

DESCRIPTION

DEODORIZING AEROSOL

5 TECHNICAL FIELD

[0001]

The present invention relates to a deodorizing aerosol having a highly fast-acting and long-lasting deodorizing effect.

10

BACKGROUND ART

[0002]

Deodorizers containing a deodorizing component have been on the market as a product for eliminating unpleasant odors in a toilet space. There are various known deodorizers for a toilet space, such as the mount type that is placed in the space and vaporizes and diffuses the deodorizing component and thereby exerts a long-lasting deodorizing effect, and the spray type that sprays the deodorizing component into the space. In particular, deodorizing aerosols are known as a deodorizer suitable for applications requiring a fast-acting effect, such as eliminating unpleasant odors after urination or defecation, and eliminating unpleasant odors in a public toilet room that stinks.

25 [0003]

Patent Document 1 discloses a deodorizing aerosol that

quickly diffuses a sufficient amount of chemical agent particles of a fragrance into a space to be treated (hereinafter simply referred to as a "treatment space"), and thereby masks unpleasant odors floating in the air by the scent of the fragrance to achieve a deodorizing effect, and
5 after deodorizing, allows the scent of the fragrance to quickly disappear.

CITATION LIST

10 PATENT LITERATURE

[0004]

Patent Document 1: International Publication
WO2017/073478

15 SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005]

However, the technique of quickly diffusing chemical agent particles into a treatment space and thereafter allowing
20 the scent of the fragrance to quickly disappear as disclosed in Patent Document 1, cannot have a sufficient deodorizing effect on unpleasant odors that are continuously generated, resulting in incomplete deodorization. A toilet room in a typical house or the like is a small space of about 2.5-3.5 m³,
25 and therefore, if an increased amount of chemical agent particles is released into such a treatment space, a user in

the treatment space strongly feels the fragrant smell of the chemical agent particles, and particularly, a consumer who does not like strong fragrant smells is likely to have an unpleasant feeling.

5 [0006]

With the above problem in mind, the present invention has been made. Embodiments of the present invention seek to provide a deodorizing aerosol that can exert a highly fast-acting and long-lasting deodorizing effect in a treatment
10 space, such as a toilet room.

SOLUTION TO PROBLEM

[0007]

According to an aspect of the present invention, there is provided a deodorizing aerosol comprising: a pressure-
15 resistant container equipped with a metering spray valve, the container containing a liquid aerosol-forming material including a deodorizing component and an organic solvent, and a propellant; and a spray button having a spray outlet connected to the metering spray valve. The deodorizing aerosol
20 is adjusted so that the spray volume by pushing the spray button once is 0.2-0.4 mL, and the spray force of the liquid aerosol-forming material sprayed by pushing the spray button once is 0.3-10.0 g·f as measured at a distance of 20 cm from the spray outlet at 25°C, the sprayed particles formed by
25 pushing the spray button and thereby spraying the liquid

aerosol-forming material in the pressure-resistant container, preferably have a particle size of 40-60 μm as measured at a distance of 15 cm from the spray outlet at 25°C, where the particle size is a d90 particle size in a cumulative volume distribution of the sprayed particles, and the volume ratio (a/b) of the liquid aerosol-forming material (a) to the propellant (b) contained in the pressure-resistant container is preferably 10/90-50/50.

[0008]

In toilet rooms, not only floating in the air of the treatment space are unpleasant odors, but also unpleasant odors are continuously generated from odor sources such as urine scattered and sticking to the wall surface, floor surface, etc. The present inventors have conceived that a deodorizing effect on odors in a toilet room can be improved by enhancing a deodorizing effect on odors generated from odor sources sticking to the wall surface, etc. With this in mind, the deodorizing aerosol of the present invention is configured so that 50 vol% or more of the liquid aerosol-forming material sprayed into the treatment space forms adhesive particles. The adhesive particles are a portion of the sprayed particles formed by spraying the liquid aerosol-forming material from the deodorizing aerosol into a treatment space of 2.5-3.5 m³ that adhere to an exposed portion (e.g., the floor surface, wall surface, and the like of a toilet space, and the surfaces of objects such as a toilet) of the treatment space in 60 minutes after spraying. Therefore, both an odor generated from an odor source sticking to an exposed portion and an odor floating in the air of the treatment space can be effectively eliminated, whereby the deodorizing effect on the entire

treatment space can be improved. In addition, even when sprayed particles (referred to as "suspendable particles") other than the adhesive particles are diffused throughout the treatment space, the concentration of the liquid aerosol-forming material in the treatment space is proportionately reduced by the adhesive particles. Therefore, a user in the treatment space inhales a very small amount of particles of the liquid aerosol-forming material, and can be inhibited from feeling an excessive fragrant smell from the liquid aerosol-forming material itself. In addition, the deodorizing aerosol of the present invention is adjusted so that the spray volume obtained by pushing the spray button once is 0.1-0.4 mL, and the spray force is 0.3-10.0 g·f as measured at a distance of 20 cm at 25°C. By thus adjusting the spray volume and spray force, adhesive particles having a suitable size can be formed, resulting in a superior deodorizing effect in a treatment space such as a toilet room.

[0009]

[0010]

By adjusting the particle sizes of the sprayed particles to the above optimum range, a portion of the sprayed particles are adhesive particle, and the other are suspendable
5 particles. Therefore, according to the deodorizing aerosol having this feature, both an odor floating in the air of the treatment space and an odor generated from an odor source sticking to an exposed portion can be eliminated.

[0011]

10

[0012]

According to the deodorizing aerosol having this feature, in the case where the volume ratio (a/b) of the liquid aerosol-forming material (a) to the propellant (b) is
15 in the above range, the adhesive particles and suspendable particles formed of the sprayed liquid aerosol-forming material are optimally balanced. As a result, the adhesive particles can reliably reach an exposed portion in the treatment space, and the suspendable particles can float in
20 the treatment space in an amount that does not produce an excessive fragrant smell which causes an unpleasant feeling. Thus, the adhesive particles and the suspendable particles are present in their respective optimum state and play their

respective roles to exert the effect of the deodorizing component to the extent possible.

[0013]

In the deodorizing aerosol of the present invention, the
5 organic solvent is preferably at least one selected from the group consisting of fatty acid esters having a total of 16-20 carbon atoms and alcohols.

[0014]

According to the deodorizing aerosol having this
10 feature, a higher fatty acid ester or an alcohol is used as the organic solvent so that the effect of each component can be efficiently exerted. In addition, when the liquid aerosol-forming material is sprayed, well-balanced adhesive particles and suspendable particles can be formed, resulting in a stable
15 deodorizing effect.

[0015]

In the deodorizing aerosol of the present invention, the deodorizing component preferably includes a plant extract and a harmonized fragrance.

20 [0016]

According to the deodorizing aerosol having this feature, an odor such as a urine or feces odor in a toilet room is harmonized with the harmonized fragrance, whereby the unpleasant odor can be perceived as a pleasant smell, i.e. a
25 sensory deodorizing effect can be obtained.

[0017]

In the deodorizing aerosol of the present invention, the

spray outlet preferably has an inner diameter of 0.2-1.0 mm.

[0018]

According to the deodorizing aerosol having this feature, in the case where the inner diameter is in the above
5 range, the balance between the adhesive particles and suspendable particles formed of the sprayed liquid aerosol-forming material is further optimized.

[0019]

In the deodorizing aerosol of the present invention, the
10 liquid aerosol-forming material preferably further includes leaf alcohol and/or leaf aldehyde.

[0020]

According to the deodorizing aerosol having this feature, by adding leaf alcohol and/or leaf aldehyde, which
15 are expected to have the relaxing effect of reducing fatigue and stress, and the like, the treatment space can be made more comfortable when the liquid aerosol-forming material is sprayed from the deodorizing aerosol into the treatment space.

[0021]

20 In the deodorizing aerosol of the present invention, the sprayed liquid aerosol-forming material is preferably diffused throughout the treatment space in 120 seconds or less.

[0022]

According to the deodorizing aerosol having this
25 feature, the sprayed liquid aerosol-forming material is diffused throughout the treatment space in 120 seconds or

less. Therefore, a highly fast-acting deodorizing effect can be exerted on both an odor residing near the ceiling and an odor residing near the floor within the period of time that a person normally occupies a toilet room.

5 [0023]

In the deodorizing aerosol of the present invention, the concentration of the liquid aerosol-forming material in the air preferably reaches 0.0007 ppm or more in 95% or more of the treatment space, in 120 seconds or less after spraying.

10 [0024]

According to the deodorizing aerosol having this feature, the concentration of the liquid aerosol-forming material in the air reaches 0.0007 ppm or more in 95% or more of the treatment space, in 120 seconds or less after spraying.

15 Therefore, the adhesive particles can be uniformly formed throughout the treatment space, i.e. from near the ceiling to near the floor.

[0025]

In the deodorizing aerosol of the present invention, the
20 treatment space is preferably a toilet room.

[0026]

According to the deodorizing aerosol having this feature, the adhesive particles adhere to exposed portions such as the wall surface, floor surface, toilet, and the like
25 of a toilet room, whereby a long-lasting deodorizing effect can be exerted on odors generated from odor sources sticking

to the exposed portions.

BRIEF DESCRIPTION OF DRAWINGS

[0027]

5 [FIG. 1] FIG. 1 is a diagram for describing a diffusion simulation of a deodorizing aerosol according to the present invention that was carried out, assuming that the deodorizing aerosol is sprayed into a treatment space of 3 m³.

10 DESCRIPTION OF EMBODIMENTS

[0028]

 A deodorizing aerosol according to the present invention is provided with: a pressure-resistant container equipped with a metering spray valve that contains a liquid aerosol-forming
15 material including a deodorizing component and an organic solvent, and a propellant; and a spray button having a spray outlet connected to the metering spray valve. When the spray button is pushed to spray the liquid aerosol-forming material contained in the pressure-resistant container, 50% by volume
20 (vol%) or more of the sprayed liquid aerosol-forming material can form adhesive particles. The adhesive particles refer to a portion of sprayed particles formed when the liquid aerosol-forming material is sprayed from the deodorizing aerosol into a treatment space of 2.5-3.5 m³, that adheres to any exposed
25 portions in the treatment space, within 60 minutes after spraying. The deodorizing aerosol of the present invention

will now be described. Note that the present invention is in no way intended to be limited to features described in embodiments and drawings described below.

[0029]

5 <Liquid Aerosol-Forming Material>

 [Deodorizing Component]

 The deodorizing component, which is one of the main components of the liquid aerosol-forming material, preferably contains a plant-derived deodorizing component and a
10 harmonized fragrance. The plant-derived deodorizing component reacts with a malodorous substance that produces an unpleasant odor, to exert a so-called chemical deodorizing effect. As such a plant-derived deodorizing component, extracts of *Forsythia viridissima*, ginkgo, fig, and the like are suitably
15 selected. These plant-derived deodorizing components can be used alone or in combination. In particular, a plant-derived deodorizing component that reacts with both an acid gas and an alkaline gas to neutralize the gases is preferably used. Alternatively, a mixture of a plant-derived deodorizing
20 component that neutralizes an acid gas and a plant-derived deodorizing component that neutralizes an alkaline gas may be used.

[0030]

 Harmonized fragrances are formulated in order to, when
25 complemented with unpleasant odors, such as urine and feces odors, as a constituent element of a scent, convert the

unpleasant odors into a pleasant smell (fragrant smell). Therefore, when a harmonized fragrance is sniffed in an environment where an unpleasant odor is present that has been designated a constituent element of a scent, the harmonized fragrance is perceived as a pleasant smell by a human, which is a sensory deodorizing effect. To reduce an unpleasant feeling caused by an unpleasant odor by means of the sensory deodorizing effect is represented by "to harmonize with an unpleasant odor".

10 [0031]

[Organic Solvent]

The organic solvent, which is another main component of the liquid aerosol-forming material, can dissolve the above deodorizing component for formulation of the liquid aerosol-forming material, and can form optimum particles when the formulated liquid aerosol-forming material is sprayed into a treatment space. Preferable examples of the organic solvent include higher fatty acid esters and alcohols. Examples of the higher fatty acid esters, which preferably have a total of 16-20 carbon atoms, include isopropyl myristate, butyl myristate, hexyl laurate, and isopropyl palmitate. Of them, isopropyl myristate is particularly preferable. Examples of the alcohols, which are preferably lower alcohols having 2 or 3 carbon atoms, include ethanol, isopropanol, and propanol. Of them, ethanol is particularly preferable. The organic solvent can be mixed with hydrocarbon solvents such as n-paraffin and

isoparaffin, glycol ethers having 3-6 carbon atoms, ketone solvents, etc.

[0032]

[Other Components]

5 The deodorizing aerosol of the present invention can include, in addition to the above components, fragrances, antifungal, antimicrobial, and microbicidal agents against molds, fungi, and the like, stabilizers, antistatic agents, defoamers, excipients, and the like, as appropriate, in the
10 liquid aerosol-forming material. For example, if the liquid aerosol-forming material contains a fragrance, the scent of the fragrance can mask unpleasant odors in the air of a treatment space. Examples of the fragrance include fragrant components, such as orange oil, lemon oil, lavender oil,
15 peppermint oil, eucalyptus oil, citronella oil, lime oil, yuzu oil, jasmine oil, cypress oil, green tea essential oil, limonene, α -pinene, linalool, geraniol, phenylethyl alcohol, amylcinnamic aldehyde, cuminaldehyde, and benzyl acetate, aroma components mixed with leaf alcohol (cis-3-hexenol) or
20 leaf aldehyde, called "green leaf volatiles," etc. By adding a fragrance to the liquid aerosol-forming material to provide the scent of a citrus, rose, lavender, or the like, consumers can have a pleasant feeling. In addition, by adding leaf alcohol, which is expected to have the relaxing effect of
25 reducing fatigue and stress, and the like, a toilet room can be made more comfortable when the deodorizing aerosol is

sprayed into the toilet room. Examples of the antifungal, antimicrobial, and microbicidal agents include hinokitiol, 2-mercaptobenzothiazole, 2-(4-thiazolyl)benzimidazole, 5-chloro-2-methyl-4-isothiazoline-3-one, triforine, 3-methyl-4-isopropylphenol, and ortho-phenylphenol.

[0033]

<Propellant>

Examples of the propellant used in the deodorizing aerosol of the present invention include liquefied petroleum gas (LPG), dimethyl ether (DME), nitrogen gas, carbonic acid gas, nitrous oxide, and compressed air. These propellants may be used alone or in combination. A propellant containing LPG as a main component is easy to use.

[0034]

In the deodorizing aerosol of the present invention, the volume ratio (a/b) of the liquid aerosol-forming material (a) to the propellant (b) is adjusted to 10/90-50/50. Within such a range, at least a portion of the liquid aerosol-forming material can be sprayed in the form of adhesive particles. As a result, adhesive particles can reliably reach an exposed portion in a treatment space, and suspendable particles can be suspended in the treatment space in an amount that does not provide an excessive fragrant smell which causes an unpleasant feeling. In addition, when both adhesive particles and suspendable particles are formed, an optimum balance therebetween is achieved. Thus, adhesive particles and

suspendable particles are present in their respective optimum states and play the respective roles to exert a deodorizing effect to the extent possible. If the volume ratio (a/b) is smaller than 10/90, i.e. the proportion of the propellant (b) contained in the pressure-resistant container is increased, sprayed particles of the liquid aerosol-forming material have an unnecessarily small size, so that the number of adhesive particles decreases. As a result, an insufficient number of adhesive particles adhere to an exposed portion in a treatment space, and therefore, an unpleasant odor that is continuously generated from an odor source sticking to the exposed portion cannot be sufficiently eliminated, likely leading to an insufficient long-lasting deodorizing effect. Meanwhile, if the volume ratio (a/b) is greater than 50/50, i.e. the proportion of the propellant (b) contained in the pressure-resistant container is decreased, it is difficult for the sprayed liquid aerosol-forming material to form adhesive particles and suspendable particles having particle sizes falling within optimum ranges, and therefore, the sprayed particles quickly settle after spraying. Therefore, suspendable particles floating in a treatment space are quantitatively insufficient, and therefore, it is difficult to quickly eliminate an unpleasant odor.

[0035]

25 <Deodorizing Aerosol>

As described above, the deodorizing component, the

organic solvent, the propellant, and other optional components to be mixed, are selected, and then contained in a pressure-resistant container, to produce an aerosol product. This aerosol product is the deodorizing aerosol of the present invention, which is used to spray the liquid aerosol-forming material into a treatment space. The liquid aerosol-forming material mainly includes the deodorizing component and the organic solvent. Although, strictly speaking, the liquid aerosol-forming material is separate from the propellant, the liquid aerosol-forming material is released together with the propellant from the pressure-resistant container, and therefore, in the description that follows, the contents of the aerosol including the liquid aerosol-forming material and the propellant may be collectively referred to as a "liquid aerosol-forming material."

[0036]

Here, the spray valve included in the deodorizing aerosol of the present invention will be described. The deodorizing aerosol of the present invention mainly includes a pressure-resistant container (aerosol container), a metering spray valve, and a spray button. The spray button, which is an actuator for spraying the liquid aerosol-forming material, is connected to the metering spray valve. The spray button has a spray outlet through which the liquid aerosol-forming material is sprayed out of the aerosol container (into a treatment space).

[0037]

When the spray button of the deodorizing aerosol is pushed once, the metering spray valve is actuated by the pressure of the propellant, and the liquid aerosol-forming material in the pressure-resistant container is lifted to the spray outlet and then sprayed into a treatment space. In this case, the spray volume is adjusted to 0.1-0.4 mL, more preferably 0.2-0.4 mL. Within such a range, at least a portion of the liquid aerosol-forming material is transformed into adhesive particles. In addition, when both adhesive particles and suspendable particles are formed, these are well balanced such that an optimum deodorizing effect can be exerted in the treatment space. If the spray volume is less than 0.1 mL, the spray volume is too small that an insufficient amount of adhesive particles adhere to an exposed portion in the treatment space, and therefore, it is difficult to eliminate an unpleasant odor that is continuously generated from an odor source sticking to the exposed portion. In addition, a small amount of suspendable particles are suspended, and therefore, an unpleasant odor floating in the air of the treatment space is not sufficiently eliminated. Meanwhile, if the spray volume is more than 0.4 mL, an unnecessarily large amount of the liquid aerosol-forming material is released into the treatment space, so that a consumer who does not like a strong fragrant smell is likely to have an unpleasant feeling. In addition, the amount of the liquid aerosol-forming material which is

consumed is excessively large, resulting in economic disadvantage.

[0038]

The deodorizing aerosol is adjusted to have a spray
5 force of 0.3-10.0 g·f as measured at a distance of 20 cm from
the spray outlet at 25°C. Within such a range, by spraying the
liquid aerosol-forming material once, adhesive particles
formed of the liquid aerosol-forming material are allowed to
smoothly reach an exposed portion in the treatment space,
10 whereby the effect of the deodorizing component can be quickly
exerted. Furthermore, the spray outlet preferably has an inner
diameter of 0.2-1.0 mm. Within such a range, the particle size
and the spray force can be suitably adjusted so that at least
a portion of the liquid aerosol-forming material can be
15 sprayed, into the treatment space, in the form of optimum
adhesive particles, and therefore, an unpleasant odor that is
continuously generated from an odor source sticking to an
exposed portion can be eliminated.

[0039]

20 The particle sizes of sprayed particles from the
deodorizing aerosol are preferably adjusted so that the 90%
particle size is 40-60 μm in the cumulative volume
distribution as measured at a spray distance of 15 cm at 25°C.
Within such a range, when the liquid aerosol-forming material
25 is sprayed into a treatment space of 2.5-3.5 m^3 , 50 vol% or

more of the sprayed liquid aerosol-forming material form adhesive particles, and a sufficient amount of adhesive particles can quickly move and adhere to an exposed portion in the treatment space. Therefore, an unpleasant odor that is continuously generated from an odor source sticking to an exposed portion can be eliminated by the deodorizing component of the adhesive particles. If the 90% particle size is less than 40 μm in the cumulative volume distribution as measured at a spray distance of 15 cm at 25°C, the particle sizes are too small that most of the particles cannot reach an exposed portion, i.e. a sufficient amount of adhesive particles are not formed. As a result, it is difficult to effectively eliminate an unpleasant odor that is continuously generated from an odor source sticking to an exposed portion. Meanwhile, if the particle sizes are more than 60 μm , the particle sizes are too large that the behavior of adhesive particles cannot be easily controlled, and therefore, it is difficult to cause adhesive particles to appropriately adhere to an exposed portion.

[0040]

Furthermore, the particle sizes of sprayed particles are more preferably adjusted so that the 10% particle size is 5 μm or less and the 50% particle size is 20-40 μm in the cumulative volume distribution as measured at a spray distance of 15 cm at 25°C. Sprayed particles having such a cumulative volume distribution have a broad particle size distribution

width. As a result, when the liquid aerosol-forming material is sprayed once from the deodorizing aerosol into a treatment space, adhesive particles having a relatively large particle size and suspendable particles having a relatively small particle size are formed.

[0041]

The suspendable particles have a particle size smaller than that of the adhesive particles. Therefore, when the liquid aerosol-forming material is sprayed into a treatment space, the suspendable particles can be quickly diffused to be suspended in the treatment space. Therefore, an unpleasant odor floating in the air of the treatment space can be eliminated by the deodorizing component of the suspendable particles. Thus, by adjusting the particle size to the above optimum range so that a portion of the sprayed liquid aerosol-forming material forms suspendable particles, the suspendable particles behave in a manner different from that of the adhesive particles, and can effectively eliminate an unpleasant odor together with the adhesive particles.

[0042]

<Diffusion Simulation>

FIG. 1 is a diagram for describing a diffusion simulation of the deodorizing aerosol of the present invention that was carried out, assuming that the deodorizing aerosol is sprayed into a treatment space of 3 m³. A technique of analyzing the concentration of a chemical agent that was

applied to the diffusion simulation of FIG. 1 will now be described.

[0043]

In order to analyze the concentration of a chemical agent (liquid aerosol-forming material), the state of diffusion of the chemical agent over time was output as a result of the analysis. Initially, an air flow calculation means was used to analyze spatial distributions of an air flow speed, a temperature, and the like until the spatial distributions became steady. Next, a chemical agent was output from an aerosol product, and the spatial distribution of the chemical agent concentration was predicted by steady-state analysis with a concentration calculation means using the analyzed air flow speed distribution, etc. In addition, changes in the concentration distribution over time were predicted by unsteady-state analysis.

[0044]

The air flow calculation means discretizes and numerically solves a three-dimensional advection-diffusion equation in simulation space using a finite difference method to obtain the velocity and direction of an air flow (the air flow speed and the air flow direction) and the temperature of air (also referred to as an "air flow state"). The air flow calculation means carries out iterative calculation by numerical analysis using a finite difference method at very short time intervals between adjacent grid points of each

small division region for the advection-diffusion equation including a k-ε turbulent model based on a Navier-Stokes equation where the motion elements, i.e. the speed, direction, and pressure, of an air flow are variables (including a
5 momentum transport equation (1), a turbulent energy transport equation (2), and a turbulent dissipation rate transport equation (3)), a heat quantity transport equation (4), and continuity equations (5)-(8), and when the air flow speed, air flow direction, air flow temperature, and air flow pressure
10 between each grid point settle into a predetermined equilibrium state, can designate the values at that time as predicted air flow speed data, predicted air flow direction data, and predicted air temperature data at each grid point.

(Momentum Transport Equation)

15 [0045]

Formula 1

$$\frac{\partial U_i}{\partial t} + U_j \frac{\partial U_i}{\partial X_j} = -\frac{\partial}{\partial X_j} \left(P + \frac{2}{3} k \right) + \frac{\partial}{\partial X_j} \left\{ \nu_i \left(\frac{\partial U_i}{\partial X_j} + \frac{\partial U_j}{\partial X_i} \right) + \frac{\partial U_j}{\partial X_i} \right\} - g \beta \Delta T \sigma_{i3} \quad (1)$$

(Turbulent Energy Transport Equation)

[0046]

20 Formula 2

$$\frac{\partial k}{\partial t} + U_j \frac{\partial k}{\partial X_j} = \frac{\partial}{\partial X_j} \left(\frac{\nu_t}{\sigma_1} \cdot \frac{\partial k}{\partial X_j} \right) + (P_k + G_k) - \varepsilon \quad (2)$$

(Turbulent Dissipation Rate Transport Equation)

[0047]

Formula 3

$$\frac{\partial \varepsilon}{\partial t} + U_j \frac{\partial \varepsilon}{\partial X_j} = \frac{\partial}{\partial X_j} \left(\frac{\nu_t}{\sigma_2} \cdot \frac{\partial \varepsilon}{\partial X_j} \right) + \frac{\varepsilon}{k} (C_1 P_k + C_3 G_k) - C_2 \frac{\varepsilon^2}{k} \quad (3)$$

(Heat Quantity Transport Equation)

[0048]

Formula 4

$$\frac{\partial T}{\partial t} + U_j \frac{\partial T}{\partial X_j} = \frac{\partial}{\partial X_j} \left(\frac{\nu_t}{\sigma_3} \cdot \frac{\partial T}{\partial X_j} \right) \quad (4)$$

(Continuity Equations)

[0049]

Formula 5

$$\frac{\partial U_i}{\partial X_i} = 0 \quad (5)$$

$$\nu_t = C_1 \rho \frac{k^2}{\varepsilon} \quad (6)$$

$$P_k = \nu_t \left(\frac{\partial U_i}{\partial X_j} + \frac{\partial U_j}{\partial X_i} \right) + \frac{\partial U_j}{\partial X_i} \quad (7)$$

$$G_k = -g\beta \frac{\nu_t}{\sigma_3} \cdot \frac{\partial T}{\partial X_j} \delta_{i3} \quad (8)$$

10 [0050]

C_1, C_2, C_3, C_t : constant

U_i : each component of the instantaneous air flow
velocity vector of an air flow

P : air flow pressure

15 ρ : air density

ν : kinematic viscosity coefficient

ν_t : eddy viscosity coefficient

k : turbulent energy

ε : turbulent dissipation rate

[0051]

The concentration calculation means discretizes and numerically solves a three-dimensional concentration diffusion domination equation about a chemical agent of interest in simulation space using a finite difference method to obtain a concentration distribution. Specifically, in the case where the air flow state (predicted air flow speed data, predicted air flow direction data, and predicted air temperature data) calculated at each grid point in the small division regions, and the amount of a diffused substance that is generated, are given, the concentration calculation means carries out iterative calculation by numerical analysis using a finite difference method at very short time intervals between adjacent grid points of each small division region for a concentration diffusion domination equation including a chemical agent (diffused substance) transport equation (9), and when the chemical agent concentration between each grid point settles into an equilibrium state, can designate the value at that time as a steady-state solution of predicted chemical agent concentration data at each grid point. Furthermore, by recording, in the course of the iterative calculation, the integrated value of the short time intervals, and the chemical agent concentration of each small division region at that time, at predetermined regular time intervals, an unsteady-state solution of predicted chemical agent concentration data can be determined. In addition, if the

amount of a diffused substance that is generated is made dimensionless, the predicted chemical agent concentration data can be predicted as a relative value corresponding to the amount of a diffused substance that is generated, instead of
 5 the absolute value.

(Diffused Substance Transport Equation)

[0052]

Formula 6

$$\frac{\partial C}{\partial t} + U_j \frac{\partial C}{\partial X_j} = \frac{\partial}{\partial X_j} \left(D_m \frac{\partial C}{\partial X_j} \right) + d \quad (9)$$

10 [0053]

U_j : each component of the instantaneous air flow velocity vector of an air flow

C : the concentration per unit volume of a diffused substance

15 d : the generation term of the diffused substance

D_m : diffusion coefficient

[0054]

As shown in FIG. 1(a), an object to be analyzed had a analysis shape in which a user 2, and a deodorizing aerosol 1
 20 with a spray outlet 1a facing diagonally upward, were placed in a treatment space of about 3 m³ (78 cm wide × 169 cm deep × 230 cm high). The analysis shape and the treatment space were divided into analysis grid squares.

[0055]

25 The analysis was carried out under conditions that the

air flow speed was set to 0 m/sec, and the influence of heat generation and temperature inside and outside the space were negligible. The spray volume per push through the spray outlet 1a of the deodorizing aerosol 1 was set to 0.2 mL. The spray force as measured at a distance of 20 cm from the spray outlet at 25°C was set to 2.9 g·f. When the liquid aerosol-forming material was sprayed, the spatial distribution of the concentration of the liquid aerosol-forming material diffused in the air was analyzed.

10 [0056]

FIG. 1(b) shows images of the results of the diffusion simulation showing the concentrations (ppm) of the liquid aerosol-forming material in the air 10 seconds, 30 seconds, 60 seconds, 120 seconds, and 170 seconds after the liquid aerosol-forming material was sprayed once from the deodorizing aerosol 1 into the treatment space. In each image of FIG. 1(b), a region where the concentration of the liquid aerosol-forming material in the air was 0.0007 ppm is indicated by the letter A. The result of the above analysis demonstrated that as shown in FIG. 1(b), after spraying, the liquid aerosol-forming material was quickly diffused, and had reached the ceiling surface and floor surface of the treatment space before 60 seconds passed after spraying, and had been diffused throughout the treatment space before 120 seconds passed after spraying. As used here, the term "diffused throughout a treatment space" refers to a state in which as shown in the

15
20
25

120-seconds-later image of FIG. 1(b), the concentration of the liquid aerosol-forming material in the air is 0.0007 ppm or more in 95% by volume of a treatment space. Incidentally, the time during which a person normally occupies a toilet room is about 5-15 minutes. Therefore, if the time it takes for the liquid aerosol-forming material to be diffused throughout a toilet space is 120 seconds, an unpleasant odor can be sufficiently eliminated within the period of time that a toilet room is used. Furthermore, 170 seconds after spraying, the liquid aerosol-forming material is diffused to the extent that the concentration thereof is uniform throughout the treatment space. Therefore, when a sufficient period of time has passed since spraying, adhesive particles have adhered to all surfaces of the treatment space including a wall surface, a floor surface, and a ceiling surface, and the state of the adhesion is maintained. As described above, the deodorizing component eliminates an unpleasant odor that is continuously generated from an unpleasant odor source sticking to an exposed portion.

[0057]

Meanwhile, the deodorizing component of the suspendable particles is gradually vaporized and diffused to eliminate an unpleasant odor floating in the air in the treatment space. In particular, unpleasant odors occurring in a toilet room include urine odors caused by ammonia and the like, and feces odors caused by hydrogen sulfide, methyl mercaptan, etc.

Ammonia is lighter than air, and therefore, tends to reside near the ceiling. Hydrogen sulfide and methyl mercaptan are heavier than air, and therefore, tend to reside near the floor. However, as shown in FIG. 1(b), the liquid aerosol-forming material sprayed from the deodorizing aerosol 1 is diffused throughout a treatment space in 120 seconds or less after spraying, and therefore, both an unpleasant odor residing near the ceiling and an unpleasant odor residing near the floor can be eliminated by the suspendable particles. Note that ammonia is alkaline gas, and hydrogen sulfide and methyl mercaptan are acid gas. If the liquid aerosol-forming material contains a deodorizing component(s) that can react with and neutralize both alkaline gas and acid gas, any kinds of malodorous substances can be chemically eliminated. The deodorizing component is preferably a mixture of a plant-derived deodorizing component that can react with and neutralize alkaline gas and a plant-derived deodorizing component that can react with and neutralize acid gas, or a plant-derived deodorizing component that can react with and neutralize both alkaline gas and acid gas.

[0058]

Thus, the deodorizing aerosol of the present invention provides two kinds of particles that are formed of the sprayed liquid aerosol-forming material and have different behaviors. These kinds of particles are present in their respective optimum states and play the respective roles to exert the

deodorizing effect to the extent possible. Thus, by utilizing the adhesive particles and the suspendable particles, a superior deodorizing effect can be exerted on both an unpleasant odor remaining in a treatment space and an unpleasant odor generated from an unpleasant odor source sticking to an exposed portion in the treatment space.

[0059]

Note that when a diffusion simulation was carried out under analysis conditions that the spray volume and spray force were set to be smaller than those in the diffusion simulation of FIG. 1, e.g. a model in which the spray volume per push was 0.1 mL, and the spray force as measured at a distance of 20 cm from the spray outlet at 25°C was set to 0.4 g·f, the result of the diffusion simulation demonstrated that the liquid aerosol-forming material was quickly diffused throughout the treatment space, like the diffusion simulation of FIG. 1. When the spray volume and spray force were set to be larger than those in the diffusion simulation of FIG. 1, e.g. a model in which the spray volume per push was 0.4 mL, and the spray force as measured at a distance of 20 cm from the spray outlet at 25°C was set to 7.0 g·f, the result of the diffusion simulation demonstrated that the liquid aerosol-forming material was quickly diffused throughout the treatment space, like the diffusion simulation of FIG. 1.

[0060]

As described above, by spraying the liquid aerosol-

forming material from the deodorizing aerosol of the present invention once into a treatment space of 2.5-3.5 m³, a highly fast-acting and long-lasting deodorizing effect is obtained. The space of 2.5-3.5 m³ is substantially equivalent to a toilet
5 space (80-85 cm wide × 140-180 cm deep × 230 cm high) in a typical house. Therefore, the deodorizing aerosol of the present invention can quickly eliminate an unpleasant odor and maintain the deodorizing effect for a long time in a toilet room of a typical house, etc. In addition, a portion of the
10 particles formed of the liquid aerosol-forming material sprayed from the deodorizing aerosol of the present invention into a treatment space are suspendable particles. Therefore, the concentration of the liquid aerosol-forming material (suspendable particles) diffused in the treatment space is
15 proportionately reduced by the adhesive particles, resulting in a low concentration in the treatment space. Therefore, a fragrant smell from the suspendable particles is reduced, so that the deodorizing aerosol of the present invention can be inhibited from causing a consumer who does not like a strong
20 fragrant smell to have an unpleasant feeling.

Examples

[0061]

<Measurement of Spray Force and Particle Size>

Deodorizing aerosols having a characteristic feature of
25 the present invention (Examples 1-3) were prepared, and their spray forces were measured. Furthermore, for the deodorizing

aerosol of Example 1, the particle sizes of sprayed particles were measured. The liquid aerosol-forming material of the deodorizing aerosol contained a total of 13.5 mL of a mixture of 1.35 g (10 w/v%) of a plant extract as a deodorizing component and 0.4 g (3 w/v%) of a harmonized fragrance, the balance being ethanol (anhydride) as an organic solvent.

[0062]

An aerosol can with a metering spray valve (0.2 mL/push) was loaded with 13.5 mL of the liquid aerosol-forming material and 31.5 mL of a propellant (main ingredient: LPG gas), where the inner pressure of the can was 0.46 MPa. Thus, a deodorizing aerosol having a total volume of 45 mL was prepared in which the volume ratio (a/b) of the liquid aerosol-forming material (a) to the propellant (b) was 30/70. This was Example 1.

[0063]

An aerosol can with a metering spray valve (0.1 mL/push) was loaded with 13.5 mL of the liquid aerosol-forming material and 31.5 mL of a propellant (main ingredient: LPG gas), where the inner pressure of the can was 0.35 MPa. Thus, a deodorizing aerosol having a total volume of 45 mL was prepared in which the volume ratio (a/b) of the liquid aerosol-forming material (a) to the propellant (b) was 30/70. This was Example 2.

[0064]

An aerosol can with a metering spray valve (0.4 mL/push)

was loaded with 13.5 mL of the liquid aerosol-forming material and 31.5 mL of a propellant (main ingredient: LPG gas), where the inner pressure of the can was 0.50 MPa. Thus, a deodorizing aerosol having a total volume of 45 mL was prepared in which the volume ratio (a/b) of the liquid aerosol-forming material (a) to the propellant (b) was 30/70. This was Example 3.

[0065]

Measurement of a spray force was carried out by pushing the spray button of the deodorizing aerosol of Example 1 once to spray toward the measurement surface of a tensilon (measuring device) located at a distance of 5 cm, 10 cm, and 20 cm from the spray outlet. The results of the measurement demonstrated that the spray force at a distance of 5 cm from the spray outlet was 3.2 g·f at 25°C, the spray force at a distance of 10 cm from the spray outlet was 3.2 g·f at 25°C, and the spray force at a distance of 20 cm from the spray outlet was 2.9 g·f at 25°C.

[0066]

Measurement of a spray force was carried out by pushing the spray button of each of the deodorizing aerosols of Examples 2 and 3 once to spray toward the measurement surface of a tensilon (measuring device) located at a distance of 20 cm from the spray outlet. The results of the measurement demonstrated that the spray force at a distance of 20 cm from the spray outlet of the deodorizing aerosol of Example 2 was

0.4 g·f at 25°C, and the spray force at a distance of 20 cm from the spray outlet of the deodorizing aerosol of Example 3 was 7.0 g·f at 25°C.

[0067]

5 Measurement of a particle size was carried out by a laser diffraction/scattering method at a distance of 15 cm from the spray outlet, where the spray button of the deodorizing aerosol of Example 1 was pushed once. The result of the measurement demonstrated that in the cumulative volume
10 distribution, the 10% particle size (Dv10) was 2.5 μm, the 50% particle size (Dv50) was 33.2 μm, and the 90% particle size (Dv90) was 53.4 μm.

[0068]

<Deodorization Effectiveness Test>

15 To verify the deodorizing effect of the deodorizing aerosol of the present invention, deodorizing aerosols (Examples 4 and 5) were produced and prepared in a manner similar to that of Example 1, and a deodorization effectiveness test was carried out using an olfactory
20 measurement method. In addition, for comparison, a deodorizing aerosol (Comparative Example 1) having components different from those of the present invention was prepared, and a similar deodorization effectiveness test was carried out.

[0069]

25 A deodorizing aerosol was produced using the same raw materials and production method as those of the deodorizing

aerosol of Example 1, except that a small amount of a citrus fragrance was added as a fragrance to the liquid aerosol-forming material. This was Example 4. A deodorizing aerosol was produced using the same raw materials and production method as those of the deodorizing aerosol of Example 1, except that a small amount of an orange fragrance was added as a fragrance to the liquid aerosol-forming material. This was Example 5.

[0070]

10 As Comparative Example 1, a conventional deodorizing aerosol was used that is commercially available and contains a fatty acid salt as a deodorizing component, a quaternary ammonium salt as a microbicidal component, and ethanol as an organic solvent.

15 [0071]

 In a deodorization effectiveness test, a predetermined amount of a malodorous substance that has odors imitating urine and feces odors was dispersed in a treatment space of 3 m³. Thereafter, the deodorizing aerosol was sprayed into the treatment space once. The odors in the treatment space were assessed by a panel of assessors using a 9-level pleasantness/unpleasantness display method immediately (0 minutes), 5 minutes, 10 minutes, 20 minutes, 30 minutes, and 60 minutes after spraying. Note that the deodorizing aerosol of Comparative Example 1 was an aerosol product that is not provided with a metering spray valve. Therefore, instead of

20

25

carrying out metering spray once, the deodorizing aerosol of Comparative Example 1 was continuously sprayed for one second according to the usage of Comparative Example 1. The sprayed amount was obtained by measuring the weight of the deodorizing aerosol before and after spraying, and calculating the difference in weight.

[0072]

In the 9-level pleasantness/unpleasantness display method, assessment criteria were employed that are compliant with the effectiveness test method specified by the Air Freshener & Deodorizer Conference, where "+4: extremely pleasant," "+3: very pleasant," "+2: pleasant", "+1: somewhat pleasant", "0: neither pleasant nor unpleasant," "-1: somewhat unpleasant," "-2: unpleasant," "-3: very unpleasant," "-4: extremely unpleasant." In the case where no deodorizing aerosol was used after the malodorous substance was dispersed, the assessment result was -3. The results (pleasantness/unpleasantness) of the deodorization effectiveness test on Examples 4 and 5 and Comparative Example 1 are shown in Table 1.

[0073]

Table 1

	Sprayed amount (g)	9-level pleasantness/unpleasantness display method					
		0 minutes later	5 minutes later	10 minutes later	20 minutes later	30 minutes later	60 minutes later
Example 4	0.127	+3	+3	+3	+2	+1	+1
Example 5	0.115	+4	+4	+3	+3	+2	+2
Comparative Example 1	1.981	0	+2	+1	-1	-2	-2

[0074]

The results of the deodorization effectiveness test demonstrated that in both of Examples 4 and 5, the assessment results were not lower than "+1: somewhat pleasant" during the entire period of time that the test was carried out. Specifically, in the case of the deodorizing aerosol of Example 4, a citrus scent was verified at all the assessment time points, i.e. 0 minutes, 5 minutes, and 10 minutes after spraying. The fragrant smell was not perceived 20 minutes or later after spraying, but the odors imitating urine and feces odors were harmonized. In the case of the deodorizing aerosol of Example 5, the orange scent was verified until 5 minutes after spraying. The scent gradually decreased from 10 minutes after spraying, but the odors imitating urine and feces odors were harmonized.

[0075]

Meanwhile, in the case of the deodorizing aerosol of Comparative Example 1, the odors imitating urine and feces odors were verified 0 minutes after spraying, and were not verified 5 minutes after spraying. However, the odors imitating urine and feces odors were verified again 10 minutes

after spraying, and thereafter, become gradually stronger until 60 minutes after spraying.

[0076]

Thus, the deodorizing aerosols of Examples 4 and 5, which are a product of the present invention, exerted a highly fast-acting and long-lasting deodorizing effect compared to Comparative Example 1, which is a commercially available product.

[0077]

10 <Chemical Deodorization Effectiveness Test>

A chemical deodorization effectiveness test was carried out on the deodorizing aerosols of Examples 1 and 4 using a device measurement method. The test method was compliant with the deodorization effectiveness test method specified by the Air Freshener & Deodorizer Conference. An unpleasant odor component (ammonia) was injected into and filled a 10-L plastic container, and thereafter, the deodorizing aerosol was sprayed once. The ammonia concentration in the container was measured before the deodorizing aerosol was sprayed, one hour after spraying, and 10 hours after spraying, using a gas detection tube, and an attenuation ratio was calculated one hour after spraying and 10 hours after spraying, using the following expression.

The attenuation ratio (%) = $100 - \{ \text{ammonia concentration after spraying (ppm)} / \text{ammonia concentration before spraying (ppm)} \} \times 100$

The results (attenuation ratio) of the chemical deodorization effectiveness test on Examples 1 and 4 are shown in Table 2.

[0078]

5 Table 2

	Ammonia attenuation ratio (%)	
	1 hour after spraying	10 hours after spraying
Example 1	66	87
Example 4	63	87

[0079]

The results of the chemical deodorization effectiveness test demonstrated that in both of Examples 1 and 4, the attenuation ratio as measured one hour after spraying was 60% or more, and the attenuation ratio as measured 10 hours after spraying further increased to 87%. Thus, the deodorizing aerosols of Examples 1 and 4 exerted a deodorizing effect that lasted for 10 hours after spraying.

15

INDUSTRIAL APPLICABILITY

[0080]

The deodorizing aerosol of the present invention is used in order to eliminate an unpleasant odor in a treatment space, and is preferably usable as a deodorizer for a toilet room, and is also usable for deodorizing living spaces, such as a living room, bedroom, doorway, kitchen, and bathroom.

20

REFERENCE SIGNS LIST

[0081]

	1	DEODORIZING AEROSOL
5	1a	SPRAY OUTLET

CLAIMS

1. A deodorizing aerosol comprising:

a pressure-resistant container equipped with a metering
5 spray valve, the container containing a liquid aerosol-forming
material including a deodorizing component and an organic
solvent, and a propellant; and

a spray button having a spray outlet connected to the
metering spray valve,

10 wherein

the deodorizing aerosol is adjusted so that the spray
volume by pushing the spray button once is 0.2-0.4 mL, and the
spray force of the liquid aerosol-forming material sprayed by
pushing the spray button once is 0.3-10.0 g·f as measured at a
15 distance of 20 cm from the spray outlet at 25°C,

the sprayed particles formed by pushing the spray button
and thereby spraying the liquid aerosol-forming material in
the pressure-resistant container, have a particle size of 40-
60 μm as measured at a distance of 15 cm from the spray outlet
20 at 25°C, where the particle size is a d90 particle size in a
cumulative volume distribution of the sprayed particles, and

the volume ratio (a/b) of the liquid aerosol-forming
material (a) to the propellant (b) contained in the pressure-
resistant container is 10/90-50/50.

25

2. The deodorizing aerosol of claim 1,
wherein

the organic solvent is at least one selected from the
5 group consisting of fatty acid esters having a total of 16-20
carbon atoms and alcohols.

3. The deodorizing aerosol of claim 1 or 2, wherein
the deodorizing component includes a plant extract and a
10 harmonized fragrance.

4. The deodorizing aerosol of any one of claims 1-3,
wherein
the spray outlet has an inner diameter of 0.2-1.0 mm.

15

5. The deodorizing aerosol of any one of claims 1-4,
wherein
the liquid aerosol-forming material further includes
leaf alcohol and/or leaf aldehyde.

20

6. The deodorizing aerosol of any one of claims 1-5,
wherein
the sprayed liquid aerosol-forming material is diffused
throughout the treatment space in 120 seconds or less.

25

7. The deodorizing aerosol of any one of claims 1-6,

wherein

the concentration of the liquid aerosol-forming material in the air reaches 0.0007 ppm or more in 95% or more of the treatment space, in 120 seconds or less after spraying.

5

8. The deodorizing aerosol of any one of claims 1-7, wherein the treatment space is a toilet room.