

DESCRIPTION

Title of Invention: WIPING SHEET AND PRODUCTION METHOD THEREFOR

Technical Field

[0001]

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

Background Art

[0002]

Nonwoven fabrics made up of entangled synthetic fibers are used in the form of wet sheet as impregnated with a cleaning fluid to clean hard surfaces of indoor equipment, automobiles, and so on. For example, patent literature 1 listed below discloses a wet cleaning sheet that retains an aqueous liquid having low fluidity and has a liquid-permeable surface layer on its working face. Patent literature 2 discloses a cleaning sheet comprising a sheet substrate impregnated with 0.01 to 50 times the mass of a surfactant. The cleaning sheet is described as effective in removing oily dirt.

Citation List

Patent Literature

[0003]

Patent literature 1: JP 2002-45323A

Patent literature 2: JP 2006-305178A

Summary of Invention

[0004]

The present invention provides a wiping sheet composed of a fiber aggregate containing synthetic fibers and impregnated with a cleaning fluid. The fiber aggregate of the wiping sheet has a dry basis weight of 50 g/m² to 100 g/m². The cleaning fluid contains at least two nonionic surfactants having different HLB values. One of the surfactants has an HLB value of from 12 to less than 15, and the other from 15 to 18. The wiping sheet contains 205 g/m² to 380 g/m² of the cleaning fluid.

[0005]

The present invention also provides a method for making the wiping sheet. The method includes forming a fiber aggregate containing synthetic fibers and impregnating the fiber aggregate with a cleaning fluid by spraying.

Brief Description of Drawings

[0006]

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

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

[Fig. 3] Fig. 3 is a schematic illustration of an apparatus that can be used suitably to produce the wiping sheet of the present invention.

[Fig. 4] Fig. 4 is a perspective view of a patterning member used in the apparatus shown in Fig. 3.

[Fig. 5] Fig. 5 schematically illustrates a cross-sectional orientation of the profiled fibers in the manufacture of the wiping sheet.

Description of Embodiments

[0007]

The cleaning sheets of patent literatures 1 and 2 cannot be said to achieve sufficient efficiency in removing caked-on greasy dirt from hard surfaces of floors, cooking facilities, and so forth, still leaving room for improvement in that regard.

[0008]

Accordingly, the present invention relates to a wiping sheet that eliminates the disadvantages of the conventional techniques.

[0009]

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, pillars, doors, and windows; office and

household equipment and fixtures; and human body and human body-related objects.

[0010]

The wiping sheet of the present invention includes a fiber aggregate containing synthetic fibers, preferably composed mainly of synthetic fibers. It is a wet sheet having the fiber aggregate impregnated with a cleaning fluid. The term “mainly” as used in the phrase “composed mainly of synthetic fibers” as used above or “mainly comprising synthetic fibers” as used in the appended claims means that the fiber aggregate has a synthetic fiber content of at least 50 mass%, preferably 60 mass% or higher, even more preferably 70 mass% or higher, in a dry state.

[0011]

The synthetic fibers are deposited, entangled, bonded, or otherwise aggregated to form the fiber aggregate. The fibers making up the fiber aggregate may or may not be fused to one another. The wiping sheet may be composed solely of the fiber aggregate or may have one or more other sheet materials or members in addition to the fiber aggregate.

[0012]

The fiber aggregate forming the wiping sheet preferably has a dry basis weight of at least 50 g/m², more preferably 55 g/m² or more, even more preferably 60 g/m² or more. The upper limit of the dry basis weight is preferably 100 g/m², more preferably 90 g/m², even more preferably 80 g/m². Specifically, the dry basis weight of the fiber aggregate is preferably 50 g/m² to 100 g/m², more preferably 55 g/m² to 90 g/m², even more preferably 60 g/m² to 80 g/m². The dry basis weight denotes a basis weight of a fiber aggregate in a dry state, and the term “in a dry state” as used herein refers to the state with a water content of not more than 3 mass%. With the dry basis weight of the fiber aggregate falling in that range, the wiping sheet exhibits both sufficient strength for wiping operations and high cleaning fluid retention.

[0013]

From the standpoint of production efficiency, the synthetic fiber is preferably made from a fiber-forming resin exemplified by various thermoplastic resins. Examples

of useful thermoplastic resins include polyolefin resins, such as polyethylene (PE) and polypropylene (PP); polyester resins, such as polyethylene terephthalate (PET); polyamide resins; vinyl resins, such as polyvinyl chloride and polystyrene; acrylic resins, such as polyacrylic acid and poly(methyl methacrylate); and fluorine-containing resins, such as polyperfluoroethylene. These resins may be used either individually or in combination of two or more thereof.

[0014]

From the viewpoint of ease of wiping operations and dirt removal efficiency, the synthetic fiber preferably has a fineness of at least 0.5 dtex, more preferably 1 dtex or greater, even more preferably 1.2 dtex or greater. The upper limit of the fineness is preferably 4 dtex, more preferably 3.5 dtex, even more preferably 3 dtex.

[0015]

The wiping sheet of the present invention is impregnated with a cleaning fluid containing water as a main component. The water content of the cleaning fluid is preferably 80.0 mass% or higher, more preferably 90.0 mass% or higher, and preferably 99.8 mass% or lower, more preferably 99.0 mass% or lower.

[0016]

The cleaning fluid contains at least two nonionic surfactants having different HLB values within a predetermined range. An HLB value is a measure of hydrophile-lipophile balance. In the present invention, an HLB value calculated according to the following expression by Oda and Teramura, et al., is adopted.

$$\text{HLB value} = (\Sigma \text{inorganic value} / \Sigma \text{organic value}) \times 10$$

[0017]

One of the two nonionic surfactants present in the cleaning fluid will hereinafter be referred to as a first nonionic surfactant. The HLB value of the first nonionic surfactant is preferably 12 or greater, more preferably 12.5 or greater, even more preferably 13 or greater, and preferably smaller than 15, more preferably 14.5 or smaller, even more preferably 14 or smaller. A combined use of the first nonionic surfactant with

another nonionic surfactant hereinafter described increases dispersibility of emulsified greasy dirt in the cleaning fluid, whereby the wiping sheet is capable of effectively removing caked-on greasy dirt from a hard surface.

[0018]

The other nonionic surfactant, hereinafter referred to as a second nonionic surfactant, has an HLB value of preferably 15 or greater, more preferably 15.5 or greater, even more preferably 16 or greater, and preferably 18 or smaller, more preferably 17.5 or smaller, even more preferably 17 or smaller. A combined use of this second nonionic surfactant having a relatively high HLB value with the aforementioned first nonionic surfactant brings about acceleration of emulsification of greasy dirt caked on a hard surface, whereby the wiping sheet is capable of effectively removing caked greasy dirt from a hard surface.

[0019]

Examples of the first nonionic surfactant include polyoxyethylene alkyl ethers, such as polyoxyethylene lauryl ether (HLB value: 12.1 – 14.9), polyoxyethylene cetyl ether (HLB value: 12.9 – 14.3), polyoxyethylene stearyl ether (HLB value: 12.8 – 13.9), and polyoxyethylene oleyl ether (HLB value: 12.1 – 13.6).

[0020]

Examples of the second nonionic surfactant include polyoxyethylene sorbitan fatty acid esters, such as polyoxyethylene sorbitan monopalmitate (HLB value: 15.6) and polyoxyethylene sorbitan coconut oil fatty acid esters (HLB value: 15.0 – 16.7).

[0021]

As long as the effects of the present invention are produced, the cleaning fluid may further contain, in addition to the first and second nonionic surfactants, a nonionic surfactant having an HLB value smaller than 12, a nonionic surfactant having an HLB value exceeding 18, and a cationic, anionic, or amphoteric surfactant. With a view to enhancing the effects of the present invention, the surfactant system of the cleaning fluid is preferably a combination of only the above recited first and second nonionic surfactants having different HLB values or a combination of the first and second nonionic surfactants

and an amphoteric surfactant. The amphoteric surfactant that can be used in the present invention is exemplified by at least one of lauryldimethylamine oxide, alkyl betaines, 2-alkyl-N-carboxymethyl-N-hydroxyethylimidazolinium betaines.

[0022]

In order to supply a sufficient amount of the cleaning fluid to emulsify and remove caked-on greasy dirt, the amount of the cleaning fluid to be infiltrated into the fiber aggregate is preferably at least 205 g/m², more preferably 260 g/m² or more, and preferably 380 g/m² or less, more preferably 325 g/m² or less. For instance, when the wiping sheet has a size of 285 mm by 205 mm as in Examples described later, the amount of the impregnating cleaning fluid per sheet is preferably at least 12 g, more preferably 15 g or more, and preferably 22 g or less, more preferably 19 g or less.

[0023]

Impregnated with the cleaning fluid containing two nonionic surfactants having different HLB values, the wiping sheet of the present invention is capable of accelerating emulsification of greasy dirt caked on a hard surface and increasing dispersibility of the emulsified greasy dirt in the cleaning fluid. Accordingly, wiping a surface to be cleaned with the wiping sheet of the present invention achieves effective removal of caked-on greasy dirt.

[0024]

With a view to further improving caked-on greasy dirt removal efficiency while eliminating discomfort of use due to a sticky or slimy feel remaining on the wiped surface, it is preferred for the cleaning fluid to contain at least 0.1 mass%, more preferably 0.2 mass% or more, and 0.5 mass% or less, more preferably 0.4 mass% or less, of each of the first and second nonionic surfactants. The total content of the first and second nonionic surfactants in the cleaning fluid is preferably 0.2 mass% or more, more preferably 0.4 mass% or more, and preferably 1.0 mass% or less, more preferably 0.8 mass% or less.

[0025]

The cleaning fluid to be infiltrated into the wiping sheet substrate preferably exhibits such foaming properties as to have predetermined foam heights measured by the

Ross-Miles method. Specifically, the Ross-Miles initial foam height of the cleaning fluid is preferably 130 mm or more, more preferably 140 mm or more, and preferably 180 mm or less, more preferably 170 mm or less, even more preferably 160 mm or less.

[0026]

The Ross-Miles foam height after 5 minutes is preferably 110 mm or more, more preferably 120 mm or more, and preferably 170 mm or less, more preferably 160 mm or less, even more preferably 150 mm or less. Using a cleaning fluid having such foaming properties enables more effective removal of caked-on greasy dirt. The above recited foaming properties can be achieved by, for example, adjusting the content(s) of the nonionic surfactants or adding an anionic, cationic, or amphoteric surfactant, a solvent (e.g., an alcohol), silicone, and so on.

[0027]

Foam height measurement by the Ross-Miles method can be carried out in accordance with JIS K3362 or ASTM D1173. A test solution may be a cleaning fluid *per se* that is to be infiltrated into the fiber aggregate, a liquid remaining on a surface wiped with the wiping sheet, or a liquid extracted from the impregnated wiping sheet by squeezing, pressing, centrifuging, or otherwise, either manually or mechanically using, e.g., an extraction device or a machine. The initial foam height is a measure for evaluating foaming power or foamability of the cleaning fluid, and the foam height after 5 minutes is a measure for evaluating foam stability. With the initial foam height and the foam height after 5 minutes being in the above respective ranges, the cleaning fluid is capable of more effectively removing caked-on greasy dirt. It is desirable for at least the cleaning fluid before infiltration into the fiber aggregate to have the Ross-Miles foam heights (initial and after 5 minutes) in the above respective ranges.

[0028]

With the view of further improving the caked-on greasy dirt removal efficiency, the cleaning fluid released from the wiping sheet preferably has a pH at 25°C of 7.8 or higher, more preferably 8.0 or higher, and preferably 9.0 or lower, more preferably 8.5 or lower. The pH of the cleaning fluid may be so adjusted by, for example, adding a pH adjustor in such an amount that does not impair the effects of the present invention.

[0029]

With the same view as above, the cleaning fluid released from the wiping sheet preferably has a viscosity at 25°C of 2 mPa·s or higher, more preferably 3 mPa·s or higher, and preferably 10 mPa·s or lower, more preferably 8 mPa·s or lower. The viscosity of the cleaning fluid is a value measured as follows. Viscometer TVB-10 (from Toki Sangyo Co., Ltd.) equipped with a spindle for low viscosity (Spindle No. M1) is used. In a beaker is put 100 mL of a test fluid at 25°C, and the viscosity of the fluid is measured by rotating the spindle as immersed in the test fluid at 60 rpm for 1 minute. The viscosity of the cleaning fluid can be adjusted to fall in that range by, for example, adding a viscosity modifier in such an amount that does not impair the effects of the present invention.

[0030]

With the same view as above, the cleaning fluid released from the wiping sheet preferably has a surface tension of 25 mN/m or higher, more preferably 27 mN/m or higher, and preferably 35 mN/m or lower, more preferably 33 mN/m or lower. The surface tension of the cleaning fluid is a value obtained as follows. In a small petri dish is put about 10 mL of a test liquid at 25°C, and the dish is placed on the stage of automatic surface tensiometer CBVD-Z from Kyowa Interface Science Co., Ltd. A platinum plate hanging from a hook attached to the spring balance of the tensiometer is moved down until it contacts the liquid. The spring load in equilibrium with the force of pulling the platinum plate into the liquid is read. The surface tension of the cleaning fluid can be adjusted to fall within the above range by, for example, the adjustment of the total content of the surfactants or the addition of a solvent, such as an alcohol, or silicone.

[0031]

In measuring the pH, viscosity, and surface tension of the cleaning fluid released from the wiping sheet, the test fluid may be a liquid remaining on a surface wiped with the wiping sheet or a liquid extracted from the impregnated wiping sheet by squeezing, pressing, centrifuging or otherwise, either manually or mechanically using, e.g., an extraction device or a machine.

[0032]

In order to reduce the unpleasant odor ascribed to greasy dirt during and after wiping, the cleaning fluid preferably contains a perfume. The perfume for use in the present invention is preferably soluble in the cleaning fluid. Examples of suitable perfumes include perfume components, such as menthol, geraniol, citronellal, citronellol, 1,8-cineol, terpineol, menthol, and linalool; and perfume compositions containing a perfume having a rose, lavender, jasmine, or ylang-ylang note. These perfume components and compositions can be used either individually or in combination thereof. The perfume may be in the form of a solution having an adjusted concentration as a result of, for example, dilution with a solvent. The content of the perfume in the cleaning fluid is preferably 0.01 mass% or more, more preferably 0.02 mass% or more, and preferably 1.0 mass% or less, more preferably 0.95 mass% or less.

[0033]

The cleaning fluid may contain additives in addition to the above-mentioned components as long as the effects of the present invention are produced. Examples of the additives include surfactants other than those described above, disinfectants or antiseptics, preservatives, fragrances, deodorants, pH adjustors, chelating agents, viscosity modifiers, and solvents such as alcohols. These additives may be used individually or in combination thereof. The content of each of the additives in the cleaning fluid is preferably 0.001 mass% to 20 mass%.

[0034]

Referring back to the fiber aggregate, the synthetic fibers making up the fiber aggregate preferably include fibers having a flat shape in a transverse cross-section, which will hereinafter be also called “profiled fibers”. The term “flat shape” is 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.

[0035]

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 also 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 for improving not only greasy dirt removing capabilities but fibrous matter (e.g., hair) capturing capabilities. Furthermore, the profiled fibers are capable of providing gaps between fibers making up the fiber aggregate, whereby the fiber aggregate exhibits capability of effectively trapping dust (fine particulate dirt) and retaining a cleaning fluid.

[0036]

With a view to further improving the dust trapping effect as well as effective fibrous matter (e.g., hair) pick-up capabilities, 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.

[0037]

With a view to enhancing the cleaning fluid retention and dust capturing capabilities by increasing the specific surface area of constituent fibers, 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 P as illustrated in Fig. 1b.

[0038]

The wiping sheet of the present invention, which includes a fiber aggregate containing synthetic fibers, may be a substantially rectangular sheet having a lengthwise direction X and a widthwise direction Y perpendicular to the lengthwise direction X as illustrated in Fig. 2. The wiping sheet 1 preferably has a three-dimensional texture on at least one side thereof in a macroscopic pattern having a curved portion as illustrated. It is more preferred for the wiping sheet 1 to have the three-dimensional texture in a macroscopic pattern having a curved portion on its working side (the side to be contacted with a surface to be cleaned). The so configured wiping sheet is capable of removing caked-on greasy dirt more effectively and capturing dust and fibrous matter (e.g., hair) more effectively.

[0039]

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 is flat with no unevenness attributed to the macroscopic relief pattern on the working side.

[0040]

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 JP 2017-113282A 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 mm 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 30 mm². Such a macroscopic texturing pattern provides another advantage of imparting aesthetic appeal to the wiping sheet.

[0041]

When the synthetic fibers of the wiping sheet are profiled fibers, the profiled fibers are deposited with different cross-sectional orientations 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 oriented 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 oriented 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).

[0042]

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, as well as further enhanced effects in removing caked-on greasy dirt.

[0043]

In the case that fibers contained in the wiping sheet are profiled fibers, 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.

[0044]

In the case that fibers contained in the wiping sheet are profiled fibers, 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, and preferably 100% or less, more preferably 80% or less.

[0045]

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, and preferably 100% or less, more preferably 80% or less. 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).

[0046]

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 follows.

[0047]

The cross-sectional major and minor axis lengths of the profiled fiber are previously measured using an SEM. Then the diameters of the profiled fibers under SEM observation are measured. The width as observed of a profiled fiber whose major axis makes 45° with the plane of the wiping sheet is used as a reference width of cross-sectional orientation of profiled fibers. A profiled fiber whose diameter as observed is in the range of from the reference width to the major axis length is determined to have major axis orientation, while a profiled fiber whose diameter as observed is

smaller than the reference width is determined to have minor axis orientation. The number of the profiled fibers having the identified orientation are counted, from which the ratios of fiber cross-sectional orientation can be calculated. The reference width for fiber orientation determination can be measured through SEM observation or trigonometrically calculated from the major axis length.

[0048]

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. The scrim is preferably located in the middle 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.

[0049]

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.

[0050]

With a view to achieving entanglement between the constituent fibers and the scrim while obtaining sufficient strength of the wiping sheet, the strands of the scrim preferably have 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 the degree of entanglement of the fibers. The strand diameter may be uniform or vary 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.

[0051]

The wiping sheet of the present invention may be composed solely of the synthetic fibers or may 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 either individually or in combination of two or more thereof. The other fibers may have either a circular or a non-circular cross-sectional shape. The proportion of the other fiber in the fiber aggregate is preferably not more than 50 mass%, more preferably 40 mass% or less, even more preferably 30 mass% or less.

[0052]

When the longest dimension of line segments that run across the cross-section of the profiled fiber 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 (see Fig. 1b), the ratio of the length A to the length B, 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 pick up fibrous matter (e.g., hair) from a surface being cleaned.

[0053]

Referring to lengths A and B, when a profiled fiber has, for example, an equilateral triangular cross-section, the side length corresponds to length A, and the length of a perpendicular from a vertex to the opposite side corresponds to length B. When a profiled fiber has an elliptic cross-section as in Fig. 1a, the major axis of the ellipse corresponds to length A, and the minor axis to length B.

[0054]

When the wiping sheet contains two or more types of profiled fibers having different cross-sectional shapes, the average of lengths A of all the types and the average of lengths B of all the types are taken as the lengths A and B, respectively.

[0055]

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 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.

[0056]

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, 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 to provide an increased contact area with dirt to be removed thereby to exhibit further enhanced dirt capturing performance.

[0057]

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 C 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 D is taken as the length D in calculating the C/D value. The C and D values referred to below are average values obtained as described.

[0058]

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.

[0059]

The lengths A to D can be measured as follows. A provided fiber aggregate is cut with a razor or a like tool taking care not to deform 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 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.

[0060]

The present invention has been described with respect to an embodiment of the wiping sheet of the present invention. The description will then be directed to a suitable method for producing the wiping sheet with reference to Fig. 3. Fig. 3 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, a texturing unit 40, and a cleaning fluid spray unit 60 in the order described. The method is roughly divided into the steps of forming a fiber aggregate containing synthetic fibers by hydroentanglement, optionally three-dimensionally texturing one side of the fiber aggregate in a macroscopic pattern, and impregnating the fiber aggregate with a cleaning fluid by spraying. In the following description the MD is coincident with the lengthwise direction X, and the cross-machine direction (CD) with the widthwise direction Y of the wiping sheet.

[0061]

The web formation unit 20 includes a carding machine 21 from which a web of synthetic 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 synthetic fibers.

[0062]

The web of synthetic 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 synthetic fibers 2 are entangled among themselves to form a fiber aggregate 1A containing the synthetic fibers, preferably composed mainly of the synthetic fibers. When combined with the scrim 15, the synthetic fibers 2 are entangled among themselves and with the scrim 15 to form a unitary fiber aggregate 1A composed of the synthetic fibers and the scrim.

[0063]

In the hydroentanglement step, the water jet pressure from the first injectors 31 preferably ranges from 30 kg/cm² to 80 kg/cm², more preferably from 40 kg/cm² to 60 kg/cm², and the web transport speed preferably ranges from 2 m/min to 10 m/min, more preferably from 4 m/min to 8 m/min.

[0064]

In the manufacture of a wiping sheet having a three-dimensional texture in a macroscopic pattern on one side thereof, the fiber aggregate 1A containing the synthetic fibers is conveyed to the texturing unit 40, wherein high-pressure water jets injected from second injectors 41 are applied to the fiber aggregate 1A to three-dimensionally texture one side of the fiber aggregate in a macroscopic pattern (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.

[0065]

In the texturing step, high-pressure water jets injected from the second injectors 41 are applied to one side of the fiber aggregate 1A transported from the hydroentanglement unit 30 as illustrated in Fig. 3. A patterning member 50 such as having the structure illustrated in Fig. 4 is disposed between a second support belt 42 and the fiber aggregate 1A, whereby recessed portions 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 a metal, a synthetic resin, and the like.

[0066]

In more detail, the water jets from the second injectors 41 impinge on the upper 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 ribs 50a (for forming recessed portions) of the patterning member 50. At the same time, the water jets cause the synthetic fibers 2 of the fiber aggregate 1A located on openings 50b (for forming raised portions) of the patterning member 50 to protrude into the openings 50b while denting the synthetic 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. Thus, the fiber aggregate is three-dimensionally textured on one side thereof in a macroscopic pattern having a curved portion.

[0067]

In the case when the fiber aggregate contains profiled fibers as the synthetic fibers, 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. 5, in the regions where the ribs 50a of the patterning member 50 underlie the synthetic fibers 2, i.e., the regions that are to become recessed portions 3 in the fiber aggregate 1A, the profiled fibers are thrust downward with their flat side having a relatively larger surface area in parallel to the upper surface of the ribs 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 the same drawing, the profiled fibers present over the openings 50b, i.e., in the regions that are to become raised portions 4 in the fiber aggregate 1A 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]

The thus produced web of fiber aggregate 1A is cut into, e.g., a rectangle as illustrated in Fig. 2 and then impregnated with a cleaning fluid 5 in the cleaning fluid spray unit 60 (impregnation step) to form a wet wiping sheet. The cleaning fluid spray unit 60 is designed to spray a cleaning fluid 5 to the fiber aggregate 1A being transported. Through the step of spraying the cleaning fluid onto the fiber aggregate, the fiber aggregate is impregnated with an appropriately adjusted amount of the cleaning fluid, and the wiping sheet production efficiency is thus improved. In the impregnation step, it is preferred to use a cleaning fluid 5 containing at least one of the above described amphoteric surfactants, perfumes, additives, and so forth to make a wiping sheet having greasy dirt removal efficiency, product stability, and sense of cleanliness.

[0069]

The thus produced 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; and human body. The wiping sheet is also useful as sanitary articles and packages.

[0070]

Since the wiping sheet of the present invention is impregnated with a cleaning fluid containing two nonionic surfactants having different HLB values, it has high efficiency in removing greasy dirt adhering to floors and cooking facilities of kitchens. Examples of greasy dirt include fats of meat origin, such as contained in meat, fat, or milk of beef, pork, chicken, and mutton; fats of fish origin; vegetable oils from cooking oils, such as salad oil, rapeseed oil, and sesame oil; and sebum from humans and pet animals. The wiping sheet of the present invention exhibits excellent greasy dirt removal efficiency even if these fats and oils are caked as a result of denaturing. The wiping sheet of the present invention achieves excellent efficiency in removing not only the greasy dirt but also dirt of other various origins, such as soy sauce, Worcestershire sauce, ketchup, carbohydrates (e.g., rice), proteins (e.g., eggs), and particulate dirt and fibrous matter (e.g., hair) associated with these dirt substances. In addition, the wiping sheet of the present invention provides excellent cleanliness after use because no stickiness or sliminess ascribed to any component of the cleaning fluid is perceived on the wiped surface after

the residual cleaning fluid on the surface dries.

[0071]

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, the wiping sheet of the present invention may be formed solely of a synthetic fiber-containing single fiber aggregate, whether single layered or multilayered, or may have a multi-ply laminate structure having a first fiber aggregate containing synthetic fibers and a second fiber aggregate containing or not containing profiled fibers or a sheet material other than a fiber aggregate. The form of the sheet material may be, for example, nonwoven fabric, woven fabric, or paper.

[0072]

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

[0073]

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

1. A wiping sheet including a fiber aggregate impregnated with a cleaning fluid, the fiber aggregate containing synthetic fibers,
 - the fiber aggregate having a dry basis weight of 50 g/m² to 100 g/m²,
 - the cleaning fluid containing at least two nonionic surfactants having different HLB values, one of the two surfactants having an HLB value of from 12 to less than 15, and the other having an HLB value of from 15 to 18, and
 - the cleaning fluid being present in an amount of 205 g/m² to 380g/m².

[0074]

2. The wiping sheet as set forth in clause 1, wherein one of the surfactants has an HLB value of preferably 12.5 or greater, more preferably 13 or greater, and preferably 14.5 or smaller, more preferably 14 or smaller.
3. The wiping sheet as set forth in clause 1 or 2, wherein the other surfactant has an HLB value of preferably 15.5 or greater, more preferably 16 or greater, and preferably 18 or smaller, more preferably 17.5 or smaller, even more preferably 17 or smaller.
4. The wiping sheet as set forth in any one of clauses 1 to 3, wherein one of the surfactants is a polyoxyethylene alkyl ether, such as polyoxyethylene lauryl ether (HLB value: 12.1 – 14.9), polyoxyethylene cetyl ether (HLB value: 12.9 – 14.3), polyoxyethylene stearyl ether (HLB value: 12.8 – 13.9), or polyoxyethylene oleyl ether (HLB value: 12.1 – 13.6).
5. The wiping sheet as set forth in any one of clauses 1 to 4, wherein the other surfactant is a polyoxyethylene sorbitan fatty acid ester, such as polyoxyethylene sorbitan monopalmitate (HLB value: 15.6) or a polyoxyethylene sorbitan coconut oil fatty acid ester (HLB value: 15.0 – 16.7).

[0075]

6. The wiping sheet as set forth in any one of clauses 1 to 5, wherein the cleaning fluid further contains an amphoteric surfactant.
7. The wiping sheet as set forth in clause 6, wherein the amphoteric surfactant is at least one member selected from lauryldimethylamine oxide, alkyl betaines, 2-alkyl-N-carboxymethyl-N-hydroxyethylimidazolium betaines.
8. The wiping sheet as set forth in one of clauses 1 to 7, wherein the cleaning fluid released from the wiping sheet has a pH of 7.8 to 9.0 at 25°C, a viscosity of 2 mPa·s to 10 mPa·s at 25°C, and a surface tension of 25 mN/m to 35 mN/m.
9. The wiping sheet as set forth in clause 8, wherein the cleaning fluid released from the wiping sheet has a pH of 8.0 or higher at 25°C.
10. The wiping sheet as set forth in clause 8 or 9, wherein the cleaning fluid released from the wiping sheet has a pH of 8.5 or lower at 25°C.

[0076]

11. The wiping sheet as set forth in any one of clauses 1 to 10, wherein the cleaning fluid further contains a perfume.
12. The wiping sheet as set forth in clause 11, wherein the perfume is preferably

soluble in the cleaning fluid and is at least one member selected from the group consisting of perfume components, such as menthol, geraniol, citronellal, citronellol, 1,8-cineol, terpineol, menthol and linalool, and perfume compositions containing a perfume having a rose, lavender, jasmine, or ylang-ylang note.

13. The wiping sheet as set forth in any one of clauses 1 to 12, wherein the cleaning fluid contains 0.1 mass% to 0.5 mass% of each of the nonionic surfactants, with the total content of the nonionic surfactants being 0.2 mass% to 1.0 mass%.

14. The wiping sheet as set forth in any one of clauses 1 to 13, wherein the fiber aggregate has a three-dimensional texture composed of raised portions and recessed portions in a macroscopic pattern on at least one side thereof, and the synthetic fibers have a flat cross-sectional shape,

the synthetic fibers present in the recessed portions having their cross-sectional major axis generally parallel with the plane of the wiping sheet, and the synthetic fibers present in the raised portions having their cross-sectional major axis generally parallel with a plane perpendicular to the plane of the wiping sheet.

15. The wiping sheet as set forth in any one of clauses 1 to 14, further including a scrim located in the middle of the thickness of the fiber aggregate.

[0077]

16. The wiping sheet as set forth in any one of clauses 1 to 15, being used to wipe a hard surface.

17. A method for making the wiping sheet as set forth in any one of clauses 1 to 16, including forming a fiber aggregate containing synthetic fibers and impregnating the fiber aggregate with a cleaning fluid by spraying.

18. The method as set forth in clause 17, wherein the fiber aggregate is composed mainly of the synthetic fibers.

19. The method as set forth in clause 17 or 18, wherein the fiber aggregate has a synthetic fiber content of at least 50 mass%, preferably 60 mass% or higher, even more preferably 70 mass% or higher, in a dry state.

20. The method as set forth in any one of clauses 17 to 19, wherein the cleaning fluid contains an additive.

21. The method as set forth in clause 20, wherein the additive is at least one member selected from the group consisting of disinfectants, antiseptics, fragrances, deodorants, pH adjustors, chelating agents, viscosity modifiers, and solvents, such as alcohols.

[0078]

22. The method as set forth in any one of clauses 17 to 21, wherein the fiber aggregate is formed using synthetic fibers having a flat cross-sectional shape.

23. The method as set forth in any one of clauses 17 to 22, further including three-dimensionally texturing one side of the fiber aggregate in a macroscopic pattern before the impregnating.

24. A method for using the wiping sheet according to any one of clauses 1 to 16, for wiping a hard surface.

Examples

[0079]

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

[0080]

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 hydroentanglement using a web of, as synthetic fibers, profiled fibers having a multilobal cross-section as illustrated in Fig. 1b. The fiber composition of the fiber aggregate was PET profiled 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 dry basis weight of the fiber aggregate was 70 g/m^2 . The fiber aggregate was cut to a size of 285 mm by 205 mm and then impregnated with 290 g/m^2 of a cleaning fluid to make a wet wiping sheet.

[0081]

The cleaning fluid was an aqueous solution containing 0.25 mass% of a polyoxyethylene alkyl ether (HLB value: 13.6) as a first nonionic surfactant and 0.25 mass% of a polyoxyethylene sorbitan fatty acid ester (HLB value: 16.7) as a second nonionic surfactant. The aqueous solution further contained 0.04 mass% of a perfume, 0.07 mass% of a viscosity modifier (Carbopol ETD2020, from CBC Co., Ltd.), 0.05 mass% of lauryldimethylamine oxide as an amphoteric surfactant, and

aminomethylpropanol as a pH adjustor of an amount required to adjust the pH of the cleaning fluid to 9.0. The pH of the cleaning fluid at 25°C before impregnation was determined using a pH meter (F22, from Horiba).

[0082]

Example 2

A wet wiping sheet was made in the same manner as in Example 1, except for using a polyoxyethylene alkyl ether (HLB value: 12.1) as a first nonionic surfactant.

[0083]

Example 3

A wet wiping sheet was made in the same manner as in Example 1, except for using a polyoxyethylene sorbitan fatty acid ester (HLB value: 15.0) as a second nonionic surfactant.

[0084]

Comparative Example 1

A wet wiping sheet was made in the same manner as in Example 1, except for replacing the first nonionic surfactant with a polyoxyethylene alkyl ether having an HLB value of 6.3 as a nonionic surfactant with an HLB value of smaller than 12.

[0085]

Comparative Examples 2 to 4

A wet wiping sheet was made in the same manner as in Example 1, except for replacing the first nonionic surfactant with a polyoxyethylene alkyl ether having an HLB value exceeding 15 (16.2 in Comparative Example 2, 18.4 in Comparative Example 3, or 18.5 in Comparative Example 4) as a nonionic surfactant.

[0086]

Comparative Examples 5 and 6

A wet wiping sheet was made in the same manner as in Example 1, except for replacing the second nonionic surfactant with a polyoxyethylene sorbitan fatty acid ester having an HLB value smaller than 15 (9.6 in Comparative Example 5 or 10.5 in

Comparative Example 6) as a nonionic surfactant.

[0087]

Comparative Example 7

A wet wiping sheet was made in the same manner as in Example 1, except for replacing the first nonionic surfactant with a polyoxyethylene alkyl ether (HLB value: 6.3) as a nonionic surfactant having an HLB value smaller than 12 and replacing the second nonionic surfactant with a polyoxyethylene sorbitan fatty acid ester (HLB value: 9.6) as a nonionic surfactant having an HLB value smaller than 15.

[0088]

Comparative Example 8

A wet wiping sheet was made in the same manner as in Example 1, except for replacing the first nonionic surfactant with a polyoxyethylene alkyl ether (HLB value: 18.5) as a nonionic surfactant having an HLB value greater than 15 and replacing the second nonionic surfactant with a polyoxyethylene sorbitan fatty acid ester (HLB value: 9.6) as a nonionic surfactant having an HLB value smaller than 15.

[0089]

Comparative Example 9

A wet wiping sheet was made in the same manner as in Example 1, except for using a cleaning fluid containing no nonionic surfactant.

[0090]

Determination of pH:

A liquid squeezed from each wiping sheet of Examples and Comparative Examples was used as a cleaning fluid released from the wiping sheet. A 30 mL portion of the cleaning fluid released from the wiping sheet was put in a beaker. The pH of the liquid in the beaker at 25°C was measured using a pH meter F22 from Horiba. The results obtained are shown in Table 1 below.

[0091]

Determination of foam heights:

Foam heights were determined according to the Ross-Miles method specified in JIS IK3362. Specifically, the cleaning fluid before impregnation was foamed, and an initial foam height and a foam height after 5 minutes were measured by the naked eye. The measurement was taken in triplicate, and the arithmetic mean of the measured heights was used as a foam height (mm). The results are shown in Table 1.

[0092]

Determination of viscosity:

The viscosity of the cleaning fluid was determined as follows. Viscometer TVB-10 (from Toki Sangyo Co., Ltd.) equipped with a rotor for low viscosity (Rotor No. M1) was used. A 100 mL portion at 25°C of the cleaning fluid released from the wiping sheet was put in a beaker, and the viscosity of the fluid was measured by rotating the rotor as immersed in the fluid at 60 rpm for 1 minute. The measurement was taken in triplicate, and the arithmetic mean of the measurement values was taken as the viscosity (mPa·s) of the fluid. The results are shown in Table 1.

[0093]

Determination of surface tension:

The surface tension of the cleaning fluid was determined as follows. Automatic surface tensiometer CBVD-Z from Kyowa Interface Science Co., Ltd. was used. A 10 mL portion of the cleaning fluid at 25°C released from the wiping sheet was put in a small petri dish. The dish was placed on the stage of the surface tensiometer. A platinum plate hanging from a hook attached to the spring balance of the tensiometer was moved down until it contacted the cleaning fluid. The spring load in equilibrium with the force of pulling the platinum plate into the fluid was read. The measurement was taken in triplicate, and the arithmetic mean of the readings was used as the surface tension (mN/m) of the cleaning fluid. The results are shown in Table 1.

[0094]

Evaluation of stability:

The stability of the cleaning fluid was evaluated as follows. In an airtight container was put 100 mL of the cleaning fluid before impregnation and left to stand at room temperature (20°C to 25°C) for 72 hours. After the standing, the cleaning fluid

was visually inspected for any sediment to rate the stability of the fluid according to the following standards. The results of evaluation are shown in Table 1.

[0095]

Stability rating standards:

A: Very stable with no sediment observed.

B: Stable with white turbidity and no sediment observed.

C: Lacking in stability with sediment observed.

[0096]

Evaluation of greasy dirt removal performance:

(1) Artificial sebum (model sebum dirt, see below) and (2) tallow of beef origin (see below) as greasy dirt to be removed were each applied to a floor material (DAG floor, from Kitakei Co., Ltd.) as a surface to be cleaned, and the thus soiled surface was wiped with the wiping sheet. The greasy dirt removal performance of the wiping sheet was evaluated visually and rated as follows. The results are shown in Table 1.

[0097]

Standards of evaluation of greasy dirt removal performance:

The greasy dirt removal performance was rated in accordance with the change in the shine of the soiled surface before and after wiping as observed visually.

5: 90% or more of the greasy dirt was removed, indicating very good performance.

4: 60% to less than 90% of the greasy dirt was removed, indicating good performance.

3: 40% to less than 60% of the greasy dirt was removed, indicating not so good performance.

2: 10% to less than 40% of the greasy dirt was removed, indicating poor performance.

1: Less than 10% of the greasy dirt was removed, indicating very poor performance.

[0098]

(1) Artificial sebum

An artificial sebum weighing 0.06 g was applied to a 14 cm × 14 cm area of the floor material. Each of the wiping sheets of Examples and Comparative Examples was

wiped back and forth once on the soiled surface in the widthwise direction of the sheet to evaluate the dirt removal performance as described above. The wiping conditions were an applied load of 160 N/m² and a speed of 1000 mm/s.

[0099]

(2) Tallow of beef origin

Beef tallow and butter were mixed in a 1:1 mass ratio, and the blend was heated at 180°C for 30 minutes to be denatured and solidified. A 1.0 g portion of the resulting blend fat was applied to the floor material. Each of the wiping sheets of Examples and Comparative Examples was wiped back and forth three times on the soiled surface in the widthwise direction of the sheet to evaluate the dirt removal performance as described above. The wiping conditions were the same as above.

[0100]

Evaluation of cleanliness:

The cleanliness of a surface after wiping with the wiping sheet of Examples and Comparative Examples was evaluated according to the following standards. The results are shown in Table 1.

[0101]

Standards of evaluation of cleanliness:

A: The wiping sheet has high foaming properties and, after the wiped surface dries, provides a good tactile sense of cleanliness, with no stickiness or sliminess left on the wiped surface.

B: The wiping sheet has poor foaming properties and lacks a sense of cleanliness after wiping.

[0102]

Table 1

		Example			Comparative Example								
		1	2	3	1	2	3	4	5	6	7	8	9
Characterization of Cleaning Fluid:													
1st Nonionic Surfactant	HLB Value	13.6	12.1	13.6	6.3	16.2	18.4	18.5	13.6	13.6	6.3	18.5	-
	Content (mass%)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	-
2nd Nonionic Surfactant	HLB Value	16.7	16.7	15.0	16.7	16.7	16.7	16.7	9.6	10.5	9.6	9.6	-
	Content (mass%)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	-
pH of Cleaning Fluid*		8.2	8.1	8.3	8.3	8.3	8.3	8.2	8.4	8.4	8.4	8.4	8.3
Ross-Miles Foam Height (mm)	Initial	150	140	160	140	150	190	150	100	90	60	120	90
	After 5 mins.	140	130	140	130	140	180	120	90	80	50	100	80
Viscosity of Cleaning Fluid* (mPa·s)		5.2	4.9	4.6	4.4	4.0	4.5	4.4	5.5	6.2	3.9	4.6	2.9
Surface Tension of Cleaning Fluid* (mN/m)		31.1	28.4	31.1	26.1	31.0	30.7	28.7	30.2	28.2	26.4	31.9	31.6
Results of Evaluation:													
Stability		A	B	B	C	A	A	A	C	C	C	C	A
Greasy Dirt Removal Performance	Artificial Sebum	5	4	4	3	3	3	2	4	4	1	1	1
	Tallow of Beef Origin	5	4	4	3	3	3	2	4	4	1	1	1
Sense of Cleanliness		A	A	A	A	A	A	A	B	B	B	A	B

* As released from the wiping sheet.

[0103]

The results shown in Table 1 prove that the wiping sheets of the present invention achieves high efficiency of removing greasy dirt, such as sebum and animal fats, and capability of effectively removing caked-on greasy dirt. In addition, the wiping sheets of the present invention provide high cleanliness after a surface wiped therewith dries, leaving no sticky or slimy feel on the surface. In contrast, the wiping sheets of Comparative Examples are inferior in greasy dirt removal performance and, in addition, poor in cleaning fluid stability or cleanliness after wiping.

Industrial Applicability

[0104]

The present invention provides a wiping sheet capable of effectively removing caked-on greasy dirt from a hard surface.

CLAIMS

1. A wiping sheet comprising a fiber aggregate containing synthetic fibers and impregnated with a cleaning fluid,
the fiber aggregate having a dry basis weight of 50 g/m² to 100 g/m²,
the cleaning fluid comprising at least two nonionic surfactants having different HLB values, one of the surfactants having an HLB value of from 12 to less than 15, and the other surfactant having an HLB value of from 15 to 18, and
the cleaning fluid being present in an amount of 205 g/m² to 380 g/m².
2. The wiping sheet according to claim 1, wherein one of the surfactants has an HLB value of 12.5 to 14.5.
3. The wiping sheet according to claim 1 or 2, wherein the other surfactant has an HLB value of 15.5 to 17.5.
4. The wiping sheet according to any one of claims 1 to 3, wherein one of the surfactants is a polyoxyethylene alkyl ether comprising at least one of polyoxyethylene lauryl ether (HLB value: 12.1 – 14.9), polyoxyethylene cetyl ether (HLB value: 12.9 – 14.3), polyoxyethylene stearyl ether (HLB value: 12.8 – 13.9), and polyoxyethylene oleyl ether (HLB value: 12.1 – 13.6).
5. The wiping sheet according to any one of claims 1 to 4, wherein the other surfactant is a polyoxyethylene sorbitan fatty acid ester comprising at least one of polyoxyethylene sorbitan monopalmitate (HLB value: 15.6) and a polyoxyethylene sorbitan coconut oil fatty acid ester (HLB value: 15.0 – 16.7).
6. The wiping sheet according to any one of claims 1 to 5, wherein the cleaning fluid further comprises an amphoteric surfactant.
7. The wiping sheet according to claim 6, wherein the amphoteric surfactant comprises at least one member selected from lauryldimethylamine oxide, alkyl betaines,

2-alkyl-N-carboxymethyl-N-hydroxyethylimidazolinium betaines.

8. The wiping sheet according to one of claims 1 to 7, wherein the cleaning fluid as released from the wiping sheet has a pH of 7.8 to 9.0 at 25°C, a viscosity of 2 mPa·s to 10 mPa·s at 25°C, and a surface tension of 25 mN/m to 35 mN/m.

9. The wiping sheet according to claim 8, wherein the cleaning fluid as released from the wiping sheet has a pH of 8.0 or higher at 25°C.

10. The wiping sheet according to claim 8 or 9, wherein the cleaning fluid as released from the wiping sheet has a pH of 8.5 or lower at 25°C.

11. The wiping sheet according to any one of claims 1 to 10, wherein the cleaning fluid further comprises a perfume.

12. The wiping sheet according to claim 11, wherein the perfume is soluble in the cleaning fluid and comprises at least one member selected from the group consisting of perfume components, such as menthol, geraniol, citronellal, citronellol, 1,8-cineol, terpineol, menthol, and linalool, and perfume component compositions containing a perfume having a rose, lavender, jasmine, or ylang-ylang note.

13. The wiping sheet according to any one of claims 1 to 12, wherein the cleaning fluid contains 0.1 mass% to 0.5 mass% of each of the nonionic surfactants, with the total content of the nonionic surfactants being 0.2 mass% to 1.0 mass%.

14. The wiping sheet according to any one of claims 1 to 13, wherein the fiber aggregate has a three-dimensional texture comprising raised portions and recessed portions in a macroscopic pattern on at least one side thereof, and the synthetic fibers have a flat cross-sectional shape,

the synthetic fibers present in the recessed portions having their cross-sectional major axis generally parallel with the plane of the wiping sheet, and the synthetic fibers present in the raised portions having their cross-sectional major axis generally parallel

with a plane perpendicular to the plane of the wiping sheet.

15. The wiping sheet according to any one of claims 1 to 14, further comprising a scrim located in the middle of the thickness of the fiber aggregate.

16. The wiping sheet according to any one of claims 1 to 15, being used to wipe a hard surface.

17. A method for making the wiping sheet according to any one of claims 1 to 16, comprising the steps of forming a fiber aggregate containing synthetic fibers and impregnating the fiber aggregate with a cleaning fluid by spraying.

18. The method according to claim 17, wherein the fiber aggregate mainly comprises the synthetic fibers.

19. The method according to claim 17 or 18, wherein the fiber aggregate has a synthetic fiber content of at least 50 mass% in a dry state.

20. The method according to any one of claims 17 to 19, wherein the cleaning fluid contains an additive.

21. The method according to claim 20, wherein the additive comprises at least one member selected from the group consisting of disinfectants, antiseptics, fragrances, deodorants, pH adjustors, chelating agents, viscosity modifiers, and solvents, such as alcohols.

22. The method according to any one of claims 17 to 21, wherein the fiber aggregate is formed using synthetic fibers having a flat cross-sectional shape.

23. The method according to any one of claims 17 to 22, further comprising three-dimensionally texturing one side of the fiber aggregate in a macroscopic pattern before the step of impregnating.

24. A method for using the wiping sheet according to any one of claims 1 to 16, for wiping a hard surface.