US 20090056729A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2009/0056729 A1**

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(43) **Pub. Date: Mar. 5, 2009**

(54) **SMOKING ARTICLE AND SMOKING ARTICLE FILTER**

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(21) Appl. No.: **12/264,032**

(22) Filed: **Nov. 3, 2008**

Related U.S. Application Data

(62) Division of application No. 10/442,357, filed on May 20, 2003.

Publication Classification

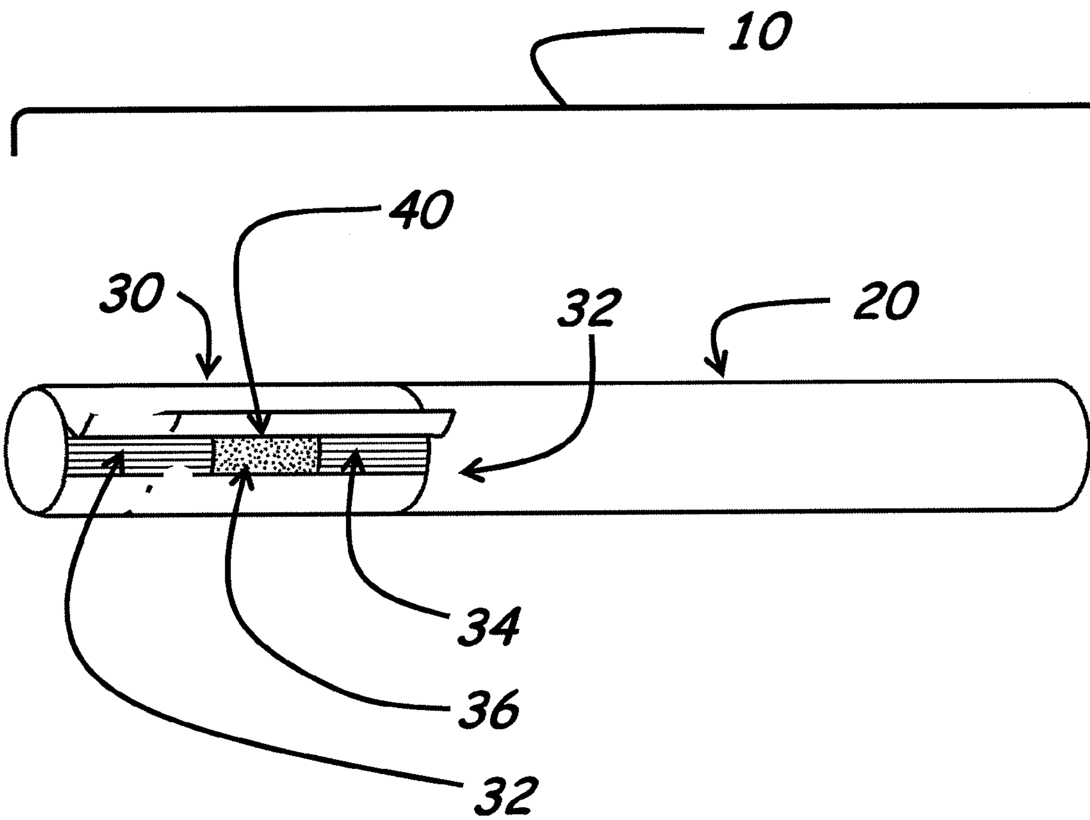
(51) **Int. Cl.**

A24D 3/04	(2006.01)
A24D 3/06	(2006.01)
A24D 3/12	(2006.01)

(52) **U.S. Cl.** **131/332**; 131/339; 131/331; 131/334

(57) **ABSTRACT**

Improved filters useful for tobacco products, such as cigarettes, and novel cigarettes having such filters are disclosed. The filters include adsorbents such as activated carbon which reduce amounts of one or more gas phase constituents of mainstream tobacco smoke. The adsorbents are treated with off-taste suppressants which reduce the off-taste associated with adsorbent containing filters and substantially restore the taste normally associated with tobacco smoke.



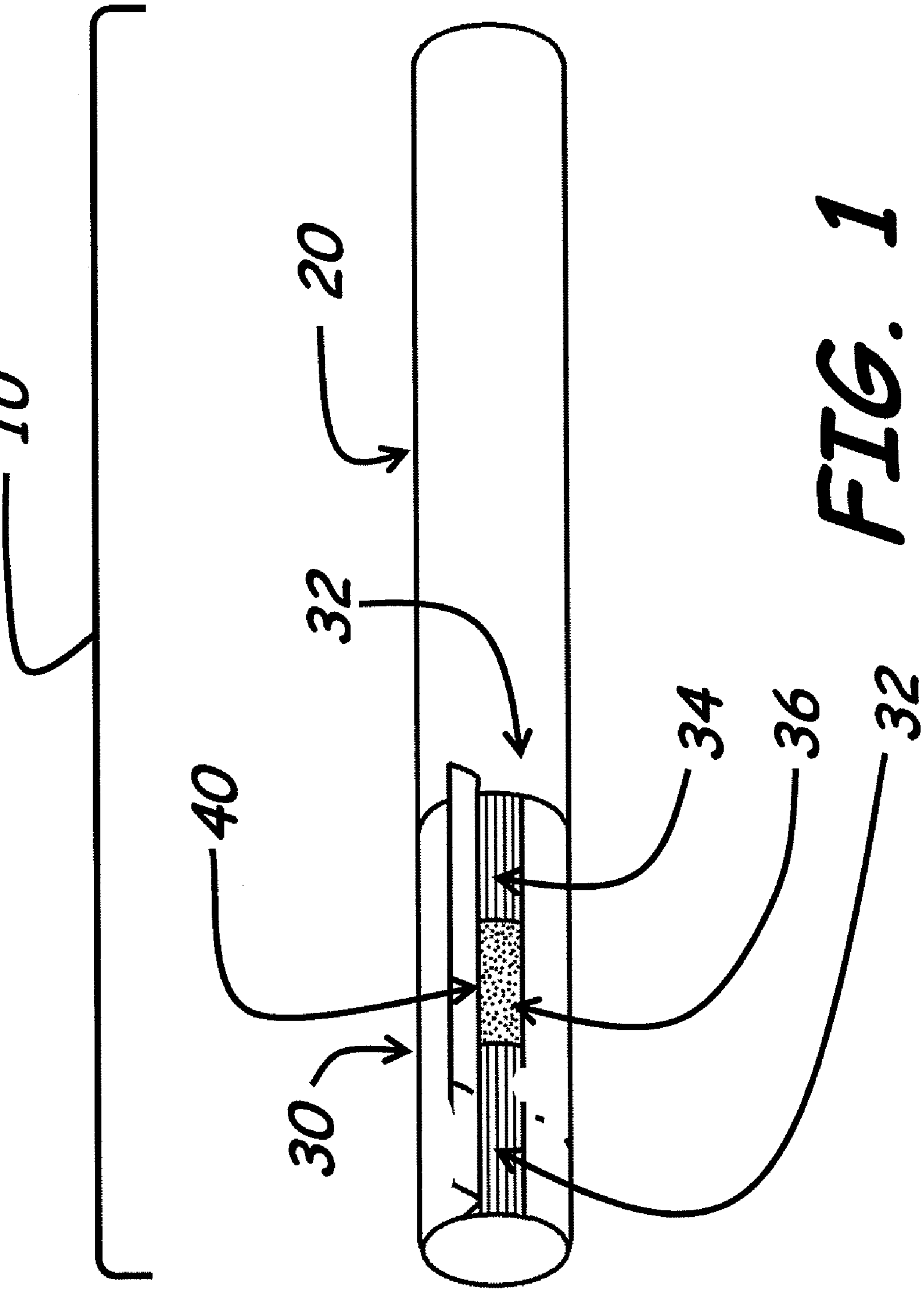


FIG. 1

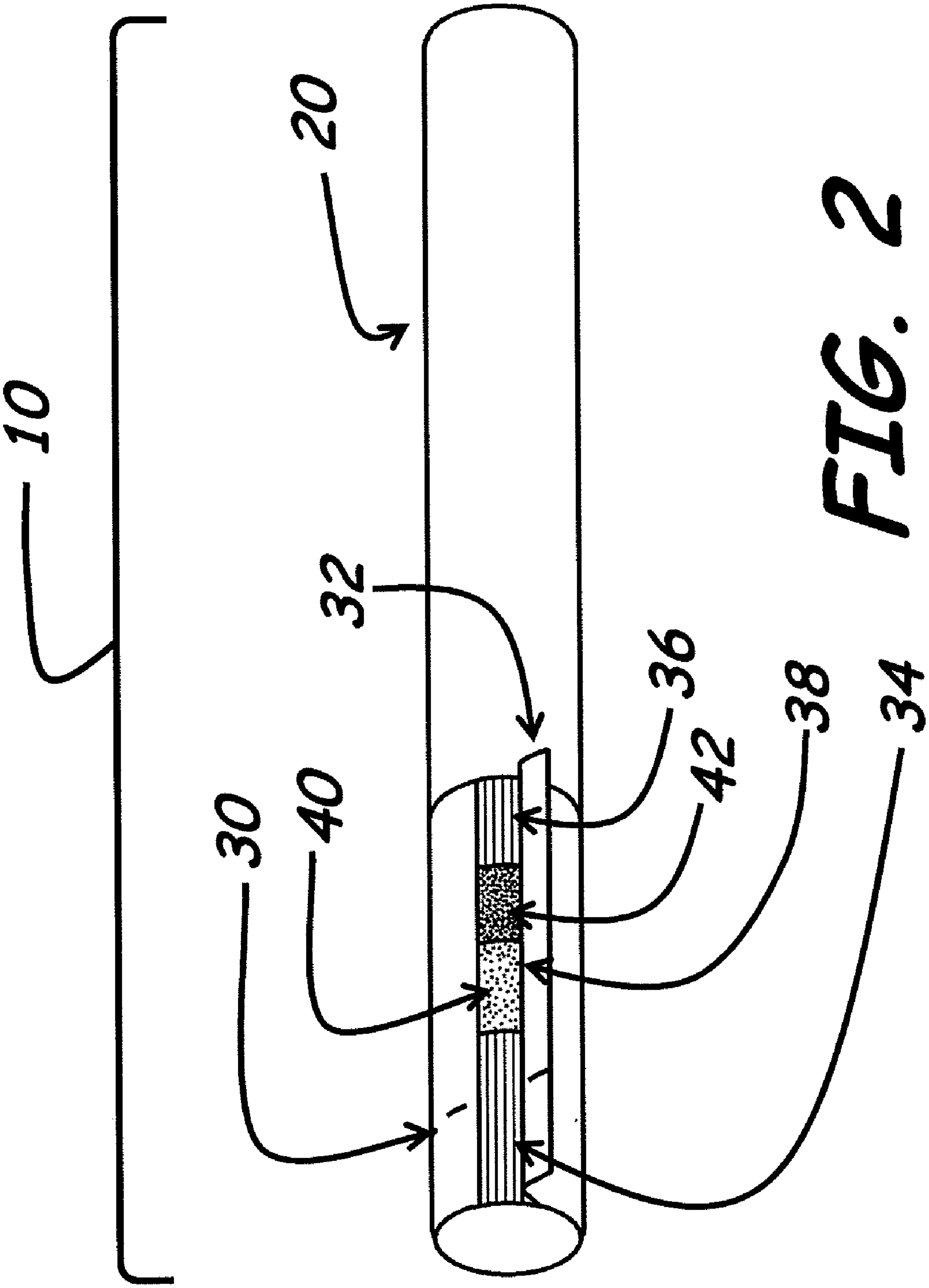


FIG. 2

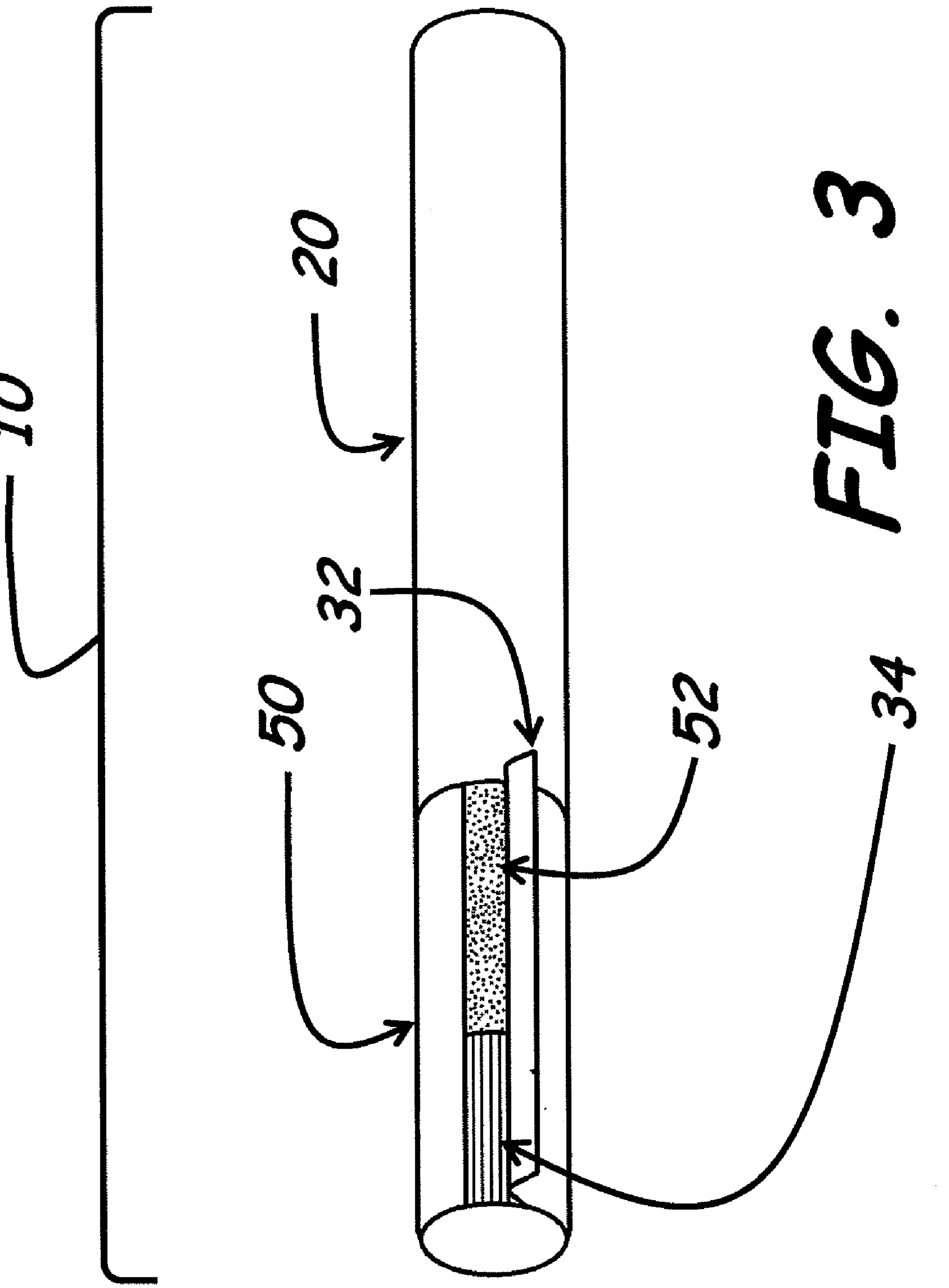


FIG. 3

Figure 4. FRUCTOSE

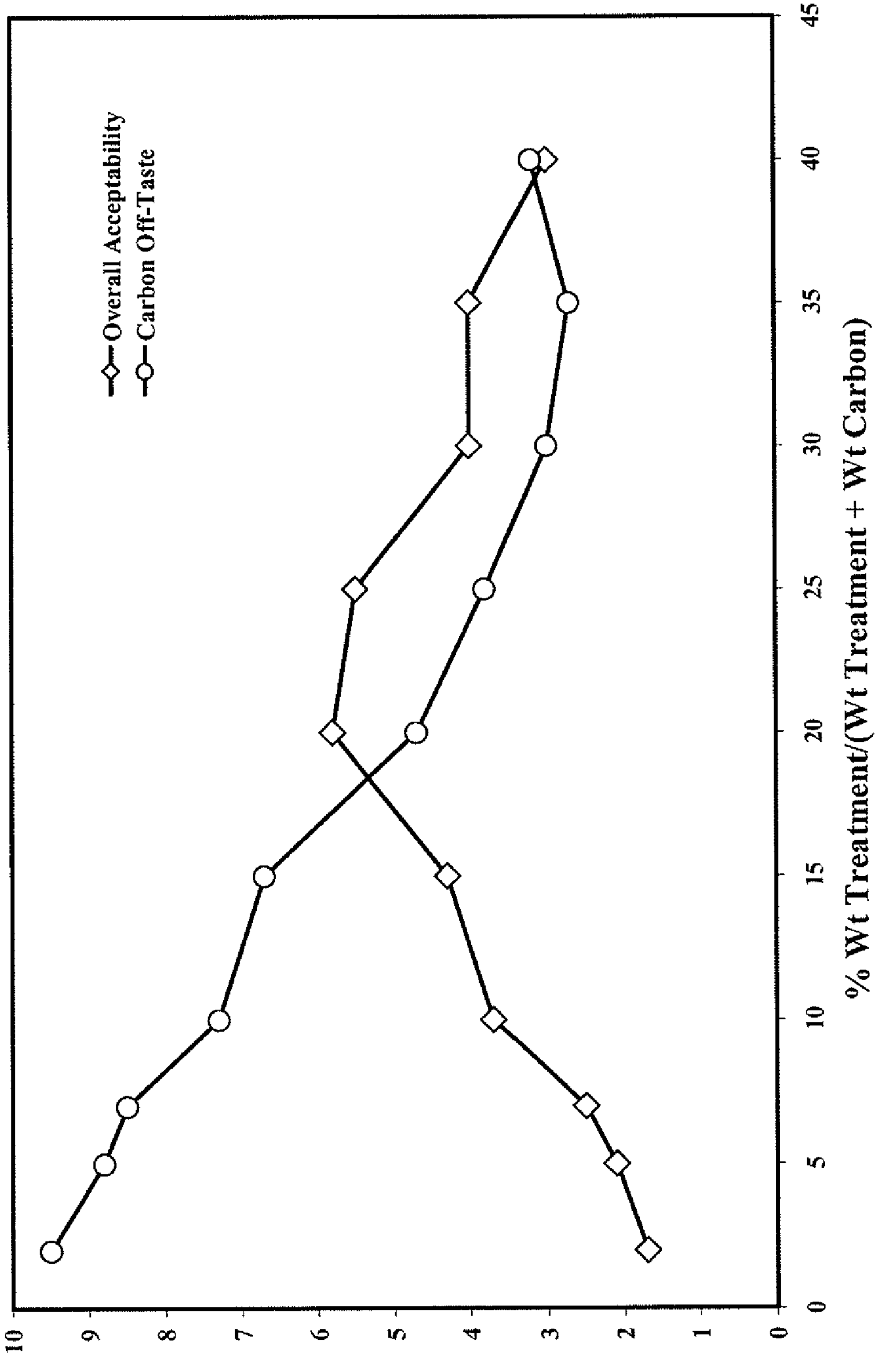


Figure 5. MANNITOL

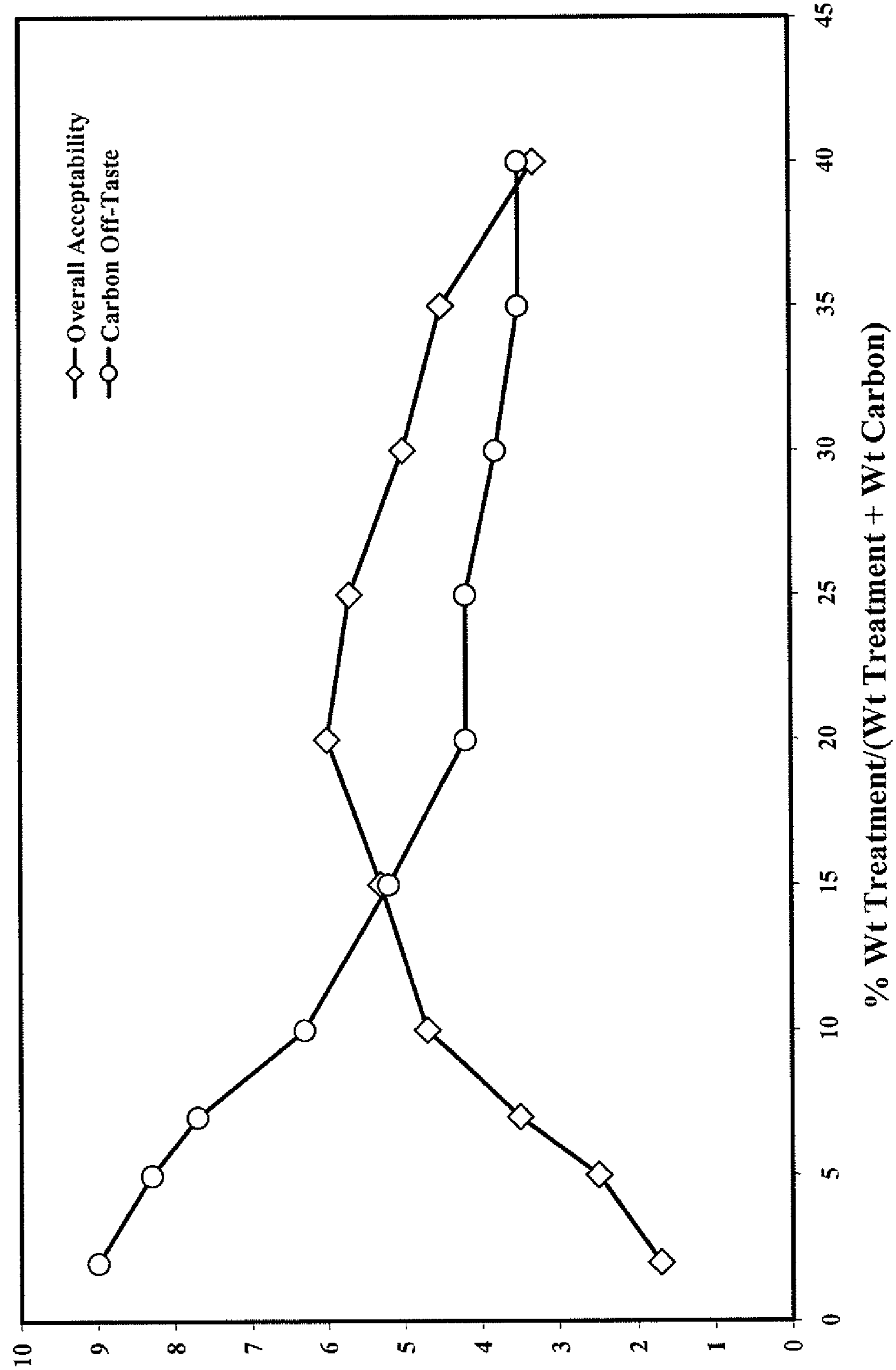


Figure 6. 50:50 MANNITOL:FRUCTOSE

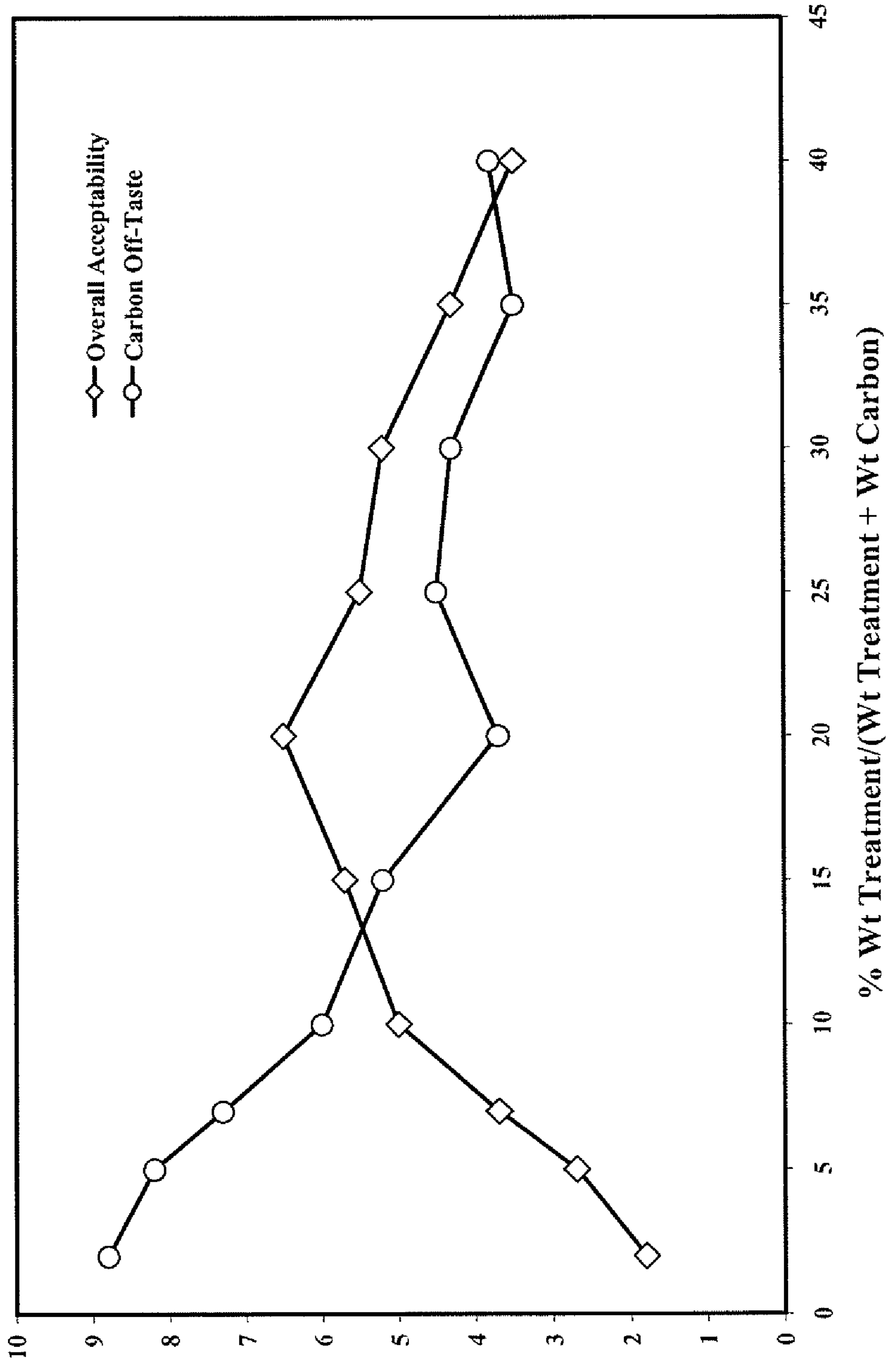
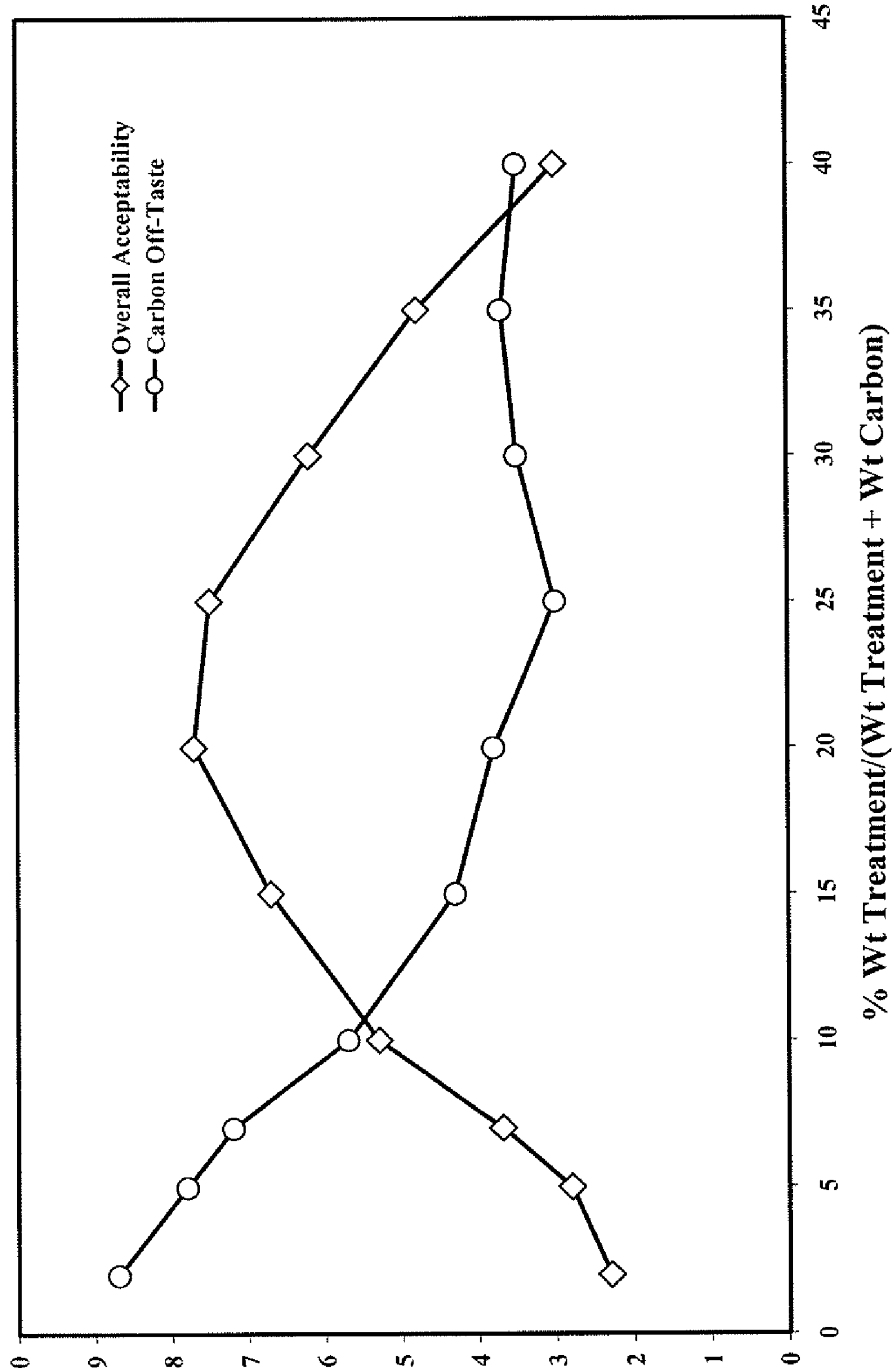


Figure 7. 46:46:8 MANNITOL:FRUCTOSE:SODIUM CHLORIDE



SMOKING ARTICLE AND SMOKING ARTICLE FILTER

[0001] This is a divisional application of U.S. Ser. No. 10/442,357 filed May 20, 2003 to which priority under 35 U.S.C. § 120 is claimed.

FIELD OF THE INVENTION

[0002] The present invention relates generally to improved filters useful for tobacco products, particularly cigarettes, and to novel cigarettes having such filters. More specifically, the invention relates to filters containing adsorbents which reduce one or more allegedly undesirable gas phase constituents normally found in mainstream tobacco cigarette smoke.

BACKGROUND OF THE INVENTION

[0003] Typically, cigarettes are comprised of a paper-wrapped cylindrical rod of cut tobacco filler, alone or combined with other tobacco or non-tobacco substances, and a filter attached at the mouth or buccal end of the rod. On combustion, the smoke passing through the filter, commonly referred to as "mainstream" smoke, contains particulate matter, e.g. tar, and gas or volatile phase constituents. The gas phase of mainstream cigarette smoke contains certain components alleged to be harmful to a smoker, including carbon monoxide, hydrogen cyanide, aldehydes such as formaldehyde, acetaldehyde, acrolein, propionaldehyde and crotonaldehyde, as well as olefinic constituents such as 1,3 butadiene.

[0004] Most commercially available cigarettes have filters which are designed to reduce particulate matter but are ineffective to remove or reduce gas phase constituents of mainstream smoke. Such filters typically include one or more plugs of fiber "tow," commonly cellulose acetate.

[0005] Filters have been designed for the removal of gas-phase constituents along with particulates. These filters usually incorporate an adsorbent material such as activated carbon (also known as "carbon," "charcoal," or "activated charcoal") in a section of the filter. Granular carbon having high surface area is recognized as an effective adsorbent for removing components such as aldehydes from mainstream smoke.

[0006] A variety of approaches to incorporating activated carbon into cigarette filters have been employed. These approaches include carbon granules dispersed within a cellulose acetate tow, paper web or filter plug wrap, sometimes called "dalmation" filters. Another approach is to place a bed or charge of granular carbon into the cavity between two plugs of cellulose acetate tow in a so-called "plug-space-plug" or "triple filter" design. Examples of commercially available filters are Caviflex, Dualcoal, Recessed Dualcoal, Sel-X-4, and Triple Filter from Baumartner Fibertec (Switzerland); Active Acetate Dual, Active Charcoal Triple Solid, Active Myria White, Active Patch Mono, Adsorbent Coated Thread, Triple Granular, and V.P.A. Dual from Filtrona International Incorporated (Milton Keynes, U.K.).

[0007] The commercial acceptance of carbon filters, however, has been limited by the "off-taste" of the mainstream smoke characteristic of such filters. The smoke from carbon-filtered cigarettes is perceived as having a taste that has been described as unpleasant, astringent, bitter and drying. See "What's happening to Charcoal Filters?" *Tobacco Reporter*, Vol. 95, No. 3 (March 1968).

[0008] The art has attempted to address this problem by introducing various flavoring substances ("flavorants") into the mainstream smoke to offset or cover up the carbon off-taste. However, the presence of flavorants tends to reduce the capacity of the adsorbent to remove the undesirable gas phase constituents. Flavorants applied as a coating to an adsorbent reduce its gas removal efficiency by decreasing the number of active sites for adsorption. It is known that flavorants in the tobacco or elsewhere in the cigarette package tend to vaporize and migrate to the activated carbon over time where they are adsorbed and thus deactivate the sites onto which they are adsorbed. For that reason, mentholated cigarettes having carbon filters require higher amounts of menthol to be added during manufacture to offset adsorption by the carbon.

[0009] Thus, there is a continuing need for a cigarette filter that significantly reduces the quantity of gas phase constituents in mainstream smoke without introducing unacceptable off-taste normally associated with the activity of gas phase adsorbents such as carbon. Further, there is a need for a carbon filter cigarette that tastes substantially like a non-carbon filter cigarette.

[0010] It is therefore an object of the present invention to provide filters for smoking articles, particularly tobacco cigarettes, that reduce quantities of one or more allegedly undesirable gas phase constituents normally found in mainstream smoke.

[0011] It is another object of the present invention to provide cigarettes having filters which utilize adsorbents, particularly activated carbon, to reduce gas phase constituents without introducing unacceptable off-taste such as normally results from use of such adsorbents.

[0012] It is a further object of the present invention to provide a carbon filter cigarette which tastes substantially like a non-carbon filter cigarette.

SUMMARY OF THE INVENTION

[0013] The foregoing and other objectives are achieved according to the invention by providing a filter containing a suitable amount of an adsorbent, preferably activated carbon, and an off-taste suppressant in association with the adsorbent. The adsorbent is capable of trapping and thereby reducing the amount of at least one allegedly undesirable gas phase constituent of mainstream smoke. The off-taste suppressant significantly reduces the characteristic off-taste stemming from the activity of the adsorbent. The composition and amount of off-taste suppressant applied to the adsorbent should be selected to maximize gas phase removal while at the same time minimizing, preferably substantially eliminating, off-taste stemming from adsorbent activity.

[0014] In a preferred embodiment of the invention, the smoking article is a tobacco cigarette having a filter that contains an activated carbon adsorbent for at least one gas-phase constituent of mainstream smoke, which has applied thereto a suitable amount of an off-taste suppressant selected from the group of molecules having B, X-B, AH-B, or AH-X-B moieties as defined by the "AH-B Theory" of sweetness discussed below in the Detailed Description of the Invention. These molecules include, but are not limited to, polyols, glycols, sugars, sugar-alcohols, oligosaccharides, polysaccharides, amino acids, amino acid derivatives, di- and tri-peptides, polypeptides, artificial sweeteners, and mixtures thereof. The off-taste suppressant preferably also includes an alkali metal or alkaline earth metal salt. The compositions and weight ranges for the off-taste suppressants applied to the adsorbent can be selected to maximize gas removal and reduction of off-taste, preferably without introducing additional foreign flavoring to the mainstream smoke so that the cigarette tastes substantially like filtered cigarette.

[0015] One example of a useful off-taste suppressant is a combination of fructose and mannitol, preferably in about a

50:50 ratio by weight. A more preferred off-taste suppressant is a combination of fructose, mannitol and sodium chloride in a ratio of about 46:46:8 by weight. It has been found that such a composition when applied to a bed of activated carbon in a range of about 2 to 40 percent by weight to the total weight of the carbon and off-taste suppressant, preferably in a range of about 5 to about 20-25 percent by weight, is particularly useful in achieving the objectives of the invention.

[0016] According to another aspect of the invention the filter may also include a chemisorbent for one or more of the allegedly undesirable gas phase constituents, preferably in admixture with the adsorbent. Preferred chemisorbents are amine derivatives of polystyrene. Admixtures of activated carbon and ion exchange resins such as polystyrene derivatives in a weight ratio of from about 25:75 to about 50:50 treated carbon to resin are particularly useful in the practice of the invention, although other ratios may be used.

[0017] The filters of the present invention are capable of reducing one or more of the allegedly undesirable volatile components of mainstream cigarette smoke including, but not limited to, aldehydes such as formaldehyde, acetaldehyde, acrolein, propionaldehyde and crotonaldehyde.

[0018] These and other aspects of the present invention will become apparent to those skilled in the art after a reading of the following detailed description of the invention, including the illustrative embodiments and examples.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The drawings are for the purpose of illustrating the invention and are not intended to be limiting.

[0020] FIG. **1** is a perspective view of one tobacco cigarette embodiment of the invention having a triple, plug-space-plug design;

[0021] FIG. **2** is a perspective view of another tobacco cigarette embodiment of the invention having a four-component filter design;

[0022] FIG. **3** is a perspective view of still another tobacco cigarette embodiment of the invention having a two-component filter;

[0023] FIG. **4** is a graph of off-taste reductions and overall acceptability provided by the samples of Example 11 using the data from Table 19;

[0024] FIG. **5** is a graph of off-taste reductions and overall acceptability provided by the samples of Example 12 using the data from Table 21;

[0025] FIG. **6** is a graph of off-taste reductions and overall acceptability provided by the samples of Example 13 using the data from Table 23;

[0026] FIG. **7** is a graph of off-taste reductions and overall acceptability of the samples of Example 15 using the data from Table 27.

DETAILED DESCRIPTION OF THE INVENTION

[0027] As used herein, the terms "adsorbent" and "chemisorbent" are intended to have their ordinary and accustomed meanings in the art, but should not be construed as limiting the invention to any particular mode of action by which gas-phase constituents in mainstream smoke are reduced. For instance, in accordance with the ordinary and accustomed nomenclature in the art, activated carbon is referred to herein as an "adsorbent," but activated carbons which reduce gas phase constituents by adsorption, absorption, chemisorption, or otherwise are contemplated as being within the scope of the invention. Similarly, in accordance with the ordinary and accustomed nomenclature in the art, ion-exchange resins are referred to herein as "chemisorbents," but resins which reduce gas phase constituents by adsorption, absorption, chemisorption, or otherwise are contemplated as being within the scope of the invention.

[0028] As used herein, the term "off-taste" refers to a taste not characteristic of the smoking article. More particularly, in the context of the present invention, "off-taste" refers to a taste typically associated with smoke that, after passing through an adsorbent such as activated carbon, has been described as unpleasant, astringent, bitter and drying. The term "off-taste suppressant" as used herein refers to a substance that reduces the perception of off-taste by a smoker.

[0029] Without wishing to be bound by any theory, it is believed that carbon off-taste arises as a result of the altered organoleptic profile of mainstream smoke produced by the adsorption of gas-phase constituents by activated carbon. The altered profile of the mainstream smoke is believed to produce bitter flavor "notes" that are not normally associated with tobacco smoke.

[0030] When reference is made to reduction or suppression of off-taste perceived by a smoker, it will be understood by those skilled in the art that the "smoker" may range from a professional smoker employed in tobacco smoking panels having acute taste perceptibility to the lay smoker whose taste sensations may be less acute. Both types of smokers can detect the difference in taste of cigarettes of this invention which have been treated with off-taste suppressants from those which have not.

[0031] Activated carbon is the preferred adsorbent. It is contemplated, however, that any adsorbent material capable of removing gas-phase constituents of mainstream smoke may be used in the practice of the invention. Some examples are charred polymers, engineered polymers, alumina, silica, clay and zeolites.

[0032] Any activated carbon material may be used in the practice of the invention, including but not limited to carbon materials derived from coal, tobacco material, peat, wood pulp, coconut hulls, kapok fibers, cotton fibers, cotton linters, and the like. Activated carbon materials of any degree of activation (surface area) may be used according to the present invention. Preferably, the activated carbon materials will have a degree of activation so as to provide about 10 to about 50 weight percent butane pickup (corresponding to about 25 to about 125 weight percent pickup of carbon tetrachloride). More preferably, the activated carbon material will provide about 60 weight percent pickup of carbon tetrachloride. Any mesh size activated carbon is useful in the practice of the invention. However, larger mesh size activated carbons may provide advantages during the manufacture of the cigarette. Preferred activated carbons are granular coconut carbons with a mesh size of about 18×40 U.S such as coconut hull based carbons available from Calgon Corp. as PCB, PCGB and GRC-11 and those available from PICA USA (Columbus, Ohio) as G278.

[0033] Applicants have surprisingly found that off-taste suppressants of the present invention can, when used in critical amounts, substantially reduce the off-taste associated with carbon-containing cigarette filters without introducing any significant additional foreign flavoring to the mainstream smoke so that the cigarette has substantially the same taste as a non-carbon filter cigarette. In other words, the off-taste suppressants of this invention can substantially restore to the smoker the taste normally associated with tobacco products which do not have carbon containing filters.

[0034] Without wishing to be bound by any theory, it is believed that the "off-taste" suppressants of the present invention function by interacting with taste receptors on the tongue. Like most biological processes, taste results from complex interactions of one or more compounds with a receptor. Since taste receptors are capable of recognizing both sweet and bitter tastes, the interaction between different compounds can markedly alter or suppress the taste associated with either compound alone.

[0035] Compounds eliciting a sweet taste are believed to share similar structural characteristics as described by the "AH-B Theory" of sweetness. See Shallenberger, R. S. and Acree, T. E., "Molecular Theory of Sweet Taste," *Nature* (London) 216(5114), p. 480 (1967). Specifically, sweet compounds have a proton donor moiety comprising an electronegative atom, such as an oxygen or nitrogen, with an attached hydrogen. In the "AH-B Theory" of taste perception, "A" represents the electronegative atom. Accordingly, the proton donor moiety can be described as "AH" where "H" represents a hydrogen atom. Examples of AH proton donors include hydroxyl groups, imines, amines, and methine groups. According to the "AH-B Theory," a sweet compounds also has an electronegative center (i.e., a proton acceptor) located about 3 Å from the hydrogen of the AH group. The electronegative center is represented by "B" in this theory and can be, for example, an oxygen atom or a nitrogen atom. The portion of a compound primarily responsible for producing sweetness (the "glucophore") is represented as AH-B.

[0036] The taste receptors in the human tongue are comprised of proteins. It has been theorized that these proteins are held together by intermolecular hydrogen bonds between the carboxylate group of glutamate (or aspartate) and the epsilon-NH_3^+ of lysine. See Acree, T. E. "A Molecular Theory of Sweet Taste—Amino Acids and Peptides," *Proceedings of Joint Symposium on Carbohydrate/Protein Interactions*, Excelsior Springs, Mo., Carbohydrate/Oilseeds Division, American Association of Cereal Chemists (1970). The carbonyl oxygen of the carboxylate and the protons of the NH_3^+ group are about 3 Å apart and are ideally situated to serve as the receptor for an AH-B glucophore through complimentary hydrogen bonding.

[0037] An additional component to molecular sweetness was identified subsequent to the development of "AH-B Theory." It is believed that lipophilic (hydrophobic) regions of a compound, if located at a specific point in space in relation to the AH-B moiety, may contribute to sweetness through interactions with hydrophobic regions of the receptor. See R. Shallenberger and M. Lindley, "A Lipophilic-Hydrophobic Component in the Stereochemistry of Sweetness," *Food Chem*., vol. 2, 145-153, (1977). Thus, it is theorized that there may be a tripartite interaction with taste receptors of the form "AH-X-B" where "X" designates a lipophilic region of a sweet compound. The lipophilic region "X", may function to increase the lipoid solubility of the compound in the receptor site to produce more intense or prolonged sweetness. Additionally, the lipophilic site X may serve to direct that portion of a sweet molecule representing AH-B into the proper orientation within the receptor.

[0038] More recently, it was discovered that sweetness can be produced by the interaction of more than one molecule with taste receptors if the AH, B, and X components are provided separately by the multiple molecules. See I. Shinoda and H. Okai, "Sweetness and Bitterness Contributions of Structural Units of Aspartame and Some Analogues," *J. Agric. Food Chem*., vol. 33, pp. 792-795 (1985). In the study by Shinoda and Okai, it was found that bitter taste is produced by molecules which have AH-X moieties but lack B moieties. When compounds having B moieties are added to the tongue following the addition of bitter AH-X compounds, the bitter taste associated with the AH-X compound is converted to sweet taste. Further, addition of compounds having X-B components to the tongue following the addition of bitter AH-X compounds results in elimination of the bitter taste.

[0039] Accordingly, in one aspect of the invention, the off-taste suppressants are compounds that possess B or X-B moieties, either alone or as part of AH-B and AH-X-B glucophores. In the case of AH-B and AH-X-B glucophores, it is believed that only the B or X-B units of these compounds combine with bitter AH-X compounds in the taste receptors to eliminate or modify the bitter taste associated therewith.

[0040] Non-limiting examples of AH-X-B and AH-B agents include polyols, glycols, sugars, sugar-alcohols, oligosaccharides, polysaccharides, amino acids, amino acid derivatives, di- and tri-peptides, polypeptides, artificial sweeteners, and mixtures thereof. Polyols include, for example, glycerol and propylene glycol. Polysaccharides include cyclodextrins, dextrin, hydrogenated oligosaccharides, hydrogenated starch hydrolysates, polydextrose, and maltodextrin. Sugar alcohols include, for example, erythritol, inositol, sorbitol, sorbose, mannitol, and xylitol. Sugars include, for example, corn syrup, sucrose, fructose, glucose, and honey. Amino acids and amino acid derivatives include, for example, glycine and preferred artificial sweeteners include aspartame.

[0041] Non-limiting examples of X-B and B agents include amides, alcohol derivatives, esters, and lactones. Amides include, for example, capsaicin and botanical extracts. Alcohol derivatives include, for example, benzyl alcohol, gingerol, guaicol, santalol, linalool and botanical extracts containing the said alcohol derivatives. Esters include, for example, ethyl propionate. Lactones include, for example, gamma-heptalactone.

[0042] It has been found that a mixture of mannitol and fructose, preferably in a weight ratio in the range of about 1:3 to about 3:1, more preferably in about a 1:1 weight ratio, is particularly effective as an off-taste suppressant for activated carbon.

[0043] Off-taste suppressants of the invention may include salts that function to suppress perception of bitter tastes, which can be used alone or, preferably, in combination with one or more AH-X-B, AH-B, X-B or B agents. Non-limiting examples of salt off-taste suppressants include alkali metal salts and alkaline earth metal salts such as sodium salts and lithium salts. Sodium chloride, sodium gluconate, monosodium glutamate, and the sodium salt of glycine are example of sodium salts that may be used according to the present invention. Preferred salt off-taste suppressants are the sodium halide salts. Sodium chloride is the most preferred salt off-taste suppressant.

[0044] Preferably, the salt suppresses off-taste without imparting a perceptible salty taste to mainstream smoke. To this end, the salt may constitute from about 0.1 to about 5 percent, and more preferably about 1 percent, of the total weight of the activated carbon and off-taste suppressant.

[0045] The optimal amount of off-taste suppressant for any given amount of adsorbent may vary greatly depending on a number of factors, including the nature and structure of the adsorbent, the composition of the off-taste suppressant and consumer preferences. The off-taste suppressant should be present in amounts sufficient to significantly suppress, and preferably substantially eliminate, adsorbent off-taste. At the higher end of the range, the weight percent of off-taste suppressant applied to the adsorbent should be selected to retain enough active carbon sites to achieve the desired reduction of undesirable gas-phase constituents, preferably without introducing additional flavor notes to the mainstream smoke so that the original taste of the smoking article is substantially restored. It will be recognized that one skilled in the art will be able to optimize the weight percentages for any given off-taste suppressant based on balancing these objectives.

[0046] Referring to the embodiment of FIG. **1**, a cigarette **10** having a tobacco rod **20** is provided with a filter **30** that can be secured to tobacco rod **20** by tipping paper, not shown. In the embodiment of FIG. **1**, filter **30** is of the so-called plug-space-plug or triple filter type. A first particulate filter component **34** at the buccal end of the filter and a second particulate filter component **36** abutting the tobacco rod **20** are spaced apart to form a filter cavity **38** therebetween. Filter cavity **38** contains a gas phase filtering material **40** which, according to the invention, includes an adsorbent having an off-taste suppressant applied thereto. The triple filter including all three components is circumscribed by a conventional paper wrapper **32**. Cigarette **10** may be any length, including but not limited to, 80 mm, 84 mm, and 99 mm.

[0047] Ventilation may be provided by one or more circumferential rows of perforations, not shown, through the tipping paper. The perforations may be located between the upstream and downstream ends of the filter cavity **38** containing the adsorbent **40**. As is well-known, ventilation reduces the amount of mainstream smoke reaching the smoker through dilution by ambient air and also tends to increase filtration efficiency by decreasing the velocity of mainstream smoke upstream of the perforations and thereby increasing its residence time in the filter.

[0048] Filter components **34** and **36** may be formed from any media capable of filtering particulates from the mainstream smoke. Non-limiting examples of suitable media include webbed or fibrous polyolefins and cellulosics. Cellulosics may include paper and cellulose acetate fiber. Preferably, filter components **34** and **36** are plugs of cellulose acetate tow well known in the art. Filter components **34** and **36** may contain a plasticizer such as triacetin for binding the fibers together. The plasticizer may have an affinity for particulate matter and further contribute to the efficiency of the tow for reducing particulate matter in the mainstream smoke. The use of plasticizers, particularly triacetin, as a binder in filter tows is well known in the art.

[0049] In a preferred embodiment, cigarette **10** is 84 mm long and downstream tow **34** is 10 mm in length. The cavity **38** formed between tows **34** and **36** ranges from about 3 mm to about 8 mm in length, and is preferably between about 5 nun and about 6 mm in length. In an embodiment where cavity **38** is 5 mm in length, the upstream tow **36** is 10 nun in length. In another embodiment, cavity **38** is 6 mm in length and upstream tow **36** is 9 mm in length. Ventilation is provided in filter cavity **38** by perforations located 14.5 mm from the buccal end of downstream tow **34**.

[0050] In another preferred embodiment, cigarette **10** is 99 mm long and downstream tow **34** is 10 mm in length. The cavity **38** formed between tows **34** and **36** ranges from about 3 mm to about 8 mm in length, and is preferably between about 5 nun and about 6 mm in length. In an embodiment where cavity **38** is 5 nun in length, the upstream tow **36** is 12 mm in length. In another embodiment, cavity **38** is 6 mm in length and upstream tow **36** is 11 nun in length. Ventilation is provided in filter cavity **38** by perforations located 14.5 mm from the buccal end of downstream tow **34**.

[0051] In accordance with another aspect of the invention, it is contemplated that chemisorbents may be used in conjunction with adsorbents treated with off-taste suppressant to provide filters having enhanced gas reduction capability. Chemisorbents include, but are not limited to, ion exchange resins, preferably selected from polystyrenes and derivatives thereof. Preferred ion exchange resins are macroporous beads functionalized with primary amine groups such as Purolite A-143 and Purolite A-109. Polyamine functionalized beads such as Rohm & Haas Amberlite IRA-95, and weak base functionalized beads such as Rohm & Haas Duolite A-7 may also be used. The most preferred ion exchange resin is Purolite A-109, which is a primary amine functionalized polystyrene crosslinked with divinylbenzene in the form of macroporous spherical beads.

[0052] The amount of adsorbent should be selected to achieve the most effective gas phase reduction within the limits of the smoking article. In the embodiment of FIG. **1**, it is preferred that the cavity **38** is completely filled with gas phase filtering material **40**. More preferably, cavity **38** is filled with about 150 mg of activated carbon in embodiments having a 6 mm filter cavity and 125 mg in embodiments having a 5 mm cavity.

[0053] In the triple filter embodiment of FIG. **1**, the chemisorbent may be present in filter cavity **38** in admixture with the adsorbent. When present, the chemisorbent is preferably in about a 25:75 to 75:25 wt./wt. admixture with the adsorbent.

[0054] When the adsorbent is present in admixture with a chemisorbent material, there will be significantly less adsorbent present for the same size cavity. For example, a gas phase filtering material comprising 25 weight % treated activated carbon and 75 weight % ion exchange resin filling a 6 mm cavity may only contain about 10 to about 31 mg of activated carbon due to the much lower density of the resin. Similarly, a 5 mm cavity filled with gas phase filtering material comprising 25 weight % treated activated carbon and 75 weight % ion exchange resin may only contain about 8 to about 27 mg of activated carbon.

[0055] Although ion exchange resins themselves have an undesirable characteristic off-taste, it has surprisingly been discovered that smoking articles having filters of the present invention which include ion exchange resins have substantially reduced resin off-taste. It is believed that certain volatile components of the ion exchange resin which produce the characteristic off-taste, such as monomers and solvents, are adsorbed by the activated carbon and thus removed from the mainstream smoke. For this reason, in embodiments where the ion exchange resin is separately positioned from and not in admixture with the adsorbent, it is desirable to position the adsorbent downstream of the resin. Such an embodiment is depicted in FIG. **2**. In FIG. **2**, the adsorbent treated with off-taste suppressant **40** is downstream of the chemisorbent **42**. The chemisorbent may be disposed in a cavity, as in the FIG. **2** embodiment, or may be present as a dispersion in a fibrous tow to form a "dalmation" filter component.

[0056] A variety of methods may be employed to apply the off-taste suppressants to the adsorbent such as activated carbon. In one method, an aqueous or ethanolic solution of the off-taste suppressant is added to the activated carbon followed by evaporation with optional heating. In a second, preferred method, an aqueous solution of the off-taste suppressant is sprayed onto activated carbon without a further drying step. A baffle mixer operating between about 150-165° C. with about 30-60 minute impregnation cycles may by used to coat about 400-1000 pounds of activated carbon with off-taste suppressant. Advantageously, it has been found that lesser quantities of off-taste suppressant may be used to suppress carbon off-taste with this method of application as compared to the evaporation technique. It has been found that the moisture from the off-taste suppressant can be used advantageously to both minimize static buildup during cigarette manufacture and pre-equilibrate the moisture in the activated carbon and tobacco rod.

[0057] A preferred embodiment of the invention employs a triple, plug-space-plug filter as in FIG. **1**, having a 6 mm cavity filled with an admixture of 18×40 U.S. mesh granular coconut activated carbon (PICA, USA) and ion exchange resin A109 (Purolite USA). The activated carbon is treated with an off-taste suppressant composition consisting of a 46:46:8 wt. % mixture of mannitol, fructose, and sodium chloride by a baffle spray coating technique. The off-taste suppressant composition is present on the carbon at 11 weight percent of the total weight of activated carbon and off-taste suppressant. The admixture of treated activated carbon and ion exchange resin consists of about 25 weight % treated activated carbon and about 75 weight % resin. When cavity **38** is 5 mm in length and fully charged with the admixture, there will be about 8 to about 27 mg of treated carbon and about 35 to about 60 mg of resin present. When cavity **38** is 6 mm in length and fully charged with the admixture, there will be about 10 to about 31 mg of treated carbon and about 43 to about 70 mg of resin present. In another preferred embodiment, the admixture of treated activated carbon and ion exchange resin consists of about 50 weight % treated activated carbon and about 50 weight % resin. When cavity **38** is 5 mm in length and fully charged with this admixture, there will be about 19 to about 66 mg of treated carbon and about 23 to about 54 mg of resin present. When cavity **38** is 6 mm in length and fully charged with this admixture, there will be about 23 to about 78 mg of treated carbon and about 28 to about 64 mg of resin present in this embodiment. In both embodiments, a 10 mm long conventional plug of fiber tow is located at the buccal end of the filter and a row of ventilation openings in the tipping paper encircle the filter about 14½ mm from its buccal end.

[0058] It is to be understood that the invention may be used in flavored smoking articles. The preferred flavoring agent is menthol. When flavored cigarettes are desired, flavoring agents may be incorporated into, for example, the tobacco, wrapping paper, plug wrap, and filter tows. In the preferred practice of the invention, no flavoring agents are added to the filter tows.

[0059] When flavored cigarettes are desired, flavoring agents may be incorporated into, for example, the tobacco, wrapping paper, plug wrap, and filter tows. In the preferred practice of the invention, no flavoring agents are added to the filter tows.

[0060] Any smokeable material may be used with the present invention. Examples of suitable smokeable tobacco materials include, but are not limited to, flue-cured, Burley, Turkish, expanded tobacco, and reconstituted tobacco. Other tobacco materials suitable for use in the present invention are described in U.S. Pat. No. 5,404,890 (Gentry et. al.) which is hereby incorporated by reference. A preferred tobacco is low tobacco-specific nitrosoamine (TSNA) tobacco.

[0061] The wrapping papers and tipping papers used in the practice of the invention may be any of the papers known in the art, including low-sidestream paper and reduced ignition propensity paper such as those disclosed in U.S. Patent Application Pub. Nos. 20020074010 (Snaidr et al), 20020129824 (Hammersmith et al.), 20020139381 (Peterson et al.), 20020179105 (Zawadzki et al), 20020179106 (Zawadzki et al.), and 20020185143 (Crooks et al.) and U.S. Pat. Nos. 5,271,419 (Arzonico et al.), 5,878,753 (Peterson et al), 5,878,754 (Peterson et al), 6,129,087 (Wallace et al.), and 6,371,127 (Snaidr et al.), which are hereby incorporated by reference.

[0062] Advantageously, it has been found that the filters of the present invention provide the additional benefit of increasing the "freshness" of cigarettes. It is postulated that tobacco loses moisture over time, resulting in increased release of gas phase components such as aldehydes, imparting a stale, harsh, or bitter taste to mainstream smoke. See U.S. Pat. No. 2,063,014 (Allen). Prior approaches to overcoming the undesirable taste associated with tobacco that has been stored for long periods of time involve covering-up the undesirable taste with flavoring agents. See, U.S. Pat. No. 3,144,024 (Eichwald et al.). In contrast, the filters of the present invention are capable of removing gas phase constituents of mainstream smoke, thereby diminishing the undesirable organoleptic perception of aged tobacco without the addition of flavoring agents. Accordingly, the cigarettes of the present invention may have an increased shelf life.

[0063] FIG. **3** illustrates another embodiment of the invention. In addition to the conventional buccal end particulate filter component **34**, which may be a plug of fiber tow, filter **50** has a "dalmation" filter component **52**. Dalmation filter component **52** is a conventional plug of particulate filter material impregnated with a gas-phase adsorbent, preferably activated carbon granules, to which off-taste suppressant according to the invention has been applied. For example, activated carbon granules may be dispersed within a cellulose acetate tow or a paper filter material, as described in U.S. Pat. Nos. 6,257,242 B1 (Stavridis), 5,622,190 (Arterbery et al.), 5,568,819 (Gentry et al.), 3,101,723 (Seligman et al.), which are hereby incorporated by reference.

[0064] The present invention is not limited to the filter designs described above. It is contemplated that other filter arrangements are suitable for use with the present invention, including but not limited to those described in European Patent Application No. 579,410 and U.S. Pat. Nos. 5,568,819 (Gentry et al.), 5,365,951 (Arterbery et al.), 5,067,499 (Banerjee et al.), 4,881,556 (Clearman et al.), 4,357,950 (Berger et al.), 3,894,545 (Crellin et al.), which are hereby incorporated by reference. It will be appreciated by one skilled in the art that certain modifications and variations of the above described embodiments are within the scope of the invention.

[0065] The following non-limiting examples are provided to illustrate usage of the invention.

EXAMPLES 1-10

[0066] In Examples 1-7 and 10, the lengths of the filter cavities provided are estimated based on the approximate density of the treated activated carbon samples. In a fully loaded condition there will be approximately 25 mg of treated activated carbon per millimeter of cavity length.

[0067] Cigarettes designated as ventilated in the following Examples contained a circumferential row of perforations somewhere along the length of the filter cavity between its upstream and downstream ends.

Example 1

[0068] Activated coconut carbon was treated with various materials as listed in Table 1. For all samples listed in this example, PCB (20×50 mesh) activated coconut carbon supplied by Calgon Carbon Corporation (Pittsburgh, Pa.) was used.

TABLE 1

Material #	Treatment	Source **	Application (% wt/total wt)	Application (mmole/gram carbon)
1-1	Glucosamine hydrochloride	Cat #G220-6; Aldrich	20.0	1.16
1-2	Glucose monohydrate	Cat #49158; Fluka	18.7	1.16
1-3	Lactose monohydrate	Cat #61339; Fluka	29.5	1.16
1-4	Maltose monohydrate	Cat #63419; Fluka	29.5	1.16
1-5	Sorbitol	Cat #S375-5; Aldrich	4.1	1.16
1-6	Mannitol	Cat #M-9647; Sigma	17.2	1.14
1-7	Fructose	Cat #15760; Riedel-de Haën	17.2	1.15
1-8	Inositol	Cat #I6652; Aldrich	17.2	1.16
1-9	Tapioca Dextrin	Crystal Tex 627; National Starch	20.0	—
1-10	Erythritol	Cat #E-7500; Sigma	12.6	1.18
1-11	Calorie Free Sweetener *	Great Value Brand; WallMart	18.7	—
1-12	Sucrose	Cat #84097; Fluka	28.2	1.15
1-13	Chitosan oligosaccharide lactate	Cat #52,368-2; Aldrich	16.9	—
1-14	Maltodextrin	Lodex-10; Mother Murphy's	19.9	—
1-15	Hydroxypropyl-β-cyclodextrin	Cat #85,608-8; Aldrich	19.9	—

* Contains: glucose, maltodextrin, and aspartame; — = not determined; ** Aldrich = Aldrich Chemical Company (Milwaukee, WI); National Starch = National Starch (Bridgewater, NJ); Sigma Chemical Company (Milwaukee, WI); Riedel-de Haën = Fluka Riedel-de Haën (Milwaukee, WI); WallMart = WallMart Stores Incorporated (Bentonville, AR); Fluka = Fluka Chemical Corporation (Milwaukee, WI); Mother Murphy's = Mother Murphy's Laboratories Incorporated (Greensboro, NC).

[0069] The carbon material was treated according to the following general procedure. Each treating agent listed in Table 1 was dissolved in water. The resulting solution was applied to the untreated carbon. Sufficient treatment material was added to the water to yield the final application as listed in Table 1. Generally, a water to carbon ratio of approximately 1.8:1 was used. The wet carbon was then dried at approximately 105° C. for approximately 12 hours.

[0070] 99-millimeter cigarettes having non-ventilated filters like that of FIG. **1** were prepared as shown in Table 2. After drying, approximately 150 milligrams of the various treated carbons were added to the cavities, which were approximately 6 mm long. Sample 1-C was loaded with approximately 150 mg. Of the untreated carbon. These cigarettes were tested against a control cigarette, (1-CTL, Table 2) having a single cellulose acetate plug with no carbon.

[0071] Cigarettes were analyzed for whole smoke carbonyl content. Whole smoke carbonyl content and carbonyl reduction data is given in Table 2. Cigarette types as listed in Table 2 were smoked and evaluated for taste properties. Cigarette type 1-C containing untreated PCB carbon was found to have a chalky, unpleasant, bitter and drying taste. Cigarettes types 1-1C through 1-8C, 1-10C, and 1-15C were found to have suppressed carbon off-taste versus type 1-C. For cigarettes types 1-1C through 1-8C, 1-10C, and 1-15C, the treatment conferred approximately 30 to 50% suppression of the base carbon off-taste. Cigarette types 1-9C, 1-11C, 1-12C, 1-13C all displayed less than about 30% suppression of the base carbon off-taste. Significantly, the treated carbon material in cigarette types 1-6C (mannitol treatment) and 1-7C (fructose treatment) showed high carbonyl removal efficiencies and the greatest suppression of base carbon off-taste. These results

TABLE 2

		Micrograms aldehyde/cigarette (% reduction versus 1-CTL)				
Cigarette #	Material #	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde
1-CTL *	—	57.6	1187.8	152.5	100.3	25.3
1-C **	PCB	38.6 (33.0)	161.7 (86.4)	8.4 (94.5)	8.1 (91.9)	0.7 (97.2)
1-1C	1-1	39.0 (32.2)	769.6 (35.2)	39.2 (74.3)	44.0 (56.2)	2.6 (89.6)
1-2C	1-2	40.9 (28.9)	418.9 (64.7)	19.7 (87.1)	19.5 (80.5)	1.7 (93.4)
1-3C	1-3	47.4 (17.6)	1090.8 (8.2)	117.4 (23.1)	87.3 (12.9)	14 (44.6)
1-4C	1-4	47.7 (17.2)	1105.0 (7.0)	129.7 (15.0)	91.8 (8.5)	15.9 (37.3)
1-5C	1-5	39.9 (30.8)	393.6 (66.9)	21.2 (86.1)	19.6 (80.5)	1.6 (93.7)
1-6C	1-6	40.1 (30.3)	274.7 (76.9)	17.7 (88.4)	16.1 (84.0)	3.5 (86.1)
1-7C	1-7	36.5 (36.7)	164.2 (86.2)	8.3 (94.6)	7.8 (92.2)	1.8 (92.8)
1-8C	1-8	41.9 (27.2)	165.5 (86.1)	11.8 (92.3)	10.3 (89.7)	2.6 (89.7)
1-9C	1-9	56.9 (1.1)	917.3 (22.8)	103.2 (32.4)	69.4 (30.8)	18.1 (28.5)
1-10C	1-10	44.7 (22.3)	272.1 (77.1)	15.9 (89.6)	13.1 (86.9)	0.5 (97.9)
1-11C	1-11	42.9 (25.5)	444.8 (62.6)	30.2 (80.2)	27.5 (72.6)	2.2 (91.2)
1-12C	1-12	46.4 (19.5)	898.2 (24.4)	78.5 (48.5)	63.1 (37.0)	11.4 (55.0)
1-13C	1-13	46.3 (19.5)	729.4 (38.6)	73.6 (51.7)	55.7 (44.5)	15.0 (40.8)
1-14C	1-14	45.6 (20.8)	674.1 (43.3)	58.5 (61.6)	50.5 (49.7)	2.4 (90.4)
1-15C	1-15	46.0 (20.1)	740.0 (37.7)	76.4 (49.9)	59.4 (40.7)	4.1 (83.7)

PCB = untreated PCB (20 × 50 mesh) activated coconut carbon supplied by Calgon Carbon Corporation (Pittsburgh, PA);
* Aldehyde contents are the average of triplicate tests;
** Aldehyde contents are the average of duplicate tests;
— = not applicable.

demonstrate that activated carbon treated with certain sugars and polyols is effective in reducing undesirable gas phase constituents of mainstream smoke while suppressing the off-taste associated with activated carbon adsorbents.

Example 2

[0072] The following test was conducted to determine the efficacy of various amino acids as off-taste suppressants for use in the present invention. Activated coconut carbon was treated with various materials as listed in Table 3. For all samples listed in this example, PCB (20×50 mesh) activated coconut carbon supplied by Calgon Carbon Corporation (Pittsburgh, Pa.) was used.

TABLE 3

Material #	Treatment	Source *	Application (% wt/total wt)	Application (mmole/gram carbon)
2-1	Asparagine	Cat #A9,300-3; Aldrich	8.49	0.70
2-2	Glutamine	Cat #G-3126; Sigma	9.45	0.71
2-3	Glycine	Cat #G620-1; Aldrich	4.84	0.68

* Aldrich = Aldrich Chemical Company (Millwaukee, WI); Sigma Chemical Company (Millwaukee, WI).

[0073] The activated carbon was treated according to the following general procedure. Each treatment material listed in Table 3 was dissolved in water. Then the resulting solution was applied to the untreated carbon. Sufficient treatment material was added to the water to yield the final application as listed in Table 3. Generally, a water to carbon ratio of approximately 2:1 was used. The wet carbon was then dried at approximately 90° C. for approximately 5 hours.

[0074] 99 millimeter cigarettes having non-ventilated filters like that of FIG. **1** were prepared. After drying, approximately 150 milligrams of the treated carbons were loaded into cavities approximately 6 mm. Sample 2-C was loaded with approximately 150 mg. Of the untreated carbon. These cigarettes were tested against a control cigarette (2-CTL, Table 4) having a single cellulose acetate plug with no carbon.

TABLE 4

Cigarette #	Material #	Micrograms aldehyde/cigarette (% reduction versus 2-CTL)				
		Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde
2-CTL	—	46.0	1077.0	131.2	88.0	25.4
2-C *	PCB	38.6 (16.0)	161.7 (85.0)	8.4 (93.6)	8.1 (90.8)	0.7 (97.2)
2-1C	2-1	40.1 (12.8)	140.9 (86.9)	7.3 (94.4)	9.3 (89.4)	1.4 (94.5)
2-2C	2-2	33.8 (26.5)	184.7 (82.9)	7.3 (94.4)	9.8 (88.9)	1.9 (92.5)
2-3C	2-3	32.4 (29.5)	114.3 (89.4)	5.1 (96.1)	7.9 (91.0)	ND

PCB = untreated PCB (20 × 50 mesh) activated coconut carbon supplied by Calgon Carbon Corporation (Pittsburgh, PA);
* Aldehyde contents are the average of duplicate tests;
— = not applicable;
ND = not detected.

[0075] Cigarettes were analyzed for whole smoke carbonyl content. Whole smoke carbonyl content and carbonyl reduction data is given in Table 4. Cigarette types as listed in Table 4 were smoked and evaluated for taste properties. Cigarette type 2-C, containing untreated PCB carbon, was found to have a chalky, unpleasant, bitter and drying taste. Cigarettes types 2-1C, 2-2C, and 2-3C were found to have suppressed carbon off-taste versus type 2-C. For cigarettes types 2-1C, 2-2C, and 2-3C the treatment conferred approximately 20% suppression of the base carbon off-taste. These results illustrate that while amino acids are effective in reducing the perceived carbon off-taste, the degree of suppression is not as large as that exhibited by the polyols and sugars described in Example 1.

Example 3

[0076] For this example, PICACARB (12×40 mesh) activated anthracite carbon supplied by PICA USA (Columbus, Ohio) was treated with mannitol and fructose. Mannitol (Cat #25,409-6, Aldrich Chemical Company; Milwaukee, Wis.), 1.07 grams, and fructose (Cat #15760, Riedel-de Haen; Milwaukee, Wis.), 1.08 grams, were dissolved in 25.33 grams of water. The solution was then applied to 10.01 grams of PICACARB anthracite carbon (PICA USA; Columbus, Ohio). The wet carbon was then dried at approximately 90° C. for approximately 12 hours.

[0077] 84 millimeter cigarettes having non-ventilated filters like that of FIG. **1** were prepared. After drying, approximately 150 milligrams of treated carbon were loaded into the cavity of one cigarette, which was approximately 6 mm long (Cigarette type 3-1C, Table 5). Another cigarette having approximately a 3 mm cavity was loaded with approximately 75 milligrams of untreated PICACARB carbon (Cigarette type 3-C, Table 5). These cigarettes were tested against a control cigarette (3-CTL, Table 5) containing single cellulose acetate plugs having no carbon.

TABLE 5

	Micrograms aldehyde/cigarette (% reduction versus 3-CTL)				
Cig. #	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde
3-CTL	31.4	913.4	110.2	70.3	28.1
3-C	37.9 (−20.7)	709.8 (22.3)	52.2 (52.6)	40.8 (42.0)	7.1 (74.7)
3-1C	39.9 (−27.1)	626.5 (31.4)	43.5 (60.5)	36.7 (47.8)	7.2 (74.4)

[0078] Mainstream smoke carbonyl content and carbonyl reduction data is given in Table 5. The taste properties of cigarette types 3-C and 3-1C were evaluated. Cigarette type 3-C, containing untreated anthracite carbon, was found to have a chalky, unpleasant, harsh, and drying taste. Significantly, it was found that although the carbonyl contents of cigarette types 3-C and 3-1C were similar, the carbon off-taste was significantly suppressed in cigarette sample 3-1C relative to cigarette sample type 3-C.

Example 4

[0079] For this example, G278 (18×40 mesh) activated coconut carbon supplied by PICA USA (Columbus, Ohio) was treated with mannitol and fructose. Mannitol (Cat #M-9647, Sigma Chemical Company; Milwaukee, Wis.), 1.01 grams, and fructose (Cat #15760, Riedel-de Haën; Milwaukee, Wis.), 1.01 grams, were dissolved in 17.51 grams of water. The solution was then applied to 10.01 grams G278 coconut carbon (PICA USA; Columbus, Ohio). The wet carbon was then dried at approximately 90° C.

[0080] 99 millimeter cigarettes having non-ventilated filters like that of FIG. **1** were prepared. After drying, approximately 180 milligrams of the treated carbon were loaded into the cavities, which were approximately 7 millimeters long (Cigarette type 4-1C, Table 6). Similar cigarettes containing approximately 150 milligrams of untreated G278 carbon (Cigarette type 4-C, Table 6) were also prepared. These cigarettes were tested against control cigarettes (4-CTL, Table 6), containing single cellulose acetate plugs having no carbon.

TABLE 6

	Micrograms aldehyde/cigarette (% reduction versus 4-CTL) *				
Cig. #	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde
4-CTL	51.1	993.6	134.8	84.5	19.8
4-C	39.0 (23.7)	200.5 (79.8)	13.6 (89.9)	12.4 (85.3)	0.7 (96.4)
4-1C	43.8 (14.4)	454.6 (54.5)	33.0 (75.5)	27.9 (67.0)	3.7 (81.2)

* Aldehyde contents are the average of duplicate tests.

[0081] Mainstream smoke carbonyl content and carbonyl reduction data is given in Table 6. The taste properties of cigarette types 4-CTL, 4-C and 4-1C were evaluated. Cigarette type 4-C, containing untreated G278 carbon, was found to have a chalky and drying taste. Also for cigarette type 4-C, the tobacco and menthol taste levels were significantly decreased relative to control cigarette type 4-CTL. Cigarette type 4-1C was found to have significantly suppressed base off-taste. Unexpectedly, the applicants discovered cigarette type 4-1C had increased tobacco and menthol taste relative to sample type 4-C.

Example 5

[0082] Activated coconut carbon was treated with various materials as listed in Table 7. For all samples listed in this example, G278 (18×40 mesh) activated coconut carbon supplied by PICA USA (Columbus, Ohio) was used.

TABLE 7

Material #	Treatment	Source *	Application (% wt/total wt)
5-1	Glycerol	Cat #G153-1; Fisher	16.8
5-2	Glycerol	Cat #G153-1; Fisher	9.3
5-3	Glycerol	Cat #G153-1; Fisher	2.4
5-4	Sorbitol	Cat #S375-5; Aldrich	28.7
5-5	Sorbitol	Cat #S375-5; Aldrich	16.8
5-6	Mannitol	Cat #M-9647; Sigma	28.8
5-7	Mannitol	Cat #M-9647; Sigma	16.9
5-8	Mannitol	Cat #M-9647; Sigma	4.9
5-9	Propylene Glycol	Production item	15.2
5-10	Xylitol	Cat #85,158-2; Aldrich	15.0

* Aldrich = Aldrich Chemical Company (Milwaukee, WI); Sigma = Sigma Chemical Company (Milwaukee, WI); Fisher = Fisher Scientific (Fair Lawn, NJ).

[0083] The carbon material was treated according to the following general procedure. Each treatment material listed in Table 7 was dissolved in water. Then the resulting solution was applied to untreated carbon. Sufficient treatment material was added to the water to yield the final application as listed in Table 7. Generally, the water to carbon ratio of approximately 1.8:1 was used. The wet carbon was then dried at approximately 105° C. for approximately 12 hours.

[0084] 84 millimeter cigarettes having non-ventilated filters like that of FIG. **1** were prepared. After drying, approximately 100 milligrams of the treated carbons were loaded onto the cavities, which were approximately 4 millimeters long. Cigarette type 5-C was prepared using 50 milligrams untreated G278 carbon. These cigarettes were tested against control cigarette (5-CTL, Table 8) having a single cellulose acetate plug with no carbon.

TABLE 8

		Micrograms aldehyde/cigarette (% reduction versus 5-CTL) *				
Cigarette #	Material #	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde
5-CTL	—	22.6	701.8	64.0	58.4	26.7
5-C	G278	19.1 (15.6)	332.2 (52.7)	19.6 (69.5)	19.2 (67.1)	10.1 (62.0)
5-1C	5-1	17.5 (22.4)	286.6 (59.2)	13.1 (79.5)	17.4 (70.3)	8.4 (68.4)
5-2C	5-2	18.7 (17.3)	193.4 (72.4)	9.5 (85.2)	11.3 (80.6)	5.6 (78.8)
5-3C	5-3	16.3 (27.9)	111.5 (84.1)	6.6 (89.7)	8.3 (85.8)	4.5 (83.1)
5-4C	5-4	24.4 (−8.1)	698.2 (0.5)	59.9 (6.5)	54.5 (6.7)	19.6 (26.3)
5-5C	5-5	19.4 (14.1)	365.7 (47.9)	21.0 (67.2)	22.6 (61.4)	8.7 (67.3)
5-6C	5-6	19.2 (15.0)	578.9 (17.5)	39.2 (38.7)	43.8 (24.9)	21.3 (20.2)
5-7C	5-7	18.8 (17.0)	361.4 (48.5)	18.9 (70.5)	22.8 (61.0)	13.1 (50.9)
5-8C	5-8	17.4 (22.8)	185.4 (73.6)	10.5 (83.5)	11.4 (80.5)	8.2 (69.3)
5-9C	5-9	19.9 (12.1)	298.2 (57.5)	15.0 (76.5)	14.6 (75.1)	5.9 (77.7)
5-10C	5-10	14.5 (35.6)	138.7 (80.2)	7.8 (87.8)	7.2 (87.7)	3.0 (88.8)

G278 = 50 milligrams/cigarette, G278 (18 × 40 mesh) activated coconut carbon supplied by PICA USA (Columbus, OH)
* Aldehyde contents are the average of duplicate tests;
— = not applicable.

[0085] Cigarettes were analyzed for whole smoke carbonyl content. Whole smoke carbonyl content and carbonyl reduction data is given in Table 8. Cigarette types as listed in Table 8 were smoked and evaluated for taste properties. The results are given in Table 9 below. Cigarette type 5-C, containing untreated G278 carbon, was found to have a chalky, unpleasant, bitter, and drying taste. Overall, polyol treatments were found to significantly suppress carbon off-taste with the level of suppression dependent upon amount and type of polyol added. See Table 9. Significantly, the treated carbon material used to prepare cigarette types 5-7C (mannitol treatment) and 5-10C (xylitol treatment) showed high carbonyl removal efficiencies and the greatest suppression of carbon off-taste.

TABLE 9

Cigarette #	Material #	Carbon Off-Taste Suppression (%)
5-C	G278	0
5-1C	5-1	40
5-2C	5-2	30
5-3C	5-3	15
5-5C	5-5	45
5-6C	5-6	75
5-7C	5-7	50
5-8C	5-8	20
5-9C	5-9	35
5-10C	5-10	55

G278 = G278 (18 × 40 mesh) activated coconut carbon supplied by PICA USA (Columbus, OH).

Example 6

[0086] Activated coconut carbon was treated with various materials as listed in Table 10. For all samples listed in this example, G278 (18×40 mesh) activated coconut carbon supplied by PICA USA (Columbus, Ohio) was used.

TABLE 10

Material #	Treatment *	Application (grams treatment/grams carbon)
6-1	Fructose, Mannitol	0.0919, 0.0923
6-2	Fructose, Mannitol, Sodium Chloride	0.0926, 0.0930, 0.0117
6-3	Fructose, Mannitol, Sodium Chloride	0.0919, 0.0924, 0.0530

* Fructose, Cat #14,092-9, Aldrich Chemical Company (Milwaukee, WI); Mannitol, Cat #25,409-6, Aldrich Chemical Company (Milwaukee, WI); Sodium Chloride, Non-iodized, Morton International, Morton Salt (Chicago, IL).

[0087] The carbon material was treated according to the following general procedure. Treatment material was dissolved in water. Then the resulting solution was applied to untreated carbon. Sufficient treatment material was added to the water to yield the final applications as listed in Table 10. Generally, a water to carbon ratio of approximately 1.7:1 was used. The wet carbon was then dried at approximately 60° C. for approximately 36 hours.

[0088] 99 millimeter cigarettes having ventilated filters like that of FIG. **1** were prepared. After drying, approximately 100 milligrams of the treated carbons were loaded into the cavities, which were approximately 4 millimeters long. These cigarettes were tested against a control cigarette type (6-CTL, Table 11) having a single cellulose acetate plug with no carbon.

[0089] Cigarettes were analyzed for whole smoke carbonyl content. Whole smoke carbonyl content and carbonyl reduction data is given in Table 11.

TABLE 11

	Micrograms aldehyde/cigarette (% reduction versus 6-CTL)				
Cig. #	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde
6-CTL	20.5	640.4	71.5	56.2	16.5
6-1C	18.1 (11.7)	302.5 (52.8)	18.3 (74.4)	20.1 (64.2)	8.5 (48.4)
6-2C	18.0 (12.2)	287.7 (55.1)	16.6 (76.8)	18.5 (67.1)	6.4 (60.9)
6-3C	21.0 (−2.6)	414.5 (35.3)	29.4 (58.9)	30.0 (46.7)	8.9 (45.8)

G278 = 50 milligrams/cigarette, G278 (18 × 40 mesh) activated coconut carbon supplied by PICA USA (Columbus, OH)
* Aldehyde contents are the average of duplicate tests.

[0090] Cigarette types as listed in Table 11 were smoked and evaluated for taste properties. Unexpectedly, applicants discovered that the presence of sodium chloride in the treatment mixture significantly enhances carbon off-taste suppression. Cigarette type 6-2C (fructose/mannitol/sodium chloride) was found to have 80% carbon off-taste suppression while type 6-1C (fructose/mannitol) was found to have 60% carbon off-taste suppression.

Example 7

[0091] Three different off-taste suppression compositions were tested using a mixer, concentrated aqueous solutions of fructose (Krystar 300, Tate & Lyle, A. E. Staley Manufacturing Company; Decatur, Ill.) and mannitol (Mannitol, USP, Welco) were spray-coated onto samples of G278 (18×40 mesh) activated coconut carbon supplied by PICA USA (Materials 7-1 and 7-2, Table 12 and Table 13). An aqueous solution of fructose (Krystar 300, Tate & Lyle, A. E. Staley Manufacturing Company; Decatur, Ill.), mannitol (Mannitol, USP, Welco), and sodium chloride (Canning and Pickling Salt, Morton Salt Company; Chicago, Ill.) was similarly applied to G278 carbon (Material 7-3, Table 12 and Table 13).

TABLE 12

Material #	Carbon (pounds)	Fructose (pounds)	Mannitol (pounds)	NaCl (pounds)	Water (pounds)
7-1	400	29.3	29.3	—	58.7
7-2	400	21.8	21.8	—	57
7-3	400	21.8	21.8	4.0	57

Carbon = G278 (18 × 40 mesh) activated coconut carbon supplied by PICA USA (Columbus, OH); Fructose = Kyrstar 300 (Tate & Lyle, A. E. Staley Manufacturing Company; Decatur, IL); Mannitol = Mannitol, USP (Welco); NaCl = Sodium chloride, Canning and Pickling Salt (Morton Salt; Chicago, IL); Water = Tap water; — = not applicable.

TABLE 13

Material #	Activity (dry)	Activity (as is)	Moisture (%)	Density (as is, grams/milliliter)
7-1	48.3	33.7	16.5	0.711
7-2	45.4	32.3	16.9	0.707
7-3	—	38.0	13.0	0.691

Moisture content determined by loss of weight on drying at 105° C. for 4 hours; Activity = CCl_4 number = 2.55 × butane activity determined by ASTM method D5742-95 “Standard Test Method for Determination of Butane Activity of Activated Carbon”; Density determined by ASTM method D2854 “Test Method for Apparent Density of Activated Carbon”; As is = as prepared; Dry = after drying at 105° C. for 4 hours.

[0092] 84 millimeter cigarettes having ventilated filters like that of FIG. **1** were prepared. The cavities of these cigarettes were loaded with the treated carbon to produce samples 7-1C, 7-2C, 7-3C and 7-4C (Table 14). Three additional sample cigarettes 7-1C, 7-2C and 7-3C were loaded with untreated carbon (Table 14). These cigarettes were tested against control cigarettes (7-CTL, Table 14) having a single cellulose acetate plug with no carbon.

[0093] Carbonyl removal data for treated and untreated carbon types are listed in Table 14. Cigarette type 7-C2 containing 50 mg of untreated carbon (Table 14) gave unacceptably bitter carbon off-taste, whereas cigarette type 7-3C containing 100 mg of fructose/mannitol/sodium chloride-treated carbon (Table 14) was found to have about 80% suppression of carbon off-taste. Both cigarette types 7-C2 and 7-3C displayed similar carbonyl removal efficiencies versus the control cigarette (7-CTL).

TABLE 14

			Micrograms aldehyde/cigarette (% reduction versus 7-CTL) *				
Cigarette #	Material #	Weight **	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde
7-CTL *	—	—	21.8	724.2	68.3	60.4	26.3
7-C1	G278	25	21.6 (0.8)	526.7 (27.3)	37.3 (45.4)	35.7 (40.9)	16.5 (37.2)
7-C2	G278	50	19.1 (12.4)	332.2 (54.1)	19.6 (71.4)	19.2 (68.2)	10.1 (61.4)
7-C3	G278	75	18.6 (14.8)	201.9 (72.1)	11.3 (83.5)	11.3 (81.3)	5.8 (77.9)
7-1C	7-1	100	16.6 (23.7)	316.5 (56.3)	7.2 (89.5)	14.6 (75.8)	12.5 (52.3)

TABLE 14-continued

			Micrograms aldehyde/cigarette (% reduction versus 7-CTL) *				
Cigarette #	Material #	Weight **	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde
7-2C	7-2	100	16.8 (22.7)	267.3 (63.1)	6.1 (91.1)	13.2 (78.2)	12.1 (53.8)
7-3C *	7-3	100	18.1 (17.1)	305.7 (57.8)	16.1 (76.4)	16.5 (72.7)	7.2 (72.5)
7-4C *	7-3	125	16.9 (22.6)	232.5 (67.9)	12.2 (82.2)	12.9 (78.7)	6.5 (75.4)

G278 = G278 (18 × 40 mesh) activated coconut carbon supplied by PICA USA (Columbus, OH)
* Aldehyde contents are the average of triplicate tests;
— = not applicable;
** = milligrams of material per cigarette.

Example 8

[0094] This is an example of how to prepare activated carbon for practice of the invention. In this example, 8.3 pounds of fructose (Krystar 300, Tate & Lyle, A. E. Staley Manufacturing Company; Decatur, Ill.) and 8.3 pounds mannitol (Mannitol, USP, Welco) are dissolved in 18.5 pounds of water. Using a mixer, the aqueous solution is sprayed on 150 pounds of G278 activated coconut carbon (18×40 mesh, supplied by PICA USA; Columbus, Ohio). After treatment, the carbon tetrachloride activity of the treated carbon was found to be 38.3 (Carbon tetrachloride number=2.55×butane activity as determined by ASTM method D5742-95 "Standard Test Method for Determination of Butane Activity of Activated Carbon").

Example 9

[0095] Approximately 37.5 pounds of A109 resin (18×40 mesh wet, Purolite USA, Bala Cynwyd, Pa.) was separated into five batches of approximately 7.5 pounds. Each batch was washed four times with approximately 3 gallons of water. The moist batches were combined and dried in a convection oven at 60° C. for 24 hours. The moisture content of the solid was found to be 34.94% by Karl Fischer titration.

[0096] Activated carbon treated with a 46:46:8 mixture by weight of fructose, mannitol and sodium chloride was prepared at PICA USA by treating 1,000 pounds of G278 activated carbon with an aqueous solution containing 54.5 pounds of fructose, 54.5 pounds of mannitol, 10 pounds of sodium chloride, and 142.5 pounds of water. After treatment, the carbon tetrachloride activity of the carbon was found to be 35.1 (Carbon tetrachloride number=2.55×butane activity as determined by ASTM method D5742-95 "Standard Test Method for Determination of Butane Activity of Activated Carbon"). The treated carbon mixture contained 11% by total weight of the 46:46:8 fructose/mannitol/sodium chloride mixture.

[0097] 84 millimeter cigarettes having non-ventilated filters like that of FIG. **1** were prepared. Cigarettes were produced having approximately 100 mg of gas-phase filtering material constituting the various mixtures of treated carbon and resin as shown in Table 15. In addition, two control cigarettes were prepared, one in which the cavity was filled with 125 g. of treated carbon assigned a value of "10" for overall acceptability and off-taste and another having an empty filter cavity which represented "0" for off-taste. Results of the taste evaluation are given in Table 15.

TABLE 15

Sample #	Carbon[1] (mg)	Resin (mg)	Carbon:Resin[2]	OA[3]	OT[4]
A	0.0	100.0	0:100	8.0	5.0
B	25.0	75.0	25:75	13.3	4.5
C	50.0	50.0	50:50	11.1	6.9
D	75.0	25.0	75:25	9.1	8.8
E	87.5	12.5	82:14	7.5	10.5

[1]Treated carbon;
[2]Weight:weight ratio of treated carbon to resin;
[3]OA = Overall Acceptability;
[4]OT = Off-taste compared to control having 125 mg of treated carbon.

[0098] During this study it was observed that the A109 resin imparts off-taste to cigarettes. This off-taste is likely due, in part, to trace amounts of the manufacturing chemicals such as primary amines in the resin. Washing the resin as described above, prior to use was found to considerably reduce the off-taste associated with the resin. Even after washing, cigarettes containing 100% A109 resin still had some off-taste similar to carbon off-taste as shown in Table 15. It is theorized that this off-taste results from the macroporous structure of the resin the profile of organic constituents in the mainstream smoke similar to way activated carbon is theorized to produce off-taste.

[0099] The highest overall acceptability was obtained from cigarettes B and C, having 25 weight % and 50 weight % treated carbon, respectively. Cigarettes B and C had a higher overall acceptability than either cigarette A having 100% resin or the 100% treated carbon control cigarette. Observed off-taste was lowest in cigarette B. Cigarette B also gave substantial reduction in off-taste. It is theorized that the presence of about 25-50 weight % carbon in these cigarettes, in addition to reducing gas-phase constituents from the tobacco, reduces the amounts of trace manufacturing chemicals introduced into the smoke from the resin. These example demonstrates a synergy in the use of carbon/resin mixtures.

[0100] Table 16 shows the gas-phase removal data for each of the cigarettes in Table 19, calculated as % reduction compared to the control cigarette having an empty filter cavity.

TABLE 16

Sample	Formaldehyde[1]	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde	OA × Ac[2]
A	40.1	84.4	88.6	78.2	68.9	675
B	19.4	72.5	75.5	71.8	77.3	965
C	17.1	69.3	78.2	70.6	78.9	769
D	10.3	54.3	72.8	65.7	72.6	494
E	19.2	56.1	79.5	70.6	79.3	421

[1]All data represents % reduction in comparison to the control cigarette with an empty cavity;
[2]OA × Ac = Overall Acceptability × % reduction in acetaldehyde.

[0101] A can be seen from Table 16, cigarette A having 100% resin gives the highest carbonyl removal efficiency. However, as the usefulness of a particular gas-phase filter material treatment depends on the ability to suppress off-taste as well as the ability to reduce gas-phase constituents. The product of the overall acceptability and gas phase removal ability of each cigarette provides one means for evaluating the optimal mixtures of treated carbon and resin. By this measure, cigarettes B and C, having 25 weight % and 50 weight % treated carbon, respectively, are the most useful according to the invention.

Example 10

[0102] Activated coconut carbon was treated with various materials as listed in Table 17. For all samples listed in this example, G278 (18×40 mesh) activated coconut carbon supplied by PICA USA (Columbus, Ohio) was used.

[0103] The carbon material was treated according to the following general procedure. Treatment material was dissolved in water. Then the resulting solution was applied to untreated carbon. Sufficient treatment material was added to the water to yield the final application as listed in Table 17. Generally, water to carbon ratios of approximately 1.8:1 were used. The wet carbon was then dried at approximately 60° C. for approximately 8 hours.

TABLE 17

Material #	Treatment *	Application (grams treatment/grams carbon)
9-1	Fructose, Mannitol, Glycine Sodium Salt Hydrate	0.1025, 0.1020, 0.0167
9-2	Fructose, Mannitol, Monosodium Glutamate Monohydrate	0.1018, 0.1013, 0.0321
9-3	Fructose, Mannitol, Sodium Gluconate	0.1020, 0.1015, 0.0370

TABLE 17-continued

Material #	Treatment *	Application (grams treatment/grams carbon)
9-4	Fructose, Mannitol, Sodium Chloride	0.1023, 0.1018, 0.0101

* Fructose, Cat #14,092-9, Aldrich Chemical Company (Milwaukee, WI); Mannitol, Cat #25,409-6, Aldrich Chemical Company (Milwaukee, WI); Glycine Sodium Salt Hydrate, Cat #21,951-7, Aldrich Chemical Company (Milwaukee, WI); Monosodium Glutamate Monohydrate, Cat #G283-4, Aldrich Chemical Company (Milwaukee, WI); Sodium Gluconate, Cat #18,633-3, Aldrich Chemical Company (Milwaukee, WI); Sodium Chloride, Non-iodized, Morton International, Morton Salt (Chicago, IL).

[0104] 99-millimeter cigarettes having ventilated filters like that of FIG. **1** were prepared. After drying, approximately 150 milligrams of treated carbon were loaded into the 6 millimeter cavities. These cigarette were tested against a control cigarette (9-CTL, Table 17) having a single cellulose acetate plug with no carbon.

[0105] Cigarettes were analyzed for whole smoke carbonyl content. Whole smoke carbonyl content and carbonyl reduction data is given in Table 18.

TABLE 18

	Micrograms aldehyde/cigarette (% reduction versus 9-CTL) *				
Cig. #	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde
9-CTL	24.2	717.0	70.6	64.0	31.5
9-1C	21.6 (10.9)	306.1 (57.3)	11.6 (83.6)	18.7 (70.7)	9.8 (68.8)
9-2C	17.2 (29.1)	317.4 (55.7)	16.2 (77.0)	22.3 (65.1)	9.5 (69.8)
9-3C	25.4 (−4.9)	506.3 (29.4)	25.3 (64.2)	34.8 (45.6)	14.0 (55.6)
9-4C	19.1 (21.0)	328.1 (54.2)	12.7 (82.0)	21.3 (66.7)	9.8 (68.8)

* Aldehyde contents are the average of duplicate tests.

[0106] Cigarette types as listed in Table 17 were smoked and evaluated for taste properties. Unexpectedly, applicants discovered that treating the carbon with combined sodium salt and sugar/polyol mixtures gave greater carbon off-taste suppression than sugar/polyol mixtures alone. Table 17 lists the off-taste suppressant in order of effective off-taste suppression. Thus, material 9-4C gave greater off-taste suppression than material 9-2C which, in turn, gave greater off-taste suppression than material 9-1C. In this test, the off-taste suppression from material 9-3C was approximately equal to that from material 9-4C. Overall, cigarette samples 9-1C, 9-2C, 9-3C, and 9-4C all exhibited significant suppression of carbon off-taste.

Examples 11-16

[0107] It has been determined that use of certain amounts of off-taste suppressant provide unexpectedly better reduction in carbon off-taste while maintaining acceptable gas-phase removal properties as demonstrated by the following examples. Unless otherwise indicated, in the following Examples the treated carbons were prepared by dissolving the indicated amount of off-taste suppressant in 20 ml of water followed by application to 10 mg of activated carbon. Following evaporation of water, the treated carbon was dried at 60° C. for 10 hours.

[0108] 85 mm hand made cigarettes having plug-space-plug filters like that of FIG. **1** were prepared. The filters had a 10 mm plug of fiber tow at the buccal end, a 9 mm plug of fiber tow at the upstream end and a 6 mm cavity in between. In each instance, 150 mg of activated carbon treated with off-taste suppressant were loading into the cavity.

[0109] The cigarettes were smoked by a panel consisting of three professional expert smokers and evaluated for carbon off-taste reduction and overall acceptability. Carbon off-taste for each cigarette was evaluated on a 0 to 10 scale, with a control cigarette (G278) having 150 mg of untreated activated carbon representing "10" on the scale and another control cigarette having an empty cavity representing "0" on the scale. The smoking panel also ranked each cigarette for overall acceptability on a 1 to 10 scale with G278 representing "1" and the cigarette with the empty cavity representing "10". Each cigarette was evaluated based on the third, fourth, and fifth puff.

[0110] For each cigarette in the Examples, gas-phase removal data was determined by using a method similar to that used by Arista Laboratories (Richmond, Va.). Cigarettes were smoked by a smoking machine and the mainstream smoke was trapped in an aqueous solution of dinitrophenyl hydrazine (DNPH). The resulting DNPH aldehyde derivatives were analyzed by HPLC to determine the quantity of selected aldehydes. The gas-phase reduction data in the Examples is expressed in terms of percent reduction in selected gas phase components in relation to the control cigarette having an empty cavity. In each instance the data represents the average of two measurements.

Example 11

[0111] To determine the effect of fructose loading on carbon off-taste suppression, overall acceptability, and carbonyl reduction, cigarettes were prepared with varying amounts of fructose present on activated carbon. As shown in Table 19, cigarettes were prepared with carbon materials having fructose loadings varying from about 2 weight % to about 40 weight %.

TABLE 19

Sample	Wt % Fructose	Fructose (g)[1]	OA[2]	Carbon OT[3]
F-2	2	0.20	1.7	9.5
F-5	5	0.53	2.1	8.8
F-7	7	0.75	2.5	8.5
F-10	10	1.11	3.7	7.3
F-15	15	1.77	4.3	6.7
F-20	20	2.50	5.8	4.7
F-25	25	3.33	5.5	3.8
F-30	30	4.29	4.0	3.0
F-35	35	5.39	4.0	2.7
F-40	40	6.67	3.0	3.2

[1]Grams of fructose dissolved in 20 ml of water for each 10 g of activated carbon
[2]Overall acceptability (OA)
[3]Carbon off-taste (Carbon OT)

[0112] For each sample, the overall acceptability was rated as greater than that for untreated carbon, which was assigned a "1." It is apparent from FIG. **4**, which graphs the off-taste reduction data in Table 19, carbon off-taste decreased as the loading of fructose was increased, with a gradual leveling off of off-taste suppression beginning at loadings above about 20 weight %. Notably, as illustrated in FIG. **4**, which also graphs the overall acceptability data in Table 19, the overall acceptability of these cigarettes increased with fructose loading up to about 20 weight % and then began to diminish at loadings above about 20 weight %. There was generally an inverse relationship between the carbon off-taste reduction and the overall acceptability as the loading of the off-taste suppressant was increased.

[0113] Table 20 shows the gas-phase removal data for each of the cigarettes in Table 19, calculated as % reduction as compared the control cigarette having an empty cavity.

TABLE 20

Sample	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde	OA × Ac[2]
F-2	40.7[1]	91.7	96.7	93.5	95.8	153
F-5	34.2	83.9	91.9	89.0	91.1	182
F-7	41.6	82.7	91.9	88.8	89.4	207
F-10	27.2	72.4	88.6	82.5	81.2	266
F-15	33.9	72.0	89.9	84.0	83.5	312
F-20	31.3	54.6	86.0	71.7	72.9	319
F-25	26.0	26.9	74.2	41.3	43.2	148
F-30	19.0	7.9	57.0	13.0	2.9	31
F-35	24.8	15.8	61.7	16.1	−1.0	63
F-40	17.8	7.9	56.2	8.2	−17.0	24

[1]All data represents % reduction in comparison to the control cigarette.
[2]OA × Ac = Overall Acceptability × % reduction in acetaldehyde.

[0114] As shown in Table 20, the ability of the treated carbon to remove gas-phase constituents diminishes rapidly at fructose loadings above about 15 weight %. This effect is likely due to deactivation of the carbon caused by increased blocking of its active sites. This conclusion is supported by the fact the treated activated carbon began caking at fructose loadings of about 15 weight %, suggesting that the surface of the activated carbon is highly coated with fructose.

[0115] Table 20 provides values for the product of overall acceptability and % acetaldehyde reduction for each cigarette. By this measure, a useful range of fructose loading is between about 2 and about 25% by weight.

Example 12

[0116] To determine the effect of mannitol loading on carbon off-taste suppression, overall acceptability, and carbonyl reduction, the cigarettes shown in Table 21 were prepared with amounts of mannitol from about 2 weight % to about 40 weight %.

TABLE 21

Sample	Wt % Mannitol	Mannitol (g)[1]	OA[2]	Carbon OT[3]
M-2	2	0.20	1.7	9.0
M-5	5	0.53	2.5	8.3
M-7	7	0.75	3.5	7.7
M-10	10	1.11	4.7	6.3
M-15	15	1.77	5.3	5.2
M-20	20	2.50	6.0	4.2
M-25	25	3.33	5.7	4.2
M-30	30	4.29	5.0	3.8
M-35	35	5.39	4.5	3.5
M-40	40	6.67	3.3	3.5

[1]Grams of mannitol dissolved in 20 ml of water for each 10 g of activated carbon
[2]Overall acceptability (OA)
[3]Carbon off-taste (Carbon OT)

[0117] In each case there was a greater overall acceptability for the treated carbon than was observed for cigarettes having untreated carbon. As was the case with fructose, it is apparent from FIG. 5, which graphs the off-taste reduction data in Table 21, that carbon off-taste decreased as the loading of fructose was increased, with a leveling off of off-taste suppression beginning at about 20 weight %. As illustrated in FIG. 5, which also graphs the overall acceptability data in Table 21, the overall acceptability increased with mannitol loading up to about 20 weight % and then begins to diminish at loadings above about 20 weight %.

[0118] Table 22 shows the gas-phase removal data for each of the cigarettes in Table 21, calculated as % reduction as compared to the control cigarette having an empty cavity.

[0119] As shown in Table 22, the ability of the treated carbon to remove gas-phase constituents diminished rapidly at mannitol loadings above about 20 weight %. Since mannitol became visible as a white coating on the activated carbon particles at about 15 weight %, it is believed that the activated carbon gradually became deactivated at the highest loadings of mannitol.

[0120] Table 22 provides values for the product of overall acceptability and % acetaldehyde reduction for each cigarette. By this measure, a useful range of mannitol loading is between 5 and 20 weight %.

Example 13

[0121] Off-taste suppressants consisting of 50/50 weight % mixtures of mannitol and fructose were examined to determine the effect of loading on carbon off-taste suppression, overall acceptability, and carbonyl reduction. As shown in Table 23, treated carbon materials were prepared with 50/50 weight % mixtures of mannitol and fructose at loadings varying from about 2 weight % to about 40 weight % of the admixture.

TABLE 23

Sample	50:50 M:F Wt %[1]	Mannitol (g)[2]	Fructose (g)[3]	OA[4]	Carbon OT[5]
MF-2	2	0.10	0.10	1.8	8.8
MF-5	5	0.26	0.26	2.7	8.2
MF-7	7	0.37	0.37	3.7	7.3
MF-10	10	0.55	0.55	5.0	6.0
MF-15	15	0.88	0.88	5.7	5.2
MF-20	20	1.25	1.25	6.5	3.7
MF-25	25	1.67	1.67	5.5	4.5
MF-30	30	2.14	2.14	5.2	4.3
MF-35	35	2.69	2.69	4.3	3.5
MF-40	40	3.33	3.33	3.5	3.8

[1]Weight % of a 50:50 (wt. %) admixture of mannitol and fructose.
[2]Grams of mannitol dissolved in 20 ml of water for each 10 g of activated carbon.
[3]Grams of fructose dissolved in 20 ml of water for each 10 g of activated carbon.
[4]Overall acceptability (OA)
[5]Carbon off-taste (Carbon OT)

[0122] As can be seen from Table 23, substantial off-taste suppression was observed for every loading of the 50/50 weight % admixture of mannitol and fructose. Additionally, the overall acceptability for each cigarette having treated carbon was greater than for the cigarette having untreated carbon. As is evident from FIG. 6, which graphs the off-taste reduction data in Table 23, there was a greater reduction in carbon off-taste as the loading of fructose was increased, with a gradual leveling of off-taste suppression at loadings above

TABLE 22

Sample	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde	OA × Ac[2]
M-2	48.4[1]	90.6	95.3	94.2	94.0	151
M-5	45.1	82.8	93.8	89.1	87.7	207
M-7	42.5	80.7	95.1	88.9	87.0	282
M-10	40.1	75.1	95.1	85.1	81.9	350
M-15	42.7	67.3	93.8	78.3	74.2	359
M-20	50.5	62.6	94.4	76.0	73.1	376
M-25	40.2	33.4	87.6	53.2	48.3	189
M-30	37.2	28.4	83.1	44.4	39.5	142
M-35	4.8	10.4	−11.6	22.4	58.7	47
M-40	13.8	11.0	17.8	30.5	62.4	37

[1]All data represents % reduction in comparison to the control cigarette having an empty cavity.
[2]OA × Ac = Overall Acceptability × % reduction in acetaldehyde.

15 weight %. As also illustrated in FIG. 6, the overall acceptability increased with loading up to 20 weight % and then began to diminish at loadings above 20 weight %.

[0123] Surprisingly, a synergistic effect was observed with the 50/50 weight % admixture of mannitol and fructose as compared to either mannitol or fructose alone. At loading from 2 weight % up to 20 weight % the admixture of mannitol and fructose yielded greater overall acceptability and greater carbon off-taste suppression than mannitol or fructose alone.

[0124] Table 24 shows the gas-phase removal data for each of the cigarettes in Table 23, calculated as % reduction as compared to the control cigarette having an empty cavity.

TABLE 24

Sample	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde	OA × Ac[2]
MF-2	38.8[1]	85.6	93.2	91.6	94.0	157
MF-5	35.3	78.5	91.0	86.9	88.5	209
MF-7	33.2	84.8	91.2	92.6	94.0	311
MF-10	31.0	76.5	87.9	87.6	90.6	383
MF-15	18.1	56.4	70.4	72.4	81.0	319
MF-20	16.6	40.3	62.0	59.9	74.2	262
MF-25	4.2	17.8	12.6	34.8	78.2	98
MF-30	−6.5	−3.0	−41.3	3.4	55.8	−15
MF-35	−3.3	−3.9	−41.8	−3.1	35.8	−17
MF-40	−23.9	−14.9	−62.5	−14.6	18.1	−52

[1]All data represents % reduction in comparison to the control cigarette with an empty cavity.
[2]OA × Ac = Overall Acceptability × % reduction in acetaldehyde.

[0125] As shown in Table 24, the ability of the treated carbon to remove gas-phase constituents diminishes rapidly at loadings above 15 weight %.

[0126] Table 24 provides values for the product of overall acceptability and % acetaldehyde reduction for each cigarette. By this measure, a useful loading range for a 50:50 wt. % admixture of mannitol and fructose is between 5 and 20 weight %.

Example 14

[0127] To further investigate the synergistic effect of off-taste suppressants consisting of mannitol and fructose mixtures, cigarette were prepared having varying weight % ratios of mannitol to fructose. As shown in Table 24, activated carbon materials were prepared at 20 weight % loadings of admixtures varying from 10:90 to 90:10 (weight %) ratios of mannitol to fructose.

TABLE 25

Sample	Wt. Ratio M:F[1]	Mannitol (g)[2]	Fructose (g)[3]	OA[4]	Carbon OT[5]
MF 10-90	10:90	0.25	2.25	5.3	5.0
MF 25-75	25:75	0.66	1.88	6.0	4.8
MF 50-50	50:50	1.25	1.25	7.3	3.8
MF 75-25	75:25	1.88	0.63	6.2	4.7
MF 90-10	90:10	2.25	0.25	5.3	4.7

[1]Ratio of mannitol to fructose (wt./wt.); Total carbon loading of 20 wt. %.
[2]Grams of mannitol dissolved in 20 ml of water for each 10 g of activated carbon.
[3]Grams of fructose dissolved in 20 ml of water for each 10 g of activated carbon
[4]Overall acceptability (OA)
[5]Carbon off-taste (Carbon OT)

[0128] As can be seen from Table 25, substantial off-taste suppression was observed for every ratio of mannitol to fructose. Additionally, the overall acceptability for each cigarette having treated carbon was greater than for the cigarette having untreated carbon. It was observed that the greatest reduction in carbon off-taste and the largest overall acceptability occurs with about a 50:50 weight/weight ratio of mannitol to fructose.

[0129] Table 26 shows the gas-phase removal data for each of the cigarettes in Table 25, calculated as % reduction as compared to a control cigarette having an empty cavity.

TABLE 26

Sample	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde	OA × Ac[2]
MF 10-90	35.8[1]	61.8	79.6	80.8	85.6	330
MF 25-75	23.5	49.0	68.9	70.1	75.3	294
MF 50-50	23.0	52.5	69.7	73.1	87.4	385

TABLE 26-continued

Sample	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde	OA × Ac[2]
MF 75-25	15.7	50.8	65.0	69.3	82.1	314
MF 90-10	24.0	53.8	65.5	71.1	86.8	287

[1]All data represents % reduction in comparison to the control cigarette.
[2]OA × Ac = Overall Acceptability × % reduction in acetaldehyde.

[0130] Table 26 provides values for the product of overall acceptability and % acetaldehyde reduction for each cigarette. While each of these cigarettes exhibit excellent overall acceptability and gas-phase removal properties, the cigarette having about a 50:50 weight/weight ratio of mannitol and fructose is the most useful according to the present invention.

Example 15

[0131] The effect of sodium chloride on carbon off-taste suppression, overall acceptability, and carbonyl reduction was studied. Off-taste suppressants consisting of 46:46:8 weight % mixtures of mannitol, fructose, and sodium chloride were examined at varying total loadings on activated carbon. As shown in Table 27, treated carbon materials were prepared with this mixture of mannitol, fructose, and sodium chloride at loadings varying from about 2 weight % to about 40 weight % of the admixture.

TABLE 27

Sample	M:F:N Wt %[1]	Mannitol (g)[2]	Fructose (g)[3]	NaCl (g)[4]	OA[5]	Carbon OT[6]
MFN-2	2	0.09	0.09	0.02	2.3	8.7
MFN-5	5	0.24	0.24	0.04	2.8	7.8
MFN-7	7	0.35	0.35	0.06	3.7	7.2
MFN-10	10	0.54	0.54	0.10	5.3	5.7
MFN-15	15	0.81	0.81	0.15	6.7	4.3
MFN-20	20	1.15	1.15	0.21	7.7	3.8
MFN-25	25	1.53	1.53	0.28	7.5	3.0
MFN-30	30	1.96	1.96	0.36	6.2	3.5

TABLE 27-continued

Sample	M:F:N Wt %[1]	Mannitol (g)[2]	Fructose (g)[3]	NaCl (g)[4]	OA[5]	Carbon OT[6]
MFN-35	35	2.47	2.47	0.45	4.8	3.7
MFN-40	40	3.05	3.05	0.56	3.0	3.5

[1]Weight % of a 46:46:8 (wt. %) admixture of mannitol, fructose, and sodium chloride.
[2]Grams of mannitol dissolved in 20 ml of water for each 10 g of activated carbon.
[3]Grams of fructose dissolved in 20 ml of water for each 10 g of activated carbon
[4]Grams of sodium chloride dissolved in 20 ml of water for each 10 g of activated carbon.
[5]Overall acceptability (OA)
[6]Carbon off-taste (Carbon OT)

[0132] As can be seen from Table 27, substantial off-taste suppression was observed for every loading of the 46:46:8 (weight %) admixture of mannitol, fructose, and sodium chloride. Additionally, the overall acceptability for each cigarette having treated carbon was greater than for the cigarette having untreated carbon. Greater reduction in carbon off-taste was observed with a 46:46:8 (weight %) admixture of mannitol, fructose, and sodium chloride than was observed for the 50:50 (weight %) admixture of mannitol and fructose for loadings from 2 weight % to 15 weight. %. Furthermore, the overall acceptability was generally much greater for the 46:46:8 (weight %) admixtures of mannitol, fructose, and sodium chloride than was observed for the 50:50 (weight %) admixtures of mannitol and fructose.

[0133] As is evident from FIG. **7**, which graphs the off-taste reduction data in Table 27, reduction in carbon off-taste increased as the loading of off-taste suppressant was increased, with a gradual leveling off of off-taste suppression at loadings above about 15 weight %. As also illustrated in FIG. **7**, the overall acceptability increased with loading up to about 20 weight % and then began to diminish at loadings above about 20 weight %.

[0134] Table 28 shows the gas-phase removal data for each of the cigarettes in Table 27, calculated as % reduction as compared to the control cigarette having an empty cavity.

TABLE 28

Sample	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde	OA × Ac[2]
MFN-2	32.6[1]	90.2	93.6	95.6	96.4	210
MFN-5	21.4	81.5	87.4	90.4	92.3	231
MFN-7	39.2	84.5	91.7	92.4	92.6	310
MFN-11	28.7	76.1	82.4	87.4	95.0	406
MFN-15	19.8	64.9	74.3	80.0	91.2	433
MFN-20	25.8	51.7	66.6	70.2	85.7	396
MFN-25	10.3	25.4	37.4	42.5	72.6	191
MFN-30	−2.9	1.7	−56.6	6.6	75.2	10
MFN-35	−0.6	−2.2	−68.6	−0.8	60.7	−11
MFN-40	−2.6	1.8	−58.6	0.7	49.5	5.5

[1]All data represents % reduction in comparison to the control cigarette.
[2]OA × Ac = Overall Acceptability × % reduction in acetaldehyde.

[0135] Table 28 provides values for the product of overall acceptability and % acetaldehyde reduction for each cigarette. By this measure, a useful loading range for a 46:46:8 weight % admixture of mannitol, fructose, and sodium chloride is between about 2 and 25 weight %. This treatment is most effective at loadings between about 7 and 20 weight. %. As indicated by this data, the 46:46:8 weight % admixture of mannitol, fructose, and sodium chloride is superior to the other off-taste suppressants described herein.

Example 16

[0136] For this example, G278 (18×40 mesh) activated coconut carbon supplied by PICA USA (Columbus, Ohio) was treated with mannitol, fructose, and sodium chloride in a large-scale spray process. Fructose (Krystar 300, Tate & Lyle, A. E. Staley Manufacturing Company; Decatur, Ill.)54.5 lbs, mannitol (Mannitol, USP, Welco) 54.5 lbs, and sodium chloride (Evaporated Granulated Salt, Morton Salt Company; Chicago, Ill.), 10 lbs, were dissolved in 142.5 lbs water. A baffle mixer was used to coat 1000 lbs G278 coconut carbon (PICA USA; Columbus, Ohio). There was no drying step of the treated carbon subsequent to spray treatment. The total loading of off-taste suppressant on the activated carbon was approximately 11 weight percent.

[0137] 84 mm cigarettes having filters like that of FIG. **1** were prepared. 150 milligrams of the spray-treated carbon were loaded into the 6 mm cavities to yield sample cigarette GX-061. To determine the effect of spray treatment on off-taste suppression, overall acceptability, and gas-phase carbonyl removal, GX-061 was compared to MFN-11. The activated carbon of cigarette MFN-11 had been treated by the laboratory method described previously, rather than a spray method, using the identical off-taste suppressant and loading as GX-061.

[0138] The results of the smoking panel analysis are shown in Table 29.

TABLE 29

Sample	M:F:N (wt. %)	OA[1]	Carbon OT[2]
MFN 11	46:46:8	5.3	5.7
GX-061	46:46:8	6.8	4.0

[1]Overall acceptability (OA)
[2]Carbon off-taste (Carbon OT)

[0139] As can be seen from Table 29, greater off-taste suppression was observed for the spray-treated sample than for the laboratory treated sample. Additionally, the overall acceptability for the sample with spray-treated carbon was greater than for the sample with solution-treated carbon, despite the fact that both samples had the same mannitol-fructose-sodium chloride loadings. It is theorized that the off-taste suppressant tends to remain on the outer surface of the carbon granules when spray treated and thus has a slightly higher availability for suppressing off-taste as compared to the laboratory prepared sampled in which the off-taste suppressant has likely penetrated the pores of the activated carbon to some extent.

[0140] Table 30 shows the gas-phase removal data as % reduction when compared to the control cigarette with an empty cavity.

TABLE 30

Sample	Formaldehyde	Acetaldehyde	Acrolein	Propionaldehyde	Crotonaldehyde	OA × Ac[1]
MFN 11	28.7	76.1	82.4	87.4	95.0	405.92
GX-061	30.6	66.6	82.4	78.9	82.3	455.32

[1]OA × Ac = Overall Acceptability × % reduction in acetaldehyde.

[0141] As can be seen in Table 30, there is some variability in the carbonyl removal data between the lab treated sample MFN 11 and the spray treated sample GX-061. While the cigarette with laboratory treated carbon shows a slightly higher acetaldehyde reduction, the cigarette with spray-treated carbon tests higher when the acetaldehyde reduction and overall acceptability are factored together. By this measure, cigarette GX-061 is the most useful cigarette according to the invention of all those tested herein.

[0142] While it is contemplated that in the practice of the present invention, one will be able to produce carbon filtered cigarettes which taste substantially like non-carbon filtered cigarettes, it should be understood that off-taste suppressants which also introduce flavor into the mainstream smoke are contemplated to be within the broad scope of the invention. However, "masking" carbon off-taste by flavoring the mainstream smoke is not the effective mechanism of carbon off-taste reduction according to the present invention, as demonstrated by the foregoing Examples. For instance, Example 12 demonstrates that there is a 37% reduction in carbon off-taste compared to an untreated carbon cigarette at a mannitol loading of 10 weight %. In view of the fact that smokers with highly acute taste perceptions did not detect even trace levels of mannitol in the mainstream smoke at that 10% loading and up until the mannitol loading reached 15 weight %, it is apparent that flavoring of the mainstream smoke was not the reason for off-taste suppression. Furthermore, in Examples 11-13 and 15, reduction in the carbon off-taste gradually levels off at off-taste suppressant loadings above about 20-25 weight % as illustrated in FIGS. **4-7**.

[0143] While the amount of off-taste suppressant used in the practice of the invention may be such that certain smokers perceive an additional sweet flavor, it is clear that the off-taste suppressants of the invention function by a mechanism that is independent of the amount of sweetness added to the mainstream smoke. One can control the presence and the amount of sweetness in the mainstream smoke by selecting appropriate compositions and loadings off-taste suppressant consistent to the preferences of the targeted consumer. In this regard, it will be understood that the threshold of detectability of the off-taste suppressants in the mainstream smoke may be higher for some smokers. In the preferred practice of this invention, the off-taste suppressants do not impart detectable flavor to the mainstream smoke.

[0144] Certain modifications and improvements will occur to those skilled in the art upon a reading of the foregoing description. It should be understood that all such modifications and improvements have been deleted herein for the sake of conciseness and readability but are properly within the scope of the following claims.

We claim:

1. A filter for a tobacco cigarette comprising:

(a) an adsorbent material in particulate form disposed in the filter, wherein the adsorbent material adsorbs at least one gas phase constituent of mainstream smoke produced when the tobacco cigarette is ignited; and

(b) an off-taste suppressant deposited on the surface of the adsorbent material which reduces mainstream smoke off-taste resulting from the presence of said adsorbent without introducing additional flavor into said mainstream smoke.

2. A cigarette filter according to claim **1** wherein said adsorbent material comprises activated carbon granules.

3. A cigarette filter according to claim **2** wherein said off-taste suppressant includes at least one component selected from the group consisting of sugars, oligosaccharides, polysaccharides, polyols, amino acids, oligopeptides, polypeptides, alkali metal salts, alkaline earth metal salts and combinations thereof.

4. A cigarette filter according to claim **3** wherein said off-taste suppressant comprises fructose.

5. A cigarette filter according to claim **3** wherein said off-taste suppressant comprises mannitol.

6. A cigarette filter according to claim **3** wherein said off-taste suppressant comprises fructose and mannitol.

7. A cigarette filter according to claim **3** wherein said off-taste suppressant comprises fructose and mannitol in about a 1:1 ratio by weight.

8. A cigarette filter according to claim **4**, **5**, **6**, or **7** wherein said off-taste suppressant composition further comprises an alkali halide salt.

9. A cigarette filter according to claim **8** wherein said alkali halide salt is sodium chloride.

10. A cigarette filter according to claim **8** wherein said alkali halide salt comprises no more than about 5% by weight of said activated carbon granules and said off-taste suppressant composition.

11. A cigarette filter according to claim **3**, **4**, **5**, **6**, or **7** wherein said off-taste suppressant comprises from about 2 to about 40 percent of the total weight of said activated carbon granules and said off-taste suppressant.

12. A cigarette filter according to claim **3**, **4**, **5**, **6**, or **7** wherein said off-taste suppressant comprises from about 5 to about 25 percent of the total weight of said activated carbon granules and said off-taste suppressant.

13. A cigarette filter according to claim **1**, **2**, **3**, **4**, **5**, **6**, or **7** further comprising a chemisorbent ion-exchange resin.

14. A cigarette filter according to claim **8** further comprising a chemisorbent ion-exchange resin.

15. A cigarette filter according to claim **14** wherein said ion-exchange resin is an amine-substituted polystyrene derivative.

16. A cigarette filter according to claim **15** wherein said resin and said activated carbon granules are present in an admixture.

17. A cigarette filter according to claim **16** wherein said activated carbon granules and said ion-exchange resin are present in a ratio of about 1:3 to about 3:1 by weight.

18. A tobacco cigarette having a filter comprising an upstream fibrous filter component and a downstream fibrous filter component, said upstream and downstream filter components defining a cavity therebetween, said filter further comprising granular activated carbon in said cavity and a composition on said activated carbon including at least one component selected from the group consisting of sugars, oligosaccharides, polysaccharides, polyols, oligopeptides and polypeptides, amino acids and further including at least one salt selected from the group consisting of, alkali metal salts, alkaline earth metal salts and combinations thereof.

19. A cigarette according to claim **18** wherein said composition comprises fructose, mannitol and an alkali halide salt.

20. A cigarette according to claim **19** wherein said alkali halide salt comprises sodium chloride.

21. A cigarette according to claim **18** wherein said composition comprises fructose and mannitol in a ratio of about 1:1 by weight.

22. A cigarette filter according to claim **18** wherein said composition comprises fructose, mannitol and sodium chloride in a ration of about 46:46:8 by weight.

23. A cigarette according to claims **18** wherein said salt comprises from about 0.1% to about 5% of the total weight of said activated carbon and said composition.

24. A cigarette according to claim **18** wherein said composition comprises from about 2 to about 40 percent of the total weight of said activated carbon and said composition.

25. A cigarette according to claim **18** wherein said composition comprises from about 5 to about 25 percent of the total weight of said activated carbon and said composition.

26. A cigarette according to claim **18**, **19**, **20**, **21**, **22**, **23**, **24** or **25** further comprising an ion exchange resin in admixture with said activated carbon.

27. A filter for a tobacco cigarette comprising:

a. an adsorbent material in particulate form disposed in the filter, wherein the adsorbent material adsorbs at least one gas phase constituent of mainstream smoke produced when the tobacco cigarette is ignited;

b. an off-taste suppressant deposited on the surface of the adsorbent material which reduces the off-taste resulting from the presence of said adsorbent without introducing flavor into the mainstream smoke, said off-taste suppressant including at least one component selected from the group consisting of sugars, oligosaccharides, polysaccharides, polyols, amino acids, oligopeptides, polypeptides, alkali metal salts, alkaline earth metal salts, and combinations thereof, and

c. a chemisorbent for at least one gas phase constituent of mainstream smoke.

28. The cigarette filter of claim **27** wherein said adsorbent material is activated carbon granules.

29. The cigarette filter of claim **28** wherein said off-taste suppressant comprises from about 2 to about 40 percent of the total weight of said activated carbon granules and off-taste suppressant.

30. The cigarette filter of claim **29** wherein said off-taste suppressant comprises from about 5 to about 25 percent of the total weight of said activated carbon granules and off-taste suppressant.

31. The cigarette filter of claim **28** wherein said off-taste suppressant comprises fructose and mannitol.

32. The cigarette filter of claim **31** wherein said off-taste suppressant further comprises sodium chloride.

33. The cigarette filter of claim **31** wherein the ratio of fructose to mannitol is from about 1:3 to 3:1 by weight.

34. The cigarette filter of claim **28** wherein said off-taste suppressant comprises an alkali halide salt.

35. The cigarette filter of claim **34** wherein said alkali halide salt comprises from about 0.1 to about 5 percent of the total weight of said activated carbon granules and said off-taste suppressant.

36. The cigarette filter of claim **28** wherein said chemisorbent is an ion-exchange resin.

37. The cigarette filter of claim **36** wherein said ion-exchange resin is a amine-substituted polystyrene derivative.

38. The cigarette filter of claim **36** wherein said ion-exchange resin comprises from about 25 to about 75 percent of the total weight of said ion-exchange resin and said activated carbon granules.

39. The cigarette filter of claim **36** wherein said ion-exchange resin comprises about 50% of the total weight of said resin and said activated carbon granules.

40. The cigarette filter of claims **28**, **29**, **30**, **31**, **32**, **33**, **34**, **35**, **36**, **37**, **38** or **39**, wherein said chemisorbent is present in admixture with said activated carbon granules.

41. A cigarette:

having a multi-component filter comprising an upstream fibrous filter component and a downstream fibrous filter component, said upstream and downstream filter components defining a filter cavity therebetween; and

a filter material in said cavity comprising

activated carbon and an ion exchange resin in a ratio of about 1:3 to about 3:1 by weight; said activated carbon having thereon an off-taste suppressant comprising

fructose and mannitol in a ratio from about 1:3 to about 3:1 by weight and in addition sodium chloride, wherein said off-taste suppressant comprises from about 2 to about 40 percent of the total weight of said activated carbon and off-taste suppressant

42. A tobacco cigarette having a filter comprising an activated carbon adsorbent for at least one gas phase constituent of mainstream smoke and an off-taste suppressant on said activated carbon which reduces off-taste resulting from the presence of said adsorbent, said off-taste suppressant comprising at least one component selected from the group of compounds having B, X-B, AH-B or AH-X-B moieties.

43. A cigarette according to claim **42** wherein said off-taste suppressant comprises at least one component selected from compounds having AH-B or AH-X-B moieties.

44. A cigarette according to claim **43** wherein said compounds having AH-B or AH-X-B moieties are selected from the group consisting of sugars, oligosaccharides, polysaccharides, polyols, amino acids, oligopeptides, polypeptides and combinations thereof.

45. A cigarette according to claim **44** wherein said off-taste suppressant comprises fructose.

46. A cigarette according to claim **45** wherein said off-taste suppressant comprises mannitol.

47. A cigarette according to claim **44** wherein said off-taste suppressant comprises fructose and mannitol.

48. A cigarette according to claim **42** wherein said off-taste suppressant further comprises at least one component selected from alkali metal salts, alkaline earth metal salts and combinations thereof.

49. A cigarette according to claims **42**, **43**, **44**, **45**, **46**, **47** or **48**, wherein said filter further comprises a chemisorbent selected from the group consisting of ion-exchange resins in admixture with said activated carbon adsorbent.

50. A cigarette according to claim **49** wherein said activated carbon and said ion-exchange resin are present in a ratio of from about 1:3 to about 3:1 by weight carbon to resin.

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