

Description

Title of Invention: WIPING SHEET

TECHNICAL FIELD

[0001]

5 The present invention relates to a wiping sheet.

BACKGROUND ART

[0002]

 Fibers made from thermoplastic resins are used in the form of nonwoven fabrics formed by fiber entanglement for multiple applications. For instance, patent literature 1
10 listed below discloses a nonwoven fabric composed of 20 to 80 mass% of flat multilobal cross-section polyester fiber and 20 to 80 mass% of cellulosic fiber. The nonwoven fabric is described as exhibiting high performance in absorption, retention, and release of fluids, such as water and chemicals, and having moderate bulkiness and flexibility and therefore useful as body cleaning wipes or for facial beauty care.

15 [0003]

 Patent literature 2 below discloses a wet cleaning sheet including a sheet substrate impregnated with a cleaning fluid, the sheet substrate including a mesh sheet and a fiber aggregate joined together by fiber entanglement. The wet cleaning sheet is three-dimensionally textured on its working side with raised portions and recessed
20 portions in a macroscopic pattern and described as having excellent hair capturing capabilities.

CITATION LIST

Patent Literature:

[0004]

25 Patent literature 1: WO 2014/132690 Pamphlet

Patent Literature 2: JP 2017-113282A

SUMMARY OF THE INVENTION

[0005]

The present invention relates to a wiping sheet having a macroscopic three-dimensionally textured pattern with raised portions and recessed portions formed on at least one side thereof and including a fiber aggregate containing modified cross-section
5 fibers (hereinafter referred to as profiled fibers) having a flat cross-section. The profiled fibers located in the recessed portions are aligned with their cross-sectional major axis generally parallel with the plane of the wiping sheet, and the profiled fibers located in the raised portions are aligned with their cross-sectional major axis generally parallel with a plane perpendicular to the plane of the wiping sheet.

10 BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

Fig. 1a and Fig. 1b are each a plan view of a cross-section of a profiled fiber used in the wiping sheet of the present invention.

15 Fig. 2 is a schematic plan of an embodiment of the wiping sheet of the present invention.

Fig. 3a is a scanning electron microscopic (SEM) image of a recessed portion of a wiping sheet made of profiled fibers having the cross-sectional shape shown in Fig. 1b. Fig. 3b is an SEM image of a raised portion of the wiping sheet.

20 Fig. 4a, Fig. 4b, Fig. 4c, Fig. 4d, and Fig. 4e are each an enlarged view of linear depressions formed in the wiping sheet of the present invention.

Fig. 5 is a schematic illustration of an apparatus that can be used suitably to produce the wiping sheet of the present invention.

Fig. 6 is a perspective view of an exemplary patterning member used in the apparatus shown in Fig. 5.

25 Fig. 7 schematically illustrates the cross-sectional orientation of the profiled fibers during manufacture of the wiping sheet.

Fig. 8a is a schematic view of a linear depression-forming member used in the apparatus of Fig. 5. Fig. 8b is a cross-section of the linear depression-forming member of Fig. 8a taken along line A-A.

30 DETAILED DESCRIPTION OF THE INVENTION

[0007]

The nonwoven fabric of patent literature 1 is intended for use in human body

cleansing or facial beauty treatment. Patent literature 1 has no mention of dust and debris trapping capabilities when the nonwoven fabric is used to wipe inanimate objects such as floors. The cleaning sheet of patent literature 2 has room for improvement in dust (fine particulate dirt) capturing capabilities.

5 [0008]

The present invention provides a wiping sheet that eliminates the problems of conventional techniques.

[0009]

10 The wiping sheet of the present invention will be described on the basis of its preferred embodiments. As used herein, the term “wiping” is used without limiting the objects to be wiped or cleansed. Examples of objects to be wiped include the interior of a building, including floors, walls, ceilings, and pillars; office and household equipment and fixtures; and human body and human body-related objects.

[0010]

15 The wiping sheet of the present invention includes a fiber aggregate containing profiled fibers, preferably composed mainly of profiled fibers. The profiled fibers are in a deposited, entangled, or bound state to form a fiber aggregate. The fibers making up the fiber aggregate may or may not be fused to one another. With a view to enhancing the degree of freedom of the fibers thereby to increase the dust capturing ratio of the fiber
20 aggregate, it is preferred for the fibers making up the fiber aggregate not to be fused to one another. The term “mainly” as used in the phrase “composed mainly of profiled fibers” as used above or “mainly comprising profiled fibers” as used in the appended claims means that the fiber aggregate constituting the wiping sheet contains profiled fibers in a proportion of at least 50 mass%.

25 [0011]

As far as a single fiber aggregate is concerned, the fiber aggregate that constitutes the wiping sheet of the present invention may have a single layer structure containing profiled fibers or a multilayer structure having a profiled fiber-containing layer and a profiled fiber-free layer. The wiping sheet of the present invention may also be

composed of a multilayered fiber aggregate having a layer containing first profiled fibers and a layer containing second profiled fibers different from the first ones.

[0012]

The wiping sheet of the present invention may be formed solely of a profiled fiber-containing single fiber aggregate (whether single layered or multilayered), or may have a multi-ply laminate structure having a first fiber aggregate containing profiled fibers and a second fiber aggregate containing no profiled fibers or a sheet material other than a fiber aggregate. The form of the fiber aggregate may be, for example, nonwoven fabric, woven fabric, or paper.

[0013]

When the wiping sheet of the present invention is formed of a single layered fiber aggregate, the proportion of profiled fibers in the wiping sheet is preferably at least 50 mass%, more preferably 60 mass% or more, even more preferably 70 mass% or more, in terms of ensuring both dust and fibrous matter (such as hair) capturing capabilities. The fibers that may be present in the wiping sheet of the present invention in addition to the profiled fibers are fibers having a circular cross-sectional shape (hereinafter called “non-profiled fibers”). In the case of the wiping sheet formed of a single layered fiber aggregate, the proportion of such non-profiled fibers is preferably 50 mass% or less, more preferably 40 mass% or less, even more preferably 30 mass% or less.

[0014]

As used herein, the term “profiled fiber” refers to a fiber having a flat shape in a transverse cross-section (hereinafter simply “cross-section”), a cross-section taken in a direction perpendicular to the lengthwise direction of the fiber. The term “flat shape” denotes a shape defined as follows. The longest dimension of line segments that run across the cross-section is taken as length A, and the longest dimension of line segments that run across the cross-section at right angles with the line segment having the length A is taken as length B. A shape having length A longer than length B is defined to be a flat shape. In short, a profiled fiber has a major axis and a minor axis in cross-section. The profiled fiber for use in the present invention is preferably symmetric about the line segment with the length A.

[0015]

A profiled fiber having such a flat cross-section is exemplified by a fiber having an elliptic cross-section shown in Fig. 1a and a fiber having a multilobal cross-section shown in Fig. 1b. For the profiled fiber with an elliptic cross-section shown in Fig. 1a, the length A corresponds to the major axis of the ellipse, and the length B the minor axis. The length A will hereinafter be called a major axis, and the length B a minor axis, irrespective of the cross-sectional shape of the profiled fiber. Use of the profiled fibers having such a cross-sectional shape allows the constituent fibers to show anisotropy in flexural stiffness so that the fiber aggregate exhibits improved fibrous matter (e.g., hair) trapping capabilities.

[0016]

More specifically, a profiled fiber shows in the cross-section a difference in flexural stiffness EI between a direction along the major axis (hereinafter “a major axis direction”) and a direction along the minor axis (hereinafter “a minor axis direction”). The flexural stiffness EI is represented by the product of the Young’s modulus E of the constituent material and the second moment of area I of the profiled fiber that is decided by the cross-sectional shape and size of the fiber. Since a profiled fiber is made of a single material and therefore has a constant Young’s modulus, the flexural stiffness of the profiled fiber depends on the second moment of area of the fiber. A profiled fiber has a greater second moment of area in its major axis direction and a smaller second moment of area in its minor axis direction. Therefore, the profiled fiber exhibits higher flexural stiffness when contacted on a surface being cleaned with its cross-sectional major axis direction substantially perpendicular to the surface being cleaned. As a result, the profiled fibers are capable of scouring the surface being cleaned and picking fibrous dirt on the surface. On the other hand, when the profiled fiber is contacted on a surface being cleaned with its cross-sectional minor axis direction substantially perpendicular to the surface being cleaned, the fiber shows a lower flexural stiffness and is therefore capable of entangling fibrous matter. Containing the profiled fibers, the wiping sheet thus exhibits effectively improved capabilities of capturing fibrous matter.

[0017]

As elaborated above, the angle between the cross-sectional major axis of the profiled fiber and the plane of the wiping sheet is of importance in terms of fibrous matter

capturing performance. Now, with a focus on the orientation of the cross-sectional major axis of the profiled fibers (hereinafter also referred to as the cross-sectional orientation), when 50% or more by number of the profiled fibers have their cross-sectional major axis making an angle smaller than 45° with the plane of the wiping sheet, the profiled fibers are defined as having their cross-sectional major axis generally parallel with the plane of the wiping sheet. When, on the other hand, 50% or more by number of the profiled fibers have their cross-sectional major axis making an angle of 45° or greater with the plane of the wiping sheet, the profiled fibers are defined as having their cross-sectional major axis generally parallel with a plane perpendicular to the plane of the wiping sheet.

[0018]

In order for the wiping sheet of the present invention to be capable of effectively trapping not only fibrous matter such as hair but dust (fine particulate dirt), the profiled fiber preferably has at least one, more preferably more than one, even more preferably more than two, lobes or convexities with a sharp vertex in its cross-section. A convexity having a sharp vertex may be delineated by (a) the intersection of two non-parallel straight lines, (b) the intersection of one straight line and one curved line, or (c) the intersection of two curved lines. For instance, the profiled fiber shown in Fig. 1b has eight sharp vertices. The sharp vertex preferably projects in a direction intersecting the major axis, particularly in a direction perpendicular to the major axis. One type of profiled fiber or a combination of two or more types of profiled fiber having different cross-sectional shapes may be used in the present invention. Examples of other profiled fibers having a sharp vertex include those having a convex polygonal shape, e.g., a triangular, tetragonal, pentagonal, or hexagonal shape; a star polygonal shape; and a W shape, in cross-section, provided that they have a specific major-to-minor axis ratio, i.e., A/B that will be elaborated later.

[0019]

With a view to enhancing dust capturing capabilities by increasing the specific surface area of constituent fibers as well as fibrous matter (e.g., hair) capturing capabilities even in using only one type of profiled fiber, the profiled fiber preferably has a cross-sectional shape of which the outer perimeter has a plurality of convexities P and a concavity R between adjacent convexities as illustrated in Fig. 1b.

[0020]

The wiping sheet of the present invention, which includes a fiber aggregate containing the above described profiled fibers, is a substantially rectangular sheet having a lengthwise direction X and a widthwise direction Y perpendicular to the lengthwise direction as illustrated in Fig. 2. As illustrated, the wiping sheet 1 has a macroscopic three-dimensional texture pattern on at least one side thereof, the macroscopic pattern having a curved portion. In order to capture fibrous matter (e.g., hair) and dust effectively, the wiping sheet 1 preferably has the macroscopic three-dimensional texture pattern having a curved portion on its working side (the side to be contacted with a surface to be wiped).

[0021]

As illustrated in Fig. 2, the wiping sheet 1 has on its one side recessed portions 3 and raised portions 4, which form the three-dimensional texture. The borderline between the recessed portion 3 and the raised portion 4 has a macroscopically curved portion. When the wiping sheet is so textured on its one side, the other side of the sheet is flat with no unevenness attributed to the macroscopic relief pattern on the working side.

[0022]

The macroscopic pattern of the three-dimensional texture is not limited to that illustrated in Fig. 2. Other examples of the macroscopic pattern include those illustrated in patent literature 2 and appropriate combinations of various figures, such as straight lines, curved lines, circles, and polygons. As used herein, the phrase “having a macroscopically curved portion” means that a part of the perimeter of a figure composing the texturing pattern is visually identifiable to be a curved line, the term “curved line” excluding curved lines defining micro-scale pores and curved lines defining drain apertures with a diameter of about 1.5 to 2 mm. From this viewpoint, the texturing pattern is preferably such that the individual raised portions 4 surrounded by the recessed portion 3 each have an area of at least 300 mm². Such a macroscopic texturing pattern provides another advantage of imparting aesthetic appeal.

[0023]

Since the profiled fibers making up the wiping sheet of the present invention

have a flat cross-sectional shape having a major and a minor axis, the profiled fibers are deposited with different cross-sectional orientation between the recessed portions 3 and the raised portions 4 of the macroscopic pattern. Specifically, the profiled fibers present in the recessed portions 3 are deposited with their plane of flatness parallel with the plane of the wiping sheet (the planar direction of the paper surface of Fig. 2), whilst those present in the raised portions 4 are deposited with their plane of flatness parallel with a plane perpendicular to the plane of the wiping sheet (the plane perpendicular to the paper surface of Fig. 2).

[0024]

To put it another way, the profiled fibers in the recessed portions 3 have their cross-sectional major axis generally parallel with the plane of the wiping sheet, and those in the raised portions 4 have their cross-sectional minor axis generally parallel with the plane of the wiping sheet. Thus, the wiping sheet has on its working side a plurality of portions having different flat plane directionality of the constituent profiled fibers. By this configuration, the wiping sheet exhibits both dust capturing capabilities owing to the high degree of freedom of the fibers and fibrous matter (e.g., hair) capturing capabilities owing to the stiffness of the fibers.

[0025]

When the profiled fibers are described as having their cross-sectional major axis generally parallel with the plane of the wiping sheet, it means that 50% or more by number of at least ten profiled fibers under observation have their cross-sectional major axis making an angle smaller than 45° with the plane of the wiping sheet. This cross-sectional orientation of the profiled fibers will hereinafter also be referred to as major axis orientation. When, on the other hand, the profiled fibers are described as having their cross-sectional major axis generally parallel with a plane perpendicular to the plane of the wiping sheet, it means that 50% or more by number of at least ten profiled fibers under observation have their cross-sectional major axis making an angle of 45° or greater with the plane of the wiping sheet. This cross-sectional orientation of the profiled fibers will hereinafter also be referred to as minor axis orientation.

[0026]

With the view of improving the dust trapping performance, the ratio of the number of the profiled fibers having their cross-sectional major axis parallel with the plane of the wiping sheet to the total number of the profiled fibers present in the recessed portions of the macroscopic pattern is preferably at least 50%, more preferably 60% or more, preferably 100% or less, more preferably 80% or less, and specifically preferably 50% to 100%, more preferably 60% to 80%.

[0027]

With the view of improving the fibrous matter (e.g., hair) trapping performance, the ratio of the number of the profiled fibers having their cross-sectional major axis parallel with a plane perpendicular to the plane of the wiping sheet to the total number of the profiled fibers present in the raised portions of the macroscopic pattern is preferably at least 50%, more preferably 60% or more, preferably 100% or less, more preferably 80% or less, and specifically preferably 50% to 100%, more preferably 60% to 80%. These ratios of fiber cross-sectional orientation can be calculated from the counts of the profiled fibers that meet the above definitions of orientation using a scanning electron microscope (SEM).

[0028]

The cross-sectional orientation of the profiled fibers can be determined by previously measuring the cross-sectional major and minor axis lengths of the profiled fiber, and measuring the fiber diameters of the profiled fibers of a wiping sheet as observed. The major axis length, minor axis length, and fiber diameter can be measured as described later using an SEM.

[0029]

Figs. 3a and 3b are each an SEM image of the working surface of a wiping sheet made of profiled fibers having the cross-sectional profile (major axis length: 20.0 μm , minor axis length: 9.0 μm) illustrated in Fig. 1b. The width as observed of a profiled fiber whose major axis makes 45° with the plane of the wiping sheet is $20.0 \mu\text{m} \times \cos 45^\circ = 14.1 \mu\text{m}$, which is used as a reference of cross-sectional orientation of profiled fiber. In the image of Fig. 3a, which shows the profiled fibers present in a recessed portion 3, 60% or more by number of the profiled fibers have widths exceeding the reference of

cross-sectional orientation, i.e., a majority of the profiled fibers show major axis orientation. On the other hand, in the image of Fig. 3b, which shows the profiled fibers 2 present in a raised portion 4, 70% or more by number of the profiled fibers have widths smaller than the reference of cross-sectional orientation, i.e., a majority of the profiled fibers show minor axis orientation.

[0030]

With the view to improving both dust capturing capabilities and capabilities of capturing fibrous matter (e.g., hair) on a wet surface being cleaned, it is preferred for the wiping sheet of the present invention to have not only the three-dimensional texture (recessed portions and raised portions) in a macroscopic pattern as illustrated in Fig. 2 but also a plurality of linear depressions 5 which are recessed from one surface of the wiping sheet toward the other surface of the wiping sheet. The plurality of linear depressions 5 extend straight in one direction. In the embodiment illustrated in Figs. 2 and 4a the plurality of linear depressions 5 extend parallel to the lengthwise direction X of the wiping sheet. With regard to the term “one direction” as used herein, the intended effect of the linear depressions 5 will be exerted when the angle between the individual linear depression 5 and a reference direction, e.g., the lengthwise direction X, is preferably 45° or smaller, more preferably smaller than 30° , even more preferably smaller than 20° .

[0031]

Arrangements illustrated in Figs. 4 of the linear depressions 5 other than the arrangement illustrated in Figs. 2 and 4a include (i) an arrangement in which adjacent linear depressions 5 in a line 5L of discrete linear depressions 5 extending along a reference direction, e.g., the lengthwise direction X (Fig. 4a) are symmetric about an axis 5S extending perpendicularly to the reference direction, e.g., in the widthwise direction Y (Fig. 4a) (see Figs. 4a, 4b, and 4c), (ii) an arrangement in which the individual linear depressions 5 in the line 5L extend in substantially the same direction (see Fig. 4d), and (iii) an arrangement in which two lines 5L of linear depressions 5 extending in the reference direction (e.g., the lengthwise direction X) and adjacent in a direction perpendicular to the reference direction (the widthwise direction Y) are symmetric about an axis 5A extending in the reference direction (the lengthwise direction X) (see Fig. 4c). These arrangements may be used in combination as long as the effects of the present invention are produced.

[0032]

The wiping sheet 1 of Fig. 2 has a plurality of the linear depressions 5 lined up at a spacing along their longitudinal direction (the lengthwise direction X) to make a plurality of lines of linear depressions 5 spaced in the widthwise direction Y of the wiping sheet 1. The individual linear depressions 5 may have the same or different lengths. The spacing between adjacent lines of linear depressions 5 may be regular or irregular. In the embodiment shown in Fig. 2, a plurality of lines of linear depressions 5 composed of a plurality of linear depressions 5 equal in length are arranged at a substantially regular spacing, and both ends of the linear depressions 5 adjacent in the direction perpendicular to their longitudinal direction are aligned in the direction X.

[0033]

The linear depressions 5 may be formed on either one of or both sides of the wiping sheet. When the linear depressions 5 are formed on the macroscopically patterned, three-dimensionally textured side, they may be formed over the entire area of that side or in only the recessed portions 3 or the raised portions 4. When the linear depressions 5 are formed on one side of the wiping sheet, the other side may have projections complementary to the linear depressions 5 or may be flat.

[0034]

With the view to improving dust capturing performance as well as fibrous matter (e.g., hair) capturing performance, the linear depressions 5 are preferably formed from the three-dimensionally textured side toward the other side and more preferably formed in only the raised portions of the macroscopic texturing pattern.

[0035]

The profiled fibers around the individual linear depressions 5 have different cross-sectional orientation from those in other regions as will be described below. The wiping sheet having the linear depressions 5 exhibits good performance in both dust and fibrous matter (e.g., hair) capturing capabilities. The wiping sheet having the linear depressions 5 exhibits particularly improved performance in catching up fibrous matter such as hair when used to clean wet surfaces in, for example, a changing room in proximity to a bathroom, a wash room, or a kitchen. Referring to Fig. 4e, a region

located between two linear depressions 5 and 5 adjacent in a direction perpendicular to the longitudinal direction of the linear depressions 5 is designated a first region 7. The profiled fibers present in a first region 7 have their cross-sectional major axis parallel with a plane perpendicular to the plane of the wiping sheet. That is, the profiled fibers present in first regions 7 have minor axis orientation.

[0036]

While the profiled fibers in the first regions 7 have the above discussed cross-sectional orientation, the ratio of the profiled fibers having their cross-sectional major axis parallel with a plane perpendicular to the plane of the wiping sheet 1 in the first regions 7 is higher than that in the raised portions 4 of the macroscopic pattern. That is, the profiled fibers in the first regions 7 have higher minor axis orientation than those in the raised portions 4 of the macroscopic pattern.

[0037]

More specifically, the profiled fibers in the first regions 7 preferably has a ratio by number of the profiled fibers having their cross-sectional major axis parallel with a plane perpendicular to the plane of the wiping sheet 1 of 50% or higher, more preferably 60% or higher, preferably 100% or lower, more preferably 80% or lower, and specifically preferably 50% to 100%, more preferably 60% to 80%. The ratio of fiber cross-sectional orientation can be calculated through SEM observation as described above.

[0038]

When the wiping sheet has a substantially rectangular shape with a size of 285 mm by 205 mm as in Example given later, the individual linear depressions 5 preferably have a length L1 (Fig. 4e) of 1 mm or greater, more preferably 3 mm or greater, and 50 mm or smaller, more preferably 20 mm or smaller, and a width W1 (Fig. 4e) of 0.1 mm or greater, more preferably 0.5 mm or greater, and 10 mm or smaller, more preferably 5 mm or smaller. With the same shape and size of the wiping sheet as above, the linear depressions 5 preferably have a depth, in the sheet thickness direction, of 0.01 mm or greater, more preferably 0.1 mm or greater, and 5 mm or smaller, more preferably 2 mm or smaller.

[0039]

With the same shape and size of the wiping sheet as above, the distance L2 (Fig. 4e) between two linear depressions 5 and 5 adjacent in the direction perpendicular to the longitudinal direction of the linear depressions 5 is preferably 0.1 mm or greater, more preferably 0.5 mm or greater, and preferably 30 mm or smaller, more preferably 10 mm or smaller. With the same shape and size of the wiping sheet as above, the distance L3 (Fig. 4e) between two linear depressions 5 and 5 adjacent in the longitudinal direction of the linear depressions 5 is preferably 0.1 mm or greater, more preferably 0.5 mm or greater, and preferably 30 mm or smaller, more preferably 10 mm or smaller.

10 [0040]

The extending directions of the profiled fibers making up the wiping sheet 1 will then be discussed. A region located between two linear depressions 5 and 5 adjacent in the longitudinal direction of the linear depressions 5 is designated a second region 8 (Fig. 4e). It is preferred that the profiled fibers present in the first regions 7 be more aligned along the linear depressions 5 than those present in the second regions 8. In Fig. 4e the profiled fibers present in the first regions 7 have a higher ratio of alignment in the longitudinal direction of the linear depressions 7, i.e., the lengthwise direction X than those present in the second regions 8. When slid on a surface to be cleaned in the widthwise direction Y, the wiping sheet having the profiled fibers aligned as described above achieves an increased contact area between the surface of the profiled fibers and the surface to be cleaned thereby to more easily pick up dust and fibrous matter (e.g., hair) from the surface being cleaned. The wiping sheet thus exhibits improved dust/fibrous matter (e.g., hair) capturing capabilities.

[0041]

25 The ratio by number of the profiled fibers present in the first regions 7 that are aligned in the longitudinal direction of the linear depressions 5 is preferably 50% or higher, more preferably 60% or higher, preferably 100% or lower, more preferably 90% or lower, and specifically preferably 50% to 100%, more preferably 60% to 90%.

[0042]

30 The ratio by number of the profiled fibers present in the second regions 8 that are

aligned in the longitudinal direction of the linear depressions 5 is preferably 0% or higher, more preferably 10% or higher, preferably 50% or lower, more preferably 40% or lower, and specifically preferably 0% to 50%, more preferably 10% to 40%, provided that the above defined ratio of the first regions 7 is higher than that of the second regions 8. The ratio of the profiled fibers that are aligned in the longitudinal direction of the linear depressions 5 can be determined by counting the fibers making 45° or a larger angle with a direction identified as the longitudinal direction of the linear depressions 5 in an SEM image.

[0043]

The profiled fiber is preferably made of fiber-forming resins, such as various thermoplastic resins. Examples of useful thermoplastic resins include polyolefin resins, such as polyethylene and polypropylene; polyester resins, such as polyethylene terephthalate; polyamide resins; vinyl resins, such as polyvinyl chloride and polystyrene; acrylic resins, such as polyacrylic acid and methyl polymethacrylate; and fluororesins, such as perfluoroethylene. These resins may be used either individually or in combination of two or more thereof.

[0044]

It is preferred in terms of wiping operability and dirt capturing efficiency that the profiled fiber have a fineness of at least 0.5 dtex, more preferably 1 dtex or greater, even more preferably 1.2 dtex or greater, and preferably 4 dtex or smaller, more preferably 3.5 dtex or smaller, even more preferably 3 dtex or smaller.

[0045]

While varying depending on the method of fiber production, a preferred fiber length of the profiled fiber is generally 1 mm to 100 mm, more preferably 10 mm to 90 mm, even more preferably 20 mm to 60 mm.

[0046]

The A to B length ratio, A/B, is preferably 1.2 or greater, more preferably 1.5 or greater, even more preferably 2 or greater, and preferably 5 or smaller, more preferably 4 or smaller, even more preferably 3 or smaller. Specifically, A/B is preferably 1.2 to 5,

more preferably 1.5 to 4, even more preferably 2 to 3. The profiled fibers with the A/B in that range easily entangle and remove fibrous matter (e.g., hair) from a surface being cleaned.

[0047]

5 With a view to providing wiping operability and dirt capturing performance, the length A is preferably 1 μm or greater, more preferably 5 μm or greater, even more preferably 10 μm or greater, and preferably 80 μm or smaller, more preferably 50 μm or smaller, even more preferably 25 μm or smaller, provided that the A/B is within the above range. With the same view, the length B is preferably 0.2 μm or greater, more preferably
10 1 μm or greater, even more preferably 2 μm or greater, and preferably 40 μm or smaller, more preferably 20 μm or smaller, even more preferably 15 μm or smaller, provided that the A/B is within the above range.

[0048]

15 When the profiled fiber has a cross-sectional configuration of which the outer perimeter has a plurality of convexities (lobes) P and a concavity R between adjacent convexities P such as illustrated in Fig. 1b, a ratio of a length C (Fig. 1b) of a line segment connecting the vertices of adjacent convexities P to a length D (Fig. 1b) of a perpendicular from the line segment to the deepest point of the concavity R, C/D, is preferably 0.1 or greater, more preferably 1 or greater, even more preferably 2 or greater,
20 and preferably 5 or smaller, more preferably 4 or smaller, even more preferably 3 or smaller. The profiled fibers having such a cross-sectional profile have an increased surface area per fiber thereby to provide an increased contact area with dirt to be removed and further enhanced dirt capturing performance.

[0049]

25 When the line segments connecting the vertices of different pairs of adjacent convexities P have different lengths C, the average of all the measured lengths is taken as the length C in calculating the C/D value. Similarly, when the perpendiculars in different concavities R have different lengths D, the average of all the measured lengths is taken as the length D in calculating the C/D value. The C and D values referred to
30 below are average values obtained as described above.

[0050]

With the view of improving wiping operability and dirt capturing performance, the length C is preferably 0.1 μm or greater, more preferably 0.5 μm or greater, even more preferably 1 μm or greater, and preferably 20 μm or smaller, more preferably 10 μm or smaller, even more preferably 5 μm or smaller, provided that the C/D is within the above range. With the same view, the length D is preferably 0.1 μm or greater, more preferably 0.5 μm or greater, even more preferably 1 μm or greater, and preferably 20 μm or smaller, more preferably 10 μm or smaller, even more preferably 5 μm or smaller, provided that the C/D is within the above range.

10 [0051]

The lengths A to D can be measured as follows. A provided fiber aggregate is cut with a knife or a like tool taking care not to damage the cross-sectional shape of the fibers. The cut surface is coated with Pt by vacuum evaporation and observed using an SEM (JSM-IT100 from JEOL Ltd.) at a magnification of 500 times to 1000 times. The lengths A to D of the fiber cross-sections in the SEM image are measured using the length measurement software provided with the SEM.

[0052]

When the wiping sheet of the present invention contains non-profiled fibers having a circular cross-section, the fineness of the non-profiled fibers is preferably 0.6 dtex or greater, more preferably 1.0 dtex or greater, even more preferably 1.2 dtex or greater, and preferably 4.0 dtex or smaller, more preferably 3.5 dtex or smaller, even more preferably 3.0 dtex or smaller, in terms of wiping operability and dirt capturing efficiency.

[0053]

25 The wiping sheet of the present invention may be composed solely of the profiled fibers or may also contain other fibers. Examples of useful other fibers include hydrophilic fibers, such as natural fibers made from wood pulp, cotton, or silk, regenerated fibers (e.g., rayon and cuprammonium rayon), and purified fibers (e.g., Lyocell); and the above-described thermoplastic resin fibers. These fibers may be used
30 either individually or in combination of two or more thereof. The other fibers may have

a circular cross-sectional shape (i.e., non-profiled fibers) or a flat cross-sectional shape (i.e., profiled fibers). When the wiping sheet has a single-layered fiber aggregate, the proportion of the other fiber in the fiber aggregate is preferably 50 mass%, or less more preferably 40 mass% or less, even more preferably 30 mass% or less.

5 [0054]

In order for the wiping sheet to have adequate strength, the fiber aggregate forming the wiping sheet preferably has a basis weight of 40 g/m² or more, more preferably 45 g/m² or more, even more preferably 50 g/m² or more. The upper limit of the basis weight is preferably 140 g/m², more preferably 100 g/m², even more preferably
10 80 g/m². Specifically, the basis weight of the fiber aggregate forming the wiping sheet is preferably 40 g/m² to 140 g/m², more preferably 45 g/m² to 100 g/m², even more preferably 50 g/m² to 80 g/m².

[0055]

For the same purpose, the wiping sheet preferably has a thickness of 0.5 mm or
15 greater, more preferably 1.0 mm or greater, under a load of 40 N/m². The upper limit of the thickness is preferably 2.5 mm, more preferably 3 mm, under the same load.

[0056]

The wiping sheet may be used in wiping operation either as such for dry mode usage or as coated, sprayed, impregnated, or otherwise combined with a cleaning fluid for
20 wet mode usage. An appropriate usage mode may be chosen according to the type of dirt to be removed or the physical properties of a surface to be wiped. With a view to enhancing the cleansing efficiency, the fiber aggregate of the wiping sheet is preferably used as combined with a cleaning fluid. The profiled fibers contained in the fiber aggregate create increased fiber interstices. This provides another advantage that the
25 wiping sheet has improved fluid-holding capacity of the cleaning fluid. The wiping sheet of the present invention is particularly effective in catching fibrous debris such as hair even when applied in a wet mode to wet surfaces, e.g., in a changing room in proximity to a bathroom, a wash room, or a kitchen.

[0057]

The cleaning fluid that can be held in the wiping sheet for wet mode usage may be of any type commonly used in wet wipes, such as water or an aqueous solution containing an additive. Examples of the additive used in the cleaning fluid include surfactants, disinfectants, perfumes, fragrances, deodorants, pH adjusters, alcohols, and
5 abrasive grains.

[0058]

In order for the wiping sheet to have sufficient strength for practical use, the wiping sheet of the present invention preferably further includes a scrim for supporting the fiber aggregate. For the same purpose, the scrim is preferably located in the middle
10 of the thickness of the fiber aggregate. The scrim is a mesh sheet that allows the profiled fibers making up the fiber aggregate to be entangled therewith and be united into one body. The scrim may have a net-like structure, a lattice structure, or a strand structure.

[0059]

The scrim may be made of a resin, such as polyolefin resins, e.g., polyethylene and polypropylene; polyester resins, e.g., polyethylene terephthalate; polyamide resins, e.g., nylon 6 or nylon 66; acrylonitrile resins, e.g., polyacrylonitrile; vinyl resins, e.g., polyvinyl chloride and polystyrene; and vinylidene resins, e.g., polyvinylidene chloride.
15

[0060]

With a view to achieving entanglement between the profiled fibers and the scrim while obtaining sufficient strength of the wiping sheet, the strand of the scrim preferably has a diameter of at least 10 μm , more preferably 500 μm or greater, and preferably 2000 μm or smaller, more preferably 1000 μm or smaller, while depending on a degree of entanglement of the fibers. The strand diameter of the scrim may be uniform or vary
20 from part-to-part. When the strand diameter varies from part-to-part, the average is taken. The scrim preferably has a basis weight of 1 g/m^2 or greater, more preferably 3 g/m^2 or greater, and preferably 20 g/m^2 or smaller, more preferably 10 g/m^2 or smaller.
25

[0061]

The present invention has been described with respect to embodiments of the

wiping sheet of the present invention. The description will then be directed to a preferred method for producing the wiping sheet with reference to Fig. 5. Fig. 5 illustrates an apparatus 10 suited to manufacture the wiping sheet. The apparatus 10 includes, along the machine direction (MD), a web formation unit 20, a hydroentanglement unit 30, and a texturing unit 40 in the order described. The method is roughly divided into the step of forming a fiber aggregate containing profiled fibers by hydroentanglement and the step of three-dimensionally texturing one side of the fiber aggregate in a macroscopic pattern. In the following description the MD is coincident with the lengthwise direction X, and the cross-machine direction (CD) with the widthwise direction Y.

[0062]

The web formation unit 20 includes a carding machine 21 from which a web of profiled fibers 2 is delivered by a guide roller 22. In the manufacture of a wiping sheet having a scrim, a web of scrim 15 is unrolled from a scrim roll 25 and combined with the web of profiled fibers 2.

[0063]

The web of profiled fibers 2 (either alone or combined with the web of scrim 15) is conveyed in the MD on a water-permeable first support belt 32 through the hydroentanglement unit 30, where high-pressure water jets injected from first injectors 31 are directed to the web(s) (entanglement step). Through the entanglement step, the profiled fibers 2 are entangled among themselves to form a fiber aggregate 1A containing the profiled fibers. When combined with the scrim 15, the profiled fibers 2 are entangled among themselves and with the scrim 15 to form a unitary fiber aggregate 1A composed of the profiled fibers and the scrim. In the hydroentanglement step, the water jet pressure from the first injectors 31 preferably ranges from 30 kg/cm^2 to 80 kg/cm^2 , more preferably from 40 kg/cm^2 to 60 kg/cm^2 , and the web transport speed in the MD preferably ranges from 2 m/min to 10 m/min, more preferably from 4 m/min to 8 m/min.

[0064]

The fiber aggregate 1A containing the profiled fibers is then conveyed on a second support belt 42 through the texturing unit 40, where high-pressure water jets are

applied onto the fiber aggregate 1A to form recessed portions and raised portions in a macroscopic pattern on one side of the fiber aggregate 1A (texturing step). The water jet pressure from the second injectors 41 and the fiber aggregate transport speed in the texturing step may be in the same ranges as in the entanglement step.

5 [0065]

In the texturing step, high-pressure water jets are directed against one side of the fiber aggregate A1 transported from the hydroentanglement unit 30 as illustrated in Fig. 5. A patterning member 50 such as having the structure illustrated in Fig. 6 is disposed between the second support belt 42 and the fiber aggregate 1A, whereby recessed portions
10 3 and raised portions 4 are formed on the opposite side (the side facing the support belt 42) of the fiber aggregate 1A in a pattern complementary to the three-dimensional pattern of the patterning member 50. The patterning member 50 is made of metal or resin.

[0066]

In more detail, the water jets from the second injectors 41 impinge on the upper
15 side of the fiber aggregate 1A to press the fiber aggregate 1A downward so that the lower side of the fiber aggregate 1A come into intimate contact with the upper side of the ribs 50a (for forming recessed portions) of the patterning member 50. At the same time, the water jets cause the profiled fibers 2 of the fiber aggregate 1A located on the openings 50b (for forming raised portions) of the patterning member 50 to protrude into the
20 openings 50b while denting the profiled fibers 2 located on the ribs 50a of the patterning member 50 in the thickness direction of the fiber aggregate 1A. The hydroentangling water is drained off through the openings 50b and drain apertures 50c formed through the ribs 50a. There is thus provided a web of wiping sheet one side of which is three-dimensionally textured in a macroscopic pattern having a curved portion.

25 [0067]

Since the wiping sheet of the present invention contains profiled fibers having a flat cross-sectional shape, the cross-sectional orientation of the profiled fibers differs between the recessed portions 3 and the raised portions 4 formed in the texturing step. As illustrated in Fig. 7, in the regions where the ribs 50a of the patterning member 50
30 underlie the profiled fibers 2, i.e., the regions that are to form recessed portions 3 of the

wiping sheet, the profiled fibers are thrust downward with their flat side having a relatively larger surface area in parallel to the upper surface of the rigs 50a by the pressure of the high-pressure water jets W. As a result, the profiled fibers located in the recessed portions 3 are oriented with their cross-sectional major axis parallel with the plane of the wiping sheet (major axis orientation). On the other hand, as illustrated in Fig. 7, the profiled fibers present over the openings 50b, i.e., in the regions that are to form raised portions 4 of the wiping sheet are free to change their cross-sectional orientation. Therefore, the profiled fibers in these regions change their cross-sectional orientation so as to diminish resistance to the high-pressure water jets W, i.e., to have their cross-sectional major axis parallel with a plane perpendicular to the plane of the wiping sheet (minor axis orientation). Thus, the profiled fibers have different cross-sectional orientation between the recessed portions 3 and the raised portions 4.

[0068]

In order to form a plurality of linear depressions 5 on one side of the wiping sheet in addition to the macroscopically patterned three-dimensional texture, a linear depression-forming member 60 such as having the structure illustrated in Figs. 8a and 8b is disposed between the patterning member 50 and the second support belt 42 as illustrated in Fig. 5.

[0069]

The linear depression-forming member 60 illustrated in Fig. 8a is composed of straight liner first wires 60a and helical second wires 60b. The regions defined by the first and second wires give passage to water. Both wires 60a and 60b are made of metal or resin.

[0070]

The first wires 60a have a circular, elliptical, or like cross-section. The first wires 60a are arranged to extend in a direction intersecting the MD in parallel with each other at substantially regular spacing. The first wires 60a are preferably in the same plane. Each second wire 60b winds around a pair of adjacent straight linear first wires 60a in a helix. Adjacent second wires 60b may have the same winding direction and pitch as illustrated in Fig. 8 or may have different winding directions and/or pitches.

Each second wire 60b has a circular cross-section or is composed of a plurality of circular cross-section wires of equal diameter arranged in parallel. The second wire 60b is wound around the first wires 60a with the line connecting the cross-sectional centers of the two or more circular wires being always in parallel to the first wires 60a. The second wire 60b may have a circular or elliptical cross-section. The second wire 60b may be wound about an axis in an elliptical helix as illustrated in Fig. 8b or in a circular or triangular helix.

[0071]

The distance A_p (Pitch A_p ; Fig. 8a) between adjacent first wires 60a determines the length L_1 (Fig. 4e) of the linear depression 5. While the distance A_p is decided as appropriate to a desired length L_1 of the linear depression 5, it preferably ranges from 1 mm to 50 mm, more preferably from 3 mm to 20 mm. The pitch B_p (Fig. 8a) of helical winding of the second wire 60b determines the distance L_2 (Fig. 4e) between adjacent linear depressions 5. While the pitch B_p is decided as appropriate to a desired distance L_2 , it is preferably 0.1 mm to 30 mm, more preferably 0.5 mm to 10 mm.

[0072]

The width B_d (Fig. 8b) of the second wire 60b determines the width W_1 (Fig. 4e) of the linear depression 5. While the width B_d is decided as appropriate to a desired width W_1 of the linear depression 5, it is preferably 0.1 mm to 10 mm, more preferably 0.5 mm to 5 mm. The winding diameter B_h (Fig. 8b) of the second wire 60b determines the depth of the linear depression 5 in the thickness of the wiping sheet and can be decided appropriately according to the relationship between the pressure of the high-pressure water jets and the transport speed.

[0073]

Returning to the formation of the linear depressions 5, the water jets from the second injectors 41 impinge on the upper side of the fiber aggregate 1A, press the lower side of the fiber aggregate 1A into intimate contact with the upper side of the ribs 50a of the patterning member 50, and, at the same time, cause the profiled fibers 2 located on the openings 50b of the patterning member 50 to protrude into the space of the openings 50b. The profiled fibers 2 protruding into the openings 50b are further thrust by the

high-pressure water jets against the second wires 60b of the linear depression-forming member 60, forming dents in the thickness direction of the fiber aggregate 1A. A plurality of linear depressions 5 are thus formed in a pattern complementary to the shape of the second wires 60b.

5 [0074]

The width Bd of the second wire 60b is smaller than the width of the rib 50a for forming a recessed portion. Therefore, the profiled fibers located on the second wire 60b are thrust by the high-pressure water jet against the second wire 60b and, at the same time, separated into two spaces 60R defined by adjacent turns of the second wire 60b. Because each space 60R is designed to have a smaller area than the opening 50b (for forming the raised portion) of the patterning member 50, the pressure of the water jets passing through the spaces 60R increases from the injection pressure. Consequently, the profiled fibers entering the spaces 60R are more likely to be oriented so as to diminish resistance to the pressure (outer force) of the high-pressure water jets W, so that the ratio of the profiled fibers having their cross-sectional major axis parallel with a plane perpendicular to the plane of the wiping sheet in the spaces 60R is still higher than that in the raised portions 4. In other words, the profiled fibers in the spaces 60R have a still higher degree of minor axis orientation than those in the raised portions 4. In addition to this, as the profiled fibers are parted by the second wires 60b, they are aligned along the length of the second wires 60b. That is, the profiled fibers 2 present in the first regions 7 located between linear depressions 5 are aligned along the linear depressions 5. There is thus produced a web of wiping sheet having its one side textured with raised portions and recessed portions in a macroscopic pattern having curved portions and also textured with linear depressions and having different cross-sectional orientation between the profiled fibers present between adjacent linear depressions and those in other regions.

[0075]

The thus produced web of fiber aggregate 1A is cut into, e.g., a rectangle as illustrated in Fig. 2 and may be used as a dry wiping sheet. Otherwise, the fiber aggregate 1A of the wiping sheet 1 may be combined with a cleaning fluid for use as a wet wiping sheet. When, for instance, the rectangular wiping sheet 1 has a size of 285 mm by 205 mm as in Examples given later, the amount of a cleaning fluid to be applied to the fiber aggregate 1A is preferably at least 1 g/sheet, more preferably 10 g/sheet or more,

and preferably 40 g/sheet or less, more preferably 25 g/sheet or less, which corresponds to 17 g/m² or more, more preferably 117 g/m², and preferably 690 g/m² or less, more preferably 430 g/m² or less.

[0076]

5 The thus prepared wiping sheet can be used either alone or as attached to a handled cleaning implement or a like tool in cleaning the interior of a building, such as floors, walls, cabinets, windowpanes, mirrors, doors, doorknobs, rugs, carpets, furniture such as desks and tables, kitchens, toilets; or human body. The wiping sheet is also useful as sanitary articles and packages.

10 [0077]

 While the present invention has been described with particular reference to its preferred embodiment, it should be noted that the present invention is not limited thereto. For example, while in the foregoing embodiment the three-dimensional texture in a macroscopic pattern as illustrated in Fig.3 is formed on one side of the wiping sheet, the
15 other side may also be textured in the same fashion. In that case, the fiber aggregate having its one side textured through the texturing step is reversed and subjected to the texturing step to have the opposite side textured three-dimensionally in a macroscopic pattern.

[0078]

20 A fiber aggregate containing non-profiled fibers can be prepared by, for example, adding a second carding machine to the web formation unit 20, feeding a web of non-profiled fibers from the second carding machine, and joining the non-profiled fiber web to the web of profiled fibers. The joined webs are subjected to the entanglement step to form a unitary fiber aggregate containing non-profiled fibers in addition to the
25 profiled fibers.

[0079]

 While in the foregoing embodiment the entanglement step and the texturing step are carried out in separate units, these two steps may be accomplished in one unit. For instance, a patterning member 50 and, if desired, a linear depression-forming member 60

may be disposed between the first support belt 32 and the web of profiled fibers in the entanglement step, whereby entanglement of the fibers and texturing of the fiber web with recessed portions and raised portions in a macroscopic pattern and, if desired, with linear depressions can be achieved simultaneously.

5 [0080]

While in the foregoing embodiment texturing of the fiber web with raised portions and recessed portions in a macroscopic pattern and texturing with linear depressions are carried out in one step, this texturing step may be divided into separate steps. For instance, the fiber aggregate is water-jet textured on one side thereof to form raised portions and recessed portions in a macroscopic pattern using the patterning member 50 in a first texturing step and then water-jet textured over the entire area thereof to form linear depressions 5 using the linear depression-forming member 60 in a second texturing step.

[0081]

15 The following clauses are considered further descriptive of the wiping sheet disclosed herein.

1. A wiping sheet having a macroscopic three-dimensionally textured pattern with raised portions and recessed portions formed on at least one side thereof and comprising a fiber aggregate comprising profiled fibers having a flat cross-section with a major axis, the profiled fibers in the recessed portion having their cross-sectional major axis generally parallel with the plane of the wiping sheet, and the profiled fibers in the raised portion having their cross-sectional major axis generally parallel with a plane perpendicular to the plane of the wiping sheet.

2. The wiping sheet as set forth in clause 1, wherein the profiled fibers each have a major axis and a minor axis in cross-section.

3. The wiping sheet as set forth in clause 1 or 2, wherein, when observing at least ten profiled fibers present in the recessed portion, 50% or more by number of at least ten profiled fibers have their cross-sectional major axis making an angle smaller than 45°

with the plane of the wiping sheet, and when observing at least ten profiled fibers present in the raised portion, 50% or more by number of at least ten profiled fibers have their cross-sectional major axis making an angle of 45° or greater with the plane of the wiping sheet.

- 5 4. The wiping sheet as set forth in any one of clauses 1 to 3, having a plurality of linear depressions in addition to the macroscopic three-dimensionally textured pattern, each of the linear depressions being recessed from one surface of the wiping sheet toward the other surface of the wiping sheet, and extending straight in one direction, wherein the profiled fibers present in a first region located between the linear depressions adjacent in
10 a direction perpendicular to the longitudinal direction of the linear depressions have their cross-sectional major axis generally parallel with a plane perpendicular to the plane of the wiping sheet, and a ratio of the profiled fibers having their cross-sectional major axis parallel with a plane perpendicular to the plane of the wiping sheet in the first region is higher than a ratio of the profiled fibers having their cross-sectional major axis parallel
15 with a plane perpendicular to the plane of the wiping sheet in the raised portion.

[0083]

5. The wiping sheet as set forth in clause 4, wherein the extending directions of each of the linear depressions is in the one direction.
6. The wiping sheet as set forth in clause 4 or 5, wherein the linear depressions are
20 arranged in such a manner to form a line extending along the one direction, and two adjacent linear depressions in the line are symmetric about an axis perpendicular to the one direction.
7. The wiping sheet as set forth in any one of clauses 4 to 6, wherein the linear depressions are arranged in such a manner to form a line extending along the one
25 direction, the linear depressions in the line extend in substantially the same direction.
8. The wiping sheet as set forth in any one of clauses 4 to 7, wherein the linear depressions are arranged in lines extending in the one direction, and the lines adjacent in a direction perpendicular to the one direction are symmetric about an axis extending in the

one direction.

9. The wiping sheet as set forth in any one of clauses 4 to 8, wherein the profiled fibers present in the first region are more aligned along the linear depressions than the profiled fibers present in a second region, the second region being located between two linear depressions adjacent in the longitudinal direction of the linear depressions.

10. The wiping sheet as set forth in any one of clauses 1 to 9, further comprising a scrim located in the middle of the thickness of the fiber aggregate.

11. The wiping sheet as set forth in any one of clauses 1 to 10, being impregnated with a cleaning fluid.

10 [0084]

12. The wiping sheet as set forth in any one of clauses 1 to 11, wherein the profiled fibers are made of a thermoplastic resin.

13. The wiping sheet as set forth in any one of clauses 1 to 12, wherein the fiber aggregate is composed mainly of the profiled fibers.

15 14. The wiping sheet as set forth in any one of clauses 1 to 13, wherein the fiber aggregate contains the profiled fibers in a proportion of at least 50 mass%.

15. The wiping sheet as set forth in any one of clauses 1 to 14, wherein fibers making up the fiber aggregate are not fused to one another.

20 16. The wiping sheet as set forth in any one of clauses 1 to 15, being formed of the fiber aggregate containing profiled fibers.

17. The wiping sheet as set forth in any one of clauses 1 to 16, wherein the fiber aggregate has a single layer structure.

[0085]

18. The wiping sheet as set forth in any one of clauses 1 to 16, wherein the fiber aggregate has a multilayered structure having a layer containing first profiled fibers and a layer containing second profiled fibers different from the first ones.
 - 5 19. The wiping sheet as set forth in any one of clauses 1 to 15, wherein the fiber aggregate has a multilayer structure having a layer containing the profiled fibers and a profiled fiber-free layer.
 20. The wiping sheet as set forth in any one of clauses 1 to 15 and 19, wherein the fiber aggregate has a multi-ply laminate structure having a first fiber aggregate containing
10 the profiled fibers and a second fiber aggregate containing no profiled fibers.
 21. The wiping sheet as set forth in any one of clauses 1 to 15, having a multi-ply laminate structure comprising the fiber aggregate containing the profiled fibers and a sheet material other than the fiber aggregate.
 22. The wiping sheet as set forth in any one of clauses 1 to 17, wherein the
15 proportion of the profiled fibers is preferably at least 50 mass%, more preferably 60 mass% or more, even more preferably 70 mass% or more.
- [0086]
23. The wiping sheet as set forth in any one of clauses 1 to 22, wherein the fiber aggregate further contains non-profiled fibers having a circular cross-section.
 - 20 24. The wiping sheet as set forth in clauses 23, wherein the non-profiled fibers are present in a proportion of preferably 50 mass% or less, more preferably 40 mass% or less, even more preferably 30 mass% or less.
 - 25 25. The wiping sheet as set forth in any one of clauses 1 to 24, wherein the profiled fiber preferably has at least one, more preferably more than one, even more preferably more than two, convexities with a sharp vertex in cross-section.

26. The wiping sheet as set forth in clause 25, wherein the profiled fiber has eight sharp vertices.

27. The wiping sheet as set forth in any one of clauses 1 to 26, wherein the profiled fiber has a cross-sectional shape of which the outer perimeter has a plurality of
5 convexities and a concavity located between adjacent convexities.

EXAMPLES

[0087]

The present invention will now be illustrated in greater detail with reference to Examples, but it should be noted that the present invention is not deemed to be limited
10 thereto.

[0088]

Example 1

A fiber aggregate having a scrim made of polypropylene (strand thickness: ca. 200 μm ; basis weight: 5 g/m^2) in the middle of its thickness was prepared by
15 hydroentanglement using thermoplastic resin profiled fibers having a multilobal cross-section as illustrated in Fig. 1b. The fiber composition of the fiber aggregate was PET multilobal fibers (fineness: 1.7 dtex): acrylic circular fibers (fineness: 1.0 dtex): rayon flat fibers (fineness: 1.7 dtex) in a mass ratio of 70:15:15. The average fiber diameter of the fiber aggregate was about 12 μm . The fiber aggregate was cut to a size
20 of 285 mm by 205 mm. The resulting wiping sheet was impregnated with 290 g/m^2 of a cleaning fluid to make a wet wiping sheet. The wiping sheet had a basis weight of 70 g/m^2 .

[0089]

Comparative Example 1

25 A wet wiping sheet was prepared in the same manner as in Example 1, except for using thermoplastic resin circular fibers in making the hydroentangled fiber aggregate. The fiber composition of the fiber aggregate was PET circular fibers (fineness: 1.45 dtex): acrylic circular fibers (fineness: 1.0 dtex): rayon flat fibers (fineness: 1.7 dtex) in a mass ratio of 70:15:15.

[0090]

Evaluation of hair capturing capabilities:

A wooden floor (DAG Flooring, purchased from Kitakei Co., Ltd.) of 6-*tatami* mat size (about 9.93 m²) was scattered with 20 human hairs of 10 cm length per *tatami* (1820 mm × 910 mm). The floor was wiped with the wiping sheet to capture the hairs. The wiping sheet was slid on the floor with its widthwise direction Y (see Fig. 2) coincident with the wiping direction. After the wiping operation, the number of hairs caught on the sheet was counted to evaluate hair capturing capabilities. The results are shown in Table 1.

10 [0091]

Evaluation of dust capturing capabilities:

A wiping test was performed on a 90 cm (in wiping direction) by 90 cm wooden floor (DAG Flooring, from Kitakei Co., Ltd.). 0.1 grams of test powder class 7 (particle size: 5 μm to 75 μm) or class 11 (particle size: 1 μm to 8 μm), both specified in JIS Z8901, was spread over a test zone measuring 15 cm in wiping direction by 90 cm which was 15 cm away from one end of the floor in the wiping direction. Each of the wiping sheets of Example and Comparative Example was slid on the floor to give two forward-and-backward wiping motions to make one wiping cycle. The wiping cycle was repeated from every 30 cm width in the lateral direction perpendicular to the wiping direction. Six wiping cycles were conducted to complete the cleaning. The wiping direction was coincident with the widthwise direction Y in Fig. 2. The change in mass of the wiping sheet between before and after the wiping operation was measured to evaluate dust capturing capabilities. The results are shown in Table 1.

[0092]

25 Table 1

		Example 1	Comparative Example 1
Hair Capturing Capabilities		good	slightly poor
Dust Capturing Capabilities	Test Powder Class 7	very good	good
	Test Powder Class 11	good	slightly poor

[0093]

5 The results in Table 1 prove that the wiping sheet of the present invention, which contains profiled fibers, combines high capabilities of capturing dust and high capabilities of capturing fibrous matter such as hair. As is seen from the evaluation of hair capturing capabilities, the wiping sheet of Example 1 exhibits particularly high hair capturing capabilities even when used in a wet mode.

INDUSTRIAL APPLICABILITY

[0094]

10 The present invention provides a wiping sheet exhibiting high capabilities of capturing both dust and fibrous matter such as hair.

CLAIMS

1. A wiping sheet having a macroscopic three-dimensionally textured pattern with raised portions and recessed portions formed on at least one side thereof and comprising a fiber aggregate comprising profiled fibers having a flat cross-section with a major axis,
5 the profiled fibers in the recessed portion having their cross-sectional major axis generally parallel with the plane of the wiping sheet, and the profiled fibers in the raised portion having their cross-sectional major axis generally parallel with a plane perpendicular to the plane of the wiping sheet.
2. The wiping sheet according to claim 1, wherein the profiled fibers each have a
10 major axis and a minor axis in cross-section.
3. The wiping sheet according to claim 1 or 2, wherein, when observing at least ten profiled fibers present in the recessed portion, 50% or more by number of at least ten profiled fibers have their cross-sectional major axis making an angle smaller than 45° with the plane of the wiping sheet, and when observing at least ten profiled fibers present
15 in the raised portion, 50% or more by number of at least ten profiled fibers have their cross-sectional major axis making an angle of 45° or greater with the plane of the wiping sheet.
4. The wiping sheet according to any one of claims 1 to 3, having a plurality of linear depressions in addition to the macroscopic three-dimensionally textured pattern,
20 each of the linear depressions being recessed from one surface of the wiping sheet toward the other surface of the wiping sheet, and extending straight in one direction, wherein the profiled fibers present in a first region located between the linear depressions adjacent in a direction perpendicular to the longitudinal direction of the linear depressions have their cross-sectional major axis generally parallel with a plane perpendicular to the plane of the
25 wiping sheet, and a ratio of the profiled fibers having their cross-sectional major axis parallel with a plane perpendicular to the plane of the wiping sheet in the first region is higher than a ratio of the profiled fibers having their cross-sectional major axis parallel with a plane perpendicular to the plane of the wiping sheet in the raised portion.

5. The wiping sheet according to claim 4, wherein the extending directions of each of the linear depressions is in the one direction.
6. The wiping sheet according to claim 4 or 5, wherein the linear depressions are arranged in such a manner to form a line extending along the one direction, and two adjacent linear depressions in the line are symmetric about an axis perpendicular to the one direction.
7. The wiping sheet as set forth in any one of claims 4 to 6, wherein the linear depressions are arranged in such a manner to form a line extending along the one direction, the linear depressions in the line extend in substantially the same direction.
- 10 8. The wiping sheet according to any one of claims 4 to 7, wherein the linear depressions are arranged in lines extending in the one direction, and the lines adjacent in a direction perpendicular to the one direction are symmetric about an axis extending in the one direction.
- 15 9. The wiping sheet according to any one of claims 4 to 8, wherein the profiled fibers present in the first region are more aligned along the linear depressions than the profiled fibers present in a second region, the second region being located between two linear depressions adjacent in the longitudinal direction of the linear depressions.
10. The wiping sheet according to any one of claims 1 to 9, further comprising a scrim located in the middle of the thickness of the fiber aggregate.
- 20 11. The wiping sheet according to any one of claims 1 to 10, being impregnated with a cleaning fluid.
12. The wiping sheet according to any one of claims 1 to 11, wherein the profiled fibers are made of a thermoplastic resin.
13. The wiping sheet according to any one of claims 1 to 12, wherein the fiber

aggregate mainly comprises the profiled fibers.

14. The wiping sheet according to any one of claims 1 to 13, wherein the fiber aggregate contains the profiled fibers in a proportion of at least 50 mass%.
- 5 15. The wiping sheet according to any one of claims 1 to 14, wherein fibers making up the fiber aggregate are not fused to one another.
16. The wiping sheet according to any one of claims 1 to 15, being formed of the fiber aggregate containing profiled fibers.
17. The wiping sheet according to any one of claims 1 to 16, wherein the fiber aggregate has a single layer structure.
- 10 18. The wiping sheet according to any one of claims 1 to 16, wherein the fiber aggregate has a multilayered structure comprising a layer containing first profiled fibers and a layer containing second profiled fibers different from the first profiled fibers.
- 15 19. The wiping sheet according to any one of claims 1 to 15, wherein the fiber aggregate has a multilayer structure comprising a layer containing the profiled fibers and a profiled fiber-free layer.
20. The wiping sheet according to any one of claims 1 to 15 and 19, wherein the fiber aggregate has a multi-ply laminate structure comprising a first fiber aggregate containing the profiled fibers and a second fiber aggregate containing no profiled fibers.
- 20 21. The wiping sheet according to any one of claims 1 to 15, having a multi-ply laminate structure comprising the fiber aggregate containing the profiled fibers and a sheet material other than the fiber aggregate.
22. The wiping sheet according to any one of claims 1 to 17, wherein the proportion of the profiled fibers is at least 50 mass%.

23. The wiping sheet according to any one of claims 1 to 22, wherein the fiber aggregate further contains non-profiled fibers having a circular cross-section.
24. The wiping sheet according to claims 23, wherein the non-profiled fibers are present in a proportion of 50 mass% or less.
- 5 25. The wiping sheet according to any one of claims 1 to 24, wherein the profiled fiber has at least one convexity with a sharp vertex in cross-section.
26. The wiping sheet according to claim 25, wherein the profiled fiber has eight sharp vertices in cross-section.
- 10 27. The wiping sheet according to any one of claims 1 to 26, wherein the profiled fiber has a cross-sectional shape of which the outer perimeter has a plurality of convexities and a concavity located between adjacent convexities.