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(54) SMOKING ARTICLES AND WRAPPING MATERIALS THEREFOR

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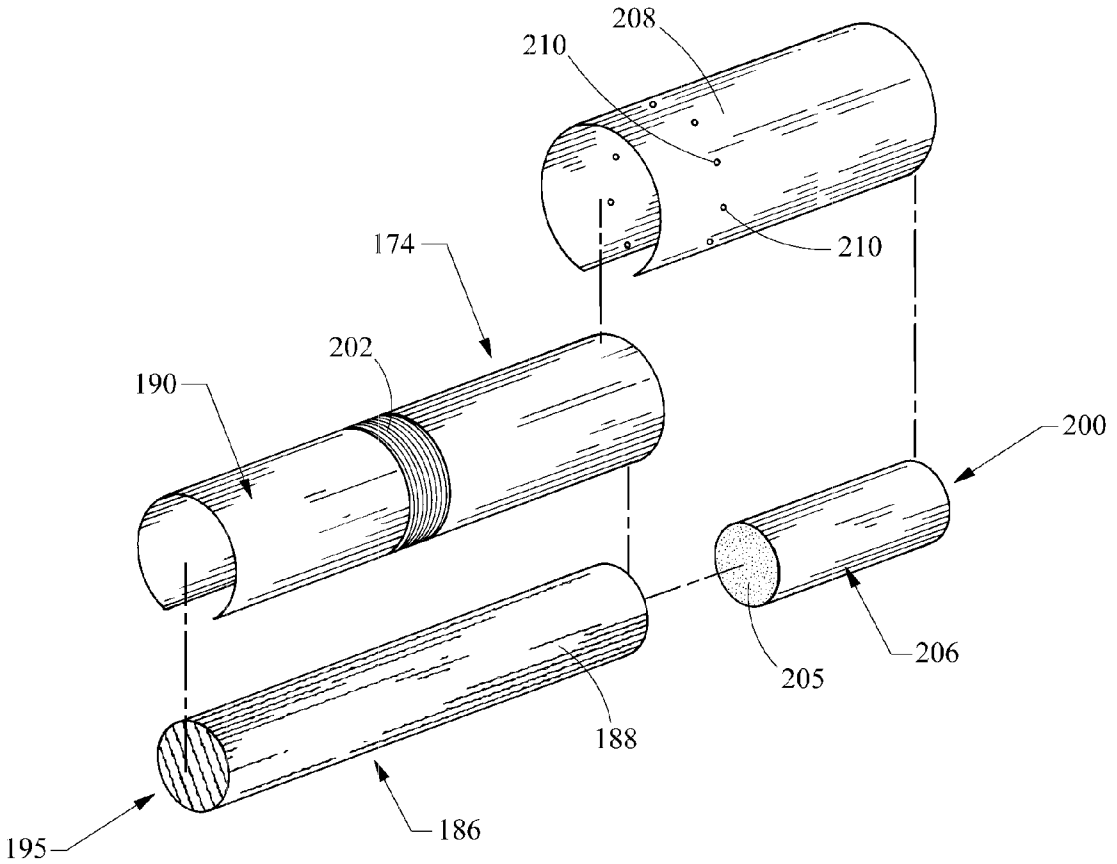
(57) **ABSTRACT**

A smoking article includes a smokable rod manufactured using a paper wrapping material having an additive material applied thereto as a pattern. The additive material is applied as coating formulation (e.g., an aqueous coating formulation) incorporating a film-forming agent such as alginate, starch, or another polymer. The wrapping material includes at least one coated region with a porosity of less than about 20 CORESTA and a diffusion capacity no greater than about 0.2 cm/sec, where the coated region is on a base sheet with a porosity of greater than about 120 CORESTA and a diffusion capacity of at least 1.7 cm/sec.



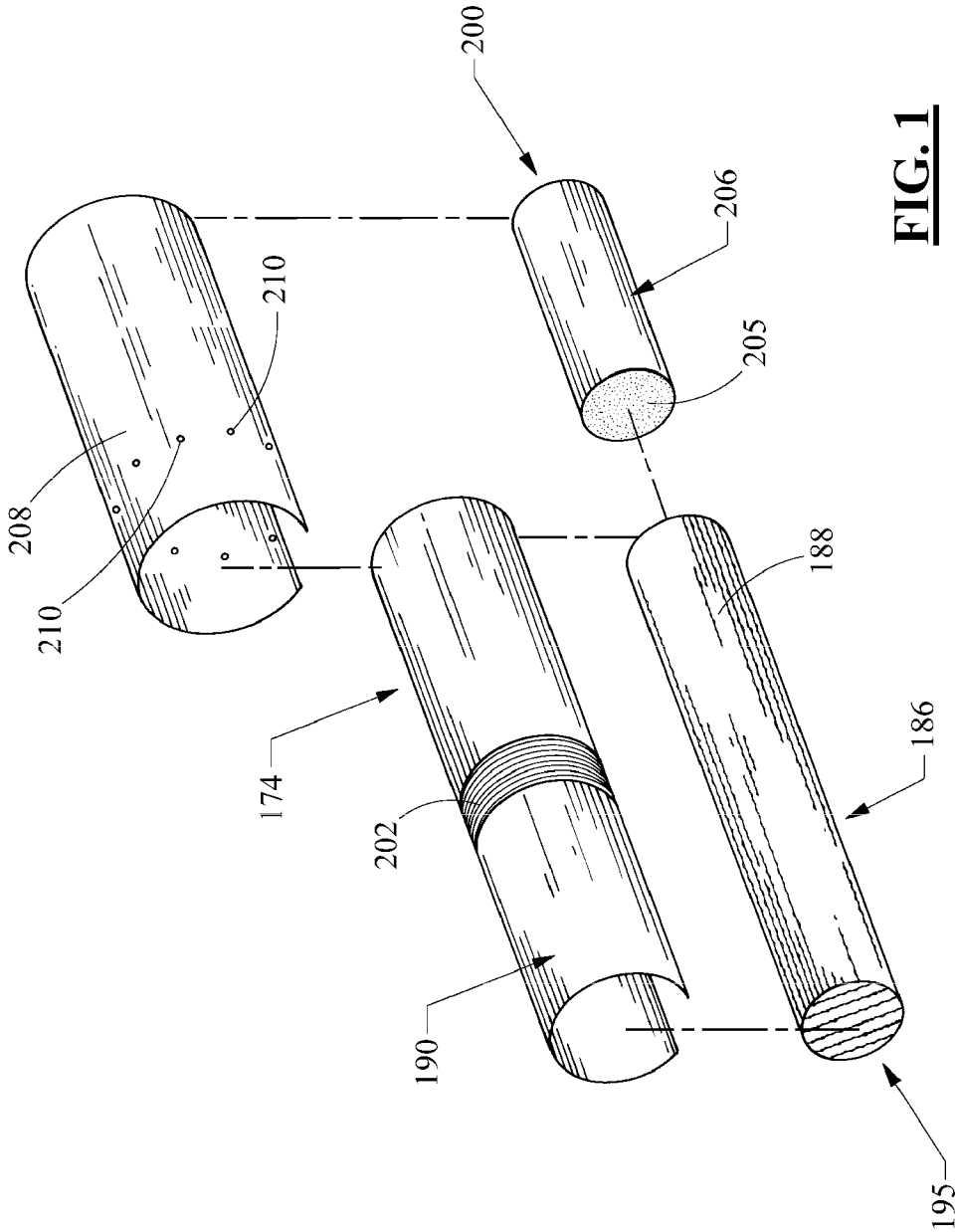


FIG. 1

SMOKING ARTICLES AND WRAPPING MATERIALS THEREFOR

FIELD OF THE INVENTION

[0001] The present invention relates to products made or derived from tobacco, or that otherwise incorporate tobacco, and are intended for human consumption. More particularly, aspects of the present invention relate to wrapping materials and to smoking articles associated with those smoking articles.

BACKGROUND OF THE INVENTION

[0002] Smoking articles, such as cigarettes, have a substantially cylindrical rod-shaped structure and include a charge, roll, or column of smokable material, such as shredded tobacco, surrounded by a paper wrapper, to form a "cigarette rod," "smokable rod" or a "tobacco rod." Normally, a cigarette has a cylindrical filter element aligned in an end-to-end relationship with the tobacco rod. Typically, a filter element comprises plasticized cellulose acetate tow circumscribed by a paper material known as "plug wrap." Certain cigarettes incorporate filter elements comprising, for example, activated charcoal particles. Typically, the filter element is attached to one end of the tobacco rod using a circumscribing wrapping material known as "tipping paper." In some smoking articles, the tipping material and plug wrap are perforated in order to provide dilution of drawn mainstream smoke with ambient air. Descriptions of cigarettes and the various components thereof are set forth *Tobacco Production, Chemistry and Technology,* Davis et al. (Eds.) 1999. Various properties of paper materials used for cigarette manufacture, and of the cigarettes manufactured using those papers, are set forth in Durocher, *TJI,* 188-194 (3/1985). For example, cigarette wrapping paper materials are known in the art as having a variety of CORESTA values up to about 200 CORESTA. The base porosity of cigarette wrapping paper materials in typical or common cigarettes is often greater than 20 CORESTA and less than 100 CORESTA, with many products having materials in about the 30 to 60 CORESTA range. CORESTA are a measure of the air flow through paper (cm^3 of air at 1 kPa pressure flowing through one cm^2 of paper area per minute).

[0003] A cigarette is used by a smoker by lighting one end of that cigarette, and burning the tobacco rod. The smoker then receives mainstream smoke into his or her mouth by drawing on the opposite end of the cigarette. During the time that the cigarette is not being drawn upon by the smoker, the cigarette remains burning.

[0004] Numerous attempts have been made to control the manner that a cigarette burns when the cigarette is not being drawn upon. For example, cigarette papers have been treated with various materials to cause cigarettes incorporating those papers to self extinguish during periods when those cigarettes are lit but are not being actively puffed. Certain treatment methods have involved applying materials to the paper in circumferential bands or longitudinal stripes, creating areas that affect the burn rate of cigarettes incorporating that type of cigarette paper. See, for example, U.S. Pat. No. 4,924,888 to Perfetti U.S. Pat. No. 3,030,963 to Cohn; U.S. Pat. No. 4,146,040 to Cohn; U.S. Pat. No. 4,489,738 to Simon; U.S. Pat. No. 4,480,650 to Weinert; U.S. Pat. No. 4,615,345 to Durocher; U.S. Pat. No. 6,606,999 to Crooks et al; U.S. Pat. No. 6,827,087 to Wanna et al; and U.S. Pat. No. 6,848,449 to Kitao et al.; U.S. Pat. No. 6,904,917 to Kitao et al.; and U.S. Patent Application Pub. Nos. 2004/0231685 to Patel et al.; 2005/0016556 to Ashcraft et al.; and 2005/0076929 to Fitzgerald et al.; each of which is incorporated herein by reference. In addition, numerous references disclose applying films to the paper wrapping materials of tobacco rods. See, for example, U.S. Pat. No. 1,909,924 to Schweitzer; U.S. Pat. No. 4,607,647 to Dashley; and U.S. Pat. No. 5,060,675 to Milford et al., each of which is incorporated herein by reference. Some cigarettes have included tobacco rods and multiple layers of circumscribing wrapping materials such as, for example. U.S. Pat. No. 4,998,543 to Goodman; U.S. Pat. No. 5,220,930 to Gentry; and U.S. Pat. No. 5,271,419 to Arzonico et al.

[0005] "Banded" paper wrapping materials that are used for cigarette manufacture include segments defined by the composition, location, and properties of the various materials within those wrapping materials. Numerous references contain disclosures suggesting various banded wrapping material configurations. See, for example, U.S. Pat. No. 1,996,002 to Seaman; U.S. Pat. No. 2,013,508 to Seaman; U.S. Pat. No. 4,452,259 to Norman et al.; U.S. Pat. No. 5,417,228 to Baldwin et al.; U.S. Pat. No. 5,878,753 to Peterson et al.; U.S. Pat. No. 5,878,754 to Peterson et al.; U.S. Pat. No. 6,198,537 to Bokelman et al.; U.S. Pat. No. 6,779,530 to Kraker; U.S. Pat. No. 6,837,248 to Zawadzki et al; and U.S. Pat. No. 6,725,867 to Peterson et al.; and U.S. Patent Application Pub. Nos. 2005/0016556 to Ashcraft et al. and 2005/0229941 to Minami et al.; each of which is incorporated herein by reference.

[0006] Methods for manufacturing banded-type wrapping materials also have been disclosed. See, for example, U.S. Pat. No. 4,739,775 to Hampl, Jr. et al.; and U.S. Pat. No. 5,474,095 to Allen et al.; and PCT Application Pub. Nos. WO 02/44700 to Watkins and WO 02/055294 to Hammersmith et al. Some of those references describe banded papers having segments of paper, fibrous cellulosic material, or particulate material adhered to a paper web. See, U.S. Pat. No. 5,263,999 to Baldwin et al.; U.S. Pat. No. 5,417,228 to Baldwin et al.; U.S. Pat. No. 5,450,863 to Collins et al.; and U.S. Pat. No. 6,502,613 to Suzuki; and U.S. Patent Application Pub. No. 2005/0045297 to Garg et al. A representative method for manufacturing cigarettes having treated wrapping materials is set forth in U.S. Pat. No. 5,191,906 to Myracle, Jr. et al. Additive materials can be applied to cigarette paper wrapping materials while those wrapping materials are being used for cigarette manufacture (i.e., in a so-called "on-line" fashion). See, for example, U.S. Pat. No. 1,999,223 to Weinberger; U.S. Pat. No. 1,999,224 to Miles; and U.S. Pat. No. 6,848,449 to Kitao et al.; U.S. Pat. No. 6,904,917 to Kitao et al.; and U.S. Patent Application Pub. Nos. 2004/0129281 to Hancock et al; 2004/0261805 to Wanna et al; 2005/0039764 to Barnes et al.; and 2005/0076929 to Fitzgerald et al.; each of which is incorporated herein by reference.

[0007] The wrapping materials configured with these structures may generally and variously be known as Low-Ignition-Propensity paper and/or FSC paper (which has been used in the art as an acronym for both "fire standards compliant" and "fire-safe cigarette" paper).

[0008] It may be desirable to supply such wrapping materials with a smoking article that provides reduced carbon monoxide in mainstream smoke. It has been observed that some smoking articles manufactured in compliance with government regulation FSC paper may deliver increased levels of carbon monoxide (see, e.g., "'Fire Safer' Cigarettes: The Effect Of The New York State Cigarette Fire Safety Standard

On Ignition Propensity, Smoke Toxicity, And The Consumer Market" Alpert, et al., Harvard School of Public Health, 2005). Thus, it may be desirable to provide smoking articles that include desirable reduced-ignition propensity features, but that do so without any increase in carbon monoxide delivery.

SUMMARY OF THE INVENTION

[0009] The present invention provides materials and methods related to manufacturing smoking articles, such as cigarettes. In a preferred aspect of the present invention, a suitable additive material is applied to the wrapping material of a cigarette rod, and that additive material includes at least one type of film-forming component. Certain additive materials incorporate a mixture of polymeric film-forming components. The additive material is applied to at least one major surface of the wrapping material, and most preferably, to one major surface of the wrapping material.

[0010] Certain embodiments of the present invention may relate to wrapping materials having additive material formulations applied thereto (most preferably in a controlled manner), and to cigarettes manufactured from those wrapping materials. For example, additive material is applied to a wrapping material as a formulation of the present invention; and that formulation incorporates at least one type of polymeric agent, and can incorporate a polymeric agent mixture. The base wrapping material may include a higher-than-traditional porosity (that is, greater than about 100 CORESTA to greater than 110 CORESTA to greater than 120 CORESTA). In certain embodiments, the base wrapping material may include higher diffusion capacities as well, on the order of about 1.6 cm/sec or greater.

[0011] In another aspect of certain embodiments of the invention, a representative additive material formulation, and in particular, a representative polymeric agent mixture, most preferably incorporates a polymeric material that can be characterized as providing film-forming properties to the formulation; that is, an agent that provides desirable functional effects or properties to the formulation. That is, film-forming agents act to provide a formulation that can allow the formulation to be applied to the wrapping material in a desired manner (e.g., as a pre-determined pattern), and can provide a treated wrapping material that exhibits desired functional behaviors. Representative film-forming agents include polymeric materials of varying molecular weights. The thickening agent and the film-forming agent can be provided by one particular type of polymeric material, or one type of polymeric material that is provided in at least two forms, or at least two ranges of molecular weights. That is, certain polymeric materials can have the ability to act as both film-forming and thickening agents. Alternatively, the thickening agent can be provided by one type of polymeric material, and the film-forming agent can be provided by a different type of polymeric material.

[0012] Representative formulations of additive materials may include water-based formulations and/or formulations containing water-miscible components (e.g., one or more alcohols), or that are non-aqueous based (e.g., organic solvent) in nature.

[0013] Optional ingredients, such as flavoring agents, preservatives, pigments and/or colorants, also can be incorporated into the aforementioned formulations. Ingredients such as water soluble and/or water insoluble filler materials (e.g., sodium chloride, calcium chloride, potassium citrate and/or calcium carbonate) also can be incorporated into those formulations.

[0014] Other embodiments of the present invention may include a method for transferring additive material to, and retaining additive material on, desired locations of a wrapping material (e.g., paper wrapping web). For example, wrapping material having a formulation incorporating a polymeric agent mixture (e.g., a formulation having an adhesive-type of character or nature) disposed thereon or otherwise applied thereto (e.g., by printing) can have liquid solvent or carrier removed (e.g., the treated wrapping material can be dried to remove significant amounts of water, when the formulation is a water-based formulation) and wound onto a roll that is adapted for later use for smoking article manufacture.

[0015] Other aspects of the present invention may include a method for transferring the polymeric agent mixture, and retaining that mixture on, desired locations of, a wrapping material suitable for use for smoking article manufacture (e.g., paper wrapping web) when manufacturing smoking articles from those materials using a cigarette making machine. That is, a formulation of additive material is applied to a continuously advancing strip of a paper web within a region of an automated cigarette-making machine system (e.g., a machine designed to produce a continuous cigarette rod) in a desired amount, in a desired configuration and in a desired location.

[0016] For a wrapping material of the present invention, the region thereof coated with coating formulation of the present invention most preferably will exhibit a diffusion capacity in that coated region that is lower than in an uncoated region.

[0017] In another embodiment of the invention, a smoking article incorporating a tobacco rod manufactured from wrapping material treated with the additive material formulation of the present invention may include at least one band of additive material located in a region of its tobacco rod such that the band is capable of providing that smoking article with the ability to meet certain smoking article extinction criteria. Certain smoking articles of the present invention including tobacco rods manufactured using certain appropriately treated wrapping materials, when tested using the methodology set forth in the Cigarette Extinction Test Method by the National Institute of Standards and Technology (NIST), Pub. 851 (1993) using 10 layers of Whatman No. 2 filter paper, meet criteria requiring extinction of greater than about 50 percent, preferably greater than about 75 percent, more preferably greater than about 90 percent, and most preferably about 100 percent, of cigarettes tested. Certain cigarettes of the present invention including tobacco rods manufactured using certain appropriately treated wrapping materials, when tested using the methodology set forth in the methodology set forth in ASTM Designation: E 2187-02b using 10 layers of Whatman No. 2 filter paper, meet criteria requiring extinction of greater than about 50 percent, preferably greater than about 75 percent, more preferably greater than about 90 percent, and most preferably about 100 percent, of cigarettes tested. This measurement may be characterized as "ASTM SE %" with reference to self-extinguishing behavior under the ASTM testing conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. **1** is an exploded perspective of smoking article, showing the smokable material, the wrapping material components, and the filter element.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Referring to FIG. **1**, there are shown the components of a smoking article **174** in the form of a cigarette. The cigarette **174** includes a generally cylindrical rod **186** of a charge or roll of smokable filler material **188** contained in a circumscribing wrapping material **190** of the present invention. The rod **186** is conventionally referred to as a "tobacco rod". The ends of the tobacco rod are open to expose the smokable filler material. At one end of the tobacco rod **186** is the lighting end **195**, and at the other end is shown a filter element **200**. The cigarette **174** is shown as having one printed band **202** printed on wrapping material **190**, and that band entirely circumscribes the cigarette rod in a direction transverse to the longitudinal axis of the cigarette. That is, the band **202** provides a cross-directional region relative to the longitudinal axis of the cigarette **174**. The band **202** most preferably is applied to the inner surface of the wrapping material **190** (i.e., facing the smokable filler material), but can be, in a much less preferred embodiment, applied to the outer surface of the wrapping material **190**. Although the cigarette **174** shown in FIG. **1** has wrapping material having one band, the cigarette also can include wrapping material having two, three, or more spaced bands. The band **202** comprises additive materials of a water-based coating formulation that incorporates a polymeric agent mixture of the present invention.

[0020] The cigarette **174** normally includes a filter element **200** or other suitable mouthpiece positioned adjacent one end of the tobacco rod **186** such that the filter element and tobacco rod are axially aligned in an end-to-end relationship, preferably abutting one another. Filter element **200** has a generally cylindrical shape, and the diameter thereof is essentially equal to the diameter of the tobacco rod. The ends of the filter element are open to permit the passage of air and smoke therethrough. The filter element **200** includes filter material **205** (e.g., plasticized cellulose acetate tow) that is overwrapped along the longitudinally extending surface thereof with circumscribing plug wrap material **206**. The filter element **200** can have two or more filter segments, and/or flavor additives incorporated therein.

[0021] The filter element **200** is attached to the tobacco rod **186** by tipping material **208** which circumscribes both the entire length of the filter element and an adjacent region of the tobacco rod. The inner surface of the tipping material **208** preferably is secured to the outer surface of the plug wrap **206** and the outer surface of the wrapping material **190** of the tobacco rod using a suitable adhesive. A ventilated or air-diluted smoking article is provided with an air-dilution means, such as a series of perforations **210**, each of which extend through the tipping material and plug wrap.

[0022] Various representative types of cigarette components are set forth in U.S. Pat. No. 5,220,930 to Gentry and U.S. Patent Application Pub. Nos. 2004/0255965 to Perfetti et al.; 2004/0261807 to Dube et al.; **2005/0066982** to Clark et al. and 2005/0066986 to Nestor et al., which are incorporated herein by reference. See, also, Johnson, Development of Cigarette Components to Meet Industry Needs, 52nd T.S.R.C. (September 1998). In addition, representative cigarette components and methods for manufacturing cigarettes from those components are set forth in U.S. Pat. No. 7,565,818, to Thomas et al., which is incorporated herein by reference.

[0023] Various types of equipment and methods for manufacturing cigarettes, and for applying additive material formulation to smoking article wrapping material, are known. For example, representative types of equipment and the operation thereof are set forth in U.S. Pat. No. 6,848,449 to Kitao et al.; U.S. Pat. No. 6,904,917 to Kitao et al.; U.S. Patent Application Pub. Nos. 2004/0129281 to Hancock et al.; 2004/0231685 to Patel et al; and 2005/0039764 to Barnes et al.; and 2005/0076929 to Fitzgerald et al.; which are incorporated herein by reference. Other representative techniques for applying additive material formulation to wrapping material are set forth in U.S. Pat. No. 6,779,530 to Kraker; U.S. Patent Application Pub. Nos. 2005/0016556 to Ashcraft et al.; 2005/0103355 to Holmes and 2005/0194014 to Read, Jr.; and PCT WO04/095957 to Bray et al., which are incorporated herein by reference. As such, there are various known manners and methods for applying additive material formulations in a desired manner (e.g., as a coating or film) to desired locations and/or in desired patterns on wrapping materials, such as paper wrapping materials suitable for use for the manufacture of tobacco rods for cigarettes.

[0024] Coating formulations incorporating the additive material for bands or other patterns configured to reduce ignition propensity by reducing air flow to the underlying tobacco rod typically are applied to wrapping material that is supplied from a roll. In one regard, the formulation can be applied to wrapping material supplied from a bobbin. The amount of wrapping material on a bobbin can vary, but the length of continuous strip of wrapping material on a bobbin typically is more than about 6,000 meters; and generally, the length of continuous strip of wrapping material on a bobbin typically is less than about 7,000 meters. The width of the wrapping material can vary, depending upon factors such as the circumference of the smokable rod that is manufactured and the width of the overlap region zone that provides for the sideseam. Typically, the width of a representative continuous strip of wrapping material useful for cigarette rod manufacture is about 19 mm to about 30 mm.

[0025] Paper wrapping materials of the present invention are useful as components of smoking articles such as cigarettes. Preferably, one layer of the wrapping material of the present invention is used as the wrapping material circumscribing the smokable material, and thereby forming the tobacco rod of a cigarette. Most preferably, the wrapping material has the coated regions located on the "wire" side thereof; and the "wire" side of that wrapping material forms the inner surface of the circumscribing wrapping material of the tobacco rod. That is, when the wrapping material is used to manufacture a smokable rod, the "wire side" major surface of the wrapping material that circumscribes the smokable material faces that smokable material. Typically, the "felt" side of the wrapping material is used as the visible outer surface of the tobacco rod. The terms "wire side" and "felt side" in referring to the major surfaces of paper sheet are readily understood as terms of art to those skilled in the art of paper and cigarette manufacture. The selection of a particular wrapping material will be readily apparent to those skilled in the art of cigarette design and manufacture. Typical paper wrapping materials are manufactured from fibrous materials (e.g., a cellulosic materials, such as wood pulp and/or flax), and optional filler materials (e.g., calcium carbonate), to form so-called "base sheets."

[0026] Wrapping materials of the present invention can be manufactured without significant modifications to the production techniques or processing equipment used to manufacture those wrapping materials. Typical wrapping material base sheets often have basis weights that vary, and exhibit

porosities that also vary. Typical base sheets have inherent porosities that are at least about 5 CORESTA, usually are at least about 10 CORESTA, often are at least about 15 CORESTA, and frequently are at least about 20 CORESTA. Base sheets of the presently presented embodiments may include inherent porosities greater than about 100 CORESTA, greater than about 110 CORESTA, greater than about 120 CORESTA, greater than about 130 CORESTA, greater than about 150 CORESTA, and that may be at least (and/or that may exceed) about 200 CORESTA. The term "inherent porosity" refers to the porosity of that wrapping material itself to the flow of air. One paper wrapping material base sheet may include wood pulp, calcium carbonate, and an ash conditioner consisting essentially of potassium citrate and may exhibit an inherent porosity of greater than about 120 to greater than about 150 CORESTA. Previous representative wrapping materials with traditional porosity ranges of about 20 to about 50 CORESTA include those commercially available paper wrapping materials that are set forth in U.S. Pat. Application Pub. Nos. 2004/0129281 to Hancock et al.; 2005/0016556 to Ashcraft et al.; and 2005/0076929 to Fitzgerald et al. Other types of wrapping materials, and components thereof, are set forth in U.S. Pat. No. 6,868,855 to Shafer et al. and U.S. Pat. Application Pub. Nos. 2004/0134631 to Crooks et al. and 2006/0027243 to Matsufuji et al.; and EP 1234514 to Grider et al.; which are each incorporated herein by reference.

[0027] The base sheets may be treated so as to impart a change to the overall physical characteristics thereof and/or so as to introduce a change in the overall chemical compositions thereof. For example, a base sheet can be electrostatically perforated, coated with a film, treated with burn chemicals, and/or treated with flavoring agents or aroma precursors. Various additives can be added to, or otherwise incorporated into, the wrapping material simultaneously to, or at different stages during or after, the paper manufacturing process. See, for example, U.S. Pat. Application Pub. Nos. 2005/0016556 to Ashcraft et al. and 2005/0076929 to Fitzgerald et al.

[0028] Typical wrapping material base sheets often incorporate fibrous material, the composition of which can vary. Often, the fibrous material will be embodied as a cellulosic material, and the cellulosic material can be a lignocellulosic material. Exemplary cellulosic materials include flax fibers, hardwood pulp, softwood pulp, hemp fibers, esparto fibers, kenaf fibers, jute fibers and sisal fibers. Mixtures of two or more types of cellulosic materials can be employed. For example, wrapping materials can incorporate mixtures of flax fibers and wood pulp. The fibers and/or base sheet constructed therefrom can be bleached or unbleached. Other fibrous materials that can be incorporated within wrapping materials include microfibers materials and fibrous synthetic cellulosic materials. See, for example, U.S. Pat. No. 4,779,631 to Durocher and U.S. Pat. No. 5,849,153 to Ishino. Representative fibrous materials, and methods for making wrapping materials therefrom, are set forth in U.S. Pat. No. 2,754,207 to Schur et al; and U.S. Pat. No. 5,474,095 to Allen et al.; and PCT App. Publ. No. WO01/48318.

[0029] Typical wrapping materials also incorporate a filler material. Often, the filler material has the form of essentially water insoluble particles. Additionally, the filler material normally incorporates inorganic components. Filler materials incorporating calcium salts are particularly preferred. One exemplary filler material has the form of calcium carbonate, and the calcium carbonate most preferably is used in particulate form. See, for example, U.S. Pat. No. 4,805,644 to Hampl; U.S. Pat. No. 5,161,551 to Sanders; and U.S. Pat. No. 5,263,500 to Baldwin et al.; and PCT App. Publ. No. WO01/48,316. Other filler materials that may be used may include one or more of agglomerated calcium carbonate particles, calcium tartrate particles, magnesium oxide particles, magnesium hydroxide gels; magnesium carbonate-type materials, clays, diatomaceous earth materials, titanium dioxide particles, gamma alumina materials, ethylcellulose particles, nitrocellulose particles, and calcium sulfate particles. See, for example, U.S. Pat. No. 3,049,449 to Allegrini; U.S. Pat. No. 4,108,151 to Martin; U.S. Pat. No. 4,231,377 to Cline; U.S. Pat. No. 4,450,847 to Owens; U.S. Pat. No. 4,779,631 to Durocher; U.S. Pat. No. 4,915,118 to Kaufman; U.S. Pat. No. 5,092,306 to Bokelman; U.S. Pat. No. 5,109,876 to Hayden; U.S. Pat. No. 5,699,811 to Paine; U.S. Pat. No. 5,927,288 to Bensalem; U.S. Pat. No. 5,979,461 to Bensalem; and U.S. Pat. No. 6,138,684 to Yamazaki; and European Pat. App. No. EP357,359. Certain filler-type materials that can be incorporated into the wrapping materials can have fibrous forms. For example, components of the filler material can include materials such as glass fibers, ceramic fibers, carbon fibers and calcium sulfate fibers. See, for example, U.S. Pat. No. 2,998,012 to Lamm; U.S. Pat. No. 4,433,679 to Cline; and U.S. Pat. No. 5,103,844 to Hayden et al.; PCT App. Publ. No. WO01/41590; and European Pat. App. No. EP1,084,629. Mixtures of filler materials can be used. For example, filler material compositions can incorporate mixtures of calcium carbonate particles and precipitated magnesium hydroxide gel, mixtures of calcium carbonate particles and calcium sulfate fibers, or mixtures of calcium carbonate particles and magnesium carbonate particles.

[0030] There are various ways by which the various additive components can be added to, or otherwise incorporated into, the base sheet. Certain additives can be incorporated into the wrapping material as part of the paper manufacturing process associated with the production of that wrapping material. Alternatively, additives can be incorporated into the wrapping material using size press techniques, spraying techniques, printing techniques, or the like. Such techniques, known as "off-line" techniques, are used to apply additives to wrapping materials after those wrapping materials have been manufactured. Various additives can be added to, or otherwise incorporated into, the wrapping material simultaneously or at different stages during or after the paper manufacturing process.

[0031] The base sheets can be treated further, and those base sheets can be treated so as to impart a change to the overall physical characteristics thereof and/or so as to introduce a change in the overall chemical compositions thereof. For example, the base sheet can be electrostatically perforated. See, for example, U.S. Pat. No. 4,924,888 to Perfetti et al. The base sheet also can be embossed, for example, in order to provide texture to major surface thereof. Additives can be incorporated into the wrapping material for a variety of reasons. Representative additives, and methods for incorporating those additives to wrapping materials, are set forth in U.S. Pat. No. 5,220,930 to Gentry, which is incorporated herein by reference. See, also, U.S. Pat. No. 5,168,884 to Baldwin et al. Certain components, such as alkali metal salts, can act a burn control additives. Representative salts include alkali metal succinates, citrates, acetates, malates, carbonates, chlorides, tartrates, propionates, nitrates and glycolates; including sodium succinate, potassium succinate, sodium citrate, potas-

sium citrate, sodium acetate, potassium acetate, sodium malate, potassium malate, sodium carbonate, potassium carbonate, sodium chloride, potassium chloride, sodium tartrate, potassium tartrate, sodium propionate, potassium propionate, sodium nitrate, potassium nitrate, sodium glycolate and potassium glycolate; and other salts such as monoammonium phosphate. See, for example, U.S. Pat. No. 2,580,568 to Matthews; U.S. Pat. No. 4,461,311 to Matthews; U.S. Pat. No. 4,622,983 to Matthews; U.S. Pat. No. 4,941,485 to Perfetti et al.; U.S. Pat. No. 4,998,541 to Perfetti et al.; and PCT App. Publ. No. WO01/08514. The paper can also be calendared to impart a generally or substantially uniform smoothness and/or thickness.

[0032] Certain components, such as metal citrates, can act as ash conditioners or ash sealers. See, for example, European Pat. App. No. EP1,084,630. A preferred ash conditioner for presently claimed embodiments may include or consist essentially of potassium citrate. A preferred ash conditioner may exclude sodium citrate, and/or it may include or consist essentially of a non-sodium metal citrate (such as, for example, potassium citrate). Other representative components include organic and inorganic acids, such as malic, levulinic, boric and lactic acids. See, for example, U.S. Pat. No. 4,230,131 to Simon. Other representative components include catalytic materials. See, for example, U.S. Pat. No. 2,755,207 to Frankenburg. Typically, the amount of chemical additive does not exceed about 3 percent, often does not exceed about 2 percent, and usually does not exceed about 1 percent, based on the dry weight of the wrapping material to which the chemical additive is applied. For certain wrapping materials, the amount of certain additive salts, such as burn chemicals such as potassium citrate and monoammonium phosphate, preferably are in the range of about 0.5 to about 0.8 percent, based on the dry weight of the wrapping material to which those additive salts are applied. Relatively high levels of additive salts can be used on certain types of wrapping materials printed with printed regions that are very effective at causing extinction of cigarettes manufactured from those wrapping materials. Exemplary flax-containing cigarette paper wrapping materials having relatively high levels of chemical additives have been available as Grade Names 512, 525, 527, 540, 605 and 664 from Schweitzer-Mauduit International. Exemplary wood pulp-containing cigarette paper wrapping materials having relatively high levels of chemical additives have been available as Grade Names 406 and 419 from Schweitzer-Mauduit International.

[0033] Flavoring agents and/or flavor and aroma precursors (e.g., vanillin glucoside and/or ethyl vanillin glucoside) also can be incorporated into the paper wrapping material. See, for example, U.S. Pat. No. 4,804,002 to Herron; and U.S. Pat. No. 4,941,486 to Dube et al. Flavoring agents also can be printed onto cigarette papers. See, for example, the types of flavoring agents used in cigarette manufacture that are set forth in Gutcho, Tobacco Flavoring Substances and Methods, Noyes Data Corp. (1972) and Leffingwell et al., Tobacco Flavoring for Smoking Products (1972).

[0034] Films can be applied to the paper. See, for example, U.S. Pat. No. 4,889,145 to Adams; U.S. Pat. No. 5,060,675 to Milford et al., and PCT App. Publ. Nos. WO02/43513 and WO02/055294. Catalytic materials can be incorporated into the paper. See, for example, PCT App. Publ. No. WO02/435134.

[0035] Typical paper wrapping materials that can be used in carrying out the present invention may be manufactured under specifications directed toward the production of a wrapping material having an overall generally consistent composition and physical parameters. For those types of wrapping materials, the composition and parameters thereof preferably are consistent when considered over regions of each of the major surfaces of those materials. However, typical wrapping materials tend to have a "two-sided" nature, and thus, there can be changes in the composition and certain physical parameters of those materials from one major surface to the other.

[0036] Though less preferred, the wrapping material can be manufactured using a paper making process adapted to provide a base web comprising multiple layers of cellulosic material. See, e.g., U.S. Pat. No. 5,143,098 to Rogers et al.

[0037] Certain other paper wrapping materials can have compositions and/or properties that differ over different regions of each of their major surfaces. The wrapping material can have regions of increased or decreased porosity provided by control of the composition of that material, such as by controlling the amount or type of the filler. The wrapping material can have regions of increased or decreased air permeability provided by embossing or perforating that material. See, for example, U.S. Pat. No. 4,945,932 to Mentzel et al. The wrapping material can have regions (e.g., pre-determined regions, such as bands) treated with additives, such as certain of the aforementioned salts. For wrapping materials having compositions and/or properties that differ over regions of their major surfaces, alignment and registration of the printed bands with patterned regions of the wrapping materials offers manufacturing complications.

[0038] Paper wrapping materials suitable for use in carrying out the present invention are commercially available. Representative cigarette paper wrapping materials have been available as Ref. Nos. 419, 454, 456, 460 and 473 Ecusta Corp.; Ref. Nos. Velin 413, Velin 430, VE 825 C20, VE 825 C30, VE 825 C45, VE 826 C24, VE 826 C30 and 856 DL from Miguel; Tercig LK18, Tercig LK24, Tercig LK38, Tercig LK46 and Tercig LK60 from Tervakoski; and Velin Beige 34, Velin Beige 46, Velin Beige 60, and Ref. Nos. 454 DL, 454 LV, 553 and 556 from Wattens. Exemplary flax-containing cigarette paper wrapping materials have been available as Grade Names 105, 114, 116, 119, 170, 178, 514, 523, 536, 520, 550, 557, 584, 595, 603, 609, 615 and 668 from Schweitzer-Mauduit International. Exemplary wood pulp-containing cigarette paper wrapping materials have been available as Grade Names 404, 416, 422, 453, 454, 456, 465, 466 and 468 from Schweitzer-Mauduit International.

[0039] The wrapping material base sheet may be pretreated, prior to application of an additive material formulation over discrete regions (e.g., as bands or so as to provide banded regions) to provide distinct coated areas and/or patterns. That is, the base sheet most preferably is treated with an appropriate coating formulation pursuant to the present invention such that virtually the entire base sheet is treated with a polymeric material (e.g., as a coating), and discrete coated areas of additive formulation may subsequently be applied over the treated base sheet. For example, virtually the entire major surface of the base sheet can be treated with a coating formulation incorporating a polymeric material, such as an alginate. The coating formulation can be applied to either or both major surfaces of the wrapping material, or the coating can be applied so as to be dispersed throughout the base web. Different application techniques may be used for the base coating formulation. For example, a liquid formula-

tion incorporating polymeric material can be sprayed on to the base sheet, printed onto the base sheet, applied using a size press, or using other suitable application and drying techniques. Preferably, the amount of polymeric material (e.g., an alginate) applied to virtually the entire base sheet is less than about 2.5 g/m^2, often less than about 1 g/m^2, and frequently less than about 0.5 g/m^2, on a dry weight basis. See, for example, U.S. Pat. Application Pub. Nos. 2005/0016556 to Ashcraft et al. and 2005/0076929 to Fitzgerald et al.

[0040] The amount of polymeric material that is applied to virtually the entire surface of the base sheet may not be sufficient on its own to provide self-extinction properties to a cigarette using the described base sheet. That is, the diffusion capacity of such a treated base sheet region may be less than about 2.5 cm/sec., but typically is greater than about 1 cm/sec., and often is greater than about 0.5 cm/sec., when measured at 25° C. This range may vary depending upon the initial, untreated properties of the base sheet. A base sheet treated in such a manner (e.g., with an alginate) so as to provide a thin but porous pre-layer thereto can be further treated with additive material to provide a pattern (e.g., bands) thereon. A representative base sheet treated with a pre-layer of alginate can, in some instances, (i) exhibit a controlled porosity and/or diffusivity, (ii) provide for control of subsequent additive material application, (iii) provide for improved drying and reduced blocking of base sheet that is subsequently treated with additive material, and (iv) provide a means for alternating to some extent the smoke chemistry of a cigarette manufactured from that treated base sheet. Regardless of the material or combination of materials used to create one or more banded regions, the banded regions may have a CORESTA value of less than 20, less than 15, less than 10, less than 5, or less than 3.

[0041] Diffusion, with respect to a cigarette wrapping material having a coated region of additive material, is the amount of gas transported through the wrapping material when a gas concentration gradient is present. See, Baker et al., The Diffusion of Carbon Monoxide out of Cigarettes, *Beitr. Tabakforsch.,* Vol. 9(3), 131-140 (1977); Drake et al., On a Cell to Measure Diffusion Coefficients of Gases through Cigarette Papers, *Int. J. Heat Mass Transfer,* Vol. 23, 127-134 (1980); Baker, The Viscous and Inertial Flow of Air through Perforated Papers, *Beitr. Tabakforsch.,* Vol. 14(5), 253-260 (1989); Miura, Oxygen Diffusion through Cigarette Paper, *Beitr. Tabakforsch.,* Vol. 19(4), 205-208 (2001); Miura et al., Heat Emission from a Burning Cigarette, *Beitr. Tabakforsch.,* Vol. 19(5), 24 5-249 (2001); Rostami et al., Modeling the Diffusion of Carbon Monoxide and Other Gases from the Paper Wrapper of a Cigarette During Puffing, *J. Anal. Pyrolysis,* Vol. 66, 263-280 (2003); Rostami et al., Modeling of a Smoldering Cigarette, *J. Anal. Pyrolysis,* Vol. 66, 281-301 (2003). An apparatus suitable for measuring the diffusion capacity of a wrapping material, including coated regions thereof, is set forth in U.S. Patent Application Pub. No. 2005/0087202 to Norman et al., which is incorporated herein by reference. See, also, Norman et al., Measurement of Gas Diffusion Capacity of Cigarette Papers, *Beitr. Tabakforsch. Int.* Vol. 21 (2205) 425-434 (2005), which is incorporated herein by reference.

[0042] The coating formulation that is applied to the wrapping material to form a band or other pattern may include at least one film-forming agent. The film-forming agent may include a polymeric material that can be applied to the wrapping material to form a pattern (e.g., spaced bands), sufficiently adhere to the wrapping material, and provide a decrease in the air permeability of the wrapping material in the area where the coating formulation is applied. The coated/treated region may provide reduced ignition propensity.

[0043] The coating formulation may also incorporate a thickening agent. Such a material preferably provides desirable rheological properties to the formulation. Such a material may be selected, and employed in a manner, such that the coating formulation has the form of a paste that can be readily applied in a desired fashion to the wrapping material. It is preferred that rheology of the coating formulation is not overly thick or overly thin, but that the paste is of such consistency that it can be applied to a wrapping material without damaging the material. Preferred coating formulations may also function as adhesives, as it is desirable for those coatings to remain in intimate contact with (e.g., to adhere to or otherwise remain secured to) desired locations on the wrapping material where those formulations are applied, and preferred thickening agents assist in facilitating such behaviors. Typically, thickening agents are polymeric materials that are selected on the basis of including relatively high molecular weights, and hence exhibiting relatively high viscosities when incorporated within a liquid formulation.

[0044] The thickening agent and the film-forming agent can be provided by one particular type of polymeric material, or one type of polymeric material that is provided in at least two forms, or in more than one range of molecular weights. That is, certain polymeric materials can have the ability to act as both film-forming and thickening agents. Alternatively, the thickening agent can be provided by one type of polymeric material, and the film-forming agent can be provided by a different type of polymeric material.

[0045] The film-forming agent(s) may include, for example, polymeric material or resin. Exemplary film-forming agents include alginates (e.g., sodium alginate or ammonium alginate, including those alginates available as Kelcosol from Kelco), pectins (e.g., including those available as TIC Pretested HM from TIC Gums), derivatives of cellulose (e.g., nitrocellulose, hydroxy ethylcellulose, ethylcellulose, carboxymethylcellulose and cellulose acetate propionate), ethylene vinyl acetate copolymers, guar gum (e.g., including Type M, Type MM, Type MM high viscosity from Frutarom; and Ticagel from TIC Gums), xanthan gum (e.g., including Keltrol from Kelco), starch (e.g., corn starch, rice starch and dextrin), modified starch (e.g., oxidized tapioca starch and oxidized corn starch), polyvinyl acetate and polyvinyl alcohol. Exemplary film-forming agents are available as Klucel hydroxypropylcellulose HPC, Aqualon sodium carboxymethylcellulose CMC, Natrosol hydroxyethylcellulose HEC and Aqualon ethylcellulose EC from Hercules Incorporated; and Walocel nitrocellulose and Walsroder nitrocellulose from Bayer AG. Suitable combinations of various film-forming agents also can be employed. Exemplary blends include blends of ethylene vinyl acetate copolymer and polyvinyl alcohol, blends of ethylcellulose and ethylene vinyl acetate copolymer, blends of nitrocellulose and ethylene vinyl acetate copolymer, and blends of ethylcellulose and nitrocellulose. The aforementioned blends of film-forming agents, including those that have hydrophobic characters, may be suitable for primary or first layer coatings for multi-layered coatings.

[0046] One representative polymeric agent is hydroxypropylcellulose. An exemplary hydroxypropylcellulose is available as Klucel EF from Hercules, Inc. Another representative

polymeric agent is hydroxypropylmethylcellulose. An exemplary hydroxypropylmethylcellulose is available as Walocel HM PA2910 (HPMC) from Wolff Cellulosics. Preferably, the amount of a representative polymeric agent, such as hydroxypropylmethylcellulose, hydroxypropylcellulose, or a combination thereof, is at least about 1 percent, generally at least about 5 percent, and often at least about 10 percent; and typically does not exceed about 30 percent, generally does not exceed about 25 percent, and often does not exceed about 20 percent; based on the total weight of the coating formulation prior to use.

[0047] Exemplary polymeric agents also can include alginates, such as sodium alginate, potassium alginate, ammonium alginate, and the like, as well as combinations thereof, and combinations thereof with one of the other polymeric agents described herein (e.g., hydroxypropylcellulose, hydroxypropylmethylcellulose). Exemplary alginates are available as Kelgin RL, Manucol LD, Manucol LB, Manugel LBA, and Keltone LVCR NF from FMC Biopolymer. See, for example, the types of alginates set forth in U.S. Pat. No. 6,779,530 to Kraker and U.S. Pat. App. Pub. No. 2007/0084475 to Oglesby, each of which is incorporated herein by reference. Other exemplary alginates are available as Kelgin LDH, Collatex A/RE and Collatex A/RK from ISP Corporation. Relatively low molecular weight alginates may act as film-forming agents, while relatively high molecular weight alginates may act as thickening agents as well as film-forming agents. If desired, mixtures of alginates, such as mixtures of relatively high molecular weight alginates and relatively low molecular weight alginates, may be employed. Preferably, the amount of an alginate is at least about 1 percent, may be at least about 5 percent, and often at least about 10 percent; and typically does not exceed about 30 percent, generally does not exceed about 25 percent, and often does not exceed about 20 percent; based on the total weight of the coating formulation prior to use. Certain alginates are those that include viscosities of greater than about 250 centipoise, typically greater than about 500 centipoise, often greater than about 750 centipoise, and even greater than about 1,000 centipoise, when present in a 3 percent by weight solution (e.g., with water as a solvent) at 25° C.

[0048] Other representative polymeric agents, and representative amounts of those polymeric agents employed in coating formulations, are of the type set forth in US Pat. App. Pub. No. 2007/0246055 to Oglesby, which is incorporated herein by reference.

[0049] The amount of film-forming agent within the coating formulation may vary. Preferably, the amount of film-forming agent is at least about 1 percent, generally at least about 5 percent, and often at least about 10 percent; and typically does not exceed about 30 percent, generally does not exceed about 25 percent, and often does not exceed about 20 percent; based on the total weight of the coating formulation prior to use (i.e., including the liquid solvent or carrier of the formulation). Although the viscosity of the formulation can vary, preferably, the film-forming agent preferably acts to thicken the formulation to a viscosity of less than about 100,000 centipoise, often about less than about 50,000 centipoise, when measured as a Brookfield viscosity (No. 6 spindle, 10 rpm, 25° C.).

[0050] When employed, the amount of thickening agent within the coating formulation may vary. The amount of thickening agent that can be employed can be selected based upon factors such as the desired rheological properties of the coating formulation, the characteristics and properties of the other components of the coating formulation (e.g., the thickening properties of the film-forming agent components), the compatibility of the thickening agent with the other components of the formulation, and the thickening properties of the thickening agent that is selected. Preferably, the amount of thickening agent is at least about 1 percent, generally at least about 5 percent, and often at least about 10 percent; and typically does not exceed about 30 percent, generally does not exceed about 25 percent, and often does not exceed about 20 percent; based on the total weight of the coating formulation prior to use (i.e., including the liquid solvent or carrier of the formulation). Although the viscosity of the formulation can vary, preferably, the thickening agent acts to thicken the formulation to a viscosity of about 15,000 centipoise to about 100,000 centipoise, preferably about 20,000 centipoise to about 30,000 centipoise, as measured as a Brookfield viscosity (No. 6 spindle, 10 rpm, 25° C.).

[0051] The coating formulation may incorporate other ingredients, in addition to the aforementioned polymeric materials. Those other ingredients can be dissolved within the liquid carrier of the coating formulation, dispersed on, or suspended within that coating formulation. Those other ingredients can be employed in order to provide specific properties or characteristics to the wrapping material.

[0052] For example, the coating formulation can incorporate flavoring agents, humectants, sugars and sugar-type compounds (e.g., sucrose, glucose, fructose, maltose, melezitose, dextrose, lactose, galactose and mannose), syrups (e.g., high fructose corn syrup and honey), wetting agents, defoaming agents, preservatives, colorants or pigments, and the like. Though not necessarily preferred, the coating formulation can incorporate water soluble (e.g., sodium chloride, calcium chloride, potassium citrate, and/or potassium chloride) and/or water insoluble (e.g., calcium carbonate or magnesium oxide) fillers. Certain salts can act to enhance the ability to remove liquid solvent or carrier of the additive material formulation during drying operations. Other ingredients can include catalytic materials (e.g., ultrafine particles or nanoparticle types of materials), metals or metal oxides (e.g., iron oxide powder), ammonium salts or ammonia generating compounds, or other types of ingredients that have the ability to alter the chemical nature or character of tobacco smoke generated by the cigarette. Preferably, the optional ingredients are essentially chemically non-reactive with other components of the formulation, at least under those conditions at which the formulation is employed. Preferably, the optional ingredients are employed in amounts that do not result in introduction of undesirable rheology to the coating formulation (e.g., introducing an undesirably high viscosity to the formulation). See, also, for example, the types of ingredients, and amounts of those ingredients, set forth in U.S. Pat. Application Pub. Nos. 2005/0016556 to Ashcraft et al. and 2005/0076929 to Fitzgerald et al.; and U.S. Pat. App. Pub. Nos. 2007/0084475 to Oglesby and 2007/0246055, to Oglesby; each of which is incorporated by reference.

[0053] The oating formulation preferably is incorporated within a suitable solvent, such as an aqueous liquid, to produce a coating formulation that is considered to be a thickened mixture. Preferred coating formulations can be considered to have a "paste-like" consistency. A representative water-based coating formulation having a solvent or carrier content of about 65 weight percent to about 85 weight percent exhibits a Brookfield viscosity (No. 6 spindle, 10 rpm, 25° C.)

that is typically greater than about 10,000 centipoise, often greater than about 20,000 centipoise, but usually less than about 800,000 centipoise, often less than about 400,000 centipoise, and frequently less than about 200,000 centipoise; and preferably about 30,000 centipoise to about 100,000 centipoise.

[0054] The suitable solvent or liquid carrier of the coating formulation most preferably is a liquid having an aqueous character, and can include relatively pure water (e.g., tap water or de-ionized water). If desired, organic solvents or liquid carriers, such as alcohols, can be employed. Although not all components of the coating formulation are necessarily soluble in the liquid carrier, it is most preferable that the film-forming components be soluble (or at least highly dispersible) in that liquid. By "soluble" in referring to the components of the coating formulation with respect to the liquid solvent, it is meant that the components for a thermodynamically stable mixture when combined with the solvent, have a significant ability to dissolve in that solvent, and do not form precipitates to any significant degree when present in that solvent.

[0055] Representative coating formulations typically incorporate about 50 to about 90, generally about 65 to 85, weight percent liquid carrier (e.g., an aqueous solution such as relatively pure water, or a non-aqueous solution); about 10 to about 50, generally about 15 to about 30, weight percent of the polymeric agent mixture (e.g., the combined weight of the polymeric thickening, low viscosity polymeric, and film-forming polymeric components); based on the total weight of liquid carrier and polymeric agent mixture. Preferably, other optional ingredients, such as the previously described salts, preservatives, sugars, flavoring agents, and the like, typically are incorporated within the coating formulation in total amounts that are less than about 15, and usually less than about 10 weight percent, based on the total weight of the coating formulation prior to use.

[0056] The relative amounts of the various other optional components of the coating formulation can vary. In many preferred embodiments, the combined amounts of ingredients such as flavorings, colorants, preservatives, fillers, and the like, preferably do not exceed about 50 percent, often do not exceed 40 percent, and frequently do not exceed about 30 percent, of the total combined weight of the film-forming agent components and optional components.

[0057] Increasing the filler ($CaCO_3$) content and decreasing the basis weight of the wrapping paper material may reduce per-cigarette carbon monoxide yields. Providing higher diffusion capacities—even without significantly increasing CORESTA values—may also reduce per-cigarette carbon monoxide yields. Net diffusion capacity (the average diffusion capacity of coated/banded and uncoated/unbanded regions) correlates to carbon monoxide yields. In particular, cigarettes using paper with higher net diffusion capacity generally will produce lower carbon monoxide yields.

[0058] Coating formulations, such as the types of water-based coating formulations described hereinbefore, are subjected to drying conditions after those formulations have been applied to the wrapping material, such as a continuous strip of paper web of wrapping material. Preferably, sufficient solvent is removed from the formulation after that formulation has been applied to the wrapping material such that the additive material that remains in contact with the wrapping material does not exhibit a sticky or tacky character or nature. Preferably, sufficient solvent (e.g., water or a non-aqueous solvent) is removed from the formulation after it has been applied to the wrapping material such that the additive material that remains in contact with the wrapping material exhibits a solvent (e.g., moisture) content of less than about 10 percent, more preferably less than about 8 percent, based on the weight of the coating formulation that remains in contact with the wrapping material. Preferably, sufficient solvent (e.g., water or a non-aqueous solvent) is removed from the formulation after that formulation has been applied to the wrapping material such that the formulation that remains in contact with the wrapping material exhibits a solvent (e.g., moisture) content of about 4 percent to about 6 percent, based on the weight of the coating formulation that remains in contact with the wrapping material.

[0059] The amount of coating formulation that is applied to the wrapping material may vary. The coating formulation preferably is applied to the wrapping material such that the dry weight of the additive material on the wrapping material is least about 1 g/m^2, often at least about 2 g/m^2, and frequently at least about 3 g/m^2. The coating formulation may be applied to the wrapping material such that the dry weight of the additive material on the wrapping material is less than about 10 g/m^2, often is less than about 7 g/m^2, and frequently is less than about 4 g/m^2. For example, a paper wrapping material having a dry basis weight of about 25 g/m^2 can be coated with coating formulation and dried to have a resulting overall dry basis weight in the coated regions of about 27 g/m^2 to about 28.5 g/m^2.

[0060] Coated regions of the wrapping material useful as the circumscribing wrapper of tobacco rods for cigarettes are produced using additive materials that are effective in reducing the porosity of the wrapping material in those regions. Film-forming materials coated onto the wrapping material have a tendency to reduce the porosity of the wrapping material. Typical coated regions of the wrapping materials have porosities that can vary. Preferably, the porosities of the coated regions of the wrapping materials are less than about 9 CORESTA, and usually are less than about 8 CORESTA. Preferably, the porosities of the coated regions of the wrapping materials are at least about 0.1 CORESTA, usually are at least about 1 CORESTA unit, and often are at least about 3 CORESTA units. Preferably, the porosities of the coated regions of the wrapping materials, particularly those wrapping materials that are used for the manufacture of cigarettes designed to meet certain cigarette extinction test criteria, are from about 3 CORESTA to about 6 CORESTA.

[0061] The wrapping material can include patterns of predetermined shapes and sizes positioned at predetermined locations, and hence, cigarettes appropriately manufactured from that wrapping material can include coated patterns of predetermined shapes and sizes positioned at predetermined locations on their smokable rods. Representative patterns are set forth in U.S. Pat. Application Pub. Nos. 2005/0016556 to Ashcraft et al.; and 2005/0076929 to Fitzgerald et al. For example, shapes of coated regions, compositions of the coating formulations, or amounts or concentrations of coating materials, can change over the length of the wrapping material. The relative positioning of the printed regions can be selected as desired. For example, wrapping materials that are used for the production of cigarettes designed to meet certain cigarette extinction test criteria, the pattern most preferably has the form of spaced continuous bands that are aligned transversely or cross directionally to the longitudinal axis of the wrapping material. Cross-directional lines or bands that

are essentially perpendicular to the longitudinal axis of the wrapping material preferably extend sufficiently across the wrapping material such that smokable rods manufactured from that wrapping material have bands that completely or nearly completely circumscribe the smokable rods. A cigarette also can be manufactured from a wrapping material including discontinuous bands positioned in a spaced apart relationship. For a wrapping material of such a cigarette, it is most preferred that discontinuous bands (e.g., bands that include a pattern, such as a series of dots, grids or stripes) cover at least about 70 percent of the surface of the band area or region of the wrapping material. A cigarette also can be manufactured from a wrapping material including at least one longitudinally extending stripe, which stripe is provided by a coating formulation, such as a coating formulation of the present invention.

[0062] Preferred wrapping materials include coatings in the form of bands that extend across the wrapping material, generally perpendicular to the longitudinal axis of the wrapping material. The widths of the individual bands can vary, as well as the spacing between those bands. Preferably, those bands have widths of at least about 2 mm, usually at least about 3 mm, frequently at least about 4 mm. However, the bands may have widths of up to about 8 mm. Preferred bands have widths of about 4 mm to about 7 mm, and often have widths of about 6 mm to about 7 mm. Such bands can be spaced apart such that the spacing between the bands (i.e., as measured from the inside adjacent edges of the bands) is at least about 10 mm; but which may be about 15 mm, 20 mm, or 25 mm, in certain instances at least about 30 mm, and on occasion at least about 35 mm; but such spacing preferably does not exceed about 50 mm. For certain preferred wrapping materials, the bands are spaced apart such that the spacing between the bands is about 15 mm to about 25 mm, more preferably about 18 mm to about 24 mm.

[0063] Preferably, the coating formulation has an overall composition, and is applied in a manner and in an amount, such that the physical integrity of the wrapping material is not adversely affected when the coating formulation is applied to selected regions of the wrapping material. It is desirable that the components of the coating formulation applied to wrapping materials not adversely affect to any significant degree (i) the appearance of cigarettes manufactured from those wrapping materials, (ii) the nature or quality of the smoke generated by those cigarettes, (iii) the desirable burn characteristics of those cigarettes, or (iv) the desirable performance characteristics of those cigarettes. Specifically, it is desirable that components of the coating formulation not introduce undesirable sensory characteristics to the smoke generated by a smoke article incorporating a wrapping material treated with that coating formulation. For preferred cigarettes, it is desirable that the coating formulation applied to the wrapping material provide the desirable extinction performance characteristics to the cigarettes manufactured using that wrapping material at relatively low coating or application levels. For example, for cigarettes evaluated for self-extinction properties using the type to test method set forth in ASTM Designation: E 2187-02b using 10 layers of Whatman No. 2 filter paper, extinction criteria most preferably are met for 100 percent of the cigarettes tested when about 2.5 g/m^2 to about 3.5 g/m^2 of preferred dry coating is applied as bands that extend around the cigarette rod and are spaced along the length of the cigarette rod.

[0064] A preferred wrapping material includes a coated region exhibiting a diffusion capacity in that coated region when measured at ambient temperature that is relatively low, but exhibits a diffusion capacity in the coated region—when measured after being subjected to exposure to a temperature significantly above ambient temperature—that is relatively high. For example, ratios of diffusion capacities for a heated coated region to an unheated coated region of a wrapping material (e.g., for a wrapping material heated at about 230° C. for an effective period of time and cooled to ambient for measurement, relative to a wrapping material maintained and measured at ambient temperature) can be greater than about 3:1, and often can be greater than about 5:1. See, U.S. Patent Application Pub. No. 2005/0087202 to Norman et al. and Norman et al., Beitr. Tabakforsch. Int. 21 (2205) 425-434, each of which is incorporated by reference.

[0065] A preferred embodiment of a wrapping material includes one or more bands of a coating formulation of the present invention. When measured at ambient temperature, each portion of the wrapping material that is a coated region or a region occupied by a band of the coating formulation preferably exhibits a diffusion capacity of less than about 0.2 cm/sec, more preferably less than about 0.1 cm/sec, and sometimes less than about 0.09 cm/sec. After being heated substantially above ambient temperature, (preferably at about 230° C.) for about 15 minutes, and cooled to ambient temperature for measurement, each coated region or region occupied by a band of the coating formulation preferably exhibits, for certain preferred formulations, a diffusion capacity of at least about 0.5 cm/sec, and more preferably at least about 0.7 cm/sec.

[0066] A preferred smoking article in the form of cigarette incorporating a tobacco rod manufactured from wrapping material treated with the additive material formulation of the present invention meets extinction criteria while also exhibiting a propensity to avoid self-extinction during normal smoking conditions. That is, a preferred cigarette, while being capable of meeting the certain extinction criteria, does not experience free air self-extinction to a significant degree, and most preferably there is a low rate of occurrence of free air self-extinction. For example, a preferred cigarette generally will not have a tendency to undergo premature extinction, such as when lit cigarettes are held in the smoker's hand or when placed in an ashtray for a brief period of time. Preferred cigarettes may undergo free air self-extinction for less than about 30 percent, preferably for less than about 15 percent, and most preferably for 0 percent, of cigarettes tested. Free air self-extinction with regards to a cigarette having a tobacco rod incorporating a wrapping material including circumscribing bands of additive material relates to those burning cigarette rods that extinguish when left to burn in air (and not in contact with a substrate).

[0067] In one embodiment, a base wrapping material is provided, having an inherent porosity of about 120 CORESTA. A surface of the base wrapping material is treated with an ash conditioner consisting essentially of potassium citrate (and excluding sodium citrate). The potassium citrate is treated so as to be present on a dry weight basis at about 0.4% to about 1%. The diffusion capacity of the treated base paper may be about 1.6 cm/sec to about 2.2 cm/sec, or it may exceed 2.2 cm/sec; it may generally be at least about 1.7 cm/sec, may often be at least about 1.9 cm/sec, may be at least about 2 cm/sec, and may sometimes be at least about 2.1 cm/sec, while it may be provided at about 2.2 cm/sec or more.

Smoking articles constructed with a base wrapping material having these characteristics showed reduced carbon monoxide yields.

[0068] A banded region of the base material may include starch such as, for example, chemically cross-linked, mechanically fragmented starch, applied in a manner configured to provide a desirable self-extinction profile. See, e.g., U.S. Pat. App. Pub. No. 2009/0266371 to Fritzsching. Alternatively, or in addition, it may be configured to include more or different polymeric materials as disclosed herein and/or as otherwise known in the art.

[0069] In one example, a sampling of base wrapping materials was provided, being constructed with wood pulp fiber furnish and calcium carbonate at 30% by weight as a filler with an inherent porosity of about 120 CORESTA (from a range of 118.9 to 127.7; all values in this example being averaged across samples from the materials, with range boundaries being identified). The basis weight of the paper was 26 gsm (no variance across sample range), and it was treated with potassium citrate only as an ash conditioner (excluding sodium citrate). Its average base diffusion capacity was about 1.78 cm/sec (from a range of 1.67 to 1.89 cm/sec). The paper was an FSC paper banded with treated/reduced-diffusion regions that were 6.5 mm wide, spaced apart 18.5 mm, with 26% band coverage (6.5 mm/25 mm) with an average diffusion capacity in the banded regions of about 0.1 cm/sec, where the banding material included starch. Smoking articles constructed with the wrapping material exhibited 100% ASTM SE. Notably, the smoking articles exhibited a reduction in mainstream carbon monoxide averaging 10.5% and a reduction of CO/Nicotine averaging 8.4%, each being measured under the FTC Smoking Regimen conditions (which are no longer designated as such by the FTC).

[0070] Those of skill in the art will appreciate that other embodiments of may be practiced within the scope of the present invention. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, that are intended to define the spirit and scope of this invention.

I claim:

1. A wrapping material for a smoking article, the wrapping material comprising a base sheet and an additive material disposed on at least one major surface thereof in a pattern forming at least one coated region, where the additive material is configured to reduce a porosity of the base sheet, so as to reduce its ignition propensity in the coated region;

wherein the at least one coated region comprises a porosity of less than about 20 CORESTA and a diffusion capacity no greater than about 0.2 cm/sec;

wherein the base sheet comprises a porosity of greater than about 120 CORESTA and a diffusion capacity of at least 1.7 cm/sec; and

wherein the base sheet comprises an ash conditioner.

2. The wrapping material of claim **1** wherein the at least one coated region comprises a porosity of less than about 10 CORESTA.

3. The wrapping material of claim **1** wherein the at least one coated region comprises a porosity of less than about 5 CORESTA.

4. The wrapping material of claim **1** wherein the at least one coated region comprises a diffusion capacity less than about 0.1 cm/sec .

5. The wrapping material of claim **1** wherein the at least one coated region comprises a diffusion capacity less than about 0.09 cm/sec.

6. The wrapping material of claim **1** wherein the base sheet comprises a porosity of greater than about 130 CORESTA.

7. The wrapping material of claim **1** wherein the base sheet comprises a porosity of greater than about 150 CORESTA.

8. The wrapping material of claim **1** wherein the base sheet comprises a porosity of at least about 200 CORESTA.

9. The wrapping material of claim **1** wherein the ash conditioner consists essentially of a non-sodium metal citrate.

10. The wrapping material of claim **1** wherein the ash conditioner consists essentially of potassium citrate.

11. The wrapping material of claim **10**, wherein the potassium citrate is present on a dry weight basis at about 0.4% to about 1%.

12. The wrapping material of claim **1** wherein the base sheet comprises a diffusion capacity of at least about 1.9 cm/sec.

13. The wrapping material of claim **1** wherein the base sheet comprises a diffusion capacity of at least about 2.2 cm/sec.

14. A smoking article comprising the wrapping material of any of claims **1**, **2**, **5**, **7**, **8**, or **10**.

15. A wrapping material for a smoking article, the wrapping material comprising a base sheet and an additive material disposed on at least one major surface thereof in a pattern forming at least one coated region, where the additive material is configured to reduce a porosity of the base sheet, so as to reduce its ignition propensity in the coated region;

wherein the at least one coated region comprises a porosity of less than about 10 CORESTA and a diffusion capacity less than about 0.2 cm/sec;

wherein the base sheet comprises a porosity of greater than about 150 CORESTA and a diffusion capacity of at least 2 cm/sec; and

wherein the base sheet comprises a non-sodium metal citrate ash conditioner.

16. A smoking article comprising the wrapping material of claim **15**.

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