

PRINTING PROCESS FOR PATTERNED WRAPPER PAPER

FIELD OF THE DISCLOSURE:

This disclosure relates generally to a process for making cigarette wrapper paper having an applied pattern of add-on material. More particularly, the disclosure concerns a process for making cigarette wrapper paper with a specially formulated oxidized starch material.

SUMMARY:

A wrapper paper for cigarettes may be fashioned with a pattern of add-on material to reduce the ignition propensity characteristics of a smoking article fashioned using the wrapper. Reduced ignition propensity characteristics reflect a lowered capability of a smoking article to cause a substrate to ignite when a smoldering smoking article is left inadvertently unattended on a substrate.

In accordance with this disclosure, a predetermined pattern of add-on material containing an aqueous starch solution may be applied to a base web of wrapper paper. The predetermined pattern may comprise a plurality of transverse bands, a plurality of longitudinal bands, a two-dimensional array of treated regions, or any other suitable pattern. Preferably, the predetermined pattern may be applied using a printing technique, such as, for example, gravure printing, offset printing, inkjet printing, spraying, die printing, or the like. Most preferably, gravure printing may be used.

To improve the ignition propensity characteristics of a smoking article fashioned from the wrapper paper, the pattern is preferably applied with a printing solution containing an oxidized starch. Preferred printing characteristics may be attained using an aqueous starch solution having a room temperature viscosity no greater than about 50mPa·s (centipoise, cP), and prepared from particles having a size in the range of about 4 microns to about 40 microns when dry, and about 90% of the particles having a size in the range of about 10 microns to about 100 microns when wet. Moreover, it is further desirable that the starch solution be slightly acidic with a pH in the range of about 6 to about 6.5. Starch employed for the printing solution preferably may be mixed with water to form a printing solution having a starch concentration of about 20% to about 24% (by weight). Another desirable characteristic of the printing solution is a relatively high surface tension, for example, on the order of $6.5 \cdot 10^{-2} \text{Nm}^{-1}$ (65 dynes/centimeter) or more.

If desired, the printing solution may be applied to the base web in two or more layers. Those layers may be vertically registered with one another, offset from one another, have portions

spaced from one another, and the like. Furthermore, a conventional filler material, such as calcium carbonate, may be included in one or more of the layers, as may be desired.

BRIEF DESCRIPTION OF THE DRAWINGS:

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

FIG. 1 is a schematic view of a gravure printing process;

FIG. 2 is a schematic view of a wrapper paper having transversely printed regions;

FIG. 3 is a schematic view of a wrapper paper having longitudinally printed regions;

FIG. 4 is a schematic view of a wrapper paper having a two-dimensional pattern;

FIG. 5 is cross-sectional view of a multilayer printed region; and

FIG. 6 is a perspective view of a smoking article having a tobacco rod constructed with the wrapper disclosed herein.

DETAILED DESCRIPTION:

Generally, a predetermined pattern of add-on material may be applied to a base web of a wrapper paper to obtain improved Ignition Propensity ("IP") characteristics and also to obtain improved Self-Extinguishment ("SE") 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 placed on a substrate, will generate sufficient heat to maintain static burning of the tobacco rod. Low values for IP are desirable as such values correlate with a reduced likelihood that a smoldering smoking article will cause combustion in an underlying substrate.

Furthermore, the predetermined pattern of add-on material is typically applied to a base web having a permeability lying in the range of about 20 to about 80 CORESTA units. When dry, the add-on material often forms a film on the base web that is effective to locally reduce permeability to values lying in the range of 0 to about 10 CORESTA units. In some applications, the add-on material is applied as an aqueous solution including starch.

Unexpectedly, it has been found that certain characteristics of the starch material give rise to predetermined patterns that yield very low Ignition Propensity values when the patterned base paper is formed into smoking articles. Even more surprising has been the realization that within the standard specifications for some well-known starch materials, batch-to-batch variations in material

properties can affect the Ignition Propensity of the resulting smoking articles. By way of example, the specifications of an oxidized tapioca starch commercially offered by National Starch & Chemical Co. as Flo-Max 8 indicate a pH in a 1% solution lying in the range of 4.5 to 6.5, with particles having molecular weights in excess of 10,000. Surprisingly, when a predetermined pattern was applied to a base web with a batch of Flo-Max 8 having a pH in the range of about 6 to about 6.5, Ignition Propensity has been found to be much improved when compared to other batches of Flo-Max 8 for which the pH was less than about 6 but still within the manufacturer's specifications.

Various balances or trade-offs need to be made in selection of starch parameters for use in applying films to wrapper paper. For example, while high molecular weight starch may give rise to effective permeability reduction, such high molecular weight starches must be used in low concentrations, resulting in a solution having a very high water content. But high-water-content films are much more difficult to effectively dry on porous wrapper paper. Moreover, it has been found that surface tension of the starch solution affects the retention of small bubbles of air -- low surface tension allows smaller bubbles to remain in the solution, whereas high surface tension causes bubbles to agglomerate and separate out of the solution giving a more uniform and consistent material for application to the wrapper paper.

Although not fully understood, the preferred pH range of the oxidized starch is believed to reflect a lower degree -- or less complete -- oxidation of the starch polymer chains giving more, longer polymer chains than the more acidic (*i.e.*, lower pH) starches.

Furthermore, longer polymer chains yield a solution having a higher viscosity. Higher viscosity for the starch solution translates to better control when applied to a wrapper paper in a printing process.

Based on these understandings, it has been found that marked improvement in the Ignition Propensity of patterned wrapper paper results for starch solutions having particular, and improved, characteristics. Those characteristics for an aqueous solution including oxidized starch include a pH in the range of about 6 to about 6.5; a surface tension of at least about $6.5 \cdot 10^{-2} \text{Nm}^{-1}$ (65 dynes/centimeter); a room temperature viscosity of no greater than about 50 mPa·s; and a particle size distribution in the range of about 4 microns to about 40 microns for dry particles, with about 90% also being in the range of about 10 microns to about 100 microns when wet. Furthermore, the particles preferably have a molecular weight such that the solution can have starch concentrations in the range of about 20% to about 24%. Preferably, the starch comprises an oxidized tapioca starch.

The aqueous starch solutions used for application to the base web or wrapper paper are typically prepared by making a starch/water mixture by first mixing the desired weight of dry starch

powder with the desired weight of room temperature water (*i.e.*, at about 15°C to about 25°C) to obtain a starch/water mixture having the preselected concentration. For example, to prepare a starch/water solution with a preselected concentration of 20%, 20 parts by weight of starch are mixed with 80 parts by weight of water. The starch/water solution is then heated to an elevated sub-boiling temperature in the range of about 90°C to about 95°C – *i.e.*, below the boiling temperature. The starch/water solution is held at the elevated temperature for about 20 to about 30 minutes for thermal soaking. Then, the starch/water solution is cooled to room temperature. That cooling step can occur by passively, such as by naturally occurring heat transfer processes; or the cooling step can be active (or forced) such as by immersion in a cooling bath or by use of a conventional mechanical cooling system. Throughout the mixing step, the heating step, the thermal soaking step, and the cooling step, the starch/water mixture is stirred. The stirring can be continuous or substantially continuous. If additional constituents, such as calcium carbonate, are to be incorporated into the starch/water solution, those constituents should be added after the starch/water solution returns to room temperature following the thermal soaking step.

Aqueous starch solutions having the characteristics specified above and prepared in the manner described above can be applied to a base web using any of a multitude of printing techniques including, by way of example and without limitation, the group consisting of gravure printing, offset printing, inkjet printing, spraying, and die printing. Other printing processes may also be suitable and are intended to lie within the teachings of this specification. Preferably, however, gravure printing may be used to apply the starch solution to a base web to obtain a patterned wrapper paper.

For example, (see FIG. 1), a base web of wrapper paper 10 may be fed from a bobbin 12 into a gravure printing system 14 where a predetermined pattern of starch solution prepared in accord with the foregoing specification is applied to the base web 10. The base web 10, with the newly applied predetermined pattern is collected on a collection bobbin 16. In otherwise conventional steps, the bobbin 16 of patterned wrapper paper may be used to fashion tobacco rods for use in making smoking articles, such as cigarettes.

The gravure printing system 14 may include one, two, three, or more printer operations 14a, 14b, 14c. As these operations are essentially the same, it will suffice to describe details of one with the understanding that the others have corresponding details. The starch solution described above may be furnished to a reservoir 20 from which it is pumped or otherwise supplied to a gravure roll 22 having a patterned surface. That roll 22 rotates in a bath of the starch solution. As the gravure roll 22 rotates, the starch solution is wiped from the roll surface by a doctor blade assembly 23 so that, as the gravure roll 22 contacts the base web 10 at the nip between the gravure roll 22 and the

resiliently faced backing roll 24, the starch solution transfers to the base web with the pattern on the surface of the gravure roll 22.

After suitable drying, the base web 10 may advance to one or more other print operations 14b, 14c where one or more additional layers of starch material in the same or different predetermined patterns may be applied to the base web 10. If desired, the starch material in other print operations may include other constituents, for example, calcium carbonate. Furthermore, if desired, the starch solution having calcium carbonate could be applied in the first printing operation 14a, while the starch solution without calcium carbonate may be applied in the second or successive printing operation 14b, 14c.

The base web 10 (see FIG. 2) typically has a transverse or cross-web direction (shown by the arrow 30) as well as a longitudinal direction (shown by the arrow 32). The predetermined pattern of add-on material may comprise a plurality of transversely oriented, generally parallel, regions or bands 34. These bands may be uniformly spaced along the length of the base web 10, or may be arranged at recurrent spacing patterns related to tobacco rod length and finished cigarette fabrication.

Alternatively, the base web 10 may include a predetermined pattern such as one or more longitudinally extending regions or stripes 36 (see FIG. 3) of add-on material. If desired, the predetermined pattern may also comprise a two-dimensional array of regions 38 (see FIG. 4) of add-on material spaced along and/or transversely of the base web 10.

Furthermore, as noted above, the add-on material can be applied in two or more layers 40, 42 (see FIG. 5). The layers can be fully registered and co-extensive with one another if so desired. Alternatively, the upper layer 42 may be split or slit into two portions 42a, 42b, each of which is superposed on the first or lower layer 40 such that a space exists between the two portions 42a, 42b. That space may extend either longitudinally or transversely on the base web 10. In a further alternative, the upper layer 42 may be superposed on the lower layer 40, but not co-extensive therewith.

A smoking article (see FIG. 6) comprises a tobacco rod 205 and a filter 207, which are attached to one another with a tipping paper 209. The tobacco rod 205 includes a wrapper 210 that is constructed in accordance with the teachings herein.

When the word "about" is used in this specification in connection with a numerical value, it is intended that the associated numerical value include a tolerance of $\pm 10\%$ around the stated numerical value. Moreover, when reference is made to percentages in this specification, it is intended that those percentages are based on weight, i.e., weight percentages.

It will now be apparent that a new, improved, and nonobvious process for making patterned wrapper paper has been described in this specification with sufficient particularity as to be understood by one of ordinary skill in the art. Moreover, it will be apparent to those skilled in the art that numerous modifications, variations, substitutions, and equivalents exist for features of the invention which do not materially depart from the spirit and scope of the invention. Accordingly, it is expressly intended that all such modifications, variations, substitutions, and equivalents which fall within the spirit and scope of the invention as defined by the appended claims shall be embraced by the appended claims.

CLAIMS:

1. A process for making patterned wrapper paper comprising the steps of:
preparing a printing solution including at least water and an oxidized starch having:
5 room temperature viscosity no greater than about 50 centipoises (50 mPa·s);
particles in the range of about 4 to about 40 microns when dry and about 90% in the
range of about 10 microns to about 100 microns when wet; and
a pH in the range of about 6 to about 6.5;
the starch further being capable of forming solution with about 20% to about 24% oxidized
10 starch content;
the printing solution having a surface tension of at least about 65 dynes per centimeter
($6.5 \cdot 10^{-2} \text{Nm}^{-1}$); and
providing a base web of wrapper paper;
applying the printing solution to the wrapper paper in a predetermined pattern.
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2. The process of Claim 1 wherein the base web has a transverse direction and wherein the
predetermined pattern comprises a plurality of bands extending generally transversely on the base
web.
- 20 3. The process of Claim 2 wherein the plurality of bands are regularly spaced from one
another along the base web.
4. The process of Claim 1 wherein the base web has a longitudinal direction and wherein the
predetermined pattern includes at least one longitudinally extending stripe.
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5. The process of Claim 1 wherein the base web has a transverse direction and a longitudinal
direction and wherein the predetermined pattern includes a plurality of regions spaced transversely
and longitudinally on the base web.
- 30 6. The process of Claim 1 wherein the printing process is selected from the group comprising
gravure printing, offset printing, inkjet printing, spraying, and die printing.
7. The process of Claim 6 wherein the printing process is gravure printing.

8. The process of Claim 1 wherein the printing solution is applied in two or more layers to the base web.

9. The process of Claim 8 wherein the printing solution in one of the layers further includes calcium carbonate.

10. The process of Claim 1 wherein the printing solution further includes calcium carbonate.

11. The process of Claim 1 wherein the step of preparing a printing solution includes:

mixing a predetermined quantity of dry starch with a predetermined quantity of room temperature water;

heating the mixture of starch and water to a sub-boiling temperature;

maintaining the mixture of starch and water at the sub-boiling temperature for a time period in the range of about 20 to about 30 minutes;

allowing the mixture of starch and water to return to room temperature; and

stirring the mixture of starch and water at least substantially continuously during the step of preparing.

12. The process of Claim 11 wherein the sub-boiling temperature is a temperature in the range of about 90°C to 95°C.

13. The process of Claim 11 wherein the step of allowing the mixture of starch and water to return to room temperature includes the step of active cooling.

14. The process of Claim 11 wherein the step of allowing the mixture of starch and water to return to room temperature includes the step of passive cooling.

15. The process of Claim 11 further including the step of adding at least one additional constituent to the mixture of starch and water after the mixture returns to room temperature.

16. The process of Claim 15 wherein the additional constituent is calcium carbonate.

17. The process as set forth in any of Claim 1 to 16, wherein the starch comprises an oxidized tapioca starch.

18. A smoking article comprising a tobacco rod, said tobacco rod including a wrapper constructed in accordance with a process set forth in any one of Claims 1 to 17.