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(54) **FRAGRANCE-SUPPORTING LOW-ADSORPTION PARTICLES, CIGARETTE FILTER, FILTER CIGARETTE, AND METHOD FOR MANUFACTURING FRAGRANCE-SUPPORTING LOW-ADSORPTION PARTICLES**

(57) A flavorant-carrying low adsorbent particle comprising a low adsorbent core particle having a BET specific surface area of less than 700 m^2/g, and a flavor-generating medium carried on the surface of the low adsorbent core particle and including a flavorant and a flavorant-holding material holding the flavorant, wherein the flavorant-holding material is present in an amount of 5 to 20% with respect to a total weight of the flavorant-carrying low adsorbent particle, and the flavorant is present in an amount of 10 to 50% with respect to a weight of the flavorant-holding material.

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Description

Technical Field

[0001] The present invention relates to a flavorant-carrying low adsorbent particle, a cigarette filter, a filter-tipped cigarette, and a method for producing the flavorant-carrying low adsorbent particle.

Background Art

[0002] Flavorant-carrying particles are embedded in a cigarette filter, flavor from the flavorant is emitted in the mainstream smoke of a cigarette, and the smoker enjoys the flavor. For example, Patent Document 1 discloses a flavor bead in which the surface of a particulate carrier such as calcium carbonate is covered with a glucan film containing a flavorant. This flavor bead is produced according to the following process. A particulate carrier is put into a fluidized-bed granulation dryer, and an aqueous glucan solution or dispersion containing a flavorant is continuously or intermittently sprayed onto the surface of the particulate carrier while blowing warm air of e.g. 80°C or lower into the dryer, followed by drying.

[0003] However, in the method of Patent Document 1, it takes a relatively long time when a large amount of a flavorant is subjected to the treatment. As a result, it is difficult to increase the amount of a flavorant carried.

Prior Art Document

Patent Document

[0004] Patent Document 1: WO 2008/072627

Summary of Invention

Problem to be solved by the Invention

[0005] Therefore, a main object of the present invention is to provide a flavorant-carrying low adsorbent particle carrying a relatively large amount of a flavorant by a treatment in a relatively short time.

[0006] In addition, another object of the present invention is to provide a cigarette filter comprising the flavorant-carrying low adsorbent particle, and a cigarette tipped with the filter.

[0007] Furthermore, still another object of the present invention is to provide a method for producing a flavorant-carrying low adsorbent particle.

Means for solving the Problem

[0008] In order to solve the above problem, according to the first aspect of the present invention, there is provided a flavorant-carrying low adsorbent particle comprising a low adsorbent core particle having a BET specific surface area of less than 700 m^2/g, and a flavor-generating medium carried on the surface of the low adsorbent core particle and including a flavorant and a flavorant-holding material holding the flavorant, wherein the flavorant-holding material is present in an amount of 5 to 20% with respect to a total weight of the flavorant-carrying low adsorbent particle, and the flavorant is present in an amount of 10 to 50% with respect to a weight of the flavorant-holding material.

[0009] According to the second aspect of the present invention, there is provided a cigarette filter comprising a filter section including the flavorant-carrying low adsorbent particle of the present invention. Further, according to the third aspect of the present invention, there is provided a filter-tipped cigarette comprising a cigarette rod and the filter of the present invention which is connected to one end of the cigarette rod.

[0010] Further, according to the fourth aspect of the present invention, there is provided a method for producing a flavorant-carrying low adsorbent particle, comprising spraying a liquid flavor-emitting composition containing a flavorant and a flavorant-holding material onto a low adsorbent core particle having a BET specific surface area of less than 700 m^2/g while stirring the low adsorbent core particle under reduced pressure.

Effects of the Invention

[0011] According to the present invention, a flavorant-carrying low adsorbent particle carrying a relatively large amount of a flavorant is provided by a treatment in a relatively short time.

Brief Description of Drawings

[0012]

FIG. 1 is a schematic cross-sectional view illustrating an example of an apparatus for producing a flavorant-carrying low adsorbent particle of the present invention.
FIG. 2 is a schematic cross-sectional view illustrating a filter-tipped cigarette according to an embodiment of the present invention.
FIG. 3 is a schematic cross-sectional view illustrating a filter-tipped cigarette according to another embodiment of the present invention.
FIG. 4 is a schematic cross-sectional view illustrating a filter-tipped cigarette according to still another embodiment of the present invention.
FIG. 5 is a schematic cross-sectional view illustrating a filter-tipped cigarette according to a further embodiment of the present invention.
FIG. 6 is a graph illustrating a measurement result of the amounts of a flavorant carried and a flavorant-holding material.
FIG. 7 is a partial fractured schematic view illustrating an apparatus for trapping components contained in the main stream smoke of a cigarette.

Mode for Carrying Out the Invention

[0013] Hereinafter, embodiments of the present invention will be described in detail.
[0014] A flavorant-carrying low adsorbent particle of the present invention comprises a low adsorbent core particle and a flavor-generating medium carried on the surface of the low adsorbent core particle and including a flavorant and a flavorant-holding material holding the flavorant. The flavorant-holding material is present in an amount of 5 to 20% with respect to the total weight of the flavorant-carrying low adsorbent particle, and the flavorant is present in an amount of 10 to 50% with respect to the weight of the flavorant-holding material.
[0015] The low adsorbent core particle used in the present invention has a BET specific surface area of less than 700 m^2/g. In the present specification, the BET specific surface area refers to a specific surface area obtained according to the publically known BET method. The core particle having a BET specific surface area of less than 700 m^2/g exhibits relatively little adsorption of the components contained in the mainstream smoke of a cigarette, and thus, exhibits a small effect on the smoking flavor and taste.
[0016] Examples of such a low adsorbent core particle include calcium silicate, activated carbon with a low activation degree, silica, ceramics, crystalline cellulose, wood, plant technical product, a styrene-divinylbenzene copolymer, an ethylene-vinyl acetate copolymer, and a water absorptive polymer such as polyvinyl alcohol and sodium polyacrylate.
[0017] It is preferable that the low adsorbent core particle has an average particle size of 75 to 2000 μm, and for example, a low adsorbent core particle having an average particle size of 75 to 1000 μm may be suitably used. In addition, the low adsorbent core particle preferably has a water retention rate of 10% or greater, and more preferably has a water retention rate of 20 to 40%. Here, the water retention rate means the proportion of water retention amount in the case where a core particle is soaked in water, with respect to the dry weight of the core particle. Any of the core particles exemplified above exhibits the above-mentioned water retention rate.
[0018] The flavor-generating medium covering the surface of the low adsorbent core particle includes a flavorant and a flavorant-holding material holding the flavorant.
[0019] Examples of the flavorant include a hydrophilic flavorant and a hydrophobic flavorant. Examples of the hydrophilic flavorant include leaf tobacco extract, natural vegetable flavorant (for example, licorice, St. John's bread, plum extract, peach extract, and the like), acids (for example, malic acid, tartaric acid, citric acid, butyric acid, and the like), saccharides (glucose, fructose, isomerized sugar, and the like). Examples of the hydrophobic flavorant include menthol, cocoas (powder, extract, and the like), esters (for example, isoamyl acetate, linalyl acetate, isoamyl propionate, linalyl butyrate, and the like), natural essential oils (as vegetable essential oils, for example, vanilla extract, spearmint, peppermint, cassia, jasmine, and the like; as animal essential oils, for example, musk, ambergris, civet, castoreum, and the like), and single flavors (for example, anethole, limonene, linalool, eugenol, vanillin, and the like).
[0020] The holding material holding the flavorant contains a film forming material and an emulsifying agent as needed. The representative examples of the film forming material used in the present invention include glucan, and examples of glucan include pullulan, maltodextrin, and hydroxypropyl cellulose. Glucan is water-soluble. A film forming material such as glucan is able to hold a flavorant by embedding the flavorant in the film formed of the film forming material. The film forming material can be used for any of a hydrophilic flavorant and a hydrophobic flavorant.
[0021] Examples of the emulsifying agent include glycerin fatty acid ester, sucrose fatty acid ester (sugar ester), sorbitan fatty acid ester, propylene glycol fatty acid ester, and lecithin. Molecules of the emulsifying agent hold a hydro-

phobic flavorant in an aqueous medium by causing the hydrophobic group of the molecule to adsorb around the oil droplet of the hydrophobic flavorant, and hold the hydrophobic flavorant after drying as well.

[0022] In the flavorant-carrying low adsorbent particle of the present invention, the flavorant-holding material is present in an amount of 5 to 20%, and preferably 5 to 10%, with respect to the total weight of the flavorant-carrying low adsorbent particle. In addition, the flavorant is present in an amount of 10 to 50% with respect to the weight of the flavorant-holding material.

[0023] The flavorant-carrying low adsorbent particle of the present invention may be prepared by spraying a liquid flavor-emitting composition containing the flavorant and the flavorant-holding material onto the low adsorbent core particle while stirring the low adsorbent core particle under reduced pressure.

[0024] The flavorant contained in the liquid flavor-emitting composition is the same as those described above, and the flavorant-holding material is also the same as those described above.

[0025] When the liquid flavor-emitting composition contains only a hydrophilic flavorant as a flavorant, it is preferable that the liquid flavor-emitting composition contains glucan as a film forming material and a hydrophilic flavorant, and further contains water as a solvent for dissolving glucan and the hydrophilic flavorant.

[0026] When the liquid flavor-emitting composition contains a hydrophobic flavorant as a flavorant (for example, when the liquid flavor-emitting composition contains only a hydrophobic flavorant as a flavorant, or when the liquid flavor-emitting composition contains a hydrophobic flavorant as well as a hydrophilic flavorant as a flavorant), it is preferable that the liquid flavor-emitting composition contains glucan as a film forming material, water as the solvent of glucan, a hydrophobic flavorant (and a hydrophilic flavorant), an oily solvent for dissolving the hydrophobic flavorant (for example, a vegetable oil or a saturated fatty acid triglyceride, preferably a medium chain saturated fatty acid triglyceride), and an emulsifying agent. When this composition contains a hydrophilic flavorant in addition to the hydrophobic flavorant, the hydrophilic flavorant dissolves in water.

[0027] In the production of the flavorant-carrying low adsorbent particle, it is preferable that the low adsorbent core particle is under reduced pressure of 12.3 kPa or lower, for example, under reduced pressure of 7.4 to 12.3 kPa, during spraying the liquid flavor-emitting composition. Moreover, at that time, it is preferable that the adsorbent core particle is at a temperature of 60°C or lower, for example, at a temperature of 40 to 60°C. By spraying the liquid flavor-emitting composition containing the flavorant and the flavorant-holding material under reduced pressure, there are benefits that a large amount of the flavorant can be carried on the low adsorbent core particle and also that a flavor-emitting composition having a high viscosity (for example, a viscosity of about 2 Pa·s) can be sprayed through a spray nozzle.

[0028] In order to produce the flavorant-carrying low adsorbent particle of the present invention, a conical ribbon mixer dryer may be used. The conical ribbon mixer dryer is described in, for example, Jpn. Pat. Appln. KOKAI Publication No. 2003-71263, Jpn. Pat. Appln. KOKAI Publication No. 2003-290641, and Jpn. Pat. Appln. KOKAI Publication No. 2007-229633. In addition, a conical ribbon mixer dryer manufactured by OKAWARA MFG. CO., LTD. is commercially available.

[0029] The basic structure of such a conical ribbon mixer dryer will be described with reference to FIG. 1. FIG. 1 illustrates a schematic cross-sectional view illustrating an example of a conical ribbon mixer dryer 10. The conical ribbon mixer dryer 10 comprises a treatment tank 12 for performing mixing and drying treatment therein, which is constituted by an inverted conical part 121 and a cylindrical part 122 united on the inverted conical part 121. The conical ribbon mixer dryer 10 comprises a double helix ribbon rotor blade 14 provided in the inside of the treatment tank 12. The double helix ribbon rotor blade 14 is attached to plural bearing bars (bearing bars 18a to 18e in FIG. 1) which are spaced apart from each other and fixed to a rotating shaft 16 longitudinally extending along the central axis of the treatment tank 12. To the inner wall of the cylindrical part 122 of the treatment tank 12, a pair of vortex flow breakers 20a and 20b (for example, having a platelike structure) is fixed above the rotor blade 14. A treated product (low adsorbent particles in the present invention) rises along the inner wall of the treatment tank 12 by the action of the ribbon rotor blade 14, and therefore the vortex flow breakers 20a and 20b cause the treated product to move near the center of the treatment tank 12 and to fall to the lower part of the treatment tank 12.

[0030] The outer boundary of the treatment tank 12 is surrounded with a jacket 22. In order to heat the content of the tank, steam is introduced through a steam inlet 22a into this jacket 22 via a line L1, and steam is discharged through a steam outlet 22b to the outside of the system via a line L2.

[0031] The upper opening of the tank is closed by a top board 24. On this top board 24, a motor 26 and a reduction gear 28 are installed, and the output shaft of the reduction gear 28 is connected to the rotating shaft 16 provided in the inside of the treatment tank 12. In addition, at the top board 24, an inlet 24a for an object to be treated (low adsorbent core particles in the present invention) is provided, and at the bottom of the treatment tank 12, an outlet 12a for treated product (flavorant-carrying low adsorbent particles in the present invention) is provided.

[0032] Moreover, to the top board 24, a bag filter 30 is attached. Of the content of the treatment tank 12, this bag filter traps particulate matter (low adsorbent particles in the present invention) and passes volatile matter (water contained in the flavor-emitting composition in the present invention). The passed volatile matter is led to a condenser 32 via a line L3. The condenser 32 is configured by, for example, a water cooled cooler, and the volatile matter passes through

the inside of an inner tube 321. The volatile matter is cooled by cooling water introduced into an outer tube 322 through a line L5, and discharged through a line L6 as a condensate (water). Water introduced into the outer tube 322 is discharged through the line L5. The inner tube 321 is connected to a pressure reducing pump P1 via a line L7, and the inside of the treatment tank 12 is decompressed by the drive of the pressure reducing pump P1.

[0033] The basic structure of the conical ribbon mixer dryer is as described above. Further, in order to prepare the flavorant-carrying low adsorbent particle of the present invention, a spray nozzle 34 for introducing the liquid flavor-emitting composition into the treatment tank 12 is provided so as to penetrate through the top board 24. The spray nozzle 34 sprays the liquid flavor-emitting composition LFC into the treatment tank 12 from a container 36 containing the liquid flavor-emitting composition via a line L8 equipped with a liquid feeding pump P2. In addition, in order to measure the temperature of the low adsorbent particles in the treatment tank 12, a temperature sensor (for example, thermocouple) 38 is provided at the lower part of the treatment tank 12.

[0034] In order to produce the flavorant-carrying low adsorbent particles of the present invention using the conical ribbon mixer dryer 10 illustrated in FIG. 1, the low adsorbent core particles LAP contained in a container 40 are introduced into the treatment tank 12 via a line L9. The liquid flavor-emitting composition contained in the container 36 is sprayed into the treatment tank 12 from the spray nozzle 34 via the line L8 according to the drive of the liquid feeding pump P2, while heating the inside of the treatment tank 12 by introducing steam having a temperature of 80°C or higher, preferably 100 to 120°C, into the jacket 22, and while stirring the low adsorbent particles by rotating the double helix ribbon rotor blade 14 according to the drive of the motor 26. During this spraying, it is preferable that the temperature of the low adsorbent particles is maintained at 70°C or lower, and preferably 60°C or lower. This temperature of the low adsorbent particles can be maintained by the heat of evaporation taken by water from the low adsorbent particles, when water in the liquid flavor-emitting composition introduced into the treatment tank 12 is heated and evaporated by steam of 80°C or higher introduced into the jacket 22.

[0035] In the flavorant-carrying low adsorbent particles produced in this manner, only water is removed by volatilization during production, but almost all of the components other than water contained in the liquid flavor-emitting composition applied to the low adsorbent core particles during production are carried on the low adsorbent core particles. Consequently, the liquid flavor-emitting composition applied to the low adsorbent core particles contains the flavorant-holding material in an amount of 5 to 20%, preferably 5 to 10%, with respect to the weight of the low adsorbent core particles used, and the flavorant in an amount of 10 to 50% with respect to the weight of the flavorant-holding material contained in the liquid flavor-emitting composition. The flavorant-holding material contained in the liquid flavor-emitting composition, particularly, a part of an aqueous solution or aqueous dispersion of the film forming material may be applied to the low adsorbent core particles in advance. The advance application of a part of the aqueous solution or aqueous dispersion of the film forming material makes it possible to suppress the temperature of the low adsorbent core particles rising at the initial stage of production of the flavorant-carrying low adsorbent particle and also suppress the generation of fine powder from the low adsorbent core particles.

[0036] In the flavorant-carrying low adsorbent particle of the present invention, the surface of the low adsorbent core particle is covered with a solid flavor-generating medium formed of the liquid flavor-emitting composition. In this solid flavor-generating medium, the flavorant is held by the flavorant-holding material, and therefore it does not occur that the flavorant is volatilized or adsorbed to charcoal during usual storage. When the flavorant-holding material is contacted with a hydrophilic component such as water contained in the mainstream smoke generated by smoking, a part of the flavorant-holding material dissolves therein and thus flavor is emitted. As a result, it is possible to enjoy the smoking flavor and taste of the flavorant.

[0037] A cigarette filter according to the second aspect of the present invention comprises a filter section including the flavorant-carrying low adsorbent particles of the present invention. In addition, a filter-tipped cigarette according to the third aspect of the present invention provides a filter-tipped cigarette comprising a cigarette rod and the filter of the present invention which is connected to one end of the cigarette rod.

[0038] The cigarette filter according to the present invention may comprise a filter section in which the flavorant-carrying low adsorbent particles of the present invention are dispersed in a general filter raw material, for example, a cellulose acetate fiber tow (bound by a plasticizer such as triacetin). The so-called charcoal filter section (a filter section comprising a filter raw material formed by dispersing activated carbon in a cellulose acetate fiber tow bound by a plasticizer such as triacetin) may be connected to one end of the above filter section. Alternatively, the cigarette filter according to the present invention may comprise a charcoal filter section and a plain filter section disposed apart from each other and the flavorant-carrying low adsorbent particles of the present invention filled in the space between these two filter sections.

[0039] Hereinafter, a cigarette having the filter of the present invention will be described with reference to FIGS. 2 to 5. In FIGS. 2 to 5, the same elements are indicated by the same reference signs.

[0040] FIG. 2 is a schematic cross-sectional view of a cigarette (filter-tipped cigarette) 50 equipped with the cigarette filter according to an embodiment of the present invention. A filter-tipped cigarette 50 comprises a cigarette rod 52 in which a tobacco filler 521, such as cut tobacco, is wrapped with a cigarette paper 522. The cigarette rod 52 is the same as that of a general cigarette.

[0041] A filter 54 is attached to one end of the cigarette rod 52. The filter 54 comprises a charcoal filter section 541 which is provided so as to be directly connected to one end of the cigarette rod 52, a flavorant-carrying low adsorbent particles-containing filter section 542 which is provided at the end of the downstream side of the charcoal filter section 541 with respect to the flow direction of the mainstream smoke, and a plain filter section 543 which is provided at the end of the downstream side of the flavorant-carrying low adsorbent particles-containing filter section 542 with respect to the flow direction of the mainstream smoke.

[0042] The charcoal filter section 541 is, for example, a filter obtained by wrapping a cellulose acetate fiber 541a, in which charcoal particles 541b are dispersed, with a filter wrapping paper 541c, and may be the same as a general charcoal filter.

[0043] The flavorant-carrying low adsorbent particles-containing filter section 542 is, for example, a filter obtained by wrapping a cellulose acetate fiber 542a, in which flavorant-carrying low adsorbent particles FLAP of the present invention are dispersed, with a filter wrapping paper 542b.

[0044] The plain filter section 543 is, for example, a filter obtained by wrapping a tow of a cellulose acetate fiber 543a with a filter wrapping paper 543b.

[0045] The filter 54 consisting of the filter sections 541, 542, and 543 is attached to one end of the cigarette rod 52 by a tipping paper 56.

[0046] FIG. 3 is a schematic cross-sectional view of a cigarette (filter-tipped cigarette) 60 equipped with the cigarette filter according to another embodiment of the present invention. In this filter-tipped cigarette 60, a filter 62 attached to a cigarette rod 52 by a tipping paper 56 comprises a charcoal filter section 541 directly attached to one end of the cigarette rod 52, and a plain filter section 622 provided so as to be spaced from the charcoal filter section 541, and the whole is wrapped with a filter wrapping paper 66. The plain filter section 622 is formed of, for example, a tow of a cellulose acetate fiber 622a, as the plain filter section 543 illustrated in FIG. 2. The space (cavity) 64 between the charcoal filter section 541 and the plain filter section 622 is filled with the flavorant-carrying low adsorbent particles FLAP of the present invention.

[0047] FIG. 4 shows a configuration in which the charcoal filter section 541 is omitted in the filter-tipped cigarette having the configuration illustrated in FIG. 2, and the flavorant-carrying low adsorbent particles-containing filter section 542 is directly connected to one end of the cigarette rod 52.

[0048] FIG. 5 shows a configuration in which a plain filter section 543 (see FIG. 2) is used instead of the charcoal filter section 541 in the filter-tipped cigarette having the configuration illustrated in FIG. 3.

Examples

[0049] Hereinafter, the present invention will be described using specific examples, but is not limited to the specific examples.

<Preparation of liquid flavor-emitting composition>

[0050] A mixture containing the components listed in Table 1 in the proportions listed in Table 1 was emulsified using an emulsifier (ROBOMICS MARK II manufactured by PRIMIX Corporation) at 7500 rpm for 15 minutes. At this time, the surrounding of the emulsifier was cooled with water such that the temperature of the mixture did not exceed 45°C. In this manner, liquid flavor-emitting compositions A to D were obtained.

[0051] COCONARD MT manufactured by Kao Corporation was used as a medium chain fatty acid triglyceride, LP-20E manufactured by The Nisshin OilliO Group, Ltd. was used as lecithin, and P-1570 manufactured by Mitsubishi-kagaku Foods Corporation was used as a sugar ester.

[Table 1]

Components	Mixing proportion (% by weight)			
	Liquid flavor-emitting composition A	Liquid flavor-emitting composition B	Liquid flavor-emitting composition C	Liquid flavor-emitting composition D
Pullulan	10	10	10	9.5
Water	79	76	80	72.3
Medium chain fatty acid triglyceride	5	5	3	4.8
Lecithin	2	2	2	1.9
Sugar ester	2	2	2	1.9

(continued)

Components	Mixing proportion (% by weight)			
	Liquid flavor-emitting composition A	Liquid flavor-emitting composition B	Liquid flavor-emitting composition C	Liquid flavor-emitting composition D
1-Menthol	2	-	-	4.8
Vanillin	-	5	-	-
Cocoa powder	-	-	3	-
Butyric acid	-	-	-	4.8

<Preparation of flavorant-carrying low adsorbent particle>

Example 1

[0052] Here, RIBOCONE RM-50-VD manufactured by OKAWARA MFG. CO., LTD. was used as a conical ribbon mixer dryer (see FIG. 1). Into the mixer dryer were put 10 kg of calcium silicate (SANWA MARUME manufactured by SANWA INSECTICIDE Co., Ltd.; average particle size: 1 mm; BET specific surface area: less than 700 m^2/g) and 6 kg of an aqueous solution containing 5% by weight pullulan, and steam of 120°C under a pressure of 200 kPa was circulated in the jacket. The pressure inside the mixer dryer was set at 12.3 kPa and the calcium silicate particles were stirred. After stirring for 5 minutes, 5 kg of liquid flavor-emitting composition A was sprayed through the spray nozzle into the mixer dryer over 40 minutes, and then further stirred and dried for 20 minutes. Flavorant-carrying calcium silicate particles were taken out of the mixer dryer, immediately put in a continuous fluidized-bed granulation dryer (MIX GRADO 0.5 TYPE manufactured by OKAWARA MFG. CO., LTD.), and subjected to sensible heat exchange and dehumidification of calcium silicate particles for 3 minutes, thereby obtaining a product of flavorant-carrying calcium silicate particles.

Example 2

[0053] A product of flavorant-carrying calcium silicate particles was obtained according to the same procedure as in Example 1 except that liquid flavor-emitting composition B was used instead of liquid flavor-emitting composition A.

Example 3

[0054] A product of flavorant-carrying calcium silicate particles was obtained according to the same procedure as in Example 1 except that liquid flavor-emitting composition C was used instead of liquid flavor-emitting composition A.

Example 4

[0055] A product of flavorant-carrying calcium silicate particles was obtained according to the same procedure as in Example 1 except that liquid flavor-emitting composition D was used instead of liquid flavor-emitting composition A.

<Manufacture of filter-tipped cigarette>

[0056] A filter-tipped cigarette having a configuration illustrated in FIG. 3 was manufactured. More specifically, the filter-tipped cigarette having a configuration illustrated in FIG. 3 was manufactured according to the following procedure. From a commercially available filter-tipped cigarette product, "Winston Lights", which is equipped with a filter having a cellulose acetate fiber tow as a filter raw material, the cellulose acetate fiber tow was removed using a pair of tweezers. Then, the vacant space part was filled with a cellulose acetate fiber tow (length: 12 mm; 8Y/29000 (that is, single fineness: 8 denier; cross-section of filament: Y type; total fineness: 29000 denier)) including 85 mg of activated carbon (KURARAY COAL GGS-H28/70 manufactured by KURARAY CHEMICAL CO., LTD.), filled with 42 mg of the flavorant-carrying calcium silicate particles obtained in Examples 1 to 4 (in 47 mm of length of the space 64 in the longitudinal direction of the cigarette rod), and finally filled with a cellulose acetate fiber tow (length: 11 mm; 2.5Y/35000). In addition, a control filter-tipped cigarette was manufactured in the same manner as above except that the space 64 was not filled with anything.

[0057] These four kinds of filter-tipped cigarettes according to the present invention were subjected to smoking. As a result, it was confirmed that flavor from the flavorant was emitted in the mainstream smoke, and flavor and taste were stronger compared to the control filter-tipped cigarette. This result indicates that a large amount of a flavorant was carried

on a low adsorbent core particle by a treatment in a short time according to the method of the present invention.

<Measurement of amounts of flavorant carried and flavorant-holding material>

[0058] In regard to the flavorant-carrying particles obtained in Examples 1 to 4, the amount of the flavorant carried and the amount of the flavorant-holding material were measured.

[0059] The flavorant-carrying particles of Comparative Examples were prepared according to Examples 1 to 3 of the Prior Art Document (WO 2008/072627). In regard to the flavorant-carrying particles thus prepared, the amount of the flavorant carried and the amount of the flavorant-holding material were measured in the same manner as those for Examples 1 to 4.

[0060] The flavorant-carrying particles according to Comparative Examples were prepared as follows.

Comparative Example 1 (Example 1 of the Prior Art Document)

[0061] 2% by weight of coffee oil was added to a previously prepared aqueous dispersion of pullulan containing 10% by weight of pullulan. The mixture was vigorously stirred in an emulsifier (emulsifier rotation speed of 2500 rpm), thus preparing a flavorant dispersion. On the other hand, 100 g of calcium carbonate particles having an average particle size of 250 μm were charged into a fluidized-bed granulation dryer, and immediately the flavorant dispersion was intermittently sprayed onto the particles (in repeated cycles of spraying for 1 minute then no spraying for 30 minutes), while blowing warm air of 75°C at a flow rate of 0.6 m/sec. In this manner, total 10 g of flavorant dispersion was sprayed onto the surface of the calcium carbonate particles, followed by drying. Thereafter, the inside of the fluidized bed was immediately cooled to room temperature, thus obtaining desired flavor beads.

Comparative Example 2 (Example 2 of the Prior Art Document)

[0062] 100 g of calcium carbonate particles having an average particle size of 250 μm were charged into a fluidized-bed granulation dryer, and an aqueous flavorant mixture solution containing 1% by weight of a tobacco flavorant, to which vanillin was added, and 9% by weight of pullulan, was continuously sprayed onto the particles, while blowing warm air of 30°C at a flow rate of 1.0 m/sec. In this manner, total 5 g of the aqueous mixture solution was sprayed onto the surface of the calcium carbonate particles, followed by drying. Thereafter, the temperature of the warm air was immediately decreased to room temperature, and the particles were cooled at a flow rate of 0.4 m/sec, thus obtaining desired flavor beads.

Comparative Example 3 (Example 3 of the Prior Art Document)

[0063] 1% by weight of coffee oil and 0.5% by weight of lecithin were added to a previously prepared aqueous dispersion of pullulan containing 10% by weight of pullulan. The mixture was vigorously stirred in an emulsifier (emulsifier rotation speed of 7500 rpm, 15 minutes), thus preparing a flavorant dispersion. On the other hand, 300 g of ground coffee bean particles having an average particle size of 250 μm to 1.4 mm were charged into a rotating fluidized-bed granulation dryer (SFC-MINI manufactured by FREUND Corporation), and the perforated rotating disk at the bottom and the mixer blades for preventing lumping were rotated at about 500 rpm and about 400 rpm, respectively, while blowing warm air of 75°C at a flow rate of 0.6 m/sec, thereby forming a fluidized bed of the ground coffee bean particles. The flavorant dispersion kept at 40°C was continuously sprayed onto the fluidized bed, thereby spraying total 90 g of flavorant dispersion on the surface of the ground coffee bean particles, followed by drying. Thereafter, the temperature of the warm air was immediately decreased to room temperature, and the particles were cooled at a flow rate of 0.4 m/sec, thus obtaining desired flavor beads.

[0064] The amount of the flavorant and the amount of the flavorant-holding material were measured as follows.

Measurement of flavorant

[0065] The flavorant-carrying particles were subjected to a shaking extraction using a mixture of purified water and methanol. The obtained extract was subjected to a gas chromatograph-mass spectrometer (GC/MS) to measure the flavorant.

Measurement of flavorant-holding material

[0066] The flavorant-carrying particles was weighed (weight A), and heated and dried for the purpose of removing water in the particles (post-drying weight B). Purified water was added to the particles after drying, and the shaking

extraction was performed, thereby eluting the flavorant-holding material. The particles were further heated and dried (post-drying weight C). The difference between the weight C and weight A was regarded as the amount of the flavorant-holding material.

[0067] The measurement result is illustrated in FIG. 6. FIG. 6 illustrates the amount of the flavorant carried and the amount of the flavorant-holding material in a proportion (% by weight) with respect to the total weight of the flavorant-carrying particles. FIG. 6 indicates that the flavorant-carrying particles according to the present invention carry a larger amount of a flavorant than the flavorant-carrying particles according to the Comparative Examples.

[0068] In addition, it was possible to prepare the flavorant-carrying particles according to the present invention by a treatment in a shorter time than the flavorant-carrying particles according to the Comparative Examples.

<Relation between BET specific surface area of core particle and adsorption ability of flavorant-carrying particle>

[0069] A flavorant-carrying activated carbon particle was prepared according to the same procedure as the preparation procedure of the flavorant-carrying calcium silicate particle of Example 1 by using activated carbon (KURARAY COAL GGS-H28/70 manufactured by KURARAY CHEMICAL CO., LTD.; average particle size: 0.4 mm; BET specific surface area: 1700 m^2/g) instead of calcium silicate as a core particle and using the flavor-emitting composition D of Table 1 as a flavor-emitting composition.

[0070] Specifically, the flavorant-carrying activated carbon particle was prepared as follows.

[0071] For the preparation, RIBOCONE RM-50-SR manufactured by OKAWARA MFG. CO., LTD. was used as a conical ribbon mixer dryer (see FIG. 1). Into the mixer dryer were put 15 kg of activated carbon (KURARAY COAL GGS-H28/70 manufactured by KURARAY CHEMICAL CO., LTD.; average particle size: 0.4 mm; BET specific surface area: 1700 m^2/g) and 6 kg of an aqueous solution containing 5% by weight pullulan, and steam of 120°C under a pressure of 200 kPa was circulated in the jacket. The pressure inside the mixer dryer was set at 12.3 kPa and the activated carbon was stirred. After stirring for 5 minutes, 7.5 kg of liquid flavor-emitting composition D was sprayed through the spray nozzle into the mixer dryer over 60 minutes, and then further stirred and dried for 5 minutes. Flavorant-carrying activated carbon particles were taken out of the mixer dryer, immediately put in a continuous fluidized-bed granulation dryer (MIX GRADO 0.5 TYPE manufactured by OKAWARA MFG. CO., LTD.), and subjected to sensible heat exchange and dehumidification of the activated carbon particles for 3 minutes, thereby obtaining a product of flavorant-carrying activated carbon particles.

[0072] Using 30 mg of the flavorant-carrying activated carbon particles thus prepared, a filter-tipped cigarette having a configuration illustrated in FIG. 3 was manufactured as follows. Specifically, the filter-tipped cigarette having a configuration illustrated in FIG. 3 was manufactured according to the following procedure. From a commercially available filter-tipped cigarette product, "Winston Lights", which is equipped with a filter having a cellulose acetate fiber tow as a filter raw material, the cellulose acetate fiber tow of a filter raw material was removed using a pair of tweezers. Then, the vacant space part was filled with a cellulose acetate fiber tow (length: 10 mm; 2.5Y/35000 (that is, single fineness: 2.5 denier; cross-section of filament: Y type; total fineness: 35000 denier)), filled with 30 mg of the flavorant-carrying activated carbon particles prepared above (in 2 mm of length of the space 64 in the longitudinal direction of the cigarette rod), and finally filled with a cellulose acetate fiber tow (length: 10 mm; 2.5Y/35000). In addition, a filter-tipped cigarette (hereinafter, referred to as a control cigarette) was manufactured in the same manner as above except that 30 mg of no flavorant-carrying activated carbon (KURARAY COAL GGS-H28/70 manufactured by KURARAY CHEMICAL CO., LTD.) was used as it is, instead of the flavorant-carrying activated carbon particles.

[0073] The filter-tipped cigarette thus manufactured was subjected to smoking, and the adsorption ability of the filter with respect to acetone in the mainstream smoke was investigated.

[0074] In this experiment, an apparatus 70 illustrated in FIG. 7 was used in order to trap components contained in the mainstream smoke of a cigarette. This apparatus 70 has a trapping device for trapping particulate matter 71 comprising a Cambridge filter 711 (a diameter of 47 mm), a tobacco mainstream smoke inflow port 71a, which holds a cigarette CIG, and a tobacco mainstream smoke outflow port 71b. Further, the apparatus 70 comprises an impinger 72. In the impinger 72, a trapping agent solution TA for trapping gaseous components in the tobacco mainstream smoke is contained. In the present experiment, 10 mL of methanol containing 200 ppm of anethole, which was an internal standard substance, was put therein as the trapping agent solution TA. The impinger 72 was accommodated in a Dewar bottle 73 containing a refrigerant RM for maintaining the trapping agent solution TA at a low temperature. In the present experiment, a mixture of dry ice and isopropanol was used as the refrigerant RM, and the temperature of the trapping agent solution TA was maintained at -70°C or lower during the experiment. The outflow port 71b of the trapping device 71 for trapping particulate matter was connected with a pipe line 74 extending into the trapping agent solution TA in the impinger 72. In addition, a suction port 76a of an automatic smoking machine 76 was connected with a pipe line 75 extending to the upper space of the trapping agent solution TA in the impinger 72. When a cigarette was ignited and the automatic smoking machine 76 was driven, the pressure inside the impinger 72 was reduced by suction via the pipe line 75. In accordance with the pressure reduction, the mainstream smoke of the tobacco passed through the Cambridge

filter 711 in the trapping device 71. At that time, the particulate matter in the mainstream smoke of the tobacco was trapped in the Cambridge filter 711, and the particulate matter-deprived mainstream smoke was introduced into the trapping agent solution TA in the impinger 72 via the pipe line 74. Bubbling occurs in the trapping agent solution TA, and the gaseous matter in the mainstream smoke is trapped in the trapping agent solution TA.

[0075] In the present experiment, the cigarette was set to the trapping device 71, and subjected to smoking using the automatic smoking machine 76 under the standard smoking conditions defined by International Organization for Standardization (1 puff: 35 mL puff for 2 seconds, puff interval: 58 seconds). After smoking was completed, the agent solution in the impinger 72 was transferred to a serum vial, and the Cambridge filter 711, in which the particulate matter was trapped, was also put into the serum vial. It was subjected to a shaking extraction at 250 times/min for 30 minutes. 1 mL of the obtained extract was put into a vial for gas chromatograph-mass spectrometer (GC/MS), and the components in the mainstream smoke were analyzed under the following conditions.

[0076] Analytical conditions of the components in the mainstream smoke:

- GC/MS: HP 7890/5975 manufactured by Hewlett-Packard development Company, D. P.
- Column: DB-1701
- Flow rate of column: 1.2 mL/min
- Temperature raising condition: The temperature was maintained at 60°C for 5 minutes, and then raised to 160°C by 5°C/min and to 250°C by 10°C/min, and then maintained at 250°C for 30 minutes.
- Ratio of injection: split 10: 1; Inlet: 220°C; Flow rate: 12 mL/min; Total flow rate: 16.2 mL/min
- MS condition: Scan parameter: 33.0 to 200.0;

Threshold: 50; MS ion source: 230°C; MS quadrupole: 150°C.

[0077] The same analysis was also performed in a cigarette having a plain filter (that is, the cigarette having a cigarette rod of a commercially available filter-tipped cigarette product, "Winston Lights", and a plain filter consisting of a cellulose acetate fiber tow (length: 20 mm; 2.5Y/70000) connected to one end thereof; hereinafter, this will be referred to as a "standard cigarette") and the above control cigarette.

[0078] From the analysis results of the filter-tipped cigarette including flavorant-carrying activated carbon particles, the control cigarette, and the standard cigarette, the value of acetone peak area for each of the cigarettes was calculated. Each of the values of acetone peak area for the filter-tipped cigarette including flavorant-carrying activated carbon particles and the control cigarette was divided by the value of acetone peak area for the standard cigarette. The obtained value was multiplied by 100 to obtain the acetone decreasing rate (%) for each of the filter-tipped cigarette including flavorant-carrying activated carbon particles and the control cigarette. The acetone decreasing rate (%) was subtracted from 100% to obtain the acetone adsorption rate.

[0079] As a result, the acetone adsorption rate with respect to the control cigarette was 48%, and the acetone adsorption rate with respect to the filter-tipped cigarette including flavorant-carrying activated carbon particles was 45%. This result indicates that when a flavorant-carrying activated carbon particle is prepared using activated carbon having a BET specific surface area of 1700 m^2/g as a core particle, the flavorant-carrying activated carbon particle has an adsorption ability corresponding to about 94% with respect to the intrinsic adsorption ability of the core particle.

[0080] Two kinds of filter-tipped cigarettes were manufactured in the same manner as the above control cigarette except that the activated carbon (30 mg) having a specific surface area of 1700 m^2/g was substituted with activated carbon (30 mg) having a specific surface area of 700 m^2/g and 1000 m^2/g, respectively. The acetone adsorption rate with respect to these cigarettes was investigated in the same manner as above. As a result, the acetone adsorption rate with respect to the former cigarette was 23%, and the acetone adsorption rate with respect to the latter cigarette was 34%.

[0081] From the above result, it is found that a core particle having a specific surface area of 700 m^2/g or greater exhibits a high adsorption ability with respect to the components contained in the mainstream smoke of a cigarette, and a core particle having a specific surface area of less than 700 m^2/g exhibits a low adsorption ability with respect to the components contained in the mainstream smoke of a cigarette.

List of Reference Signs

[0082] 10: Conical ribbon mixer dryer, 12: Treatment tank, 12a: Outlet for treated product, 121: Inverted conical part of treatment tank, 122: Cylindrical part of treatment tank, 14: Double helix ribbon rotor blade, 16: Rotating shaft, 18a to 18e: Bearing bar, 20a and 20b: Vortex flow breaker, 22: Jacket, 22a: Steam inlet, 22b: Steam outlet, 24: Top board, 26: Motor, 28: Reduction gear, 24a: Inlet for object to be treated, 30: Bag filter, 32: Condenser, 321: Inner tube of condenser, 322: Outer tube of condenser, P1: Pressure reducing pump, 34: Spray nozzle, 36: Container for liquid flavor-emitting composition (LFC), P2: Liquid feeding pump, 38: Temperature sensor, 40: Container for low adsorbent core particles (LAP),

[0083] 50 and 60: Filter-tipped Cigarette, 52: Cigarette rod, 521: Tobacco filler, 522: Cigarette paper, 54 and 62: Filter,

541: Activated carbon-containing filter section, 542: flavorant-carrying low adsorbent particles-containing filter section, 543: Plain filter section, FLAP: Flavorant-carrying low adsorbent particles, 541a, 542a, 543a, and 622a: Cellulose acetate fiber, 541b: Charcoal particles, 542b, 543b, and 66: Filter wrapping paper, 56: Tipping paper, 622: Plain filter section, 64: Cavity,

[0084] 70: Apparatus for trapping components contained in mainstream smoke of cigarette, 711: Cambridge filter, CIG: Cigarette, 71: Trapping device for trapping particulate matter, 71a: Tobacco mainstream smoke inflow port, 71b: Tobacco mainstream smoke Outflow port, 72: Impinger, TA: Trapping agent solution for trapping gaseous components in tobacco mainstream smoke, 73: Dewar bottle, RM: Refrigerant, 74 and 75: Pipe line, 76: Automatic smoking machine, 76a: Suction port.

Claims

1. A flavorant-carrying low adsorbent particle comprising:

   a low adsorbent core particle having a BET specific surface area of less than 700 m^2/g, and
   a flavor-generating medium carried on the surface of the low adsorbent core particle and including a flavorant and a flavorant-holding material holding the flavorant,
   wherein the flavorant-holding material is present in an amount of 5 to 20% with respect to a total weight of the flavorant-carrying low adsorbent particle, and the flavorant is present in an amount of 10 to 50% with respect to a weight of the flavorant-holding material.

2. The flavorant-carrying low adsorbent particle according to claim 1, wherein the flavorant-carrying low adsorbent particle is produced by spraying a liquid flavor-emitting composition containing a flavorant and a flavorant-holding material onto the low adsorbent core particle having a BET specific surface area of less than 700 m^2/g while stirring the low adsorbent core particle under reduced pressure.

3. A cigarette filter comprising a filter section including the flavorant-carrying low adsorbent particle according to claim 1 or 2.

4. A filter-tipped cigarette comprising a cigarette rod and the filter according to claim 3 which is connected to one end of the cigarette rod.

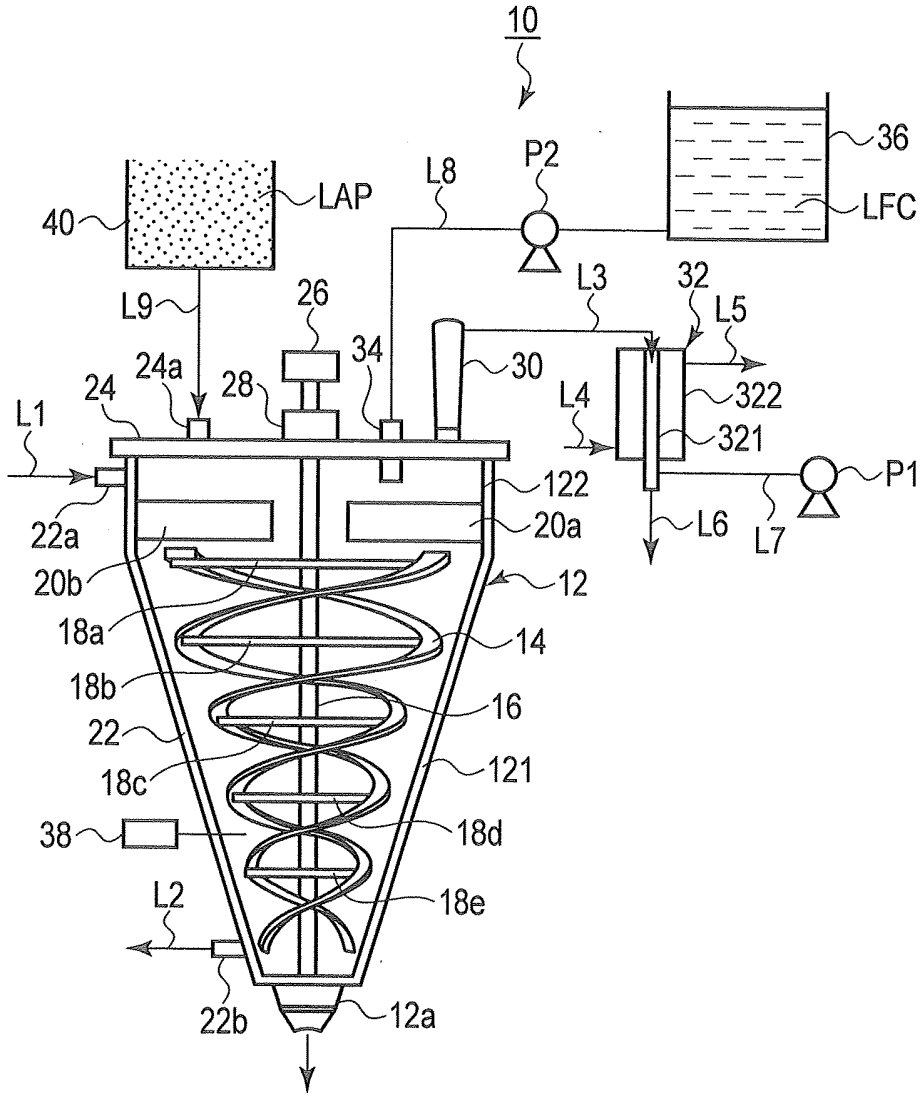
5. A method for producing a flavorant-carrying low adsorbent particle comprising:

   spraying a liquid flavor-emitting composition containing a flavorant and the flavorant-holding material onto a low adsorbent core particle having a BET specific surface area of less than 700 m^2/g while stirring the low adsorbent core particle under reduced pressure.

6. The method for producing a flavorant-carrying low adsorbent particle according to claim 5, wherein the liquid flavor-emitting composition contains the flavorant-holding material in an amount of 5 to 20% with respect to a total weight of the flavorant-carrying low adsorbent particle, and the flavorant in an amount of 10 to 50% with respect to a weight of the flavorant-holding material.

7. The method for producing a flavorant-carrying low adsorbent particle according to claim 5 or 6, wherein the reduced pressure is a pressure of 12.3 kPa or lower.

8. The method for producing a flavorant-carrying low adsorbent particle according to any one of claims 5 to 7, wherein the low adsorbent core particle is maintained at a temperature of 60°C or lower during the spraying.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L8
LAP
40
L3
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L5
L9
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321
L1
122
P1
22a
20a
L6
L7
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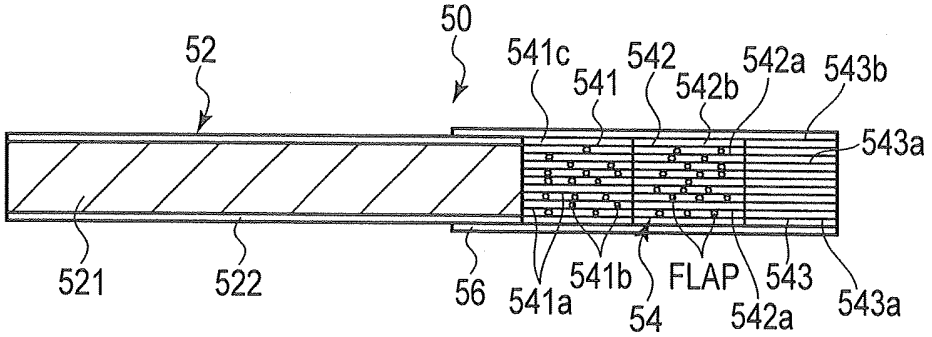
18d
L2
18e
22b
12a

FIG. 1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541b
FLAP
543
543a
54
542a

FIG. 2

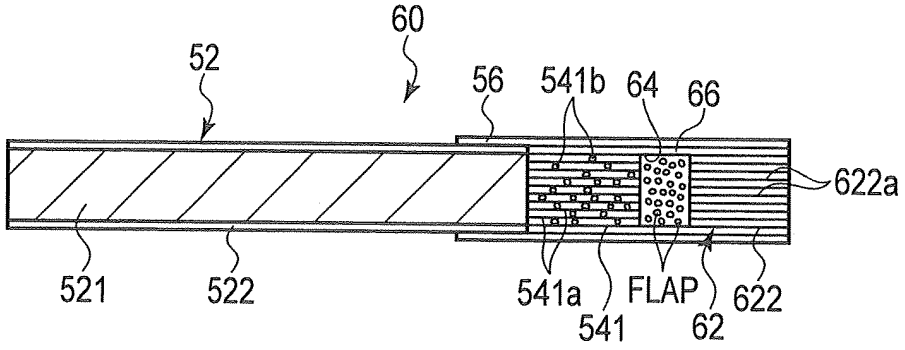

FIG. 3

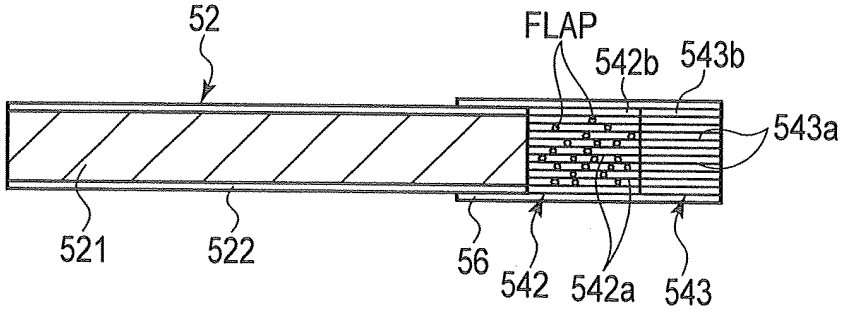

FIG. 4

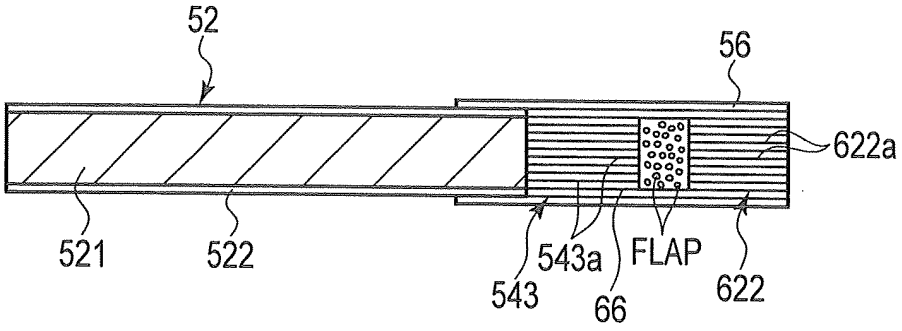

FIG. 5

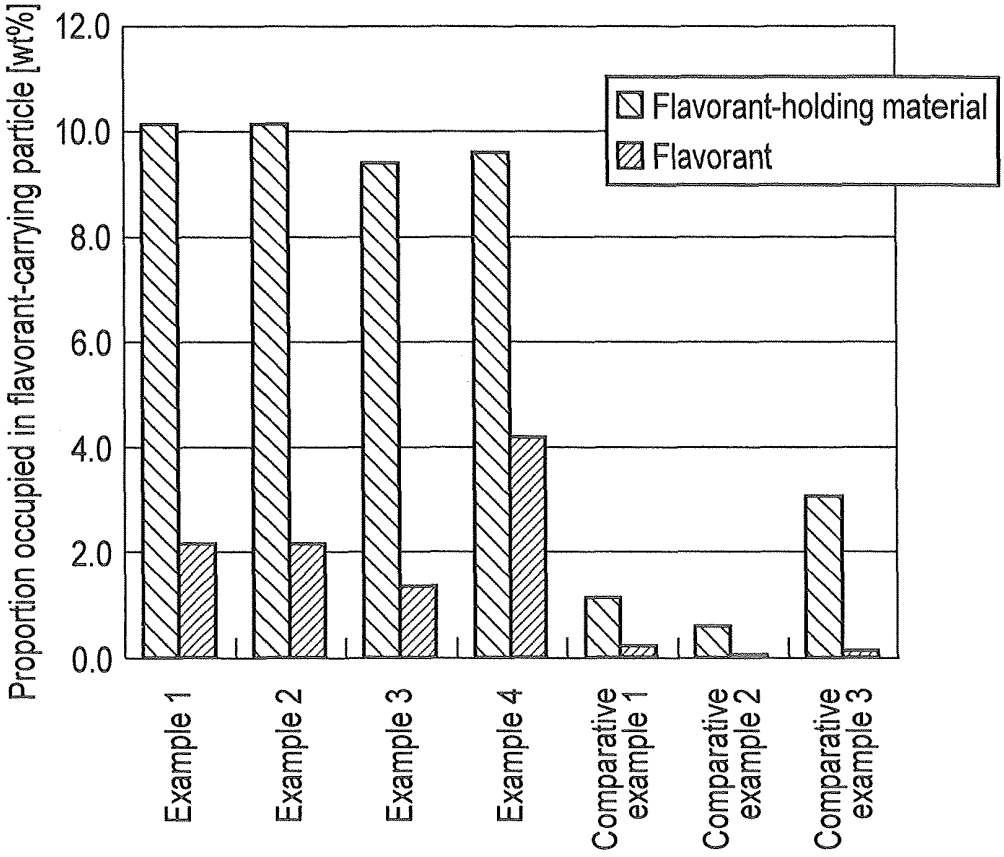
Proportion occupied in flavorant-carrying particle [wt%]
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Flavorant-holding material
Flavorant
Example 1
Example 2
Example 3
Example 4
Comparative example 1
Comparative example 2
Comparative example 3

FIG. 6

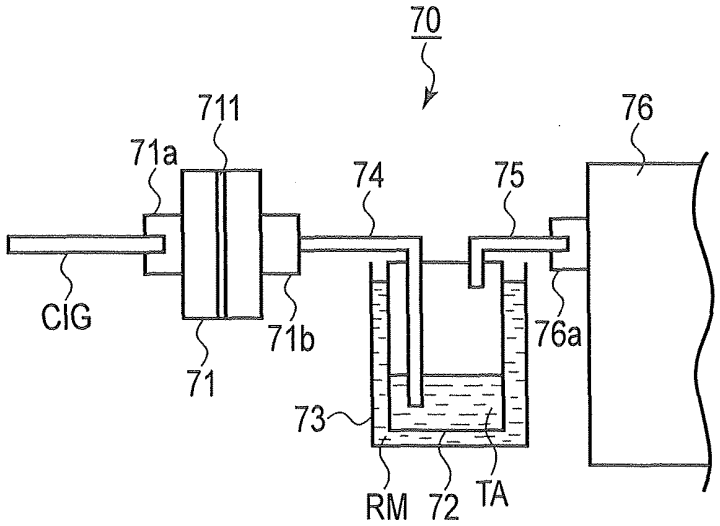
70
711
71a
74
75
76
CIG
71b
76a
71
73
RM
72
TA

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/067725

A. CLASSIFICATION OF SUBJECT MATTER
C11B9/00(2006.01)i, *A24D3/08*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C11B9/00, A24D3/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012
Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X Y	JP 2006-248832 A (Taiyo Kagaku Co., Ltd.), 21 September 2006 (21.09.2006), claim 1; paragraphs [0043], [0069] to [0076], [0086], [0095] (Family: none)	1-8 1-8

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 October, 2012 (05.10.12)	16 October, 2012 (16.10.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/067725

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	JP 2008-156791 A (Rengo Co., Ltd.), 10 July 2008 (10.07.2008), claims 1, 4; paragraph [0037]; examples & US 2009/0246525 A1 & EP 2042635 A1 & WO 2008/078682 A1	1-8
Y	JP 43-028077 B (Nippon Senbai Kosha), 08 December 1968 (08.12.1968), page 1, left column; page 2, left column (Family: none)	1-8
X Y	JP 2009-012996 A (Enex Co., Ltd.), 22 January 2009 (22.01.2009), claims 1, 4, 8; paragraph [0022]; example 6 (Family: none)	1,2,5-8 3,4
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- JP 2003071263 A **[0028]**
- JP 2003290641 A **[0028]**
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