

DESCRIPTION

Title of Invention: CLEANING SHEET

Technical Field

[0001]

The present invention relates to a cleaning sheet.

Background Art

[0002]

The assignee common to this application previously proposed a cleaning sheet capable of abrading or scouring a surface to be cleaned to remove dirt, which contains 10 to 90 mass% of thermoplastic fibers having a fiber length of 2 to 15 mm and a fineness of 10 to 150 dtex and 10 to 90 mass% of cellulose fibers and having a large number of ends of the thermoplastic fibers exposed on the surface thereof (see patent document 1 below). The cleaning sheet is characterized by its capability of sufficiently removing dirt by abrasion or scouring.

[0003]

Patent Literature 2 below discloses another cleaning article having abrading ability to remove dirt, which includes a substrate, a water-soluble binder, and a plurality of abrasive particles releasably secured to the substrate by the water-soluble binder. The abrasive cleaning article disclosed is designed to release the abrasive particles from the substrate upon contact with a solvent.

Citation List

Patent Literature

[0004]

Patent Literature 1: JP 2003-61885A

Patent Literature 2: JP 2008-529589A

Summary of Invention

[0005]

The cleaning sheet of Patent Literature 1 has a scouring surface on only one side thereof. Therefore, it has a single scouring effect and is incapable of providing different scouring effects according to the toughness of dirt. Furthermore, during scouring operation, a user's hand put on the flat surface of the sheet opposite to the scouring surface may tend to unintentionally slip on the flat surface, making it difficult to scour smoothly.

[0006]

The abrasive cleaning article of Patent Literature 2 is designed such that, upon contact with a solvent, the water soluble binder dissolves in the solvent to release the abrasive particles and that the hardness of the released particles is made use of to remove dirt. That is, use of abrasive particles is essential. Therefore, the substrate per se is not expected to have scouring effect. Since the abrasive cleaning article described in ibid does not permit the abrasive particles to release in its dry state, it is useful exclusively in a wet state. Even when it is used in a wet state, the abrasive particles do not release until the water soluble binder dissolves in a solvent, so that it takes time for the abrasive particles to release.

[0007]

The invention provides a cleaning sheet including a liquid retentive layer containing cellulosic fibers and heat-fusible fibers having a fineness of 0.5 to 5 dtex and a fiber length of 2 to 15 mm and an airlaid layer laid on one side of the liquid retentive layer. The airlaid layer contains thermoplastic fibers. The individual fibers constituting the airlaid layer are fusion bonded or adhesively bonded to one another at their intersections. The airlaid layer contains large-diameter thermoplastic fibers having a fineness of 10 to 150 dtex and a fiber length of 2 to 15 mm and small-diameter thermoplastic fibers having a fineness of 0.5 to 5 dtex and a fiber length of 2 to 15 mm. The airlaid layer has the ends of a plurality of the large-diameter thermoplastic fibers exposed on the surface thereof to provide abrading or scouring capabilities for dirt removal from a surface being cleaned. The liquid retentive layer also has the ends of a plurality of the large-diameter thermoplastic fibers exposed on its surface opposite to the surface facing the airlaid layer. The number of the ends exposed on the surface of the liquid retentive layer is smaller than that of the ends exposed on the surface of the airlaid layer.

Brief Description of Drawings

[0008]

[Fig. 1] Fig. 1 is a schematic perspective view showing an embodiment of the cleaning sheet of the invention.

[Fig. 2] Fig. 2 is a schematic cross-sectional view showing a cross-sectional structure of the cleaning sheet of Fig. 1.

[Fig. 3] Fig. 3 is a schematic enlarged view of an essential part of the cross-sectional structure of Fig. 2.

[Fig. 4] Fig. 4 schematically illustrates the mechanism of dirt removal with the cleaning sheet of Fig. 1.

[Fig. 5] Fig. 5 is a schematic illustration of an apparatus suited to make the cleaning sheet of Fig. 1.

[Fig. 6] Fig. 6(a) is a schematic cross-sectional view showing a cross-sectional structure of another embodiment of the cleaning sheet of the invention. Fig. 6(b) is a schematic enlarged view of an essential part of the cross-sectional structure of Fig. 6(a).

Description of Embodiments

[0009]

The invention will be described on the basis of its preferred embodiments with reference to the accompanying drawings. A cleaning sheet 1 of the embodiment illustrated in Figs. 1 and 2 is suitably used to clean a hard surface. The cleaning sheet 1 is designed for dry cleaning and is substantially free from a liquid component such as a liquid cleaner. The expression “substantially free” as used herein is intended to mean that the proportion of a liquid component in the cleaning sheet 1 is not more than 3 mass%. The cleaning sheet 1 has a liquid retentive layer 4 and an airlaid layer 5. That is, the cleaning sheet 1 has a dual layer structure composed of the liquid retentive layer 4 and the airlaid layer 5, with no other layers interposed between the liquid retentive layer 4 and the airlaid layer 5. This does not mean to exclude the presence of another or other layers between the liquid retentive layer 4 and the airlaid layer 5. Another or other layers may be interposed between the liquid retentive layer 4 and the airlaid layer 5 according to particular uses. The liquid retentive layer 4 and the airlaid layer 5 are superposed on each other and united together. Uniting the layers may be achieved by various means, such as fusion bonding, adhesive bonding, and sewing.

[0010]

Having a dual layer structure composed of the liquid retentive layer 4 and the airlaid layer 5, the cleaning sheet 1 has one of its sides defined by the surface of the liquid retentive layer 4 and the other side defined by the surface of the airlaid layer 5.

[0011]

The liquid retentive layer 4 is capable of absorbing and retaining water. On the other hand, the airlaid layer 5 has a scouring ability for dirt removal. In this sense, the airlaid layer will also be called a scouring layer. The liquid retentive layer 4 contains cellulosic fibers and heat-fusible fibers having a fineness of 0.5 to 5 dtex and a fiber length of 2 to 15 mm. The airlaid layer 5 is a layer formed by providing an airlaid web containing thermoplastic fibers and bonding the fibers constituting the airlaid web to one another by fusion bonding or adhesive bonding at their intersections.

[0012]

The cleaning sheet 1 may have the surface of the scouring layer 5 patterned with depressions and protrusions. For example, as illustrated in Fig. 1, the surface of the scouring layer 5 may be heat embossed in a diamond lattice pattern to form depressions 8 in a diamond lattice pattern. The depression 8 is a fusion bonded portion having a higher density than the surrounding region, and the region surrounded by the depressions 8 defining a diamond shape is a non-embossed portion providing a protrusion 7. The non-embossed portion is a non-fusion-bonded portion having a lower density than the depression 8. The depression 8 is a portion densified by the heat and pressure applied in heat embossing to have an increased density compared with the non-embossed portion. That is, the depression 8 has a higher density than the non-embossed portion. The heat embossing may be conducted for the purpose of not only patterning the scouring layer 5 in relief but also uniting the scouring layer 5 and the liquid retentive layer 4.

[0013]

The pattern of the depressions 8 is not limited to a diamond lattice and may be any desired pattern, such as lines, dots, and specifically designed patterns. The total area of the depressions 8 is preferably 5% or more, more preferably 10% or more, and

preferably 50% or less, more preferably 40% or less, relative to the area of the cleaning surface of the cleaning sheet 1. Specifically, the total area of the depressions 8 is preferably 5% to 50%, more preferably 10% to 40%, relative to the area of the cleaning surface of the cleaning sheet 1. The total area of the depressions 8 relative to the cleaning surface area will be referred to as an area ratio of the depressions 8. With the area ratio of the depressions 8 falling in the above range, the cleaning sheet 1 will have successfully have surface strength and cleaning performance in good balance.

[0014]

The cleaning sheet 1 may have perforations (not shown in the drawings) so that a user may tear the cleaning sheet 1 along the perforation line to make it smaller and convenient to use for cleaning. As long as the cleaning sheet 1 can be cut to easy-to-use shape and size, the pattern of the perforations is not limited.

[0015]

The scouring layer 5, the other layer composing the cleaning sheet 1, contains large-diameter thermoplastic fibers 2 (hereinafter simply referred to as large-diameter fibers) as one type of the thermoplastic fibers. As used herein, the term “large-diameter fiber” shall define a fiber having a fineness of 10 to 150 dtex. Fibers having such a large fineness have high stiffness and thereby exert sufficiently high scouring effect. From this viewpoint, the fineness of the large-diameter fibers 2 is 10 dtex or more, preferably 20 dtex or more, more preferably 30 dtex or more, and it is 150 dtex or less, preferably 130 dtex or less, more preferably 120 dtex or less. Specifically, the fineness of the large-diameter fibers 2 is preferably 10 to 150 dtex, more preferably 20 to 130 dtex, even more preferably 30 to 120 dtex. By the presence of such large-diameter fibers 2, the cleaning sheet 1 exhibits an excellent scouring action on a -encrusted surface of pots and pans, or a dirt-encrusted surface of a kitchen, a bathroom, and the like. The cleaning sheet 1 has the ends of a plurality of the large-diameter fibers 2 exposed on the surface of the scouring layer 5 to exhibit abrading or scouring capabilities on a surface to be cleaned.

[0016]

The large-diameter fibers 2 are preferably staple fibers. Large-diameter staple

fibers 2 are less likely to bend and thereby have increased stiffness. Furthermore, use of staple fibers as the large-diameter fibers 2 enables successful formation of the scouring layer 5 by an air-laying method as will be described. From these viewpoints, the fiber length of the large-diameter fibers 2 is preferably 2 mm or longer, more preferably 3 mm or longer, even more preferably 4 mm or longer, and preferably 15 mm or shorter, more preferably 8 mm or shorter, even more preferably 6 mm or shorter. Specifically, the fiber length of the large-diameter fibers 2 is preferably 2 to 15 mm, more preferably 3 to 8 mm, even more preferably 4 to 6 mm. The large-diameter fibers 2 with the length within the above range have sufficiently high stiffness and are effectively prevented from falling out of the scouring layer 5. Furthermore, the large-diameter fibers 2 with the above length are successfully air-laid to form the scouring layer 5.

[0017]

The large-diameter fibers 2 are preferably present in a proportion of 10 mass% or more relative to the mass of the cleaning sheet 1 to provide for sufficient scouring capabilities for dirt removal. The scouring capabilities are further enhanced when the amount of the large-diameter fibers 2 in the cleaning sheet 1 is 30 mass% or more, preferably 50 mass% or more. The proportion of the large-diameter fibers 2 in the cleaning sheet 1 is preferably 90 mass% or less. Specifically, the proportion of the large-diameter fibers 2 in the cleaning sheet 1 is preferably 10 to 90 mass%, more preferably 30 to 90 mass%, even more preferably 50 to 90 mass%.

[0018]

The large-diameter fibers 2 may be of, for example, polyolefin resins such as polyethylene and polypropylene, polyester resins such as polyethylene terephthalate, acrylic resins such as polyacrylic acid and polymethacrylic acid, vinyl resins such as polyvinyl chloride, polyamide resins such as nylon, various metals, glass, or minerals. When resin-made large-diameter fibers 2 are used, the resin preferably has a Rockwell hardness of R40 to R150. In order to obtain improved scouring capabilities, it is preferred to use a resin with a Rockwell hardness of R80 to R150. Bicomponent conjugate fibers composed of two resins selected from the above described resin materials in, e.g., a sheath-core configuration or side-by-side configuration are also useful. Particularly preferred large-diameter fibers 2 are acrylic fibers, polyester

fibers, polyvinyl chloride fibers, polyamide fibers, and polyolefin fibers in terms of providing good scouring effect without scratches on a surface being cleaned (e.g., stainless steel, tile, enamel, or cultured marble). Use of heat fusible fibers is also recommended for prevention of fall-off of fibers. For example, it is advantageous to use heat-fusible conjugate fibers composed of resins of different melting temperatures, i.e., a low-melting resin and a high-melting resin, with at least part of the surface of the fiber being made of the low-melting resin. Examples of the low-melting/high-melting resin combination include high density polyethylene/polypropylene, low density polyethylene/polypropylene, polypropylene/ethylene-butene-1 crystalline copolymer, high density polyethylene/polyethylene terephthalate, nylon-6/nylon-66, low melting polyester/polyethylene terephthalate, and polypropylene/polyethylene terephthalate.

[0019]

The heat-fusible conjugate fibers may have a side-by-side, sheath-core, eccentric sheath-core, multilayer (three or more layers), hollow side-by-side, hollow sheath-core, modified cross-section, islands-in-the-sea, or a like configuration, provided that at least part of the surface of the individual conjugate fiber should be formed of the low-melting resin. Preferred heat fusible conjugate fibers are those composed of at least one thermoplastic resin selected from high density polyethylene, linear low density polyethylene, an ethylene-butylene-1 crystalline copolymer, and low-melting polyesters, such as a polyethylene terephthalate-polyethylene isophthalate copolyester, as a low-melting component and polypropylene or polyethylene terephthalate as a high-melting component in a side-by-side, sheath-core, or eccentric sheath-core configuration. Conjugate fibers composed of low melting polyester and polyethylene terephthalate are particularly preferred in the interests of good scouring action for dirt removal.

[0020]

Crimped fibers are also useful as the large-diameter fibers 2. Use of crimped fibers brings about improved thick feel (bulkiness) that will provide improved comfort in use. The form of crimps may include spiral or helical, zigzag, and U shape, any of which is suitably used in the invention.

[0021]

The large-diameter fibers 2 may include one kind or two or more kinds of fibers. In the case the large-diameter fibers 2 may include two or more kinds of fibers, it is preferred that the cleaning sheet 1 contain large-diameter fibers whose length and fineness are within the above-described ranges in a total proportion that is within the above-described range.

[0022]

The scouring layer 5 also contains small-diameter thermoplastic fibers (not shown) the fineness of which is smaller than that of the large-diameter fibers 2 (hereinafter simply referred to as “small-diameter fibers”) as another type of the thermoplastic fibers. It is preferred to use small-diameter fibers having a fineness of 0.5 dtex or more, more preferably 1 dtex or more, and 5 dtex or less, more preferably 3 dtex or less, with the proviso that the fineness of the small-diameter fibers is smaller than that of the large-diameter fibers 2. Specifically, it is preferred to use fibers having a fineness of 0.5 to 5 dtex, more preferably 1 to 3 dtex. The proportion of the small-diameter fibers in the scouring layer 5 is preferably 1 mass% or more, more preferably 5 mass% or more, and preferably 50 mass% or less, more preferably 30 mass% or less. Specifically, the proportion of the small-diameter fibers in the scouring layer 5 is preferably 1 to 50 mass%, more preferably 5 to 30 mass%. The presence of the small-diameter fibers in addition to the large-diameter fibers 2 in the scouring layer 5 enables reduction of the basis weight of the scouring layer 5 while maintaining the abrading or scouring capabilities.

[0023]

The small-diameter fibers are preferably staple fibers similarly to the large-diameter fibers 2. The fiber length of the small-diameter fibers is preferably 2 mm or longer, more preferably 3 mm or longer, even more preferably 4 mm or longer, and preferably 15 mm or shorter, more preferably 8 mm or shorter, even more preferably 6 mm or shorter. Specifically, the fiber length of the small-diameter fibers is preferably 2 to 15 mm, more preferably 3 to 8 mm, even more preferably 4 to 6 mm. It is preferred that the small-diameter fibers be made of a thermoplastic resin which may be either the same or different from that of the large-diameter fibers 2. It is particularly preferred for the small-diameter fibers be formed of heat-fusible fibers.

[0024]

The scouring layer 5 has its constituent fibers joined to one another at their intersections. In detail, the joining occurs at the intersections of the large-diameter fibers 2, the intersections of the small-diameter fibers, and the intersections between the large-diameter fiber 2 and the small-diameter fiber. A plurality of the large-diameter fibers 2 stand to have their ends exposed on the surface of the scouring layer 5. When the large-diameter fiber 2 is described as standing, it is meant that the longitudinal direction of the large-diameter fiber 2 (the direction perpendicular to the cross-sectional surface of the fiber) forms an angle of preferably at least 30°, more preferably 45° or greater, with an in-plane direction of the scouring layer 5. When the angle is 0°, the fiber lies down. When the large-diameter fiber 2 stands, one end of the fiber 2 is visible on the surface of the scouring layer 5 when viewed from above. It is preferred that at least 50%, more preferably 80% or more, of the large-diameter fibers 2 present in the scouring layer 5 stand. The joining between the large-diameter fibers 2 at their intersections combined with the existence of the ends of the large-diameter fibers 2 on the surface of the scouring layer 5 provides the scouring layer 5 with sufficient abrading or scouring capabilities. In this case, not all the large-diameter fibers 2 constituting the scouring layer 5 are required to have their end exposed on the surface of the scouring layer 5. It is only necessary that the ratio of the standing large-diameter fibers 2 be such that is enough to produce sufficient scouring effect.

[0025]

In order for the large-diameter fibers 2 to have their end exposed on the surface of the scouring layer 5, it is advantageous that the scouring layer 5 be formed by the air-laying method. When large-diameter staple fibers 2 and small-diameter staple fibers are deposited by the air-laying method to make an airlaid fiber web, and the fibers of the web are joined at their intersections, the ends of the large-diameter fibers 5 are easily exposed on the surface of the scouring layer 5. The joining of the fibers at their intersections may be achieved by, for example, adhesive bonding or fusion bonding.

[0026]

The basis weight of the scouring layer 5 is preferably 20 g/m² or more, more preferably 30 g/m² or more, and preferably 200 g/m² or less, more preferably 150 g/m² or less. Specifically, the basis weight of the scouring layer 5 is preferably 20 to

200 g/m², more preferably 30 to 150 g/m². The cleaning sheet 1 of which the scouring layer 5 has a basis weight falling within that range exhibits an ensured ability to remove tough dirt adhering to surfaces in kitchens, bathrooms, and other wet rooms.

[0027]

The scouring layer 5 has voids among the constituent fibers. The voids include those formed between the large-diameter fibers 2, those formed between the small-diameter fibers, and those formed between the large-diameter fiber 2 and the small-diameter fiber. In particular, the voids formed between the large-diameter fibers 2 are likely to be retained even when acted on by an external force. As illustrated in Fig. 3, the void space permits the presence of a plurality of abrasive particles 6. Abrasive particles 6 are allowed to exist in the void spaces without being adhesively secured to the fibers even though they are in contact with the fibers. The numeral 9 in Fig. 3 indicates an adhesive bond or fusion bond at the intersection of the large-diameter fibers 2. The abrasive particles 6 are used with a view to enhancing the abrading capabilities of the scouring layer 5 by the synergistic effect with the scouring capabilities of the large-diameter fibers 2. It is preferred for the abrasive particles 6 to be present in the space releasably from the scouring layer 5. As used herein, the expression “be present releasably” means that the abrasive particles 6 are present in the scouring layer 5 in a fashion that allows at least part of the abrasive particles 6 to fall off the scouring layer 5 when the cleaning sheet 2 is shaken, folded, or otherwise externally forced as it is not wetted. Therefore, the abrasive particles 6 are not secured to the fibers by a binder unlike, for example, the technique described in Patent Literature 2. The cleaning sheet 1 is different from the technique of Patent Literature 2 particularly in that the abrasive particles are not released upon contact with water or an aqueous solution but easily fall off by an external force, such as shaking, in a dry state. A specific method for having the abrasive particles 6 be present in the scouring layer 5 in such a releasable fashion will be described later.

[0028]

It is preferred that the amount of released adhesive particles (g/m²) released from the cleaning sheet 1 as measured by the method below be 0.1% or more, more preferably 0.3% or more, and preferably 3.0% or less, more preferably 2.0% or less, relative to the amount of originally present adhesive particles 6 (g/m²). Specifically,

the amount of released adhesive particles 6 (g/m^2) is preferably 0.1% to 3.0%, more preferably 0.3% to 2.0%, relative to the amount (g/m^2) of the originally present adhesive particles 6.

[0029]

Method for Determining Amount of Released Adhesive Particles:

The degree of release of the abrasive particles 6 from the scouring layer 5 can be determined as follows. The cleaning sheet 1 is cut into a rectangular specimen measuring $7\text{ cm} \times 10\text{ cm}$. The specimen was held with both hands with the 7-cm short side up and torn downward into two in the longitudinal direction at a tearing rate of 5 cm/sec in an environment of $20^\circ\text{C} \pm 5^\circ\text{C}$. The substance fallen by the tearing was collected and weighed, and the measured weight (g) was converted to weight per square meter, which shall define the amount of released adhesive particles 6.

[0030]

The abrasive particles 6 are preferably uniformly present through the thickness of the scouring layer 5. Nevertheless, it is advantageous that the abrasive particles 6 are substantially absent in a surface portion 5A including the outermost surface of the scouring layer 5. The surface portion 5A is the outermost portion, in the thickness direction, formed of an aggregate of the ends 2A of the large-diameter fibers 2 constituting the scouring layer 5. It is particularly advantageous that those large-diameter fibers 2 of which the end is exposed on the surface of the scouring layer 5 have substantially no abrasive particle 6 attached to their end portion 2A including the end. As used herein, the expression “substantially no adhesive particles 6 attached” shall mean that the total number of abrasive particles 6 attaching to the end of five selected large-diameter fibers 2 is not more than 10% of the total number of abrasive particles 6 attaching to the same five large-diameter fibers 5 in the transverse middle portion of the scouring layer 5 as observed from a 50 ± 5 times magnified image. As used herein, the term “transverse middle portion” shall define the middle part of the scouring layer 5 divided into equal three parts in its thickness direction. When the abrasive particles 6 are distributed in such a fashion, the abrasive particles 6 are released to a surface being cleaned quickly and in large quantity when removing the dirt off the surface with the scouring layer 5. As a result, quick and sure dirt removal can easily be accomplished. If the abrasive particles 6 are present up to the outermost surface of

the scouring layer 5, when the cleaning sheet 1 is applied to a wet surface to be cleaned, the abrasive particles 6 on the outermost surface of the scouring layer 5 would be wetted and be less likely to be released from the scouring layer 5. Consequently, the abrasive particles 6 are less likely to be supplied to the surface. As used herein, the term “end portion” shall define the portion extending from the exposed end to a depth corresponding to not more than 5 times the diameter of the large-diameter fiber 2.

[0031]

The amount of the abrasive particles 6 in the scouring layer 5 is preferably 150 mass% or more, more preferably 200 mass% or more, and preferably 900 mass% or less, more preferably 750 mass% or less, relative to the mass of the scouring layer 5. Specifically, the amount of the abrasive particles 6 is preferably 150 to 900 mass%, more preferably 200 to 750 mass%, relative to the mass of the scouring layer 5. With that amount of the abrasive particles 6 present in the scouring layer 5, synergism with the scouring capabilities of the large-diameter fibers 2 is exhibited to provide further improved abrading capabilities of the scouring layer 5.

[0032]

The abrasive particles 6 are preferably water insoluble particles. The abrasive particles 6 preferably have a Mohs hardness of 3 to 7 in terms of abrading performance. Examples of such abrasive particles 6 include calcium carbonate, zeolite, and silica (silica stone powder). These abrasive particles may be used either individually or in combination thereof. The average particle size of the abrasive particles 6 is preferably 5 μm or greater, more preferably 10 μm or greater, and preferably 50 μm or smaller, more preferably 40 μm or smaller. Specifically, the average particle size of the abrasive particles 6 is preferably 5 to 50 μm , more preferably 10 to 40 μm . It is preferred for the abrasive particles 6 to have not only the above described average particle size but a particle size distribution. By the use of the abrasive particles 6 with the hardness and average particle size described, a sufficient abrasive effect is produced while effectively preventing scratching of surfaces.

[0033]

The average particle size of the abrasive particles 6 is determined by the

electrical resistance method using a Coulter counter.

[0034]

The scouring layer 5 may contain other cleaning component in addition to the abrasive particles 6. For example, various surfactants may be used with the view of enhancing the cleaning effect. Examples of useful surfactants include anionic surfactants, such as alkylbenzenesulfonic acids, and nonionic surfactants, such as polyoxyethylene alkyl ethers. With a view to aiding rinsing, the scouring layer 5 may contain a polymer of acrylic acid, methacrylic acid, or maleic acid or a salt thereof or a maleic acid-vinyl monomer copolymer or a salt thereof.

[0035]

The abrasive particles 6 can be incorporated into the scouring layer 5 by, for example, the method described below. A cleaning sheet before being loaded with the abrasive particles 6 is provided. The term “load” means to apply the abrasive particles 6 so as to be present in the scouring layer. The method for making the cleaning sheet before being loaded with the abrasive particles 6 will be described later. Separately, a slurry containing the abrasive particles 6 is prepared. Water is conveniently used as a liquid medium of the slurry. Specific examples of the slurry are described, e.g., in JP 2006-104264A and JP 2006-104265A. The slurry may contain a trace amount of a surfactant to assist dispersion of the abrasive particles 6. The amount of the surfactant, if used, is preferably not more than 20 mass%, more preferably not more than 10 mass%, relative to the mass of the slurry. The slurry may, but preferably does not, contain a surfactant. Whether or not the slurry contains a surfactant, the slurry is applied and dried to have the abrasive particles 6 releasably held between fibers but not secured thereto. As used herein, the expression “not secured” means that the abrasive particles 6 are not fixed to the fibers by adhesive bonding or fusion bonding and at least partly released from the scouring layer 5 simply upon, for example, shaking without using a solvent such as an aqueous solution.

[0036]

The slurry is applied to the scouring layer 5 of a cleaning sheet before being loaded with the abrasive particles 6. The slurry may be applied using, for example, a

die coater or a gravure roll coater. By the application, a wet coating film containing the abrasive particles 6 is formed in the scouring layer 5. While the coating film is wet, a smooth-surfaced member is pressed onto the scouring layer 5, whereby the slurry fills the spaces formed between the large-diameter fibers 2 constituting the scouring layer 5 and, at the same time, the surface portion 5A of the scouring layer 5 is deprived of the slurry. As a result, the abrasive particles 6 are substantially absent in the surface portion 5A including the outermost surface of the scouring layer 5, and those large-diameter fibers 2 of which the end is exposed on the surface of the scouring layer 5 have substantially no adhesive particles 6 attached to their end portion 2A inclusive of the end. As previously defined, the term “end portion” shall refer to the portion extending from the exposed end to the position located at a distance not more than 5 times the diameter of the large-diameter fiber 2 (indicated by reference 2A in Fig. 3).

[0037]

The member used to press the scouring layer 5 may be, for example, synthetic resin film, a metal plate, natural fiber, or synthetic fiber thread. Synthetic resin film is preferred.

[0038]

After the surface portion 5A inclusive of the outermost surface of the scouring layer 5 is substantially deprived of the abrasive particles 6 by the pressing, the coating layer is dried. After the drying, the surface of the scouring layer 5 is wiped with a wiping member so that the surface portion 5A inclusive of the outermost layer of the scouring layer 5 is made still freer from the abrasive particles 6. Examples of useful wiping member include fiber sheets, such as woven or nonwoven fabric, synthetic resin fiber brushes, and natural fiber brushes.

[0039]

The liquid retentive layer 4 of the cleaning sheet 1 will then be illustrated. The liquid retentive layer 4 is a layer capable of absorbing and retaining water. To accomplish the capability, the liquid retentive layer 3 preferably contains hydrophilic fibers 3. For example, cellulosic fibers are suitably used as hydrophilic fibers. Examples of cellulosic fibers include pulp fiber, cotton fiber, and rayon fiber, with pulp

fiber being preferred. Softwood pulp fiber is particularly preferred with a view to prevention of fall-off of the hydrophilic fibers 3 and development of moderate sheet strength.

[0040]

The fiber length of the hydrophilic fibers 3 contained in the liquid retentive layer 4 is decided as appropriate to the method for forming the liquid retentive layer 4. For example, when the liquid retentive layer 4 is made by the air-laying method, the fiber length of the hydrophilic fibers 3 is preferably 0.1 to 15 mm, more preferably 0.3 to 10 mm. When the air-laying method is adopted, the intersections between fibers are joined by fusion bonding or adhesive bonding. In the case of adhesive bonding, any binder may be used, including acrylonitrile-butadiene rubber.

[0041]

The proportion of the hydrophilic fibers 3 in the cleaning sheet 1 is preferably 10 mass% or more, more preferably 20 mass% or more, and preferably 90 mass% or less. Specifically, the proportion of the hydrophilic fibers 3 in the cleaning sheet 1 is preferably 10 to 90 mass%, more preferably 20 to 90 mass%, in terms of absorbency for soiled liquid. The liquid retentive layer 4 preferably contains, in addition to the hydrophilic fibers 3, heat fusible fibers having a fineness of 0.5 to 5 dtex, preferably 1 to 3 dtex, and a fiber length of 2 to 15 mm, preferably 3 to 8 mm. The proportion of the heat fusible fibers in the liquid retentive layer 4 is preferably 10 to 90 mass%, more preferably 10 to 80 mass%. Useful heat fusible fibers are exemplified by low-melting polyolefin fibers, low-melting polyester fibers, and conjugate fibers composed of a low-melting resin and a high-melting resin with the low-melting resin forming part of the fiber surface, such as those described supra.

[0042]

The basis weight of the liquid retentive layer 4 is preferably 30 g/m² or more, more preferably 40 g/m² or more, and preferably 100 g/m² or less, more preferably 80 g/m² or less. Specifically, the basis weight of the liquid retentive layer 4 is preferably 30 to 100 g/m², more preferably 40 to 80 g/m². The liquid retentive layer 4 of which the basis weight is in that range is capable of sufficiently absorbing and

retaining soiled liquid. The overall basis weight of the cleaning sheet 1 including the scouring layer 5 and the liquid retentive layer 4 is preferably 50 to 300 g/m².

[0043]

The cleaning sheet 1 has the ends of a plurality of the large-diameter fibers 2 exposed also on the surface of the liquid retentive layer 4 opposite to the surface facing the scouring layer 5 to exhibit abrading and scouring performance on a surface to be cleaned for dirt removal. In other words, the cleaning sheet 1 has abrading and scouring capabilities on both sides thereof. It should be noted that the number of the ends of the large-diameter fibers 2 on the surface of the scouring layer 5 is different from that on the surface of the liquid retentive layer 4. When comparing the number of the large-diameter fibers 2 present on the surface of the liquid retentive layer 4 with the number of the ends of the large-diameter fibers 2 present on the surface of the scouring layer 5, the number of the large-diameter fibers 2 present on the surface of the liquid retentive layer 4 is preferably smaller than the number of the ends of the large-diameter fibers 2 present on the surface of the scouring layer 5. The large-diameter fibers 2 on the surface of the scouring layer 5 and those on the surface of the liquid retentive layer 6 being of the same material, the scouring capabilities depend on the number of the fiber ends. Therefore, the scouring layer 5 and the liquid retentive layer 4 have different scouring capabilities. More specifically, the scouring layer 5 has higher scouring capabilities than the liquid retentive layer 4. In cleaning a surface, a user is able to choose which of the scouring layer 5 and the liquid retentive layer 4 is appropriate according to the toughness of dirt. Since the surface of the cleaning sheet 1 opposite to the surface being used for cleaning has ends of the large-diameter fibers 2, to which a user's hand is applied, the ends of the large-diameter fibers 2 produce a frictional force to prevent slippage of the hand, thereby providing improved convenience in cleaning. With a view to further ensuring these advantageous effects, the number of the large-diameter fibers 2 on the surface of the liquid retentive layer 4 is preferably at least 0.1%, more preferably 0.3% or more, even more preferably 0.5% or more, of the number of the ends of the large-diameter fibers on the surface of the scouring layer 5. The number of the large-diameter fibers 2 on the surface of the liquid retentive layer 4 is preferably 20% or less, more preferably 15% or less, even more preferably 10% or less, of the number of the ends of the large-diameter fibers on the surface of the scouring layer 5. Specifically, the number of the

large-diameter fibers 2 on the surface of the liquid retentive layer 4 is preferably 0.1% to 20%, more preferably 0.3% to 15%, even more preferably 0.5 to 10%, of the number of the ends of the large-diameter fibers on the surface of the scouring layer 5.

[0044]

The number of the ends of the large-diameter fibers on the surface of the scouring layer 5 and the liquid retentive layer 4 measured obtained as follows. The cleaning sheet is cut into a rectangular specimen measuring 10 cm × 1 cm. The specimen is placed with its 10 cm-long cut surface in front of an observer. The upper surface of the cleaning sheet is observed using, for example, a magnifier from the direction making an angle of 10° with the upper surface of the cleaning sheet 1, and the number of the large-diameter fibers that stand making of an angle of 25° or greater with the surface of the cleaning sheet 1 is counted. The number counted is divided by ten to give the number of the large-diameter fiber ends per square centimeter. In the case when the sample is too small to cut into a specimen with the above size, a specimen of any size is cut out, the area of the surface to be observed is measured, the number of the large-diameter fibers is counted in the same manner as above, and the counted number is converted to the number per unit area (cm²), which may define the number of the ends of the large-diameter fibers.

[0045]

The number of the ends of the large-diameter fibers 2 present on the surface of the scouring layer 5 should be sufficient to develop sufficient abrading or scouring capabilities to remove dirt from a surface to be cleaned and is preferably 20 or greater, more preferably 50 or greater, even more preferably 100 or greater, and still even more preferably 120 or greater, per cm², and preferably 4000 or fewer, more preferably 2000 or fewer, even more preferably 1000 or fewer, still even more preferably 600 or fewer, per cm². Specifically, the number is preferably 20 to 4000, more preferably 50 to 2000, even more preferably 100 to 1000, still even more preferably 120 to 600, per cm².

[0046]

On the other hand, the number of the ends of the large-diameter fibers 2 present on the surface of the liquid retentive layer 4 is preferably 0.1 or greater, more preferably

1 or greater, even more preferably 5 or greater, still even more preferably 10 or greater, per cm^2 and preferably 100 or fewer, more preferably 60 or fewer, even more preferably 50 or fewer, still even more preferably 40 or fewer, per cm^2 , with the view of development of a sufficient frictional force against a user's hand and removal of less tough dirt. Specifically, the number is preferably 0.1 to 100, more preferably 1 to 60, even more preferably 5 to 50, still even more preferably 10 to 40, per cm^2 .

[0047]

Attention being focused on a single large-diameter fiber 2, one of the ends of the fiber 2 is present on the surface of the scouring layer 5. The other end of the fiber 2 may be present on the surface of the liquid retentive layer 4 or inside the scouring layer 5 or the liquid retentive layer 4. Otherwise, one of the ends of the fiber 2 may be present on the surface of the liquid retentive layer 4, and the other end of the fiber 2 may be present inside the liquid retentive layer 4 or the scouring layer 5. Thus, the large-diameter fibers 2 are present partly in the scouring layer 5 and partly in the liquid retentive layer 4.

[0048]

As described earlier, the cleaning sheet 1 is dry before use. On use, it may be used in a dry state or wetted state. In the case that the cleaning sheet 1 is used in a wetted state, cleaning may be carried out by first wetting a surface to be cleaned, e.g., a hard surface with water, cleaning the wetted hard surface with the scouring layer 5, and wiping the soiled water off the wet hard surface with the liquid retentive layer 4. Since the surface of the liquid retentive layer 4 has scouring capabilities, too, the wiping operation achieves both removal of the soiled water and further cleaning of the hard surface.

[0049]

The mechanism of dirt removal with the cleaning sheet 1 will be discussed here. In the case when the cleaning sheet 1 is used as wetted, a hard surface is first wetted with water. The cleaning sheet 1 is applied to the wetted hard surface on its scouring layer 5 and rubbed. This causes the abrasive particles 6 to be released from the scouring layer 5 and supplied to the surface being cleaned (designated a surface C)

as illustrated in Fig. 4. The released abrasive particles 6 and a large number of the ends of the large-diameter fibers 2 exposed on the surface of the scouring layer 5 abrade or scour the dirt-encrusted surface C to thereby remove the dirt D from the dirt-encrusted surface C. The removed dirt D is dissolved or dispersed in water and absorbed by the liquid retentive layer 4 together with water. In this way, the dirt-encrusted surface C is cleaned off.

[0050]

The cleaning sheet 1 preferably has a smaller air permeability in the vertical (thickness) direction (hereinafter designated air permeability T_{VD}) than in the in-plan direction (the air permeability in this direction will hereinafter be designated air permeability T_{MD}). It is also preferred that the liquid retentive layer 4 have a smaller air permeability T_{VD} than the scouring layer 5. This enables the abrasive particles 6 held between the fibers of the scouring layer 5 to remain within the scouring layer 5 without moving to the side of the liquid retentive layer 4, whereby the abrasive particles 6 are readily released to a surface being cleaned even with no aid of a liquid medium such as water in cleaning. It is desirable that the movement of the abrasive particles 6 from the scouring layer 5 to the liquid retentive layer 4 be prevented by the above described control of the air permeability so as to allow the abrasive particles 6 to be present in a relatively higher density in a position closer to the reverse side of the scouring layer 5 (i.e., closer to the liquid retentive layer 4) and be relatively scarce or absent in the surface side (the cleaning surface side). The ratio of the air permeability T_{MD} to the air permeability T_{VD} can be so controlled by, for example, adjusting the degree of standing of the constituent fibers. According as the constituent fibers stand, the air permeability in the vertical direction increases, and the air permeability in the in-plan direction decreases.

[0051]

The ratio, T_{MD}/T_{VD} , in the above described range may be established by, for example, appropriately adjusting the air-laying conditions in the formation of the scouring layer 5, the length and fineness of the large-diameter fibers 2, and the like and controlling the degree of standing of the large-diameter fibers 2 or the density of the large-diameter fibers 2 as referred to above.

[0052]

A plurality of the cleaning sheets 1 may be regularly stacked one on the other and packaged in a packaging material to be supplied in the form of a package. The packaging material preferably has an opening for access to the cleaning sheet 1 and a resealable closure member for closing the opening. In stacking the cleaning sheets 1, the cleaning sheets 1 are regularly stacked with the liquid retentive layer 4 facing upward, and the stack is preferably packaged in a packaging material with the liquid retentive layer 4 facing the side of the opening. The packaging manner described above is favorable in that the scratchy feel (the sensation of skin irritation caused by the standing large-diameter fibers 2) is reduced when a user picks up the cleaning sheet 1 with his/her fingers. This is because, when a user picks up the cleaning sheet 1 from the package with user's fingers, the user's finger pads contact the liquid retentive layer 4 having relatively fewer ends of the large-diameter fibers 2 and are less likely to contact the scouring layer 5 that can have a scratchy feel. It is recommended to mark or otherwise indicate the side of the liquid retentive layer so as to help a user to distinguish.

[0053]

To protect the contents, the above described packaging material is preferably put in a second packaging material having a hang hole or hook in its margin. The hang hole or hook of the second packaging material is for enabling hanging the package. The package using the second packaging material is advantageous in that it is easily hung in merchandise display. The second packaging material may be resealable.

[0054]

The packaging material may be provided, per se, with a hang hole or hook in its margin to be hung without using a second packaging material. The packaging material may be resealable.

[0055]

In another embodiment of packaging, the cleaning sheet 1 may be individually packaged in a packaging material. The individual package may have a cut line or perforations for helping a user to open the package. The individual packaging material

is preferably provided with a hang hole or hook in its margin to enable hanging the individual package. The individual package of this type is advantageous in that it is easily hung in merchandise display. Such an individual package may be one of a plurality of individual packages joined in series. In this case, only the first individual package is made hangable by providing a hang hole or hook, and the second to the fifth, or maybe up to the tenth packages are made separable along a joint line or perforations. Such a connected series of the individual packages can be hung in display in stores and may be dispensed individually.

[0056]

In still another embodiment of packaging, the cleaning sheet 1 may be produced as a continuous length sheet rolled into a roll, which is packaged in a packaging material. This type of merchandise may be made easier and more convenient to use by providing the continuous length with a tear aid means, such as a transverse cut line or transverse perforations, at regular intervals.

[0057]

The cleaning sheet 1 of the present embodiment can be produced by the methods below in accordance with the methods described in JP 2003-61885A.

Method 1:

An airlaid web containing cellulosic fibers is provided. The constituent fibers of the web are bonded to one another at their intersections by fusion bonding or with a binder to make a liquid retentive layer 4. Separately, an airlaid web containing large-diameter fibers and small-diameter fibers is provided, and the fibers constituting the web are bonded to one another at their intersections by fusion bonding or with a binder to make a scouring layer 5. The scouring layer 5 is superposed on one side of the liquid retentive layer 4 and united together.

Method 2:

An airlaid web containing large-diameter fibers and small-diameter fibers is superposed on one side of an airlaid web containing cellulosic fibers. The constituent fibers of each web are bonded to one another at their intersections by fusion bonding or

with a binder to form a liquid retentive layer 4 and a scouring layer 5 and, at the same time, the two webs are united together.

[0058]

In methods 1 and 2, the liquid retentive layer 4 having the ends of large-diameter fibers exposed on its surface can be formed by, for example, using a small amount of the large-diameter fibers in the formation of the cellulose fiber-containing web by air-laying method to incorporate the large-diameter fibers into the liquid retentive layer 4.

[0059]

Method 2A below may be adopted as a modification of method 2.

Method 2A:

An airlaid web containing cellulosic fibers, small-diameter fibers, and large-diameter fibers is provided, and the fibers constituting the web are bonded to one another at their intersections by fusion bonding or with a binder to make a liquid retentive layer 5. Separately from the formation of the liquid retentive layer 5, an airlaid web containing large-diameter fibers and small-diameter fibers is provided, and the fibers constituting the web are bonded to one another at their intersections by fusion bonding or with a binder to make an airlaid scouring layer 5. The scouring layer 5 is superposed on, and united with, one side of the liquid retentive layer 4. This method may be carried out using, for example, the apparatus 10 shown in Fig. 5.

[0060]

The apparatus 10 illustrated in Fig. 5 includes an endless forming belt 13 running in one direction D. The forming belt 13 is formed of an air-permeable material, for example, a metal mesh. Above the forming belt 13 are provided a first forming head 11 and a second forming head 12 for fiber feed along the running direction D of the forming belt 13. The first forming head 11 is upstream of the second forming head 12. The forming heads 11 and 12 are supplied with a first fiber material and a second fiber material, respectively, from the respective unshown feeders. The first fiber material contains cellulosic fibers, small-diameter fibers, and large-diameter fibers, while the second fiber material contains large-diameter fibers and

small-diameter fibers and does not contain cellulosic fibers. The forming heads 11 and 12 are each supplied with air from an unshown air source. The air supplied to the forming heads 11 and 12 is used to deliver and deposit the first and second fiber materials, respectively, on the forming belt 13. The forming heads 11 and 12 each have a plurality of brush rollers 14. Each brush roller 14 includes a roller body and comb tooth projecting on the peripheral surface of the roller body. The comb tooth stand in the direction normal to the peripheral surface of the roller body. The brush roller 14 is used to disperse the first and second fiber materials fed to the forming heads 11 and 12, respectively.

[0061]

The apparatus 10 has a first suction box 21 and a second suction box 22 located inside the running forming belt 13 at positions opposite to the forming heads 11 and 12, respectively. The first suction box 21 and the second suction box 22 generate suction while the first and second fiber materials are transported in an air stream and delivered from the forming heads 11 and 12, respectively, whereby the fibers are surely deposited on the forming belt 13.

[0062]

Production of the cleaning sheet 1 using the apparatus 10 is carried out as follows. The first fiber material containing cellulosic fibers, small-diameter fibers, and large-diameter fibers is fed to the first forming head 11, dispersed by the brush rollers 14, transported in an air stream, and scattered downward, i.e., on the upper side of the forming belt 13 to form an airlaid web as a liquid retentive layer 4. On the liquid retentive layer 4 is then formed an airlaid web as a scouring layer 5 containing large-diameter fibers and small-diameter fibers. The scouring layer 5 is formed by feeding the second fiber material containing small-diameter fibers and large-diameter fibers to the second forming head 12, dispersed by the brush rollers 14, transported in an air stream, and scattered downward, i.e., on the upper side of the liquid retentive layer 4. The liquid retentive layer 4 and the scouring layer are united together by a predetermined means.

[0063]

In the production of the cleaning sheet 1 using the apparatus 10, the number of the ends of the large-diameter fibers exposed on the surface of the liquid retentive layer 4 opposite to the surface facing the airlaid layer 5 can be controlled by adjusting the degree of suction by the first suction box 21 in forming the airlaid web of a liquid retentive layer 4. In detail, the number of the ends of the large-diameter fibers exposed on the surface of the liquid retentive layer 4 opposite to the surface facing the airlaid layer 5 increases with the degree of suction of the first suction box 21. The number of the ends of the large-diameter fibers exposed on the surface of the liquid retentive layer 4 opposite to the surface facing the airlaid layer 5 also increases with the proportion of the large-diameter fibers in the first fiber material.

[0064]

While the apparatus 10 has two forming heads for fiber delivery, it may have three or more forming heads. For example, the apparatus 10 may have a first forming head, a second forming head, and a third forming head in that order from the upstream side in the running direction D. In that case, it is preferred to install as many suction boxes as the forming heads, i.e., a first, a second, and a third suction box. In using the apparatus having this configuration, it is preferred that a first fiber material containing cellulosic fibers, small-diameter fibers, and large-diameter fibers is fed to the first forming head; a second fiber material containing cellulosic fibers and small-diameter fibers and not containing large-diameter fibers is fed to the second forming head; and a third fiber material containing small-diameter fibers and large-diameter fibers and not containing cellulosic fiber is fed to the third forming head. The resulting cleaning sheet 1 has a liquid retentive layer 4 made of the first fiber material, a scouring layer 5 made of the third fiber material, and an interlayer interposed between the layers 4 and 5 and having a fiber composition intermediate between the layers 4 and 5. In this case, too, the number of the ends of the large-diameter fibers exposed on the surface of the liquid retentive layer 4 opposite to the surface facing the airlaid layer 5 increases with the degree of suction by the first suction box 21. The second suction box preferably exerts a weaker suction force than the first suction box and the third suction box.

[0065]

Figs. 6(a) and 6(b) illustrate another embodiment of the cleaning sheet 1 of the invention. The cleaning sheet 1 shown in Figs. 6(a) and 6(b) is different from that

shown in Figs. 1 through 4 in structure of the liquid retentive layer 4. While the cleaning sheet of Figs. 1 through 4 has no abrasive particles attached to the end of the large-diameter fiber 2 present on the surface of the liquid retentive layer 4, the cleaning sheet 1 of the present embodiment has void spaces between the ends of the large-diameter fibers 2 present on the surface of the liquid retentive layer 4, and abrasive particles 6 releasably present in the spaces. The large-diameter fibers 2 of which the ends are present on the surface of the liquid retentive layer 4 have substantially no abrasive particles 6 attached to their end portion including the end. The abrasive particles 6 are in contact with the large-diameter fibers 2 but are not fixed to the fibers, e.g., with adhesive. The abrasive particles 6 are preferably present in the void spaces releasably from the liquid retentive layer 4. As used herein, the expression “be present releasably” means that the abrasive particles 6 are present in the liquid retentive layer 4 in a fashion that allows at least part of the abrasive particles 6 to fall off the liquid retentive layer 4 when the cleaning sheet 1 is shaken, folded, or otherwise externally forced as it is not wetted.

[0066]

The abrasive particles 6 are preferably present uniformly through the thickness of the liquid retentive layer 4. Nevertheless, it is advantageous that the abrasive particles 6 be substantially absent in a surface portion including the outermost surface of the liquid retentive layer 4. The term “surface portion” is as defined supra. The expression “substantially absent” as used herein is as defined supra. When the abrasive particles 6 are distributed in such a fashion, the abrasive particles 6 are released to a surface being cleaned quickly and in large quantity when removing the dirt off the surface with the liquid retentive layer 4. As a result, quick and sure dirt removal can easily be accomplished. As used herein, the term “end portion” shall define the region from the exposed end to the depth corresponding to not more than 5 times the diameter of the large-diameter fiber 2.

[0067]

The description of the cleaning sheet illustrated in Figs. 1 to 4 applies as appropriate to the undescribed details of the cleaning sheet 1 of the present embodiment.

[0068]

While the invention has been described with reference to its preferred embodiments, it is not limited thereto. For example, while the cleaning sheet 1 that has been described is of dry type, it may be impregnated with water or an aqueous cleaner containing water and a surfactant to be formulated into a wet type.

[0069]

While in the foregoing embodiments incorporation of the abrasive particles 6 into the scouring layer 5 is achieved by pressing a smooth-surfaced member onto the coating film of the slurry containing the abrasive particles 6, drying the applied slurry, and wiping the dried surface with a fiber sheet, the operation of wiping with a fiber sheet may not be conducted. The same applies equally to the liquid retentive layer 4.

[0070]

While in the foregoing embodiments the cleaning sheet 1 has the abrasive particles 6 attached to the large-diameter fibers, the use of the abrasive particles 6 is not essential to the invention. The abrasive particles 6 may not be used for some particular uses.

[0071]

In relation to the foregoing embodiments, the following cleaning sheets are further disclosed.

<1> A cleaning sheet comprising a liquid retentive layer containing cellulosic fibers and heat-fusible fibers having a fineness of 0.5 to 5 dtex and a fiber length of 2 to 15 mm and an airlaid layer laid on one side of the liquid retentive layer,

the airlaid layer containing thermoplastic fibers and having the individual constituent fibers fusion-bonded or adhesively bonded to one another at their intersections,

the airlaid layer containing large-diameter thermoplastic fibers having a fineness of 10 to 150 dtex and a fiber length of 2 to 15 mm and small-diameter thermoplastic fibers having a fineness of 0.5 to 5 dtex and a fiber length of 2 to 15 mm,

the airlaid layer having the ends of a plurality of the large-diameter thermoplastic fibers exposed on the surface thereof to provide abrading or scouring

capabilities for dirt removal from a surface being cleaned, and

the liquid retentive layer having the ends of a plurality of the large-diameter thermoplastic fibers exposed on its surface opposite to the surface facing the airlaid layer, the number of the ends exposed on the surface of the liquid retentive layer being smaller than that of the ends exposed on the surface of the airlaid layer.

[0072]

<2>

The cleaning sheet as set forth in clause <1>, wherein the number of the ends of the large-diameter thermoplastic fibers present on the surface of the liquid retentive layer is 0.1% to 20% of the number of the ends of the large-diameter thermoplastic fibers present on the surface of the airlaid layer.

<3>

The cleaning sheet as set forth in clause <1> or <2>, wherein the large-diameter thermoplastic fibers are present in a proportion of 10 mass% or more relative to the mass of the cleaning sheet.

<4>

The cleaning sheet as set forth in any one of clauses <1> to <3>, having a proportion of preferably 10 to 90 mass%, more preferably 30 to 90 mass%, even more preferably 50 to 90 mass% of the large-diameter thermoplastic fibers relative to the mass of the cleaning sheet.

<5>

The cleaning sheet as set forth in any one of clauses <1> to <4>, being obtained by providing a web containing the cellulosic fibers and the heat-fusible fibers and having its constituent fibers fusion bonded or adhesively bonded to one another at their intersections to form the liquid retentive layer, providing a web containing the large-diameter thermoplastic fibers and the small-diameter thermoplastic fibers and having its constituent fibers fusion bonded or adhesively bonded to one another at their intersections to form the airlaid layer, superposing the airlaid layer on one side of the liquid retentive layer, and uniting the airlaid layer and the liquid retentive layer together.

<6>

The cleaning sheet as set forth in any one of clauses <1> to <4>, being obtained by superposing a web containing the large-diameter thermoplastic fibers and the small-diameter thermoplastic fibers on one side of a web containing the cellulosic

fibers and the heat-fusible fibers and bonding the fibers constituting each web to one another at their intersections and between the two webs to each other by fusion bonding or adhesive bonding to form the liquid retentive layer and the airlaid layer and, at the same time, to unite the liquid retentive layer and the airlaid layer together.

[0073]

<7>

The cleaning sheet as set forth in any one of clauses <1> to <6>, wherein the airlaid layer has void spaces between the large-diameter thermoplastic fibers and has abrasive particles held releasably in the spaces, and

those large-diameter fibers of which the end is exposed on the surface of the airlaid layer opposite to the surface facing the liquid retentive layer have substantially no abrasive particle attached to their end portion including the end.

<8>

The cleaning sheet as set forth in any one of clauses <1> to <7>, having a dual layer structure composed of the liquid retentive layer and the airlaid layer.

<9>

The cleaning sheet as set forth in any one of clauses <1> to <8>, wherein the airlaid layer has its surface patterned with depressions and protrusions.

<10>

The cleaning sheet as set forth in any one of clauses <1> to <9>, wherein the airlaid layer has depressions in a diamond lattice pattern on its surface.

<11>

The cleaning sheet as set forth in any one of clauses <1> to <10>, wherein the airlaid layer has a depression in a pattern of a diamond lattice and a protrusion surrounded by the diamond lattice on its surface, the protrusion being a non-fusion-bonded portion having a lower density than the depression, and the depression having a higher density than a non-embossed portion.

[0074]

<12>

The cleaning sheet as set forth in any one of clauses <1> to <11>, wherein the airlaid layer has its surface patterned with depressions and protrusions, the depressions being arranged in a line pattern, a dot pattern, or a specifically designed pattern.

<13>

The cleaning sheet as set forth in any one of clauses <1> to <12>, wherein the airlaid layer has its surface patterned with depressions and protrusions, and

the total area of the depressions is preferably 5% to 50%, more preferably 10% to 40%, relative to the area of the cleaning surface of the cleaning sheet.

<14>

The cleaning sheet as set forth in any one of clauses <1> to <13>, having perforations.

<15>

The cleaning sheet as set forth in any one of clauses <1> to <14>, wherein the large-diameter thermoplastic fibers are staple fibers.

<16>

The cleaning sheet as set forth in any one of clauses <1> to <15>, wherein the large-diameter thermoplastic fibers are crimped fibers.

[0075]

<17>

The cleaning sheet as set forth in any one of clauses <1> to <16>, wherein the small-diameter thermoplastic fibers are staple fibers.

<18>

The cleaning sheet as set forth in any one of clauses <1> to <17>, wherein a plurality of the large-diameter thermoplastic fibers stand to have their ends exposed on the surface of the airlaid layer.

<19>

The cleaning sheet as set forth in any one of clauses <1> to <18>, wherein the large-diameter thermoplastic fibers stand with their longitudinal direction forming an angle of preferably at least 30°, more preferably 45° or greater, with an in-plane direction of the airlaid layer.

<20>

The cleaning sheet as set forth in any one of clauses <1> to <19>, wherein the cellulosic fibers are hydrophilic fibers.

<21>

A cleaning sheet package comprising a packaging material and a stack of more than one cleaning sheet as set forth in any one of clauses <1> to <20> packaged in the

packaging material.

[0076]

<22>

The cleaning sheet package as set forth in clause <21>, wherein the packaging material has an opening for access to the cleaning sheet and a resealable closure member for closing the opening.

<23>

The cleaning sheet package as set forth in clause <21> or <22>, wherein the more than one cleaning sheet is laid with its liquid retentive layer side up.

Industrial Applicability

[0077]

As described above in detail, the cleaning sheet of the invention has scouring capabilities on each side thereof, and the scouring capabilities differ between the two sides. Therefore, a user is able to choose which side is suitable to use according to the toughness of dirt to be removed. Since the side opposite to the side being used for scouring exhibits a frictional force to prevent slippage of the user's hand, thereby providing improved convenience in scouring cleaning.

CLAIMS

1. A cleaning sheet comprising a liquid retentive layer containing cellulosic fibers and heat-fusible fibers having a fineness of 0.5 to 5 dtex and a fiber length of 2 to 15 mm and an airlaid layer laid on one side of the liquid retentive layer,

the airlaid layer containing thermoplastic fibers and having the individual constituent fibers fusion-bonded or adhesively bonded to one another at their intersections,

the airlaid layer containing large-diameter thermoplastic fibers having a fineness of 10 to 150 dtex and a fiber length of 2 to 15 mm and small-diameter thermoplastic fibers having a fineness of 0.5 to 5 dtex and a fiber length of 2 to 15 mm,

the airlaid layer having the ends of a plurality of the large-diameter thermoplastic fibers exposed on the surface thereof to provide abrading or scouring capabilities for dirt removal from a surface being cleaned, and

the liquid retentive layer having the ends of a plurality of the large-diameter thermoplastic fibers exposed on its surface opposite to the surface facing the airlaid layer, the number of the ends exposed on the surface of the liquid retentive layer being smaller than that of the ends exposed on the surface of the airlaid layer.

2. The cleaning sheet according to claim 1, wherein the number of the ends of the large-diameter thermoplastic fibers present on the surface of the liquid retentive layer is 0.1% to 20% of the number of the ends of the large-diameter thermoplastic fibers present on the surface of the airlaid layer.

3. The cleaning sheet according to claim 1 or 2, wherein the large-diameter thermoplastic fibers are present in a proportion of 10 mass% or more relative to the mass of the cleaning sheet.

4. The cleaning sheet according to any one of claims 1 to 3, having a proportion of 10 to 90 mass% of the large-diameter thermoplastic fibers relative to the mass of the cleaning sheet.

5. The cleaning sheet according to any one of claims 1 to 4, being obtained by

providing a web containing the cellulosic fibers and the heat-fusible fibers and having its constituent fibers fusion bonded or adhesively bonded to one another at their intersections to form the liquid retentive layer, providing a web containing the large-diameter thermoplastic fibers and the small-diameter thermoplastic fibers and having its constituent fibers fusion bonded or adhesively bonded to one another at their intersections to form the airlaid layer, superposing the airlaid layer on one side of the liquid retentive layer, and uniting the airlaid layer and the liquid retentive layer together.

6. The cleaning sheet according to any one of claims 1 to 4, being obtained by superposing a web containing the large-diameter thermoplastic fibers and the small-diameter thermoplastic fibers on one side of a web containing the cellulosic fibers and the heat-fusible fibers and bonding the fibers constituting each web to one another at their intersections and between the two webs to each other by fusion bonding or adhesive bonding to form the liquid retentive layer and the airlaid layer and, at the same time, to unite the liquid retentive layer and the airlaid layer together.

7. The cleaning sheet according to any one of claims 1 to 6, wherein the airlaid layer has void spaces between the large-diameter thermoplastic fibers and has abrasive particles held releasably in the spaces, and

those large-diameter fibers of which the end is exposed on the surface of the airlaid layer opposite to the surface facing the liquid retentive layer have substantially no abrasive particle attached to their end portion including the end.

8. The cleaning sheet according to any one of claims 1 to 7, having a dual layer structure composed of the liquid retentive layer and the airlaid layer.

9. The cleaning sheet according to any one of claims 1 to 8, wherein the airlaid layer has its surface patterned with depressions and protrusions.

10. The cleaning sheet according to any one of claims 1 to 9, wherein the airlaid layer has depressions in a diamond lattice pattern on its surface.

11. The cleaning sheet according to any one of claims 1 to 10, wherein the airlaid

layer has a depression in a pattern of a diamond lattice and a protrusion surrounded by the diamond lattice on its surface, the protrusion being a non-fusion-bonded portion having a lower density than the depression, and the depression having a higher density than a non-embossed portion.

12. The cleaning sheet according to any one of claims 1 to 11, wherein the airlaid layer has its surface patterned with depressions and protrusions, the depressions being arranged in a line pattern, a dot pattern, or a specifically designed pattern.

13. The cleaning sheet according to any one of claims 1 to 12, wherein the airlaid layer has its surface patterned with depressions and protrusions, and
the total area of the depressions is 5% to 50% relative to the area of the cleaning surface of the cleaning sheet.

14. The cleaning sheet according to any one of claims 1 to 13, having perforations.

15. The cleaning sheet according to any one of claims 1 to 14, wherein the large-diameter thermoplastic fibers are staple fibers.

16. The cleaning sheet according to any one of claims 1 to 15, wherein the large-diameter thermoplastic fibers are crimped fibers.

17. The cleaning sheet according to any one of claims 1 to 16, wherein the small-diameter thermoplastic fibers are staple fibers.

18. The cleaning sheet according to any one of claims 1 to 17, wherein a plurality of the large-diameter thermoplastic fibers stand to have their ends exposed on the surface of the airlaid layer.

19. The cleaning sheet according to any one of claims 1 to 18, wherein the large-diameter thermoplastic fibers stand with their longitudinal direction forming an angle of at least 30° with an in-plane direction of the airlaid layer.

20. The cleaning sheet according to any one of claims 1 to 19, wherein the cellulosic fibers are hydrophilic fibers.
21. A cleaning sheet package comprising a packaging material and a stack of more than one cleaning sheet according to any one of claims 1 to 20 packaged in the packaging material.
22. The cleaning sheet package according to claim 21, wherein the packaging material has an opening for access to the cleaning sheet and a resealable closure member for closing the opening.
23. The cleaning sheet package according to claim 21 or 22, wherein the more than one cleaning sheet is laid with its liquid retentive layer side up.