

DESCRIPTION

Title of Invention: WIPING SHEET AND METHOD FOR MANUFACTURING SAME

Technical Field

[0001]

5 The present invention relates to a wiping sheet and a method for manufacturing the same.

Background Art

[0002]

Various attempts have been made to enhance the functions and the like of a nonwoven fabric by forming a textured structure at a surface of the nonwoven fabric.

10 For example, Patent Literature 1 discloses a nonwoven fabric that is formed by accumulating polymeric fibers constituted by at least one of nanofibers and microfibers through electrospinning and that has minute protruding and depressed patterns at predetermined positions in a plane thereof. In this literature, there is a mention to the effect that, with this nonwoven fabric, the functions thereof are sophisticated due to the shape specificity provided by the minute protruding and depressed pattern structure, the cellular affinity, the materials' structural properties, and the like are improved, and
15 adjustment of the biofunctionality is also enabled.

[0003]

Patent Literature 2 discloses a nonwoven fabric containing ultrafine fibers of 1
20 dtex or less and with a surface thereof having protrusions and depressions. The surface of this nonwoven fabric includes fiber bundles in which a plurality of fibers are entangled and depressions that are located near the fiber bundles. Also, the number of ultrafine fibers in the fiber bundles is greater than the number of ultrafine fibers in the depressions. In this literature, there is a mention to the effect that this nonwoven fabric has excellent
25 bulkiness, is flexible, and has a soft tactile feel when touched by an object surface.

Citation List

Patent Literature

[0004]

Patent Literature 1: JP 2006-328562A

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Patent Literature 2: JP 2009-13544A

Summary of Invention

[0005]

The present invention provides a wiping sheet including a fiber aggregate in which at least first fibers and second fibers that have a smaller diameter than the first
10 fibers are contained and the first and the second fibers are entangled, the wiping sheet having a first surface that is used as a wiping surface and a second surface that is located on the opposite side to the first surface. The proportion of the second fibers that are present at the first surface is higher than the proportion of the second fibers that are present at the second surface. A plurality of protrusions are formed on the first surface
15 side. The proportion of the first fibers that are present in a top portion of each protrusion to all the fibers constituting the protrusion is higher than the proportion of the second fibers that are present therein. The proportion of the second fibers that are present in a base portion of each protrusion to all the fibers constituting the protrusion is higher than the proportion of the first fibers that are present therein.

20 [0006]

Also, the present invention provides, as a preferred method for manufacturing the above-described wiping sheet, a method for manufacturing a wiping sheet, the method including disposing a stacked body composed of a fiber aggregate of first fibers and a fiber aggregate of second fibers that have a smaller diameter than the first fibers such that
25 the fiber aggregate of the second fibers opposes a protrusion forming member that has a plurality of openings, and, in this state, directing water jets to the stacked body from the first-fiber fiber aggregate side to thereby entangle the first fibers and the second fibers and cause the fiber aggregates located at the openings to protrude into the openings.

Brief Description of Drawings

[0007]

[Fig. 1] Fig. 1 is an enlarged view of a relevant portion of a protrusion of a wiping sheet of the present invention.

5 [Fig. 2] Fig. 2 is a schematic illustration of an apparatus for manufacturing the wiping sheet of the present invention.

[Fig. 3] Fig. 3 is a plan view of an embodiment of a protrusion forming member used in the present invention.

[Fig. 4] Fig. 4 is an enlarged view of a relevant portion for illustrating a
10 manufacturing process of the wiping sheet of the present invention.

[Fig. 5] Fig. 5 is a cross-sectional view taken along line A-A in Fig. 3.

[Fig. 6] Fig. 6 is a plan view of another embodiment of the protrusion forming member used in the present invention.

[Fig. 7] Fig. 7 is an enlarged view (view corresponding to Fig. 4) of a relevant
15 portion for illustrating another manufacturing process of the wiping sheet of the present invention.

[Fig. 8] Fig. 8 is a cross-sectional view taken along line B-B in Fig. 6.

[Fig. 9] Fig. 9 is a graph showing frictional resistance values of wet wiping sheets of Example 1 and Comparative Example 1.

20 [Fig. 10] Fig. 10 is a graph showing frictional resistance values of dry wiping sheets of Example 2 and Comparative Examples 2 and 3.

Description of Embodiments

[0008]

A wiping sheet made of a nonwoven fabric is often used as an article for wiping
25 hard surfaces of flooring, furniture, and the like. Although Patent Literature 1 above discloses a technology related to a nonwoven fabric, the nonwoven fabric disclosed therein is intended for application to a medical device for regenerative medicine or the like, and no mention is made of the functionality of the nonwoven fabric when used for wiping or cleaning purposes.

[0009]

When the nonwoven fabric having the textured structure disclosed in Patent Literature 2 is used as a cleaning implement, since the nonwoven fabric contains fine fibers, frictional resistance between the nonwoven fabric and an object to be cleaned increases, and thus, the ease of operation of the nonwoven fabric during cleaning may be poor.

[0010]

Therefore, the present invention relates to a wiping sheet that reduces frictional resistance between the wiping sheet and an object to be wiped and that provides enhanced ease of operation during wiping.

[0011]

Hereinafter, a wiping sheet of the present invention will be described based on preferred embodiments thereof. “Wiping” as used in the present invention means both cleaning and wiping, and includes, for example, cleaning buildings, such as floor surfaces, wall surfaces, ceilings, and pillars; cleaning fixtures and fittings; wiping articles; wiping the body and body-related instruments; and the like.

[0012]

The wiping sheet of the present invention is composed of a fiber aggregate. Fibers constituting the fiber aggregate include at least first fibers and second fibers that have a smaller diameter than the first fibers. The first fibers and the second fibers form the fiber aggregate in which the first fibers are entangled with each other, the second fibers are entangled with each other, and the first fibers and the second fibers are entangled with each other. A wiping solution may be retained in this fiber aggregate. The wiping solution and a retaining method for the wiping solution will be described in detail later. Note that the term “wiping sheet” as simply used herein refers to a wiping sheet in which the wiping solution is retained or a wiping sheet in which the wiping

solution is not retained, depending on the context.

[0013]

A fiber aggregate used for a wiping sheet 10 is a composite fiber aggregate made up mainly of the first and the second fibers that are entangled. Here, a wiping surface of the wiping sheet 10 will also be referred to as a front surface or a first surface, and the surface opposite to the wiping surface will also be referred to as a back surface or a second surface.

[0014]

Fig. 1 is an enlarged view of a relevant portion of a vertical cross section of an embodiment of the wiping sheet of the present invention. As shown in Fig. 1, the wiping sheet 10 contains first fibers 20 and second fibers 40. Also, the wiping sheet 10 has a first surface 50Y and a second surface 50X that is located on the opposite side to the first surface 50Y. The first surface 50Y of the wiping sheet 10 is used as a wiping surface when the wiping sheet 10 is used. As shown in Fig. 1, a fiber aggregate of the second fibers 40, which have a small fiber diameter, is present on the upper side in Fig. 1, and this side is the wiping surface. Accordingly, the lower side in Fig. 1 is the opposite side to the wiping surface, that is, the back surface.

[0015]

The wiping sheet 10 protrudes from the second surface 50X side toward the first surface 50Y side, and thus, a protrusion 50A is formed. A plurality of protrusions 50A are formed in the direction of the plane of the wiping sheet 10. Each protrusion 50A has a shape in which the first surface 50Y of the wiping sheet 10 bulges from a flat surface 50Y'. On the second surface 50X side, a region corresponding to the protrusion 50A is depressed from a flat surface 50X' of the second surface 50X toward the first surface 50Y and forms a depression 50C. Depending on the method for manufacturing the wiping sheet 10, the entire second surface 50X may be a flat surface. Note that, in the present

specification, descriptions regarding the first surface 50Y (wiping surface) do not include the protrusions 50A.

[0016]

Each protrusion 50A is a solid protrusion with the inside thereof being filled with
5 the first fibers 20 and/or the second fibers 40. The shape and the size of the protrusions 50A may be the same or may be different. With consideration given to the ease of manufacture of the wiping sheet 10, it is preferable that the shape and the size of the protrusions 50A are the same.

[0017]

10 The protrusions 50A can be regularly or irregularly arranged on the first surface 50Y side of the wiping sheet 10. If the protrusions 50A are regularly arranged at the first surface 50Y, the protrusions 50A can be regularly arranged in, for example, a longitudinal direction and/or a width direction of the wiping sheet 10. In either case where the protrusions 50A are regularly arranged and irregularly arranged, forming the plurality of
15 protrusions 50A on the first surface 50Y or wiping surface side makes it possible to effectively reduce the frictional force between a surface to be wiped and the wiping sheet 10 during a wiping operation using the wiping sheet 10 and to facilitate the wiping operation.

[0018]

20 As shown in Fig. 1, in a vertical cross-sectional view of the wiping sheet 10, the first fibers 20 and the second fibers 40 are unevenly located. More specifically, in the wiping sheet 10, the proportion of the second fibers 40 that are present at the first surface 50Y, which is the wiping surface, is higher than the proportion of the second fibers 40 that are present at the second surface 50X, which is the surface opposite to the wiping surface.
25 Adopting this configuration, and forming the plurality of protrusions 50A on the first surface 50Y side, work together to make it possible to enhance the wiping effect provided

by the wiping sheet 10.

[0019]

As described above, in the wiping sheet 10, the proportion of the second fibers 40 that are present at the wiping surface is higher than the proportion of the second fibers 40 that are present at the surface opposite to the wiping surface. In addition, when
5 attention is paid to the first surface 50Y, which is the wiping surface, in a top portion 50T of each protrusion 50A formed on the first surface 50Y side, the proportion of the first fibers 20 that are present in the top portion 50T to all the fibers constituting that protrusion 50A is higher than the proportion of the second fibers 40 that are present
10 therein. On the other hand, in a base portion 50B of the protrusion 50A, the proportion of the second fibers 40 that are present in the base portion 50B to all the fibers constituting that protrusion 50A is higher than the proportion of the first fibers 20 that are present therein. Unexpectedly, it was found that as a result of the first and the second fibers 20 and 40 that constitute the protrusion 50A being present in the above-described
15 proportions, the frictional force between the surface to be wiped and the wiping sheet 10 can be effectively reduced.

[0020]

Preferably, the frictional force between the surface to be wiped and the wiping sheet 10 is such that the resisting force that acts when the surface to be wiped is wiped
20 with the wiping sheet 10 of a size of $10\text{ cm} \times 25\text{ cm}$ under a pressure of 55 N/m^2 is 10 N or less, more preferably 5 N or less, and even more preferably 4 N or less. There is no limitation on the lower limit value of the resisting force, and lower values are more preferable; however, if the resisting force is as low as about 0.8 N, the wiping operation can be smoothly performed.

25 [0021]

Specifically, the resisting force that acts during wiping is measured in the

following manner. An alligator clip is put on an end of a push-pull gauge (RX-20 manufactured by Aikoh Engineering Co., Ltd.), and a head portion of a Quickle Wiper (manufactured by Kao Corporation) with a 285 mm × 205 mm wiping sheet fitted thereto is attached to the clip. The maximum load that is recorded by the push-pull gauge when
5 the head portion is slid on a flooring (Konbitto New Advance 101 manufactured by Wood One Co., Ltd.) over a distance of 1 m at a speed of 1 cm/sec is measured as the resisting force.

[0022]

The above-described top portion 50T of a protrusion 50A refers to a region from
10 the top to $(1/3)H$ of the protrusion 50A, where H represents the height of the protrusion 50A. On the other hand, the base portion 50B of a protrusion 50A refers to a region from the flat surface 50Y' of the first surface 50Y to $(1/3)H$.

[0023]

From the standpoint of even more effectively reducing the frictional force
15 between the surface to be wiped and the wiping sheet 10, it is preferable that the proportions of the first fibers 20 and the second fibers 40 that are present in the top portion 50T of each protrusion 50A to all the fibers constituting the protrusion 50A are such that the proportion of the first fibers is three or more times the proportion of the second fibers in terms of the number of fibers. From the same standpoint, it is
20 preferable that the proportions of the first fibers 20 and the second fibers 40 that are present in the base portion 50B of each protrusion 50A to all the fibers constituting the protrusion 50A are such that the proportion of the second fibers is two or more times the proportion of the first fibers in terms of the number of fibers.

[0024]

25 The frictional force between the surface to be wiped and the wiping sheet 10 may also depend on the shape of the protrusions 50A. From the standpoint of even more

effectively reducing the frictional force, the width W of each protrusion 50A is preferably 400 μm or greater, more preferably 800 μm or greater, and even more preferably 900 μm or greater. Also, the width W is preferably 10 mm or less, more preferably 8 mm or less, and even more preferably 5 mm or less. The width W is preferably from 400 μm to 10 mm, more preferably from 800 μm to 8 mm, and even more preferably from 900 μm to 5 mm. As shown in Fig. 1, the width W is measured beginning at a position where the protrusion 50A starts rising from the flat surface 50Y' of the first surface 50Y of the wiping sheet 10. When attention is focused on a single protrusion 50A, if the width W of the protrusion 50A that is measured varies according to the direction, the above-described width W of the protrusion 50A refers to the greatest width that is measured. Also, when attention is focused on a plurality of protrusions 50A, if different protrusions 50A that are measured have different widths, the above-described width W of the protrusions 50A refers to an arithmetic mean value of the widths of the individual protrusions 50A that are measured.

15 [0025]

From the same standpoint, the height H of each protrusion 50A is preferably 110 μm or greater, more preferably 500 μm or greater, and even more preferably 900 μm or greater. Also, the height H is preferably 25 mm or less, more preferably 20 mm or less, and even more preferably 18 mm or less. The height H is preferably from 110 μm to 25 mm, more preferably from 500 μm to 20 mm, and even more preferably from 900 μm to 18 mm. As shown in Fig. 1, the height H is the distance from the flat surface 50Y' of the first surface 50Y of the wiping sheet 10 to the top of the protrusion 50A. When attention is focused on a plurality of protrusions 50A, if different protrusions 50A have different heights, the above-described height of the protrusions 50A refers to an arithmetic mean value of the heights of the individual protrusions 50A that are measured.

[0026]

The density with which the protrusions 50A are formed on the first surface 50Y side may also influence the frictional force between the surface to be wiped and the

wiping sheet 10. From the standpoint of even more effectively reducing the frictional force, it is preferable that, when a virtual circle having a diameter of 20 mm is drawn at any position on the first surface 50Y, the number of protrusions 50A that are located within the virtual circle is 10 or greater, more preferably 15 or greater, and even more preferably 20 or greater. Also, the number of protrusions 50A is preferably 60 or less, more preferably 50 or less, and even more preferably 40 or less. The number of protrusions 50A is preferably from 10 to 60, more preferably from 15 to 50, and even more preferably from 20 to 40.

[0027]

10 The wiping sheet 10 of the present invention may be in a dry form in which the wiping solution is not retained (hereinafter, this form may also be referred to as a “dry wiping sheet”) or in a wet form in which the wiping solution is retained (hereinafter, this form may also be referred to as a “wet wiping sheet”). If the wiping sheet 10 of the present invention is made as a wet wiping sheet, it is preferable that the wiping solution is retained in at least a fiber aggregate that is located on the second surface side. Note that when the wiping solution is retained in at least a fiber aggregate that is located on the second surface side, this means a form in which the wiping solution is contained in the fiber aggregate on the opposite side to the wiping surface, and this form also includes a form in which the wiping solution is also contained between gaps of a fiber aggregate on the wiping surface side. Note that, preferably, the greater amount of wiping solution is retained in the fiber aggregate on the opposite side to the wiping surface.

[0028]

In particular, if the wiping sheet 10 of the present invention is made as a wet wiping sheet, in addition to the plurality of protrusions 50A described above are formed, also the proportions of the first fibers 20 and the second fibers 40 that are present in the top portion 50T and the base portion 50B of each protrusion 50A, the width W and the height H of the protrusions 50A on the first surface 50Y side, and/or the density with which the protrusions 50A are formed satisfy the above-described specific ranges, the

effect of reducing the frictional resistance during wiping advantageously becomes even more profound.

[0029]

Considering that the wiping effect provided by the wiping sheet 10 can be even
5 further increased due to the combination with the formation of the plurality of protrusions
50A, and that, if the wiping sheet 10 is made as a wet wiping sheet 10, a large amount of
wiping solution can be stably retained, the percentage of the area occupied by the second
fibers at the wiping surface, of the surfaces of the wiping sheet 10 including the gaps, is
preferably from 40% to 99%, more preferably from 45% to 95%, and even more
10 preferably from 50% to 90%. On the other hand, the percentage of the area occupied by
the second fibers at the surface opposite to the wiping surface is preferably from 0% to
55%. The area occupied by the second fibers at the wiping surface is obtained by, for
example, measuring the area occupied by fibers having a small fiber diameter from an
image, or a photograph or the like, of the wiping surface. Hereinafter, the area occupied
15 by fibers can be obtained in a similar manner to that described above. Accordingly, the
area ratio is a value obtained by dividing the area occupied by the fibers by the area that is
to be measured. Note that, to express the area ratio in percentage (%), the area
percentage is 100 times the value obtained by the division.

[0030]

20 Here, for example, when the above-described area percentage is 99%, which is
the upper limit of the range from 40% to 99%, the remaining 1% is constituted by gaps.
The gaps are necessary in order for the wiping solution to be released to the wiping
surface when the wet wiping sheet 10 is used. By adjusting the proportion of these gaps,
especially in the case where the wet wiping sheet 10 is used, it is possible to suppress the
25 amount of wiping solution that is released to wipe dirt off the surface to be wiped to the
required amount, even if the wiping sheet is strongly rubbed against the surface to be
wiped. Moreover, as a result of setting the percentages of the areas occupied by the
second fibers at the wiping surface and the opposite surface in the above-described

manner, gaps are increased, and thus, the amount of wiping solution retained in the wet wiping sheet 10 increases. An excessively low percentage of the area occupied by the second fibers at the wiping surface results in more than the required amount of wiping solution being released. Therefore, the area that can be wiped decreases.

5 [0031]

In the wiping sheet 10, it is preferable that the percentage of the area occupied by the second fibers 40 in planes that are parallel to the wiping surface decreases in a stepwise manner or a curved manner, or in a combined manner, in the thickness direction toward the side opposite to the wiping surface. In particular, by setting the percentage of the area occupied by the second fibers 40 in a region spanning between 50% and 100% of the thickness of the wiping sheet 10 from the surface opposite to the wiping surface to be within a range from 50% to 100%, it is possible to increase the amount of wiping solution that is retained in the case of the wet wiping sheet 10. Here, the percentage of the region of the thickness where the percentage of the area occupied by the second fibers 40 is set to be within the range from 50% to 100% is preferably from 1% to 90%, more preferably from 5% to 70%, and even more preferably from 7% to 50%. Note that, by adopting the above-described preferred percentage of thickness, it is possible for the required amount of wiping solution to be released to wipe dirt off the surface to be wiped when the wiping sheet 10 is made as a wet wiping sheet. Note that, as shown in Fig. 1, the thickness of the wiping sheet 10 refers to the distance T from the surface opposite to the wiping surface to the top of a protrusion 50A.

[0032]

Here, in order to obtain information about the inside of the wiping sheet 10, a confocal laser microscope can be used. With the use of a confocal laser microscope, a spectrum of the inside of a specimen can be obtained, and, for example, the component distribution inside the specimen can be nondestructively observed through Raman imaging of the specimen in a depth direction.

[0033]

The wet wiping sheet 10 is composed of at least two layers, that is, a solution retaining layer that retains the wiping solution and a wiping solution release layer, and the wiping surface is included in the release layer. In particular, in order to enable a large amount of wiping solution to be retained, the percentage of the area occupied by the second fibers in the region spanning between 50% and 100% of the thickness of the wiping sheet 10 from the surface opposite to the wiping surface is set to be from 1% to 100%. With this configuration, the solution retaining layer can retain much of the wiping solution. On the other hand, the release layer is a portion including the wiping surface and excluding the solution retaining layer.

[0034]

In the wiping sheet 10, it is preferable that the capillary pressure on the wiping surface side is higher than that on the opposite side to the wiping surface. Thus, especially when the wiping sheet 10 is used as a wet wiping sheet, even if the wiping sheet is strongly rubbed during wiping, the amount of wiping solution that is released to wipe dirt off the surface to be wiped can be controlled to be the required amount. Therefore, even when a large area is to be wiped as in the case of a rug, a carpet, a floor, or the like, the necessity to replace the wiping sheet 10 with a new wiping sheet 10 in the middle of wiping can be eliminated, or the frequency of replacement can be reduced.

20 [0035]

Here, the capillary pressure is known to follow the relationship below:

$$P_c = 2k\gamma_L / r \times \cos\theta$$

where P_c represents the capillary pressure (N/m²) of a fiber aggregate, γ_L represents the surface tension (N/m) of a liquid, θ represents the contact angle (rad) of the liquid with fibers, r represents the fiber diameter (m), and k represents a correction factor.

[0036]

Pc derived from the equation above is a value using a summary statistic derived from measurement of a fiber aggregate. In order to measure Pc, the surface tension of a liquid, the fiber diameter, the contact angle of the liquid with fibers, and the correction factor need to be measured. The surface tension is an average value of ten measurements performed in an environment at 20°C and 65% R.H. using an automatic surface tensiometer, like a DY-200 manufactured by Kyowa Interface Science Co., Ltd., based on a plate method. With respect to the fiber diameter, 30 fibers are measured per observation under a scanning electron microscope with an observation magnification of 350, and an average value obtained by performing this measurement randomly at a total of five locations, that is, an average value of the diameters of 150 fibers is taken as the fiber diameter. The contact angle of a liquid with fibers is obtained by identifying constituent fibers of the fiber aggregate using Fourier transform infrared spectroscopy (FTIR) and measuring the contact angle on a resin plate having the same composition. Specifically, with the use of a fully-automatic contact angle meter, like a DMO-901 manufactured by Kyowa Interface Science Co., Ltd., a droplet of 1 μ L is deposited on the plate and the contact angle after a lapse of 3 seconds is measured, and an average value of measurements performed at five locations on the plate is taken as the contact angle. Note that, if the fibers are made of a plurality of materials, the contact angle is measured for each material in a similar manner, and, for the value that is used in computation of Pc, a weighted average value of the contact angles based on the surface area ratio between the fiber components is taken as θ in the equation above. With respect to the correction factor, determination of water absorptiveness according to the Klemm method specified in JIS P 8141 is performed, the weight of liquid absorbed is determined from the absorption height, and the determined weight absorbed is divided by the total of capillary cross sections constituting the nonwoven fabric, and thus, the capillary pressure Pc can be derived. The correction factor k is calculated from the thus determined Pc.

[0037]

As is clear from the equation above, the smaller the fiber diameter, the higher the

capillary pressure. In the wiping sheet 10, the capillary pressure on the wiping surface side is increased by reducing the fiber diameter.

[0038]

The wiping sheet 10 is constituted by at least two types of fibers having different
5 fiber diameters. The two types of fibers are each independently exemplified by polyester, polyamide, polyolefin, a cellulose fiber, and fibers made of various metals, glass, and minerals. Among these, polyester, polyamide, polyolefin, and a cellulose fiber are preferable.

[0039]

10 The polyester can be any polyester that has a structure in which the polymer main chain has an ester bond. Examples thereof include polyethylene terephthalate (PET), polytrimethylene terephthalate (PTT), polybutylene terephthalate (PBT), polyethylene naphthalate (PEN), and polybutylene naphthalate (PBN).

[0040]

15 The polyolefin is obtained from a monomer that has an ethylenically unsaturated group. Examples thereof include polyethylene, polypropylene, ethylene-propylene copolymers, polyvinyl acetate, ethylene-vinyl acetate copolymers, cyclic acetals of polyvinyl alcohol, acrylic resins (including acrylic resins and methacrylic resins), and polyvinyl chloride. As described above, the polyolefin may be a homopolymer or a
20 copolymer.

[0041]

The polyamide can be any polyamide that has a structure in which the polymer main chain has an amide bond. Examples thereof include polycondensation nylons such as nylon 6, nylon 11, and nylon 12, as well as co-condensation nylons such as nylon 66,
25 nylon 610, nylon 612, nylon 6T, nylon 6I, nylon 9T, and nylon M5T. Other examples

include polyamides obtained from a diamine component and a dicarboxylic acid component, which will be described below.

[0042]

Examples of the diamine component include aliphatic diamine compounds, such
 5 as tetramethylenediamine, pentamethylenediamine, 2-methylpentanediamine,
 hexamethylenediamine, heptamethylenediamine, octamethylenediamine,
 nonamethylenediamine, decamethylenediamine, dodecamethylenediamine,
 2,2,4-trimethyl-hexamethylenediamine, and 2,4,4-trimethylhexamethylenediamine.
 Other examples include alicyclic diamine compounds, such as
 10 1,3-bis(aminomethyl)cyclohexane, 1,4-bis(aminomethyl)cyclohexane,
 1,3-diaminocyclohexane, 1,4-diaminocyclohexane, bis(4-aminocyclohexyl)methane,
 2,2-bis(4-aminocyclohexyl)propane, bis(aminomethyl)decalin, and
 bis(aminomethyl)tricyclodecane. Yet other examples include diamine compounds
 having an aromatic ring, such as methaxylylenediamine, paraxylylenediamine,
 15 bis(4-aminophenyl)ether, paraphenylenediamine, and bis(aminomethyl)naphthalene.

[0043]

Examples of the carboxylic acid component include aliphatic dicarboxylic acid
 compounds, such as succinic acid, glutaric acid, pimelic acid, suberic acid, azelaic acid,
 adipic acid, sebacic acid, undecanedioic acid, and dodecanedioic acid. Other examples
 20 include phthalic acid compounds, such as isophthalic acid, terephthalic acid, and
 orthophthalic acid. Yet other examples include naphthalenedicarboxylic acid
 compounds, such as 1,2-naphthalenedicarboxylic acid, 1,3-naphthalenedicarboxylic acid,
 1,4-naphthalenedicarboxylic acid, 1,5-naphthalenedicarboxylic acid,
 1,6-naphthalenedicarboxylic acid, 1,7-naphthalenedicarboxylic acid,
 25 1,8-naphthalenedicarboxylic acid, 2,3-naphthalenedicarboxylic acid,
 2,6-naphthalenedicarboxylic acid, and 2,7-naphthalenedicarboxylic acid.

[0044]

These diamine components and dicarboxylic acid components as well as the nylons may be used alone or in combination, in each case.

[0045]

5 The cellulose fiber may be a natural fiber or a synthetic fiber, and examples of the synthetic fiber include acylated fibers, such as acetate of cellulose.

[0046]

Moreover, mixed fibers of these fibers, for example, polyethylene/polyethylene terephthalate, polypropylene/polyethylene terephthalate, and the like can also be used.

10 [0047]

In the present invention, among the aforementioned fibers, polyethylene terephthalate, polypropylene, acrylic resins, nylons, and cellulose fibers are more preferable. With regard to the acrylic resins (in particular, acrylic acid), those having a repeating unit obtained from an ester thereof or methacrylic acid or an ester thereof are
15 preferable.

[0048]

The fiber length of the fibers, that is, the average fiber length of all the fibers used in the present invention depends on the method for manufacturing the fibers, but is, in general, preferably from 1 to 100 mm, more preferably from 10 to 90 mm, and even
20 more preferably from 20 to 60 mm.

[0049]

The diameter of the first fibers 20 is preferably from 10 to 30 μm and more preferably from 15 to 25 μm . On the other hand, the diameter of the second fibers 40 is preferably from 0.1 to 9 μm and more preferably from 0.5 to 5 μm .

[0050]

Fibers having different fiber diameters may be composed of the same components or different components; however, in the present invention, it is preferable that these fibers are composed of the same components. Moreover, with respect to the
5 fiber length as well, fibers having different fiber diameters may have the same fiber length or different fiber lengths, but in the present invention, it is preferable that these fibers have the same fiber length.

[0051]

The basis weight of the fibers constituting the wiping sheet 10 is preferably from
10 1 to 100 g/m², more preferably from 5 to 50 g/m², and even more preferably from 10 to 30 g/m² on the wiping surface side. On the other hand, at the surface on the opposite side to the wiping surface, the basis weight is preferably from 10 to 50 g/m², more preferably from 15 to 30 g/m², and even more preferably from 20 to 25 g/m².

[0052]

15 In relation to the basis weight of the fibers constituting the wiping sheet 10, the thickness T of the wiping sheet 10 under a load of 40 Pa is preferably 1 mm or greater, more preferably 1.2 mm or greater, and even more preferably 1.5 mm or greater. Also, under the same load, the thickness T is preferably 5 mm or less, more preferably 4 mm or less, and even more preferably 3 mm or less. The thickness T of the wiping sheet 10
20 under a load of 370 Pa is preferably from 0.8 to 3 mm, more preferably from 0.9 to 2.8 mm, and even more preferably from 1 to 2.5 mm. When the thickness T of the wiping sheet 10 is set to be within this range, the wiping sheet 10 has sufficient stiffness and strength, and the ease of operation during wiping is favorable.

[0053]

25 In the present invention, it is preferable that, in particular, fibers having different fiber diameters are entangled without being fusion-bonded to each other. This increases

gaps between the fibers when compared with a case where the fibers are fusion-bonded to each other. As a result, if the wiping solution is retained in the wiping sheet 10, the amount of wiping solution that is retained increases.

[0054]

5 With respect to the wet wiping sheet 10, the amount of wiping solution that is released from the wiping surface to the surface to be wiped while wiping is performed once, that is, while the surface to be wiped is wiped once is preferably 0.5 g/tatami mat or greater, more preferably 0.7 g/tatami mat or greater, and even more preferably 1.0 g/tatami mat or greater. The upper limit of the release amount is realistically 8 g/tatami
10 mat or less, preferably 7 g/tatami mat or less, and more preferably 6 g/tatami mat or less. If the above-described release amount is excessively small, the surface cannot be sufficiently wiped, and if the release amount is excessively large, the wiping solution is likely to be left on the wiping surface. Here, a tatami mat is 1,820 mm × 910 mm in dimensions and has an area of 1.6552 m².

15 [0055]

 The conditions under which release behavior is measured are that the wiping load (load W) is 0.16 kN/m² and the wiping speed (speed V) is 1 m/s. If the wiping solution is retained in the wiping sheet of the present invention, the release amount per tatami mat when measured under these measurement conditions is within the
20 above-described range.

[0056]

 The maximum amount of wiping solution that can be retained in the wiping sheet 10, that is, the amount of wiping solution that is initially retained is preferably 1 g/sheet or greater, more preferably 10 g/sheet or greater, and even more preferably 12 g/sheet or
25 greater when the dimensions of a single wiping sheet 10 are 285 mm × 205 mm as will be described in examples later. The upper limit of the amount of wiping solution that is

initially retained is realistically 40 g/sheet or less, preferably 30 g/sheet or less, and more preferably 20 g/sheet or less.

[0057]

With this configuration, the target release amount, 1 g/tatami mat or greater, of
5 wiping solution that is released while wiping is performed once can be achieved, and furthermore, this release amount can be maintained for six or more tatami mats.

[0058]

The wiping solution used in the wiping sheet 10 is similar to those commonly
used in wet wiping sheets. That is to say, the wiping solution may be water alone or an
10 aqueous solution containing a surfactant. However, an aqueous solution containing a surfactant is preferable.

[0059]

The surfactant may be any of a nonionic surfactant, an amphoteric surfactant, a
cationic surfactant, and an anionic surfactant. For example, an anionic surfactant, such
15 as alkylbenzenesulfonic acid, or a nonionic surface activity, such as polyoxyethylene alkylether, can be used.

[0060]

The wiping solution may also contain an additive. Examples of the additive
include additives for enhancing the rinsing effect, such as polymers of acrylic acid,
20 methacrylic acid, or maleic acid or salts thereof, and copolymers of maleic acid and other vinyl monomers or salts thereof. Other examples include germicides, perfumes, aromatics, deodorizers, polishing particles, pH regulators, aqueous organic solvents such as alcohols, and the like.

[0061]

The amounts of the surfactant and the additive, such as those listed above, are within ranges that are commonly used for wet wiping sheets.

[0062]

Next, a preferred method for manufacturing the wiping sheet 10 shown in Fig. 1
5 will be described with reference to Figs. 2 to 8. Fig. 2 shows a manufacturing apparatus 1 that is suitably used to manufacture the wiping sheet 10. The manufacturing apparatus 1 is constituted by a web forming portion 2, an entanglement portion 3, an electrostatic spinning portion 4, and a protrusion forming portion 5.

[0063]

10 The web forming portion 2 forms a web of the first fibers 20. The web forming portion 2 includes a carding machine 21 for forming a web from the first fibers 20, which are the material of the wiping sheet 10.

[0064]

The entanglement portion 3 entangles the web of the first fibers 20 using water
15 jets. The entanglement portion 3 includes first water jet nozzles 31 that direct the water jets to the web of the first fibers 20, and a first support belt 32 formed of an endless belt. The first water jet nozzles 31 are located above the web of the first fibers 20 and the first support belt 32, and is configured to be able to direct high-pressure water jets over the entire area of the web of the first fibers 20 in a width direction thereof. The first support
20 belt 32 is disposed so as to oppose the first water jet nozzles 31, and has a structure (not shown) in which holes are formed in a lattice-like pattern or the like in order to allow the directed water to pass through. The entangled web of the first fibers 20 that are entangled by the water jets directed from the first water jet nozzles 31 is conveyed by the first support belt 32 to the electrostatic spinning portion 4.

25 [0065]

The electrostatic spinning portion 4 generates the second fibers 40, which are composed of nanofibers, through electrostatic spinning and deposits the second fibers 40 on one surface of the entangled web of the first fibers 20 that have been entangled by the water jet nozzles 31 in the entanglement portion 3. The electrostatic spinning portion 4 includes an ejecting portion 41 that ejects a raw material solution of the second fibers 40 to perform electrostatic spinning, and a collecting electrode 42 for collecting the ejected raw material solution as the second fibers 40. The ejecting portion 41 is constituted by a portion that supplies the raw material solution of the second fibers 40, an electrode, a voltage applying portion, and the like (these are not shown). A positive voltage or a negative voltage is applied to the ejecting portion 41. The collecting electrode 42 is disposed so as to oppose the ejecting portion 41. The collecting electrode 42 is composed of a conductive member and is grounded.

[0066]

When a voltage is applied to the ejecting portion 41, the raw material solution of the second fibers 40 is charged by electrostatic induction before being ejected from the ejecting portion 41, and is then ejected in the charged state. In the raw material solution ejected in the charged state, the self-repulsion of the raw material solution and the like occur due to the effect of the electric field, and thus, the second fibers 40 are generated as thin fibers at nano-size level (nanofibers). The generated second fibers 40 are randomly deposited onto one surface of the entangled web of the first fibers 20 that is travelling near the collecting electrode 42, and thus constitutes a fiber aggregate. A stacked body 50 of the fiber aggregates respectively composed of the first fibers 20 and the second fibers 40 is formed through this electrostatic spinning process. The obtained stacked body 50 is conveyed to the protrusion forming portion 5.

[0067]

As the raw material solution of the second fibers 40 used in electrostatic spinning, a solution in which a high molecular weight compound that composes the second fibers 40 is dissolved or dispersed in a solvent, or a melt obtained by melting a high molecular

weight compound can be used. The method that uses a solution in which a high molecular weight compound is dissolved or dispersed in a solvent can also be referred to as solution-type electrostatic spinning, and the method that uses a melt obtained by melting a high molecular weight compound can also be referred to as melt-type electrostatic spinning. In the present invention, either of these electrostatic spinning methods can be used.

[0068]

In the protrusion forming portion 5, water jets are directed to the stacked body 50 of the fiber aggregate of the first fibers 20 and the fiber aggregate of the second fibers 40 to entangle the first fibers and the second fibers and also form protrusions. The protrusion forming portion 5 is constituted by second water jet nozzles 51 that direct the water jets to the stacked body 50 from the first fibers 20 side, a protrusion forming member 52 that forms protrusions on the second fibers 40 side using the water jets, a second support belt 53 that is provided below the protrusion forming member 52, and a conveyance belt 54 that conveys the stacked body 50 in which the protrusions are formed to a downstream manufacturing step.

[0069]

As shown in Fig. 2, the second water jet nozzles 51 are located on the first fibers 20 side of the stacked body 50, and are configured to be able to direct the water jets over the entire area of the stacked body 50 in the width direction thereof. The protrusion forming member 52 is located below the stacked body 50, and is disposed so as to oppose the fiber aggregate of the second fibers. As shown in Fig. 3, a plurality of circular openings 52a are regularly formed throughout the protrusion forming member 52. The protrusion forming member 52 is not particularly limited as long as it has openings, and perforated metal, a plastic net, or the like can be used. Also, the shape of the openings 52a is not particularly limited, and, in addition to the circular shape shown in Fig. 3, an elliptical shape as well as polygonal shapes such as a triangle, a quadrangle, and a pentagon can also be adopted. The protrusion forming member 52 may be integrated

into the second support belt 53 by a means such as sewing or adhesion.

[0070]

As shown in Figs. 2 and 4, the water jets directed from the second water jet nozzles 51 to the surface 50X on the first fibers 20 side press the surface 50Y of the stacked body 50 on the second fibers 40 side against an upper surface of the protrusion forming member 52 so that the surface 50Y comes into close contact with that upper surface. Simultaneously, the water jets cause the fiber aggregates of the first fibers 20 and the second fibers 40 located at the openings 52a to protrude into the openings 52a, thereby forming a plurality of protrusions 50A. At this time, sifting of the first fibers 20 and the second fibers 40 occurs, and thus, in the top portion 50T of each protrusion 50A, the proportion of the first fibers 20 that are present in the top portion 50T to all the fibers constituting the protrusion 50A becomes higher than the proportion of the second fibers 40 that are present therein. Simultaneously, in the base portion 50B of each protrusion 50A, the proportion of the second fibers 40 that are present in the base portion 50B to all the fibers constituting the protrusion 50A becomes higher than the proportion of the first fibers 20 that are present therein. As a result of these steps, the stacked body 50 in which the plurality of protrusions 50A are formed can be obtained.

[0071]

As shown in Fig. 5, the width L of the openings 52a in the protrusion forming member 52 is preferably from 400 μm to 10 mm. With this width L, protrusions 50A that have favorable appearances and that can reduce the resistance during wiping can be formed in the stacked body 50.

[0072]

As shown in Fig. 5, the thickness T of the protrusion forming member 52 is preferably from 800 μm to 3 mm and more preferably from 900 μm to 2 mm. With the thickness within this range, favorable protrusions 50A can be formed in the stacked body

50.

[0073]

As another embodiment (hereinafter referred to as the second embodiment) of the protrusion forming portion 5, as shown in Figs. 6 and 7, in addition to the protrusion forming member 52, a second protrusion forming member 520 can also be used to form two types of protrusions, protrusions 50A and second protrusions 520A, in the stacked body 50 (hereinafter, the protrusions 50A of the second embodiment will also be referred to as the first protrusions 50A). In the second embodiment, as shown in Fig. 6, the second protrusion forming member 520 is disposed so as to be laid on top of the above-described protrusion forming member 52. In the second protrusion forming member 520, a large number of quadrangular openings 520a are regularly formed over the entire area thereof. As shown in Fig. 8, the width L_a of the quadrangular openings 520a is greater than the width L of the openings 52a of the protrusion forming member 52. In this manner, by using the two types of protrusion forming members 52 and 520 that are laid one on top of the other, it is possible to form large numbers of regularly-arranged first protrusions 50A and second protrusions 520A on the first surface 50Y side of the wiping sheet 10 (hereinafter also referred to as the wiping sheet 10' in the second embodiment), with shapes in which the first protrusions 50A bulge from top portions of the second protrusions 520A.

[0074]

According to the second embodiment, in which the two types of protrusion forming members 52 and 520 are used laid one on top of the other, on the first surface 50Y side of the wiping sheet 10', the wiping sheet 10' has the first protrusions 50A and the second protrusions 520A, which are composed of a macroscopic pattern (rhombus-shaped lattice-like pattern in the second embodiment) that is larger than the first protrusions 50A, and two-level steps are formed by the first protrusions 50A being located within the second protrusions 520A. In this case, in the top portion of each first protrusion 50A, the proportion of the first fibers 20 that are present in the top portion to

all the fibers constituting the first protrusion 50A is higher than the proportion of the second fibers 40 that are present therein, and in the base portion of each first protrusion 50A, the proportion of the second fibers 40 that are present in the base portion to all the fibers constituting the first protrusion 50A is higher than the proportion of the first fibers
5 20 that are present therein.

[0075]

In the second embodiment, in which the two types of protrusion forming members 52 and 520 are used laid one on top of the other, as shown in Fig. 7, the water jets that are directed from the second water jet nozzles 51 to the surface 50X on the first
10 fibers 20 side press the stacked body 50 against the second protrusion forming member 520 so that surface 50Y on the second fibers 40 side come into close contact with the second protrusion forming member 520. At this time, the first fibers 20 and the second fibers 40 enter the openings 520a, and thus, a plurality of second protrusions 520A that have a shape corresponding to the shape of the openings in the second protrusion forming
15 member 520 are regularly formed. Furthermore, the water jets directed from the second water jet nozzles 51 press the surface 50Y of the second protrusions 520A on the second fibers 40 side against the protrusion forming member 52 so that the surface 50Y comes into close contact with the protrusion forming member 52, and thus, a large number of first protrusions 50A are formed in the top portions of the second protrusions 520A in a
20 regularly arranged manner. With this configuration, in which a plurality of first protrusions 50A are formed bulging from the top portion of a single second protrusion 520A, the first protrusions 50A and the second protrusions 520A produce a shape in which there are two different levels of height. This process also enables a stacked body 50 in which a plurality of protrusions 50A are formed to be obtained as is the case with
25 the embodiment in which the protrusion forming member 52 is used alone.

[0076]

In the wiping sheet 10' of the second embodiment, which is obtained through the above-described process, the first protrusions 50A and the second protrusions 520A are

formed so as to protrude from the surface (second surface) 50X on the first fibers 20 side toward the surface (first surface) 50Y on the second fibers side. The first protrusions 50A and the second protrusions 520A have shapes that bulge from the flat surface of the first surface 50Y. Moreover, as described above, the first protrusions 50A are located
5 within the second protrusions 520A and have shapes that bulge from the top portions of the second protrusions 520A. With these shapes, protrusions in which there are two different levels of height when viewed from the flat surface of the first surface 50Y are formed. Depending on the method for manufacturing the wiping sheet 10' of the second embodiment, the entire area of the second surface 50X may constitute a flat surface, or
10 regions of the second surface 50X that correspond to the first protrusions 50A and the second protrusions 520A may be depressed.

[0077]

As shown in Fig. 8, the width La of the openings 520a in the second protrusion forming member 520 is preferably from 400 μm to 10 mm and more preferably from 420
15 μm to 8 mm. With this width La, second protrusions 520A that have favorable appearances and that can reduce the resistance during wiping can be formed in the stacked body 50.

[0078]

As shown in Fig. 8, the thickness T of the second protrusion forming member
20 520 is preferably from 600 μm to 4 mm and more preferably from 700 μm to 3 mm. With the thickness within this range, second protrusions 520A that have favorable appearances and that can reduce the resistance during wiping can be formed in the stacked body 50.

[0079]

25 Referring again to Fig. 2, finally, the stacked body 50 in which the protrusions 50A have been formed by the protrusion forming portion 5 is conveyed downstream from

the protrusion forming portion 5 by the conveyance belt 54, and thus, a desired dry wiping sheet 10 (or wiping sheet 10') can be obtained. Moreover, after the stacked body 50 in which the protrusions 50A have been formed by the protrusion forming portion 5 is conveyed downstream from the protrusion forming portion 5 by the conveyance belt 54, a
5 wiping solution can also be supplied to the stacked body 50 from a surface side of the wiping sheet 10 that corresponds to the second surface and thus retained in the stacked body 50. As a result of performing this step, a desired wet wiping sheet 10 (or wiping sheet 10') can be obtained.

[0080]

10 If a wet wiping sheet 10 (or wiping sheet 10') is to be manufactured, the amount of wiping solution that is retained in the wiping sheet is preferably 6 g/sheet or greater, more preferably 8 g/sheet or greater, and even more preferably 10 g/sheet or greater when the dimensions of a single wiping sheet are set to be 285 mm × 205 mm as will be described in examples below. The upper limit of the amount of wiping solution that is
15 contained in the wiping sheet is preferably 40 g/sheet or less, more preferably 30 g/sheet or less, and even more preferably 20 g/sheet or less. Spraying, application, dipping, and other methods can be adopted as the method for allowing the wiping solution to be retained in the wiping sheet.

[0081]

20 The thus manufactured wiping sheet 10 (or wiping sheet 10') can be used by itself, or while being fitted to a cleaning implement such as a wiper, to wipe buildings, such as floor surfaces and wall surfaces; fixtures and fittings, such as closets, windowpanes, mirrors, doors, and doorknobs; rugs and carpets; furniture, such as desks and tables; kitchens; toilets; and the body, and can also be used for sanitary products,
25 packaging, and the like.

[0082]

Although the present invention has been described above based on preferred embodiments thereof, the present invention is not limited to the foregoing embodiments. For example, in Fig. 2, the numbers, the water pressures, and the like of the first and the second water jet nozzles 31 and 51 may be the same or may be different.

5 [0083]

Moreover, although the wiping sheet 10 (or wiping sheet 10') of the foregoing embodiments contains the two types of fibers, the first and the second fibers, a wiping sheet may also be adopted which contains three or more types of fibers instead.

[0084]

10 In relation to the foregoing embodiment, the present invention further discloses the following wiping sheet and method for manufacturing the same.

<1> A wiping sheet comprising:

a fiber aggregate in which at least first fibers and second fibers that have a smaller diameter than the first fibers are contained and the first and the second fibers are entangled, the wiping sheet having a first surface that is used as a wiping surface and a second surface that is located on the opposite side to the first surface,

wherein a proportion of the second fibers that are present at the first surface is higher than a proportion of the second fibers that are present at the second surface,

a plurality of protrusions are formed on the first surface side,

20 a proportion of the first fibers that are present in a top portion of each protrusion to all the fibers constituting the protrusion is higher than a proportion of the second fibers that are present therein, and

a proportion of the second fibers that are present in a base portion of each protrusion to all the fibers constituting the protrusion is higher than a proportion of the first fibers that are present therein.

[0085]

<2> The wiping sheet as set forth in clause 1,
wherein the first fibers and the second fibers are entangled without being
fusion-bonded to each other.

5 <3> The wiping sheet as set forth in clause 1 or 2,
wherein the percentage of an area occupied by the second fibers at the first
surface is preferably from 40% to 99%, more preferably from 45% to 95%, and even
more preferably from 50% to 90%, and
the percentage of an area occupied by the second fibers at the second surface is
10 preferably from 0% to 55%.

<4> The wiping sheet as set forth in any one of clauses 1 to 3,
wherein the plurality of protrusions are regularly arranged.

<5> The wiping sheet as set forth in any one of clauses 1 to 4,
wherein regions corresponding to the protrusions on the second surface side are
15 depressed from a flat surface of the second surface toward the first surface and form
depressions.

<6> The wiping sheet as set forth in any one of clauses 1 to 4,
wherein the entire second surface constitutes a flat surface.

[0086]

20 <7> The wiping sheet as set forth in any one of clauses 1 to 6,
wherein the protrusions are solid protrusions filled with fibers inside.

<8> The wiping sheet as set forth in any one of clauses 1 to 6,
wherein the protrusions are solid protrusions filled with the first fibers and/or the
second fibers inside.

25 <9> The wiping sheet as set forth in any one of clauses 1 to 8,
wherein the protrusions are regularly arranged on the first surface side of the
wiping sheet.

<10> The wiping sheet as set forth in any one of clauses 1 to 9,
wherein the protrusions are regularly arranged in a longitudinal direction and/or

a width direction of the wiping sheet.

<11> The wiping sheet as set forth in any one of clauses 1 to 10,
wherein the protrusions have a width from 400 μm to 10 mm and a height from
110 μm to 25 mm.

5 [0087]

<12> The wiping sheet as set forth in any one of clauses 1 to 11,
wherein the protrusions have a width of more preferably 800 μm or greater, and
even more preferably 900 μm or greater, and the width W is more preferably 8 mm or less,
and even more preferably 5 mm or less.

10 <13> The wiping sheet as set forth in any one of clauses 1 to 12,
wherein, on the first surface side of the wiping sheet, the wiping sheet has the
protrusions and second protrusions composed of a macroscopic pattern that is larger than
the protrusions, and two-level steps are formed by the protrusions being located within
the second protrusions, and

15 in the top portion of each protrusion, the proportion of the first fibers that are
present in the top portion to all the fibers constituting the protrusion is higher than the
proportion of the second fibers that are present therein, and in the base portion of each
protrusion, the proportion of the second fibers that are present in the base portion to all
the fibers constituting the protrusion is higher than the proportion of the first fibers that
20 are present therein.

<14> The wiping sheet as set forth in clause 13,
wherein the protrusions are formed within top portions of the second protrusions
that are larger than the protrusions.

<15> The wiping sheet as set forth in clause 13,
25 wherein a plurality of the protrusions are formed within the top portion of each
second protrusion.

[0088]

<16> The wiping sheet as set forth in any one of clauses 1 to 15,

wherein the frictional force between the surface to be wiped and the wiping sheet is such that the resisting force that acts when the surface to be wiped is wiped with the wiping sheet of a size of 10 cm × 25 cm under a pressure of 55 N/m² is 10 N or less, more preferably 5 N or less, and even more preferably 4 N or less.

5 <17> The wiping sheet as set forth in any one of clauses 1 to 16,
wherein the proportions of the first fibers and the second fibers that are present in the top portion of each protrusion to all the fibers constituting the protrusion are such that the proportion of the second fibers is three or more times the proportion of the first fibers in terms of the number of fibers.

10 <18> The wiping sheet as set forth in any one of clauses 1 to 17,
wherein the proportions of the first fibers and the second fibers that are present in the base portion of each protrusion to all the fibers constituting the protrusion are such that the proportion of the second fibers is two or more times the proportion of the first fibers in terms of the number of fibers.

15 <19> The wiping sheet as set forth in any one of clauses 1 to 18,
wherein the first fibers and the second fibers are each independently made of polyester, polyamide, polyolefin, a cellulose fiber, various metals, glass, or a mineral, and among these, polyester, polyamide, polyolefin, and a cellulose fiber are preferable.

<20> The wiping sheet as set forth in any one of clauses 1 to 19,
20 wherein the first fibers and the second fibers are composed of the same components.

[0089]

<21> The wiping sheet as set forth in any one of clauses 1 to 20,
wherein the diameter of the first fibers is preferably from 10 to 30 μm and more
25 preferably from 15 to 25 μm.

<22> The wiping sheet as set forth in any one of clauses 1 to 21,
wherein the diameter of the second fibers is preferably from 0.1 to 9 μm and more preferably from 0.5 to 5 μm.

<23> The wiping sheet as set forth in any one of clauses 1 to 22,

wherein a wiping solution is retained at least in a fiber aggregate that is located on the second surface side.

<24> The wiping sheet as set forth in clause 23, comprising:

a release layer from which the wiping solution is released and a solution
5 retaining layer in which the wiping solution is retained, the release layer including the first surface.

[0090]

<25> The wiping sheet as set forth in any one of clauses 1 to 24,

wherein, when a virtual circle having a diameter of 20 mm is drawn at any
10 position on the first surface, from 10 to 60 of the protrusions are present within the virtual circle.

<26> The wiping sheet as set forth in any one of clauses 1 to 25,

wherein a basis weight of the fibers constituting the wiping sheet is from 1 to
100 g/m² on the wiping surface side.

15 <27> The wiping sheet as set forth in any one of clauses 1 to 26,

wherein a thickness of the wiping sheet under a load of 40 Pa is from 1 to 5 mm.

[0091]

<28> A method for manufacturing the wiping sheet as set forth in any one of clauses 1 to 27, the method comprising:

20 disposing a stacked body composed of a fiber aggregate of first fibers and a fiber aggregate of second fibers that have a smaller diameter than the first fibers such that the fiber aggregate of the second fibers opposes a protrusion forming member that has a plurality of openings, and, in this state, directing water jets to the stacked body from the first-fiber fiber aggregate side to thereby entangle the first fibers and the second fibers
25 and cause the fiber aggregates located at the openings to protrude into the openings.

<29> The method for manufacturing a wiping sheet according to clause 28,

wherein the fiber aggregate of the second fibers is formed through melt-type electrostatic spinning.

Examples

[0092]

Hereinafter, the present invention will be described in greater detail using examples. However, the scope of the present invention is not limited to the following
5 examples.

[0093]

Example 1

A wiping sheet 10 having the structure shown in Fig. 1 was manufactured using the manufacturing apparatus 1 and the protrusion forming member 52 shown in Figs. 2 to
10 5. A cotton blend containing PET, acryl, and rayon in a mass ratio of 7:1.5:1.5 and having an average diameter of 11.4 μm was used as the first fibers 20. Polypropylene obtained through electrospinning and having an average diameter of 1 μm was used as the second fibers 40. The basis weight of the first fibers 20 was 60 g/m^2 , and the basis weight of the second fibers 40 was 5 g/m^2 . The wiping sheet 10 was rectangular and had
15 dimensions of 285 mm $\times$ 205 mm and a thickness T of 1.6 mm. The protrusions 50A on the first surface 50Y side of the wiping sheet 10 had a height H of 0.7 mm and a width W of 2 mm. An average of 34 protrusions 50A were arranged within each virtual circle having a diameter of 20 mm. The percentage of the area occupied by the second fibers 40 at the first surface 50Y was 90%, and the percentage of the area occupied by the
20 second fibers 40 at the second surface 50X was 5%. The proportion of the first fibers 20 that were present in the top portion 50T of each protrusion 50A to all the fibers constituting the protrusion 50A was 2 times that of the second fibers 40 in terms of the area (had an area percentage of 67%), and the proportion of the second fibers 40 that were present in the base portion 50B of each protrusion 50A to all the fibers constituting the
25 protrusion 50A was 1.1 times that of the first fibers 20 in terms of the area (had an area percentage of 52%).

The wiping sheet 10 of the Example 1 was made as a wet wiping sheet by allowing a wiping solution to be retained therein. The wiping solution was retained at least in the fiber aggregate that was located on the second surface side. The amount of

wiping solution that was retained was 20 g/sheet. A 0.01 mass% aqueous solution of a surfactant (Emulgen 108 manufactured by Kao Corporation) was used as the wiping solution.

[0094]

5 Example 2

A wiping sheet was manufactured in a similar manner to that of Example 1, except that the wiping solution was not retained in the wiping sheet of Example 1. That is to say, the wiping sheet of Example 2 was a dry wiping sheet.

[0095]

10 Comparative Example 1

A Scotch-Brite (registered trademark) wet sheet for floor care manufactured by 3M was used as a wet wiping sheet. This wet wiping sheet was composed of fiber aggregates of small-diameter fibers and large-diameter fibers, but the protrusions of the present invention were not formed at its wiping surface.

15 [0096]

Comparative Example 2

A Scotch-Brite (registered trademark) wet sheet for floor care manufactured by 3M was dried for 24 hours in an environment at a temperature of 20°C and a relative humidity of 65% and used as a dry wiping sheet. This wiping sheet was composed of
20 fiber aggregates of small-diameter fibers and large-diameter fibers, but the protrusions of the present invention were not formed at its wiping surface.

[0097]

Comparative Example 3

A Super Fine adsorbent dry sheet manufactured by The Yamazaki Corporation
25 was used as a dry wiping sheet. This wiping sheet was composed of fiber aggregates of

small-diameter fibers and large-diameter fibers, but the protrusions of the present invention was not formed at its wiping surface.

[0098]

Evaluation

5 An area of 1.8 m² of a flooring (Konbitto New Advance 101 manufactured by Wood One Co., Ltd.) serving as the surface to be wiped was wiped with the wiping sheet of each of the examples and comparative examples under a pressure of 55 N/m², and the resisting force at that time was measured using the above-described method. Figs. 9 and 10 show the results.

10 [0099]

 A comparison between the resisting forces of Example 1 and Comparative Example 1, which were the wet wiping sheets, showed that, as shown in Fig. 9, the resisting force of Example 1 was 2.7 N, while the resisting force of Comparative Example 1 was 15.7 N. Based on these results, it can be seen that the wet wiping sheet 10 of
15 Example 1 has low frictional resistance during wiping and provides excellent ease of operation.

[0100]

 A comparison between the resisting forces of Example 2 and Comparative Examples 2 and 3, which were the dry wiping sheets, showed that, as shown in Fig. 10,
20 the resisting force of Example 2 was 1.8 N, while the resisting force of Comparative Example 2 was 2.2 N, and the resisting force of Comparative Example 3 was 4.1 N. Based on these results, it can be seen that the dry wiping sheet 10 of Example 2 has low frictional resistance during wiping and provides excellent ease of operation, as is the case with the wet wiping sheet 10 of Example 1.

25 [0101]

In particular, as is clear from the comparisons between Example 1 and Comparative Example 1 and between Example 2 and Comparative Example 2, it can be seen that the reduction in frictional resistance is profound if the wiping sheet of the present invention is used as a wet wiping sheet.

5 Industrial Applicability

[0102]

According to the present invention, a wiping sheet that has reduced frictional resistance during wiping and provides improved ease of operation during wiping, as well as a method for manufacturing the wiping sheet are provided.

CLAIMS

1. A wiping sheet comprising:
 - a fiber aggregate in which at least first fibers and second fibers that have a smaller diameter than the first fibers are contained and the first and the second fibers are
 - 5 entangled, the wiping sheet having a first surface that is used as a wiping surface and a second surface that is located on the opposite side to the first surface,
 - wherein a proportion of the second fibers that are present at the first surface is higher than a proportion of the second fibers that are present at the second surface,
 - a plurality of protrusions are formed on the first surface side,
 - 10 a proportion of the first fibers that are present in a top portion of each protrusion to all the fibers constituting the protrusion is higher than a proportion of the second fibers that are present therein, and
 - a proportion of the second fibers that are present in a base portion of each protrusion to all the fibers constituting the protrusion is higher than a proportion of the
 - 15 first fibers that are present therein.
2. The wiping sheet according to claim 1,
 - wherein the first fibers and the second fibers are entangled without being fusion-bonded to each other.
3. The wiping sheet according to claim 1 or 2,
 - 20 wherein the percentage of an area occupied by the second fibers at the first surface is from 40% to 99%, and
 - the percentage of an area occupied by the second fibers at the second surface is from 0% to 55%.
4. The wiping sheet according to any one of claims 1 to 3,
 - 25 wherein the plurality of protrusions are regularly arranged.

5. The wiping sheet according to any one of claims 1 to 4,
wherein regions corresponding to the protrusions on the second surface side are depressed from a flat surface of the second surface toward the first surface and form depressions.
- 5 6. The wiping sheet according to any one of claims 1 to 4,
wherein the entire second surface constitutes a flat surface.
7. The wiping sheet according to any one of claims 1 to 6,
wherein the protrusions are solid protrusions filled with fibers inside.
8. The wiping sheet according to any one of claims 1 to 6,
10 wherein the protrusions are solid protrusions filled with the first fibers and/or the second fibers inside.
9. The wiping sheet according to any one of claims 1 to 8,
wherein the protrusions are regularly arranged on the first surface side of the wiping sheet.
- 15 10. The wiping sheet according to any one of claims 1 to 9,
wherein the protrusions are regularly arranged in a longitudinal direction and/or a width direction of the wiping sheet.
11. The wiping sheet according to any one of claims 1 to 10,
wherein the protrusions have a width from 400 μm to 10 mm and a height from
20 110 μm to 25 mm.
12. The wiping sheet according to any one of claims 1 to 11,
wherein the protrusions have a width of 800 μm or greater and 8 mm or less.

13. The wiping sheet according to any one of claims 1 to 12,
wherein, on the first surface side of the wiping sheet, the wiping sheet has the
protrusions and second protrusions composed of a macroscopic pattern that is larger than
5 the protrusions, and two-level steps are formed by the protrusions being located within
the second protrusions, and
in the top portion of each protrusion, the proportion of the first fibers that are
present in the top portion to all the fibers constituting the protrusion is higher than the
proportion of the second fibers that are present therein, and in the base portion of each
10 protrusion, the proportion of the second fibers that are present in the base portion to all
the fibers constituting the protrusion is higher than the proportion of the first fibers that
are present therein.
14. The wiping sheet according to claim 13,
wherein the protrusions are formed within top portions of the second protrusions
15 that are larger than the protrusions.
15. The wiping sheet according to claim 13,
wherein a plurality of the protrusions are formed within the top portion of each
second protrusion.
16. The wiping sheet according to any one of claims 1 to 15,
20 wherein a resisting force that acts when a surface to be wiped is wiped with the
wiping sheet of a size of 10 cm × 25 cm under a pressure of 55 N/m² is 10 N or less.
17. The wiping sheet according to any one of claims 1 to 16,
wherein the proportions of the first fibers and the second fibers that are present
in the top portion of each protrusion to all the fibers constituting the protrusion are such
25 that the proportion of the second fibers is three or more times the proportion of the first

fibers in terms of the number of fibers.

18. The wiping sheet according to any one of claims 1 to 17,
wherein the proportions of the first fibers and the second fibers that are present
in the base portion of each protrusion to all the fibers constituting the protrusion are such
5 that the proportion of the second fibers is two or more times the proportion of the first
fibers in terms of the number of fibers.
19. The wiping sheet according to any one of claims 1 to 18,
wherein the first fibers and the second fibers are each independently made of
polyester, polyamide, polyolefin, a cellulose fiber, various metals, glass, or a mineral.
- 10 20. The wiping sheet according to any one of claims 1 to 19,
wherein the first fibers and the second fibers are composed of the same
components.
21. The wiping sheet according to any one of claims 1 to 20,
wherein the diameter of the first fibers is from 10 to 30 μm .
- 15 22. The wiping sheet according to any one of claims 1 to 21,
wherein the diameter of the second fibers is from 0.1 to 9 μm .
23. The wiping sheet according to any one of claims 1 to 22,
wherein a wiping solution is retained at least in a fiber aggregate that is located
on the second surface side.
- 20 24. The wiping sheet according to claim 23, comprising:
a release layer from which the wiping solution is released and a solution
retaining layer in which the wiping solution is retained, the release layer including the

first surface.

25. The wiping sheet according to any one of claims 1 to 24,
wherein, when a virtual circle having a diameter of 20 mm is drawn at any
position on the first surface, from 10 to 60 of the protrusions are present within the virtual
5 circle.
26. The wiping sheet according to any one of claims 1 to 25,
wherein a basis weight of the fibers constituting the wiping sheet is from 1 to
100 g/m² on the wiping surface side.
27. The wiping sheet according to any one of claims 1 to 26,
10 wherein a thickness of the wiping sheet under a load of 40 Pa is from 1 to 5 mm.
28. A method for manufacturing the wiping sheet according to any one of claims 1 to
27, the method comprising:
disposing a stacked body composed of a fiber aggregate of first fibers and a fiber
aggregate of second fibers that have a smaller diameter than the first fibers such that the
15 fiber aggregate of the second fibers opposes a protrusion forming member that has a
plurality of openings, and, in this state, directing water jets to the stacked body from the
first-fiber fiber aggregate side to thereby entangle the first fibers and the second fibers
and cause the fiber aggregates located at the openings to protrude into the openings.
29. The method for manufacturing a wiping sheet according to claim 28,
20 wherein the fiber aggregate of the second fibers is formed through melt-type
electrostatic spinning.