

PATTERNED WRAPPER PAPER WITH ELEVATED CHALK LEVEL

Field of the disclosure

This disclosure relates generally to a smoking article and, more particularly, a banded
5 wrapper paper for use in cigarette manufacturing.

Summary

According to one aspect, there is provided a smoking article comprising: a quantity of
tobacco; a wrapper paper surrounding the quantity of tobacco and defining a tobacco rod having
10 a pair of ends, the wrapper paper having a transverse direction and including at least one
banded region between the ends of the tobacco rod, and including a base web, the banded
region having at least two layers, wherein a first layer is adjacent the base web and includes
calcium carbonate, and a second layer essentially free of calcium carbonate is in superposed
relation to said first layer.

15 According to one aspect, there is provided a wrapper paper for a smoking article
comprising a base web of paper, having a longitudinal direction and a transverse direction, and
including a plurality of banded regions extending in the transverse direction while being spaced
from one another in the longitudinal direction, the banded region having at least two layers, a
first layer adjacent the base web comprising a mixture of starch material and calcium carbonate
20 particles, the content of calcium carbonate particles in the first layer being at least about 80% of
the content of the starch material in the first layer, and a second layer comprising a starch
material in superposed relation to said first layer.

According to one aspect, there is provided a method of manufacturing a banded paper
comprising: establishing a banded region of layered add-on material at spaced locations on one
25 side of a base web, said establishing step including applying a first layer of add-on material
having a reflective agent and adding a second layer essentially free of said reflecting agent in
superposed relation to said first layer; and conducting a reflectance-based inspection operation
directed upon said second layer.

Also disclosed is a smoking article that includes a tobacco rod with a wrapper paper
30 formed from a base web having a nominal permeability. Zones of add-on material are
preferably applied to the base web such that the zones extend transversely of the base web and
are spaced from one another in the longitudinal direction of the base web. Preferably, each
zone is applied to the base web in two layers, one layer preferably comprising starch and
another layer preferably comprising a mixture of starch and calcium carbonate.

By applying the starch layer on top of the layer comprising a mixture of starch and calcium carbonate, which is merely a preferred arrangement, reflectance of the zones of add-on material will vary from reflectance of the base web to a degree that facilitates machine vision inspection predicated on such variance, yet the enhanced reflectance of the calcium carbonate content, which can overwhelm machine vision detection operations, is shielded by the superposed layer of starch which lacks a calcium carbonate content. Accordingly, optical inspection of the zones of add-on material is enhanced. Moreover, reflectance on the obverse side of the base web is substantially uniform so that existence of the zones of add-on material is not visually apparent when viewed by the consumer from the opposite side of the base web.

Brief description of the drawings

Many objects and advantages of the present disclosure will be apparent to those skilled in the art when this specification is read in conjunction with the accompanying drawings, wherein like reference numerals are applied to like elements and wherein:

FIG. 1 is a schematic perspective view of a smoking article according to this disclosure;

FIG. 2 is a schematic view of wrapping paper according to this disclosure;

FIG. 3 is an enlarged partial cross-sectional view taken along the line 3-3 of FIG. 2; and

FIG. 4 is a schematic view of wrapper printing and inspection.

Detailed description

In accordance with this description, a smoking article 20 (see FIG. 1) may include a tobacco rod 22 formed from a wrapper paper 23. The wrapper paper 23 surrounds a quantity of tobacco 24 so as to make a generally circularly cylindrical tobacco rod 22, although the tobacco

rod 22 may be oval or other cross-sectional shape. One end 28 of the tobacco rod 22 is lightable and sometimes called the "lit end" for reference purposes. A second end 30 of the tobacco rod 22 is sometimes called the "tipped end" or "mouth end" for reference purposes. If desired, a filter 32 may be provided at the mouth end 30 of the tobacco rod 22 to remove certain constituents from tobacco smoke during use of the smoking article 20. Typically, the filter 32 is attached to the tobacco rod 22 by the tipping paper 32.

Between the first and second ends 28, 30 of the tobacco rod 22, the wrapper paper 23 has a zone or region 26 of add-on material. The zone 26 of add-on material preferably extends in the circumferential direction at spaced locations around the tobacco rod 22 of the smoking article 20. While the zone 26 of add-on material is depicted in this disclosure as being substantially continuous in its circumferential direction, other configurations for the add-on material are within the spirit and scope of this disclosure. For example, the zone 26 of add-on material may be substantially continuous, as shown, or may have one or more longitudinally extending separations so as to define a C-shaped zone or several arcuately-shaped portions generally symmetrically positioned when viewed in cross section transverse to the longitudinal axis 34 of the tobacco rod 22. In addition, the zone 26 of add-on material may be divided into two or more substantially ring-shaped portions that are spaced from one another along the axis 34 by a distance that typically does not exceed the width of the rings measured in a direction generally parallel to the axis 34 of the tobacco rod 22. The spacing feature provides a "slit" in the band structure. It is also within the contemplation of this disclosure that the zone 26 may comprise a plurality of patches disposed circumferentially around the tobacco rod 22, with patches of adjacent zones 26 being circumferentially displaced from patches of adjacent zones according to a predetermined pattern such as taught in commonly assigned U.S. Patent Application Serial No. 60/924,666, the entire contents of which are incorporated herein by this reference thereto.

For purposes of this description, zone 26 of add-on material is applied to the wrapper paper 23 to obtain improved ignition propensity characteristics and also to obtain improved self-extinguishment characteristics.

Ignition propensity is a standard test conducted as set forth in ASTM E 2187--04, "Standard Test Method for Measuring the Ignition Strength of Smoking articles", which is incorporated herein in its entirety by this reference thereto. Ignition propensity measures the probability that a smoking article, when smoldering and placed on a substrate, will generate sufficient heat to maintain smoldering of the tobacco rod. Low values for ignition propensity are desirable as such values correlate with a reduced likelihood that a smoldering smoking article, when inadvertently left unattended, will cause combustion in an underlying substrate.

Self extinguishment herein is a reference to smoldering characteristics of a smoking article under free burn conditions. To evaluate self extinguishment, a laboratory test is conducted at a temperature of $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ and relative humidity of $55\% \pm 5\%$, both of which should be monitored by a recording hygrothermograph. Exhaust hood(s) remove combustion products formed during testing. Prior to testing, smoking articles to be tested are conditioned at $55\% \pm 5\%$ relative humidity and $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ for 24 hours. Just prior to testing, the smoking articles are placed in glass beakers to assure free air access.

SE testing takes place within an enclosure or test box. A single port smoking machine or an electric lighter is used to ignite the smoking articles for the test. During testing, an apparatus or "angle holder" holds the smoking articles to be tested by holding an end at angles of 0° (horizontal), 45° , and/or 90° (vertical). Preferably, twenty (20) smoking articles are tested at each of the 0° , 45° , and 90° positions. If more than one apparatus is used, the apparatuses are preferably positioned such that the smoking articles face away from each other to avoid cross interference. If a smoking article goes out before the front line of the smoldering coal reaches the tipping paper, the outcome is scored as "self-extinguishment"; on the other hand, if the smoking article continues smoldering until the front line of the smoldering coal reaches the tipping paper, then the outcome is scored as "non-extinguishment". Thus, for example, a self extinguishment value of 95% indicates that 95% of the smoking articles tested exhibited self-extinguishment under free burn conditions; while a self extinguishment value of 20% indicates that only 20% of the smoking articles tested exhibited self-extinguishment under such free burn conditions.

The self extinguishment value may be referred to in terms of "self extinguishment at 0° value", "self extinguishment at 45° value", or "self extinguishment at 90° value", each of which refers to the value of self extinguishment at the specified tested angle. In addition, the self extinguishment value may be referred to in terms of "Self extinguishment Average value", which refers to an average of the three angular positions: namely, an average of (i) the "Self-Extinguishment at 0° value", (ii) the "Self-Extinguishment at 45° value", and (iii) the "self-Extinguishment at 90° value". A reference to "Self-Extinguishment value" does not distinguish between self extinguishment at 0° , self extinguishment at 45° , self extinguishment at 90° , or self extinguishment average values and may refer to any one of them.

The phrases "self extinguish under free burn conditions" or "self extinguishment under free burn conditions" as used herein, refer to the extinguishment of a smoldering cigarette without puffing, when such cigarette is subjected or exposed to free burn conditions.

The zones 26 of add-on material determine and regulate the ignition propensity and self extinguishment characteristics of the smoking article 20. Those zones 26 of add-on material are applied to a base web 40 (see FIG. 2) of the wrapper paper 23. Permeability of the base

web 40 may be in the range of about 25 to about 100 Coresta. Currently, the preferred permeability of the base web lies in the range of about 33 to about 65 Coresta, with the most preferred permeabilities being about 33 and about 60. The base web 40 has a longitudinal direction 42 extending along the length of the wrapper paper 23 and a transverse direction 44
5 extending transversely across the width of the wrapper paper 23 so as to be generally perpendicular or transverse to the longitudinal direction 42.

Those zones 26 of add-on material may be applied to the base web 40 preferably by a printing technique. While one or more printing technique selected from the group consisting of direct printing, offset printing, inkjet printing, gravure printing, and the like, may be used to apply
10 the zone 26, preferably a gravure printing process will be used. Gravure printing provides ample control over deposition rates, deposition patterns, and the like, and is suitable for high-speed printing on the base web 40. For purposes of this disclosure, "high-speed" printing refers to printing processes where the base web 40 advances through the printing process at a linear speed greater than about 300 feet/min. For cigarette manufacturing purposes, base web
15 printing speeds greater than 450 feet/min. are preferred, and speeds greater than 500 feet/minute or more are even more preferred. In this regard, it has been found that the rates of deposition for add-on material, as well as the quality of the pattern of deposited add-on material varies considerably when wrapper paper prepared by high-speed printing processes is compared with wrapper paper prepared by low-speed printing processes. Surprisingly, it has
20 been found that higher-speed printing operations achieve an enhanced situation where desirable ignition propensity values (performance) and desired self extinguishment values (performance) occur at essentially the same time.

One object of this description is to provide wrapper papers 23 (see FIG. 2) produced at commercial-scale high-speed which, when formed into a tobacco rod 22, exhibit ignition
25 propensity values no greater than 25 and self extinguishment values no greater than 50. Accordingly, deposit rates and characteristics of the resulting printed regions are important features of high-speed printing here. While those ignition propensity and self extinguishment values are considered to be adequate at this time, even more preferred is an ignition propensity value for the resulting smoking article no greater than about 15; and the most preferred ignition
30 propensity value for the resulting smoking article is no greater than about 10. Lower self extinguishment values are also desired. In this connection, a more preferred self extinguishment value is less than about 25; while the most preferred self extinguishment value is less than about 10.

To attain those preferred ignition propensity and self extinguishment characteristics, the
35 zones of add-on material 26 are preferably prepared in two layers 50, 52 (see FIG. 3). Preferably, one surface of the base web 40 is provided with a first layer 50 of add-on material at

a first gravure printing station. After drying, a second layer 52 of add-on material is applied to the wrapper paper. Preferably, the second layer 52 is arranged to be superposed on and substantially co-extensive with the first layer 50.

The materials used for the layers 50, 52 have been found to be important in the ignition propensity and self extinguishment performance of a smoking article manufactured using the wrapper paper discussed herein. More particularly, one of the layers 50, 52 is preferably printed with a starch solution. While an aqueous starch solution is presently preferred as the aqueous component is readily dried, use of a non-aqueous starch solution is also within the spirit and scope of this disclosure. The other of the layers 50, 52 is preferably printed with a solution comprising a mixture of calcium carbonate (or chalk) particles and starch. As with the first layer, the second layer preferably is applied as an aqueous solution, but a non-aqueous solution also falls within the spirit and scope of this disclosure.

The relative thickness of these layers need not be the same, and preferably is different. For example, the layer containing starch and calcium carbonate may be at least about 1.5 times the thickness of the starch layer. More preferably, the layer containing starch and calcium carbonate may be at least about 2 times the thickness of the starch layer. Even more preferably, the layer containing starch and calcium carbonate may be at least about 2.5 times the thickness of the starch layer. And most preferably, the layer containing starch and calcium carbonate may be at least about 3 times the thickness of the starch layer.

While many types of starch are contemplated, tapioca starch is presently preferred for the starch component of the layers 50, 52. A suitable commercially available starch is FLO-MAX8 available from National Starch & Chemical Co.

Similarly, many types of calcium carbonate particles are contemplated as falling within the spirit and scope of this disclosure. Presently, however, calcium carbonate available from Solvay Chemicals, Inc., as SOCAL 31 is a suitable commercially available calcium carbonate. SOCAL 31 is an ultrafine, precipitated form of calcium carbonate having an average particle size of about 70 nm (nanometers). Larger particles of calcium carbonate have been observed to not function as well in this application when compared to the ultrafine, precipitated form of calcium carbonate, due at least in part to the tendency of larger particles to precipitate from solution more quickly and due at least in part to the need for greater quantities to attain the beneficial characteristics discussed herein.

Surprisingly, it has been found that the CaCO_3 /starch ratio is a significant factor in determining ignition propensity and self extinguishment performance of a smoking article fashioned from the wrapper paper of this disclosure prepared by high-speed printing. The CaCO_3 /starch ratio is determined as the ratio, by weight, of calcium carbonate to starch for the zone 26 of add-on material, i.e., for both layers. More specifically, a CaCO_3 /starch ratio of at

least about 35% is preferred to obtain ignition propensity and self extinguishment (0) performance less than about 25%. Even more preferred is a CaCO_3 /starch ratio of at least about 45% to obtain ignition propensity and self extinguishment (0) performance less than about 20%.

5 If desired, the layer 50 printed on the base web 40 (see FIG. 3) may be the starch layer, and the layer 52 may be the layer comprising a mixture of starch and calcium carbonate. A presently preferred arrangement, however, places the mixture of starch and calcium carbonate in the first layer 50 and applies only starch in the other layer 52.

10 It has been observed that (i) the optical reflectance of the base web 40 and (ii) the optical reflectance of the mixture of starch and calcium carbonate are quite similar. In fact, those two reflectances are sufficiently similar that optical inspection equipment can have operational difficulty. On the other hand, (i) the optical reflectance of the base web 40 and (ii) the optical reflectance of a layer comprising starch have been observed to be substantially different.

15 The different reflectance characteristics of the layers 50, 52 are advantageously used to enhance the optical inspection characteristics of the wrapper paper of this disclosure. With the starch layer deposited on top of the starch-calcium-carbonate layer, optical inspection of the wrapper paper is materially enhanced. More particularly (see FIG. 4), as the base web 40 advances from a supply bobbin 60 through the gravure printing apparatus 61 to the take-up bobbin 62, the web 40 may also pass through an inspection station 64. In the inspection station 20 64, a light source 66 is focused on the moving web 40. A light beam 70 emanating from the light source 66 reflects from the surface of the moving base web 40 such that the reflected light is collected by a sensor 68. As each zone 26 of add-on material moves through the inspection station 64, the zone 26 interrupts the light beam 70 and modulates the quantity of light reflected to the sensor 68. Because the reflectance of the starch layer is different from the reflectance of 25 the base web 40, the sensor 68 can be constructed to sense the presence or absence of a zone 26. When coupled with an input related to the speed of the base web through the inspection station, an even more sophisticated sensor 68 can determine the width of the zone 26 in the longitudinal direction of the base web 40, as well as longitudinal spacing between adjacent zones, for quality control and manufacturing consistency.

30 Surprisingly, as calcium carbonate levels are increased in the banded zones 26 exposed to the optical inspection, or machine vision, systems, those systems have been observed to become less reliable. That reduced reliability appears to result from increased reflectivity of the surface of the banded zones 26. Such increased reflectivity overwhelms, or "blinds", the inspection systems -- a phenomenon perhaps resulting because the reflectance of banded 35 zones 26 with high calcium carbonate levels is comparable to, and may be substantially

equivalent to, the reflectance of the base web itself. That reflectance parity seems to result when the calcium carbonate level in the surface region of the banded zones 26 is greater than about 80% of the starch level in the surface region of the banded zones 26.

That reflectance parity problem can be alleviated by establishing an structure for the banded zones 26 in which the surface region has a reflectance which is sufficiently different from the reflectance of the base web that the inspection systems consistently identify the reflectance variation to identify parameters related to the banded regions 26, including by way of example presence of the reflectance variation (beginning or end of banded region 26), absence of the reflectance variation (a missing banded region 26, or a misplaced banded region 26), and longitudinal extent of a banded region 26 or spacing between banded regions 26 (e.g., how long a particular reflectance continues for a sensed velocity or speed of the base web through the inspection station). One way of establishing a desired structure for the banded zones 26 is to provide the increased calcium carbonate layer in a position more remote from the inspection system than the layer having essentially starch. Stated differently, by superposing the starch layer on the calcium-carbonate-containing layer, efficacy of optical inspection systems will not be impeded, but will continue to be effective.

Such an arrangement of layers in the banded region 26 provides another surprising and beneficial attribute for the wrapper paper. When the first layer of the banded region 26 applied to the base web contains both calcium carbonate and starch, the presence of the banded region 26 is less evident when observed or examined from the side of the base web opposite to the side on which the banded region 26 is applied -- i.e., the side opposite from the side where machine vision operates. In fact, as the calcium carbonate levels approach high levels which are the subject of this disclosure, presence or existence of the banded region 26 becomes less visible to a consumer, and may actually become substantially invisible to an ordinary consumer.

Such visual masking is important because consumers of smoking articles are accustomed to products in which the wrapper paper exhibits a uniform, homogeneous appearance. The preferred arrangement for the layers 50, 52 (see FIG 3) yields a further significant advantage to a smoking article manufactured using the wrapper paper of this disclosure.

From the foregoing description and the attached drawings, those skilled in the art will understand that a method of manufacturing a banded wrapper paper for smoking articles has been described. In that process, banded regions 26 (see FIG. 2) of layered add-on material are established as spaced locations on one side of the base web 23. Spacing of those banded regions 26 may be selected so as to be substantially greater than the width of those banded regions 26 in the longitudinal direction 42 of the base web 40. The width of the banded regions

26 may be selected to lie in the range of about 5mm to about 10mm (millimeters); and the spacing between those banded regions 26 may be in the range of about 12mm to about 40mm.

To establish the banded regions 26, a first layer 50 (see FIG. 3) of add-on material may be applied to one side of the base web 40, where the add-on material includes a reflective agent. That reflective agent may be selected to calcium carbonate, or chalk, and may be an ultrafine precipitated form of calcium carbonate. The banded regions 26 are further formed by adding or applying a second layer essentially free of the reflecting agent in superposing position relative to the first layer. That step of superposing the second layer 52 on the first layer 50 may be accomplished such that the second layer 52 is substantially coextensive with the first layer 50. Both the first layer 50 and the second layer 52 preferably include starch, such as tapioca starch, in aqueous solution, where the starch has reflectance properties substantially different from the reflectance properties of the calcium carbonate. As discussed above, the composition of the starch and calcium carbonate layer may be formed by mixing the starch and the calcium carbonate in substantially equal proportions.

When the banded regions 26 have been applied to the base web 40, a reflectance-based inspection operation 64 (see FIG. 4) is directed toward the surface of the base web 40 to which the add-on material has been applied. That reflectance-based inspection 64 uses the different reflectance properties of the base web 40 and the second layer 52 to provide information about the banded regions 26 including, for example and without limitation, the presence of the banded region 26, the beginning of the banded region 26, the end of the banded region 26, and the width of the banded region 26 in the longitudinal direction of the web 40. That inspection is conducted while the base web 40 moves through the inspection station 64 at commercial production speeds.

Where the base web 40 with the banded regions 26 is used to form a tobacco rod 22 (see FIG. 1), the base web 40 may be slit longitudinally into portions having a transverse width corresponding to the circumference of a tobacco rod plus the width of a glue seam. Using conventional equipment such as a making machine, the base web 40 is fed into the machine where cut tobacco filler is deposited on the side of the paper web 40 (see FIG. 3) to which the banded regions 26 have been applied so that the banded regions 26 are on the inside of the resulting tobacco rod 22. Also in conventional manner, the wrapper paper is wrapped around the cut tobacco filler and sealed with a longitudinal seam. With the foregoing arrangement, any visual inspection of the tobacco rod is directed toward a side of the paper web 40 that is free of the add-on material. In this way, presence of the banded regions 26 of add-on material is visually obscured from detection by the consumer and the appearance of the wrapper paper is more uniform. To this end, as the portion of calcium carbonate in the mixture approaches the portion of starch in the mixture, the presence of the banded regions 26 becomes less and less

visible from the consumer side of the tobacco rod, and when those two components are substantially equal, presence of the banded regions 26 upon visual inspection is difficult, if not impossible, to detect.

The preferred arrangement of the layers of add-on material thus makes use of a optical
5 characteristic of the banded material to facilitate or effectuate machine inspection of the wrapper paper having banded regions 26 on its base web 40. Where the composition of one layer has optical characteristics comparable to those of the base web 40, that one layer is shielded from the machine inspection apparatus by the second layer which is superposed on the first layer, where the second layer exhibits optical characteristics that are distinguishable from those
10 characteristics of the base web 40. The optical characteristic inspected may be reflectance, brightness, or other specular characteristic of the paper.

When the word "about" is used herein in connection with a numerical value, the intent is to include not only that numerical value but also values within in a tolerance or range of $\pm 5\%$ of the precise numerical value associated with the word "about".

15 It will now be apparent to those skilled in the art that this specification describes a new, useful, and nonobvious smoking article. It will also be apparent to those skilled in the art that numerous modifications, variations, substitutes, and equivalents exist for various aspects of the smoking article that have been described in the detailed description above. Accordingly, it is expressly intended that all such modifications, variations, substitutions, and equivalents that fall
20 within the spirit and scope of the invention, as defined by the appended claims, be embraced thereby.

CLAIMS:

1. A smoking article comprising:
a quantity of tobacco;
a wrapper paper surrounding the quantity of tobacco and defining a tobacco rod having
5 a pair of ends, the wrapper paper having a transverse direction and including at least one
banded region between the ends of the tobacco rod, and including a base web,
the banded region having at least two layers, wherein a first layer is adjacent the base
web and includes calcium carbonate, and a second layer essentially free of calcium carbonate
is in superposed relation to said first layer.
- 10 2. A smoking article according to claim 1 in which one layer of the banded region
comprises a starch material, and a second layer of the banded region comprises a mixture of
starch material and calcium carbonate particles, the content of calcium carbonate particles in
the second layer being at least about 80% of the content of the starch material in the second
layer.
- 15 3. A smoking article according to claim 1 or 2 wherein weight of calcium carbonate particles
in the second layer is at least about 80% of the weight of the starch material in the second layer.
4. A smoking article according to any preceding claim wherein the weight of the second
layer is greater than the weight of the first layer.
5. A smoking article according to any preceding claim in which the content of calcium
20 carbonate particles in the banded region being at least about 35% of the content of the starch
material in the banded region.
6. A wrapper paper for a smoking article comprising a base web of paper, having a
longitudinal direction and a transverse direction, and including a plurality of banded regions
extending in the transverse direction while being spaced from one another in the longitudinal
25 direction, the banded region having at least two layers, a first layer adjacent the base web
comprising a mixture of starch material and calcium carbonate particles, the content of calcium
carbonate particles in the first layer being at least about 80% of the content of the starch
material in the first layer, and a second layer comprising a starch material in superposed relation
to said first layer.
- 30 7. A paper wrapper for a smoking article according to claim 6 wherein calcium carbonate
content of each band is greater than about 35% by weight of the starch content of each band.

8. A paper wrapper for a smoking article according to claim 6 or 7 wherein the base web surrounds tobacco to form a tobacco rod and wherein the tobacco rod has an ignition propensity of less than about 25.

9. A paper wrapper for a smoking article according to claim 6, 7 or 8 wherein the base web surrounds tobacco to form a tobacco rod, and wherein the tobacco rod has a self extinguishment at 0° of less than about 25.

10. A method of manufacturing a banded paper comprising:

establishing a banded region of layered add-on material at spaced locations on one side of a base web, said establishing step including applying a first layer of add-on material having a reflective agent and adding a second layer essentially free of said reflecting agent in superposed relation to said first layer; and

conducting a reflectance-based inspection operation directed upon said second layer.

11. A method according to claim 10 further including the step of applying a first layer having a mixture of starch and calcium carbonate, where calcium carbonate is the reflecting agent.

12. A method according to claim 11 further including the step of mixing the starch and calcium carbonate in substantially equal proportions.

13. A method of manufacturing a tobacco rod by orienting banded paper constructed in accordance with any of claims 10 to 12 to receive cut tobacco filler on the one side that received the layered add-on material; and wrapping tobacco such that visual inspection by a consumer is directed toward a side of the base web free of add-on material.

14. A method according to claim 10, in which one layer of the banded region comprises a starch material, and a second layer of the banded region comprises a mixture of starch material and calcium carbonate particles, the content of calcium carbonate particles in the second layer being at least about 80% of the content of the starch material in the second layer