The smoking article of any preceding claim, wherein the at least one additional polymer comprises polyvinyl alcohol, preferably wherein the polyvinyl alcohol has a number average molecular weight of less than 80000 kg/kmol, preferably less than 55000 kg/kmol.

30 14. A method of producing a smoking article according to any preceding claim, comprising:
providing one or more segments of material for forming a mouthpiece;
providing a sheet of polymeric film comprising starch in an amount of less than 30% by weight of the polymeric film and at least one additional water-soluble polymer;
35 wrapping the sheet of polymeric film around at least one of the segments to form a mouthpiece, the mouthpiece comprising the one or more segments of material and a dissolvable plug wrap consisting of the sheet of polymeric film; and

securing the mouthpiece in axial alignment with an aerosol generating substrate with a tipping wrapper circumscribing at least a portion of the mouthpiece.

15. Use of a sheet material consisting of a polymeric film as a plug wrap in a smoking article,
5 wherein the polymeric film comprises starch in an amount of less than 30% by weight of the polymeric film and at least one additional water-soluble polymer.

