

/ DISPOSABLE WIPER SHEET AND METHOD FOR PRODUCING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a disposable wiper sheet for use in cleaning or sterilizing flush toilets or cleaning the private parts of human bodies, which can be disposed of in toilets after its use. More specifically, the invention relates to a disposable wiper sheet, of which the both surfaces exhibit satisfactory and a variety of cleaning effects, and which hardly floats but easily sinks in water pooling in flush toilets or in septic tanks.

2. Description of Prior Art

For cleaning toilets and rooms and for cleaning the private parts of babies before changing their diapers, use is made of water-decomposable wet wiper sheets. Those water-decomposable wet wiper sheets could be disposed of in flush toilets after their use. They comprise water-decomposable sheets made from fibers, such as wood pulp fibers or the like, and a water-soluble or water-swellaable binder, and liquid chemicals infiltrated into the sheets. The liquid chemicals comprise water, alcohols, surface active agents, disinfectants, preservatives, essence or perfume, etc., additionally containing metal ions which are for preventing the dissolution of the binder. The wet wiper sheets are not decomposed while having the liquid chemicals with metal ions as infiltrated thereinto, and can maintain their strength. After having been disposed of in flush toilets along with water, the wet wiper sheets are decomposed in flush toilets or in septic tanks as the metal ions in the liquid chemicals are diluted with a large amount of water.

Conventional wet wiper sheets are not voluminous but thin, as comprising a single, flat water-decomposable sheet or comprising two

or three such sheets overlaid together. Therefore, when the conventional wet wiper sheets are used for cleaning the intended areas while being held with hands, they are difficult to surely hold with hands. Hence, the wet wiper sheets are slippery over hands and are difficult to use.

In order to obtain more voluminous wet wiper sheets like floorclothes, it may be taken into consideration to overlay a plurality of bulky sheets of, for example, non-woven fabric together to produce them. In such a voluminous wet wiper sheet, however, the overlaid sheets may contain a large amount of air therebetween, resulting in the increase in the buoyancy of the wiper sheet. As a result, the voluminous wet wiper sheets are problematic in that they float in water pooling in flush toilets and are difficult to flush and, in addition, they are difficult to sink in septic tanks.

The wet wiper sheets of that type are generally folded in four or eight and packed in containers. In general, the thus-folded wet wiper sheets are used for cleaning the intended areas while being still folded in four, eight or even two, and after having been used so, they are disposed of in flush toilets while being still kept folded in four, eight or so. In those folded wiper sheets, air exists in the valleys formed in the inside between the folded surfaces facing to each other, thereby making the wiper sheets have a buoyancy, with the result that the wiper sheets are difficult to flush into the drainpipes from flush toilets. Some conventional wet wiper sheets of that type are perforated so as to be separated into two parts via the perforation. In those, however, the perforations are not long enough to make air, which exists in the valleys, escape therethrough when the wet wiper sheets are disposed of in flush toilets. Therefore, even though perforations are made in wet wiper sheets, the buoyancy of the sheets could not be reduced.

The invention is to solve the prior art problems such as those mentioned hereinabove, and its object is to provide a disposable wiper sheet capable of being disposed of in toilets after having been used for cleaning, and to provide a method for producing it. The disposable wiper sheet of the invention is characterized in that, though it is voluminous, its buoyancy is small, and that it can be easily sunk in water pooling in flush toilets and in septic tanks.

Specifically, the invention is to provide a disposable wiper sheet, in which air existing in the valleys formed in the inside between the folded surfaces facing to each other can easily escape therefrom when it is disposed of in flush toilets while being folded in four, eight or even two, so that the wiper sheet is easy to sink into water pooling in flush toilets and in septic tanks.

The invention is to further provide a disposable wiper sheet, of which the both surfaces are made to differ in their expansion in such a manner that either one surface is selected to be used for cleaning in different ways.

The invention is to still further provide a voluminous, disposable wiper sheet, of which one surface is more expanded to have an improved cleaning effect, while the other is less expanded to thereby reduce as much as possible the amount of air existing in the sheet, with the result that the wiper sheet can be easily sunk in water pooling in flush toilets and in septic tanks.

SUMMARY OF THE INVENTION

The disposable wiper sheet of the invention comprises a plurality of water-decomposable sheets overlaid together and partly bonded together at a plurality of adhesive parts, and is characterized in that at least one of the overlaid sheets is processed to have expansions between the adhesive parts to be voluminous and that at least one of

the overlaid sheets is processed to have a large number of minute or fine holes through which air existing in the spaces as formed between the sheets due to the expansions can escape outside the wiper sheet.

The disposable wiper sheet of the invention is further characterized in that it comprises a water-decomposable inner sheet which has a low expansion ratio (crepe ratio) or which is not expansible, and a water-decomposable outer sheet which has a higher expansion ratio (crepe ratio) than the inner sheet, both being overlaid together, that the inner and outer sheets are partly bonded together at a plurality of adhesive parts, that the outer sheet is processed to have expansions between the adhesive parts to be voluminous due to the difference in the expansion ratio between the both sheets which expand when their crinkles are spread, that at least one of these inner and outer sheets is processed to have a large number of minute or fine holes through which air existing in the spaces as formed between the sheets due to the expansions can escape outside the wiper sheet.

Preferably, in the disposable wiper sheet of the invention, two such outer sheets are overlaid on the both surfaces of the inner sheet, and the outer sheet is processed to have a large number of minute or fine holes.

Concretely, in the disposable wiper sheet of the invention, the adhesive parts are aligned in plural rows at a predetermined pitch to give the expansions in the areas between the adjacent rows of the adhesive parts.

The disposable wiper sheet of the invention is packed in a container while being folded, and is used while still being folded. Hence, the disposable wiper sheet of the invention is further characterized in that the folded parts of the sheet are partly cut to have openings through which air existing inside the folded parts can escape outside the wiper sheet.

More preferably, the disposable wiper sheet of the invention is folded in two along one folding line, and is further folded along another folding line that is perpendicular to that folding line, in which the areas around the two folding lines that intersect at right angles are partly cut to have openings through which air existing inside the folded parts can escape outside the wiper sheet.

In the disposable wiper sheet of the invention, the folding lines are perforated to have perforations via which the sheet is separated into separate pieces, in which the length of the partial openings for air removal shall be longer than the that of each perforation, and may be formed on the line of the perforations.

In another embodiment of the disposable wiper sheet of the invention, the outer sheets to be attached to the both surfaces of the inner sheet have different expansion ratios in such a manner one outer sheet as attached to one surface of the inner sheet has a higher expansion ratio while the other outer sheet as attached to the other surface of the inner sheet has a lower expansion ratio than that of said one sheet and that the expansions formed in the former outer sheet having a higher expansion ratio are larger than those formed in the latter outer sheet having a lower expansion ratio than that of said one outer sheet.

In the disposable wiper sheet of the invention of that embodiment, the expansions are formed in the regions between the adjacent rows of the adhesive parts at which the two outer sheets are bonded to the both surfaces of the inner sheet, at the same intervals as those at which the rows of the adhesive parts are aligned, and of the expansions, those as formed in the outer sheet having a higher expansion ratio are larger than the others as formed in the other outer sheet having a lower expansion ratio.

Also in the disposable wiper sheet of the invention of that embodiment, the outer sheets are processed to have a large number of

minute or fine holes through which air existing in the spaces between the outer sheets and the inner sheet can escape outside the wiper sheet.

In the disposable wiper sheet of the invention of that embodiment, it is desirable that the difference in the expansion ratio between the inner sheet and the outer sheet having a higher expansion ratio is 20 % or more to 80 % or less, that the difference in the same between the inner sheet and the outer sheet having a lower expansion ratio is 10 % or more to 50 % or less, and that the difference in the same between the two outer sheets is 10 % or more to 20 % or less.

The method for producing the disposable wiper sheet of the invention is characterized in that it comprises;

a step of mixing raw material fibers and a water-soluble or water-swellaable binder;

a step of applying the resulting mixture of the raw material fibers and the water-soluble or water-swellaable binder as prepared in the previous mixing step, onto the outer surface of a paper-making cylinder having a large number of small projections formed on its surface, to thereby form a paper or fiber web having minute or fine holes formed therein in accordance with the small projections of the cylinder;

a step of forming a large number of crinkles on the paper or fiber web having the minute or fine holes;

a step of overlaying the sheet as prepared in the previous step to have minute or fine holes and crinkles, on a sheet which has crinkles but has a lower expansion ratio to expand more poorly than the former sheet when impregnated with liquid chemicals, or on a non-expansile sheet having no crinkles, followed by partly bonding the each sheets together; and

a step of impregnating the thus-bonded sheets with liquid chemicals to spread the crinkles of the sheet having a larger expansion ratio,

thereby forming expansions in the areas between the adjacent adhesive parts in said sheet having a larger expansion ratio.

In the method for producing the disposable wiper sheet of the invention, it is desirable that the sheet having a lower expansion to expand poorly when its crinkles are spread, or the non-expansible sheet with no crinkles is used as the inner sheet, while the sheet having minute or fine holes and crinkles is used as the outer sheet and attached to the both surfaces of the inner sheet. In this, the thus-attached outer sheets are made to have expansions due to the difference in the expansion ratio between the inner sheet and the outer sheets that may expand when their crinkles are spread, and hence, a disposable wiper sheet having expansions on its both surfaces is obtained.

The outer sheet and/or the inner sheet are/is crinkled, for example, in a crinkling process in which the sheet(s) is/are crinkled by means of the blade as applied to the surface of a drum having a high rotation speed prior to being transferred from the drum having such a high rotation speed to a drum having a low rotation speed.

The disposable wiper sheet of the invention is used, for example, in cleaning toilets, and is disposed of in flush toilets after having been used, and hence, this is decomposable with water in toilets and in septic tanks. The disposable wiper sheet of the invention comprises a plurality of sheets, in which each sheet is paper or non-woven fabric comprising natural pulp fibers or chemical fibers of, for example, rayon, and is made to be decomposable in water. Those plural sheets are made of fibers of, for example, natural pulp, and a water-soluble or water-swellaable binder of, for example, carboxymethylation pulp or carboxymethyl cellulose, which is to bind the fibers. The plural sheets are bonded together, for example, with a water-soluble adhesive such as water-soluble carboxymethyl cellulose.

The plural sheets for use in the invention may be any ones capable of being decomposed in septic tanks, and are not limited to those mentioned hereinabove.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view showing the outline structure of the disposable wiper sheet of the invention.

Fig. 2 (A) (B) (C) shows the cross-sectional views of plural sheets being bonded together to give the disposable wiper sheet of the invention.

Fig. 3 is a partly-cut plan view showing one embodiment of the bonding pattern of the disposable wiper sheet of the invention.

Fig. 4 is an explanatory view illustrating the outline of a wet paper manufacturing process.

Fig. 5 is a partly-enlarged view showing the cylinder used in Fig. 4.

Fig. 6 is a perspective view showing the disposable wiper sheet of the invention as folded in four.

Fig. 7 is a partly-enlarged view of Fig. 6.

Fig. 8 is a perspective view showing another embodiment of the disposable wiper sheet of the invention.

Fig. 9 is a cross-sectional view of the disposable wiper sheet of Fig. 8.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

The disposable wiper sheet 1 of Fig. 1 is used, for example, in cleaning toilets or cleaning the private parts of human bodies, and is disposed of in flush toilets after its use. This is decomposable in water pooling in flush toilets or in water in septic tanks.

This wiper sheet 1 has a three-layered structure, which is comprised of an inner sheet S1 and outer sheets S2, S2 as attached to the both

surfaces of the inner sheets S1 while being partly bonded thereto at the adhesive parts a, . . . a, as in Fig. 3. As the inner sheet and/or the outer sheets, for example, used is crinkled crepe paper. The inner sheet S1 was crinkled (creped) to have crinkles but has a low expansion ratio (crepe ratio) to expand poorly when it is impregnated with liquids and its crinkles are spread, or it is not crinkled and is therefore not expansible. The outer sheets S2, S2 were crinkled to have crinkles and have a high expansion ratio (crepe ratio) to expand greatly when they are impregnated with liquids and their crinkles are spread. The adhesive parts a, . . . a are aligned in rows A, . . . A. The outer sheets S2, S2 are processed to have expansions between the adjacent rows A, A of those adhesive parts a, . . . a, to be voluminous. Being different from that constitution, the disposable wiper sheet of the invention may have a two-layered structure which is comprised of one inner sheet S1 and one outer sheet S2 as partly bonded together. Also in this two-layered structure, the outer sheet S2 is processed to have expansions between the adjacent rows A, A of the adhesive parts a, . . . a.

; The inner sheet S1 and the outer sheet S2 are prepared by bonding raw material fibers of, for example, natural pulp together with a water-soluble or water-swellaable binder. The term "water-swellaable" means that the binder is swollen in water. The water-soluble or water-swellaable binder includes, for example, carboxymethyl cellulose, carboxymethylation pulp, polyvinyl alcohols, starch, carrageenan, galactomannan, acrylates, etc. With the water-soluble or water-swellaable binder, the inner sheet S1 and the outer sheet S2 can be decomposed in water.

The sheets S1 and S2 have a large number of minute or fine holes formed therein. Those minute or fine holes are formed in the inner sheet S1 and the outer sheet S2 while the sheets are produced in a wet paper manufacturing process.

Fig. 4 is to explain the wet paper manufacturing process, in which raw material fibers of, for example, natural pulp and a water-swellable binder such as carboxymethylation pulp are stirred in the material stock tank 10 along with water, and then fed to the wire part 11. In the wire part 11, the stock adheres to the outer surface of the cylinder 12 due to the circulation pressure from the pump 13 to form paper (or fiber web) W around the surface. The thus-formed paper (or fiber web) W is transferred into the wet felt zone 14, then into the top felt zone 15, and thereafter onto the drier drum 16, on which it is dried. As in Fig. 5, the surface of the cylinder 12 is processed to have small projections 12a. The paper (fiber web) W is pressed against those projections 12a, which penetrate through the paper (fiber web) W to form minute or fine through-holes 3. Alternatively, the density of the parts of the paper (fiber web) W against which the projections 12a were pressed is reduced to give minute or fine holes through which air passes easily.

The sheet (outer sheet S2 or inner sheet S1) thus dried on the drier drum 16 is wound up via the winder drums 18, 19. A doctor blade 17 is applied to the surface of the drier drum 16. In this system, the rotation speed of the winder drums 18, 19 is smaller than that of the drier drum 16. Due to the difference in the rotation speed between the drier drum 16 and the winder drums 18, 19, the outer sheet S2 and/or the inner sheet S1 are/is processed to have minute or fine crinkles. In that manner, the outer sheet S2 and/or the inner sheet S1 are/is subjected to the crinkling process (creping process). In crinkling the sheets S1 and S2, the difference in the rotation speed between the drier drums 16 and the winder drums 18, 19 varies depending on the respective sheets. The difference in the rotation speed between the drier drums 16 and the winder drums 18, 19 produces a difference in the degree of crinkles to be formed in the inner sheet S1 and the outer sheet S2, whereby the expansion ratio (crepe ratio) of the sheets to expand when their crinkles are spread

can be controlled. The inner sheet S1 has a low expansion ratio (that is, has a low crepe ratio), or is not crinkled at all. The outer sheets S2 have a higher expansion ratio (that is, has a higher crepe ratio) than the inner sheet S1.

Where a water-soluble binder such as carboxymethyl cellulose is used, it is applied to the sheets before or after the sheets are crinkled.

The inner sheet S1 and the outer sheets S2 are overlaid together, as in Fig. 2(A). In Fig. 2(A), an adhesive 2 is applied onto the both surfaces of the inner sheet S1, and thereafter the outer sheets S2, S2 are attached to those both surfaces. The adhesive 2 is applied to the surfaces to give the adhesive parts a, . . . a, for example, as in Fig. 3. The adhesive 2 may be, for example, water-soluble carboxymethyl cellulose.

After the outer sheets S2, S2 are overlaid on the both surfaces of the inner sheet S1, the entire structure comprising those sheets is, while being moistened, sandwiched between hot plates 4 and 5 or hot rolls under pressure at the parts to which the adhesive 2 was applied. The hot plate 5 or the hot roll is provided with projections 5a, . . . 5a, in accordance with the adhesive parts a, . . . a, and the sheets are pressed against those projections 5a, . . . 5a under heat, whereby the inner sheet S1 and the outer sheets S2, S2 are bonded together at the adhesive parts a, . . . a. The wiper sheet comprising the inner sheet S1 and the outer sheets S2, S2 were bonded together is shown in Fig. 2(B).

The thus-bonded inner sheet S1 and outer sheets S2, S2 are then impregnated with liquid chemicals comprising water, alcohols, surface active agents, preservatives, deodorants, and essence of perfume, and additionally containing metal ions for preventing those sheets from decomposing in water. After having been thus impregnated with such chemicals, the crinkles of the sheets are spread so that the sheets expand.

In this structure, since the outer sheets S2, S2 have a higher expansion ratio (that is, have a higher crepe ratio) than the inner sheet S1, the outer sheets S2, S2 expand more greatly than the inner sheet S1 when their crinkles were spread. Therefore, as in Fig. 2(C), the outer sheets S2, S2 shall have the expansions B, . . . B, between the adjacent rows A, A, of the adhesive parts a, . . . a. As a result, the wiper sheet 1 thus produced may be voluminous.

The liquid chemicals with which the wiper sheet 1 is impregnated contain metal ions of, for example, calcium or strontium, as so mentioned hereinabove. The carboxyl groups to be in the water-swellaable carboxymethylation pulp, which is in the inner sheet S1 and the outer sheets S2, S2 as the binder, and those to be in the water-soluble carboxymethyl cellulose which is applied to those sheets to bond them together, are bridged with the metal ions existing in the liquid chemicals to form bridged complexes. The thus-formed, bridged complexes prevent the binder and also the adhesive parts from being decomposed. When the disposable wiper sheet is disposed of in flush toilets after its use, the liquid chemicals existing therein are diluted with a large amount of water so that the binder and the adhesive parts therein become decomposable in water.

Fig. 3 shows one embodiment of the adhesive pattern of the adhesive parts a, . . . a.

In Fig. 3, the inner sheet S1 and the outer sheets S2, S2 are partly bonded together at the short linear adhesive parts a, . . . a represented by (1), . . . (1). These adhesive parts a, . . . a are aligned in rows in the direction Y at regular intervals. As in Fig. 1, each row of the adhesive parts a, . . . a that extends in the direction of Y is represented by A. Those adhesive parts a, . . . a are aligned at certain angles relative to the direction of the crinkles b, . . . b of the outer sheets S2, S2 (the direction of X) and relative to the direction of the rows

of the adhesive parts a, . . . a (the direction of Y). Therefore, the crinkles b, . . . b are blocked by the adhesive parts a, . . . a. The rows A, . . . A of the adhesive parts a, . . . a are formed at regular intervals in the direction of X.

After the sheets S1, S2, S2 are impregnated with liquid chemicals, the minute or fine crinkles that were formed through the crinkling process are spread in the direction of Y. In this case, since the inner sheet is bonded to the both outer sheets S2, S2 at the parts (1), . . . (1) of the adhesive parts a, . . . a, the outer sheets S2, S2 do not expand in the direction of Y at the parts (1), . . . (1). As opposed to those, the outer sheets S2, S2 expand easily at the other parts (2), . . . (2) as sandwiched between the adjacent adhesive parts a, a, whereby the parts (2), . . . (2) of the outer sheets S2, S2 are easily loosened due to the spread (α), . . . (α) in the direction Y. As a result, formed are valleys (3), . . . (3) in the region as sandwiched between the adjacent rows A, A of the adhesive parts a, . . . a as aligned in the direction of Y, and those valleys are between the adjacent adhesive parts a, a. In addition, also formed are hills (4), . . . (4) (expansions B, . . . B) between the adjacent parts (2), (2). In that manner, therefore, the expansions B, . . . B are formed repeatedly in waves in the region as sandwiched between the adjacent rows A, A of the adhesive parts a, . . . a, at an alignment pitch that is almost the same as that of the adhesive parts a, . . . a. Those expansions B, . . . B improve the cleaning effect of the wiper sheet 1 of the invention.

In order to make the outer sheets S2, S2 have the expansions B, . . . B, such as those in Fig. 1, in such a manner that those expansions B, . . . B each may have suitable spaces C, . . . C, it is desirable that the difference in the expansion ratio between the inner sheet S1 and the outer sheets S2, S2 that expand when their crinkles are spread is defined to be 20 % or more to 80 % or less, as has been so mentioned hereinabove.

In the thus-formed, wiper sheet 1, formed are the expansions B, . . . B in the region between the adjacent rows A, A of the adhesive parts a, . . . a, as in the cross-sectional view of Fig. 2(C), and those expansions B, . . . B produce the spaces C, . . . C, between the outer sheets S2, S2 and the inner sheet S1. Accordingly, the disposable wiper sheet 1 is voluminous as a whole. When the wiper sheet 1 is disposed of in toilets after its use, air existing in the spaces C, . . . C escapes outside through the minute or fine holes 3 formed in the inner sheet S1 and the outer sheets S2, S2. Accordingly, the buoyancy of the wiper sheet 1 is lowered, and in addition, water penetrates into the inner sheet S1 and the outer sheets S2, S2 through those minute or fine holes 3, resulting in that the wiper sheet 1 is easy to sink into water pooling in flush toilets or in septic tanks.

In the disposable wiper sheet of Fig. 2, all the inner sheet S1 and the outer sheets S2, S2 are processed to have the minute or fine holes 3. Apart from this embodiment, only the outer sheets S2, S2 could be processed to have such minute or fine holes 3 to thereby reduce the buoyancy of the wiper sheet comprising them. Needless-to-say, the wiper sheet of this modification is also easy to flush in flush toilets.

Preferably, the size of the minute or fine holes to be formed in the sheets (raw sheets) in the wet paper manufacturing process may be, for example, from approximately 1.0 mm to 5.0 mm diameter. The minute or fine holes to be formed in the disposable wiper sheet of the invention could well be such that air existing in the spaces between the constitutive sheets can escape outside the wiper sheet through those holes. Therefore, the holes may be either fine ones that could be seen with the naked eye or extremely minute ones. In addition, the holes may also be such ones as formed in raw paper or non-woven fabric between the parts having a higher density and those having a lower density, all

being disposed at regular pitches, where the parts (rough parts) having a lower density are to be the holes through which air can escape outside.

To form a large number of such minute or fine holes in the constitutive sheets, a different process is employable in which a fiber web is formed on a porous belt and an air shower is applied over the fiber web to thereby form a large number of minute or fine holes in the fiber web in accordance with the pores of the belt. If desired, minute or fine holes may be formed on the entire surface of each constitutive sheet, using needles or the like.

Fig. 6 shows a perspective view showing the wiper sheet 1 of the invention while being folded. Fig. 7 is a partly-enlarged view of Fig. 6.

In most cases, the wiper sheet 1 is folded in two along the folding part (folding line) L1, and is further folded in two, totaling in four, along the folding part (folding line) L2 that is perpendicular to the folding line L1, as in Fig. 6. This may be still further folded in two, totaling in eight, along the folding part (folding line) L3. When packed in a container, the wiper sheet 1 is generally folded in eight. When used in wiping dirty areas, the wiper sheet 1 is usually in the condition as folded in four, as in Fig. 6, or in the condition as folded in eight, though depending on the size of the hand and on the shape and the size of the subject to be cleaned thereby. The entire size of the wiper sheet 1 as spread shall be in such a degree that the sheet 1 can be conveniently used in the condition as folded in four or eight.

The folding line L2 is perforated to have perforations P1. The wiper sheet 1 is folded in two along the folding part (folding line) L1 and can be divided into two via the perforations P1. The perforations P1 are formed at regular pitches to be not so long the length of each perforations. As in Fig 6 and Fig. 7 (this is a partly-enlarged view of Fig. 6), it is desirable that the folding line L1 is partly processed

to have long openings P2, P3. The openings P2, P3 are sufficiently longer than the perforations P1. The openings P2 are formed on the folding line L1, while the opening P3 is formed around the area at which the folding lines L1 and L2 intersect.

Accordingly, when the wiper sheet 1 is, after its use, disposed of in flush toilets while it has been folded in two along the folding line L1, or in four as in Fig. 6, or even in eight, air existing in the parts (i) in the valleys as formed in the sheet 1 folded in two along the folding line L1 could easily escape outside the sheet 1 through the openings P2 and P3. As a result, the buoyancy of the sheet 1 is prevented from being increased due to the absence of air in the parts (i) of those valleys, resulting in that the sheet 1 is easy to sink into water pooling in flush toilets or in septic tank.

If the sheet 1 is disposed of in flush toilets, while it has been folded in four as in Fig. 6 or even in eight, air shall exist not only in the valley parts (i) around the folding line L1 but also in the part (ii) inside the area at which the folding lines L1 and L2 intersect. In that case, air existing in the part (ii) can easily escape outside the sheet 1 through the opening P3. Accordingly, even if the disposable wiper sheet of the invention is disposed of in flush toilets while it has been folded, its buoyancy is reduced and the wiper sheet is easy to sink into water pooling in flush toilets or in septic tanks.

If desired, long openings P2 and P3 may be formed in the middle of the line of perforations P1 formed on the folding line L2.

Fig. 8 is a perspective view showing another embodiment of the disposable wiper sheet of the invention, and Fig. 9 is a cross-sectional view showing a part of Fig. 8. The disposable wiper sheet 11 has a three-layered structure comprised of the inner sheet s1 and the outer sheets s2, s3 as partly bonded to the both surfaces of the inner sheet s1 at the adhesive parts a1, . . . a1. Like those of the disposable wiper

sheet 1 illustrated hereinabove, the outer sheets s2, s3 in this disposable wiper sheet 11 have expansions B1, B2 in each area between the adjacent rows A1, A1 of the adhesive parts a1, . . . a1, thereby to make the wiper sheet 11 voluminous. This wiper sheet 11 differs from the wiper sheet 1 in that the expansions of the outer sheet s2 are larger than those of the outer sheet s3, as in Fig. 8 and Fig. 9. Specifically, in the wiper sheet 11, the volume of each space C1 formed between the inner sheet s1 and the outer sheet s2 is larger than that of each space C2 formed between the inner sheet s1 and the outer sheet s3.

Like the inner sheet S1 and the outer sheets S2, S2 of the wiper sheet 1, the inner sheet s1, the outer sheet s2 and the outer sheet s3 of the wiper sheet 11 each are prepared by binding raw material fibers of, for example, natural pulp with a water-soluble or water-swellaable binder, and these are decomposable in water. Also like the inner sheet S1 and the outer sheets S2, S2 of the wiper sheet 1, the constitutive sheets s1, s2 and s3, or at least the outer sheets s2 and s3, of the wiper sheet 11 are processed to have a large number of minute or fine holes 13. The minute or fine holes 13 of those constitutive sheets s1, s2 and s3 of this wiper sheet 11 may be formed through the wet paper manufacturing process of producing the sheets s1, s2 and s3, like those of the constitutive sheets S1, S2 of the wiper sheet 1.

The inner sheet s1, the outer sheet s2 and the outer sheet s3 are also crinkled, using the drier drum 16 and the winder drum 18 as in Fig. 4. In producing those sheets s1, s2 and s3, the rotation speed of the drier drum 16 differs from that of the winder drums 18, 19. Depending on this difference in the rotation speed between those drums, the expansion ratio (crepe ratio) of each of these sheets s1, s2, s3 is varied. Like the inner sheet S1 of the wiper sheet 1, the inner sheet s1 of the wiper sheet 11 shall have a low expansion ratio (that is, this shall have a low crepe ratio), or is not crinkled at all to be non-expansible.

The outer sheet s2 shall be crinkled to have a higher expansion ratio (that is, to have a higher crepe ratio) than the inner sheet s1. The outer sheet s3 shall be crinkled to have a higher expansion ratio (that is, to have a higher crepe ratio) than the inner sheet s1, but have a lower expansion ratio (that is, have a lower crepe ratio) than the outer sheet s2.

The wiper sheet 11 is produced by overlaying the inner sheet s1, the outer sheet s2 and the outer sheet s3 together, followed by pressing them against the hot plates, such as those in Fig. 2(a), while being moistened, whereby the sheets s1, s2, s3 are partly bonded at the adhesive parts a1, . . . a1.

The thus partly-bonded inner sheet s1 and outer sheets s2, s3 are impregnated with liquid chemicals comprising water, alcohols, surface active agents, preservatives, deodorants, essence or perfume, and metal ions which are for preventing those sheets from being decomposed in water. After having been impregnated with the liquid chemicals, the crinkles of the sheets are spread. In this case, since the outer sheet s2 has a higher expansion ratio (crepe ratio) than the inner sheet s1, the former expands greatly than the latter. Accordingly, as in Fig. 9, the thus-expanded outer sheet s2 shall have the expansion B1 in each area between the adjacent rows A1, A1 of the adhesive parts a1, . . . a1. Similarly, the crinkles of the outer sheet s3 are spread whereby the outer sheet s3 is to have the expansion B2 in each area between the adjacent rows A1, A1 of the adhesive parts a1, . . . a1 due to the difference in the expansion ratio between the outer sheet s3 and the inner sheet s1.

In this case of the wiper sheet 11, the expansion ratio (crepe ratio) of the outer sheet s3 is smaller than that of the outer sheet s2. Therefore, the volume of each expansion B2 of the outer sheet s3 is smaller than that of each expansion B1 of the outer sheet s2. In other words,

the volume of each space C2 formed between the inner sheet s1 and the outer sheet s3 is smaller than that of each space C1 formed between the inner sheet s1 and the outer sheet s2.

When the wiper sheet 11 of that type is used to wipe dirty subjects, its outer sheet s2 having larger expansions B1 shall face the surface of the subject to be wiped therewith. As the case may be, the wiper sheet 11 may also be used with its outer sheet s3 facing the surface of the subject to be wiped therewith. When the wiper sheet 11 is packed in a container, it is preferable to fold the wiper sheet 11 in such a manner that the outer sheet s2 is to form the outer surface of the folded wiper sheet 11, or that is, in such a manner that the outer sheet s2 faces outward. This is because when a user uses the disposable wiper sheet 11 as folded in four or in eight, the outer sheet s2 is directed to the surface of the subject to be wiped with the sheet 11 in most cases. Since the volume of the expansions B1 of the outer sheet s2 is large, the wiper sheet 11, when used in that manner, can effectively exhibit its wiping effect and is especially effective in wiping rough surfaces.

The wiper sheet 11 as folded in that manner may also be used after having been turned over. Even if used after having been turned over, that wiper sheet 11 can also exhibit effectively its wiping effect. In this case, the outer sheet s3 faces outward and is directed to the surface of the subject to be wiped with wiper sheet 11. Even if the wiper sheet 11 is used with its outer sheet 3 facing the subject to be wiped therewith, it still exhibits its good wiping effect since the outer sheet s3 has the expansions B2. However, the volume of the expansions B2 of the outer sheet s3 is smaller than that of the expansions B1 of the outer sheet s2. Therefore, the use of the wiper sheet 11 with its outer face s3 facing the subject to be wiped therewith is recommended for wiping relatively smooth surfaces. As is known from the above, the wiper sheet 11 of this embodiment is expected to exhibit different wiping effects, depending

on the mode of using it as to whether its outer sheet s2 is directed to the subject to be wiped therewith or its outer sheet s3 is directed thereto.

The wiper sheet 11 has expansions on its both surfaces and is voluminous as a whole, and therefore it is easy to hold with hands. In this, the volume of the expansions B2 of the outer sheet s3, which is the back surface of the wiper sheet 11, is relatively reduced so that the volume of the spaces C2 is made smaller than that of the spaces C1. As a result, the total amount of air existing in the wiper sheet 11 is reduced as much as possible. For these reasons, the wiper sheet 11 does not have any excessive buoyancy and is easy to sink into water pooling in flush toilets and in septic tanks. Specifically, even if the volume of the expansions B1 of the outer sheet s2 of the wiper sheet 11 is controlled to such a degree that the wiper sheet 11 is effective in wiping dirty subjects, the total amount of air existing in the wiper sheet 11 can be reduced as much as possible so that the buoyancy of the wiper sheet 11 can therefore be prevented from being large.

In particular, in the wiper sheet 11 illustrated in Fig. 8 and Fig. 9, the inner sheet s1 and the outer sheets s2, s3 are processed to have a large number of minute or fine holes 13, so that air existing in the spaces C1, C2 can easily escape outside through those holes 13 while the wiper sheet 11 is in water pooling in flush toilets or in septic tanks, with the result that the wiper sheet 11 can be more easily sunk in water.

In order to make both the outer sheet s2 and the outer sheet s3 have the expansions B1, B2 in such a manner the expansions B1, B2 can have suitable spaces C1, C2, and to make the expansions of the outer sheet s2 larger than those of the outer sheet s3, as in Fig. 9 mentioned hereinabove, it is preferable that the difference in the expansion ratio between the inner sheet s1 and the outer sheet s2, of which the crinkles

are spread, is 20 % or more to 80 % or less. It is also preferable that the difference in the expansion ratio between the inner sheet s1 and the outer sheet s3, of which the crinkles are spread, is 10 % or more to 50 % or less. It is further preferable that the difference in the expansion ratio between the outer sheet s2 and the outer sheet s3 is not smaller than 10 %, more preferably not smaller than 20 %.

The expansion ratio of each sheet as referred to herein is represented by $\{(\Delta x - x)/x\} \times 100 (\%)$, in which x indicates the original length of the sheet, and Δx indicates the length of the expanded sheet which was floated on a liquid to make its crinkles spread.

In the embodiment illustrated hereinabove, at least both the outer sheet s2 and the outer sheet s3 are processed to have a large number of minute or fine holes 13. Without being limited to the illustrated case, only the outer sheet s2 capable of forming large spaces C1 between the sheet s2 and the inner sheet s1 could be processed to have a large number of such minute or fine holes 13. In the illustrated case, even though all the sheets s1, s2 and s3 are not always processed to have a large number of such minute or fine holes 13, the buoyancy of the wiper sheet 11 itself can still be reduced since the volume of the spaces C2 formed between the inner sheet s1 and the outer sheet s3 is small.

As has been mentioned hereinabove, since the disposable wiper sheet of the invention comprises a plurality of overlaid sheets each having expansions, and is voluminous, it is easy to hold with hands and exhibits excellent wiping effects. Though air may exist between the adjacent constitutive sheets due to their expansions, it can easily escape outside the wiper sheet. Therefore, the wiper sheet of the invention shall have a low buoyancy while it is in water pooling in flush tanks or in septic tanks, and is easy to sink into water.

Even if the disposable wiper sheet of the invention is disposed of in flush toilets while being folded in two, four or even eight, air

existing in the folded areas of the wiper sheet can easily escape outside so that the wiper sheet is easy to sink into water pooling in flush toilets or in septic tanks.

In another embodiment of the disposable wiper sheet of the invention, the volume of the expansions formed in one surface, or that is, in the outer sheet s2 is made larger while that of the expansions formed in the other surface, or that is, in the outer sheet s3 is made smaller. Therefore, the both surfaces (of the outer sheet s2 and the outer sheet s3) of the wiper sheet of that embodiment are expected to exhibit different wiping effects. In this, in addition, since the sheets s1, s2 and s3 are processed to have spaces between the inner sheet s1 and the outer sheet s2, and also between the inner sheet s1 and the outer sheet s3, the wiper sheet comprising those sheets s1, s2 and s3 is voluminous as a whole. In this, moreover, since the volume of the spaces formed between the inner sheet s1 and the outer sheet s3 is made smaller than that of the spaces formed between the inner sheet s1 and the inner sheet s2, the buoyancy of the wiper sheet relative to water is reduced. Therefore, the wiper sheet of that embodiment is easy to hold with hands, while exhibiting various wiping effects, and is easy to sink when flushed in toilets.

The disposable wiper sheet of the invention, as has been described in detail hereinabove, is packed in plastic containers or the like, while being wet with liquid chemicals. Different from that mode, the disposable wiper sheet of the invention may also be packed in containers while being dry. In the latter case, the dry wiper sheet may be impregnated with liquid chemicals to be wetted prior to its use, or may be used directly while dry. The method for forming the expansions of the disposable wiper sheet of the invention is not limited to the illustrated one where the difference in the expansion ratio (crepe ratio) between the constitutive sheets to be overlaid together to give the wiper

sheet produces the intended expansions. Apart from this, for example, a corrugating process is employable for that purpose in which the constitutive sheets are previously corrugated to have the intended expansions and thereafter partly bonded together. This process may be effected to make the constitutive sheets expand to have expansions between the adjacent adhesive parts.



CLAIMS:

1. A disposable wiper sheet comprising a plurality of water-decomposable sheets overlaid together and partly bonded together at a plurality of adhesive parts, wherein;

at least one of the sheets is the sheet(s) having a higher expansion ratio which is crinkled to have a high expansion ratio, and expands when it is impregnated with liquids to spread its crinkles;

the other sheet(s) is/are the sheet(s) having a lower expansion ratio which is/are crinkled to have a lower expansion ratio than that of said sheet having a higher expansion ratio, and expand(s) more poorly than said sheet having a higher expansion ratio when impregnated with liquids to spread its/their crinkles, or is/are non-crinkled and non-expansible one(s);

said sheet(s) having a higher expansion ratio expands/expand, after having been impregnated with liquids, to have expansions in the regions between the adjacent adhesive parts due to the difference in the expansion ratio between the sheet(s) having a higher expansion ratio and the sheet(s) having a lower expansion ratio or the non-crinkled and non-expansible sheet, and becomes/become voluminous, while forming spaces between the sheet(s) having a higher expansion ratio and the sheet(s) having a lower expansion ratio or the non-expansible sheet(s); and

at least the sheet(s) facing outward of those constitutive sheets is/are processed to have a large number of minute or fine holes through which air existing in said spaces between those constitutive sheets can escape outside of the wiper sheet.

2. The disposable wiper sheet according to claim 1, wherein said sheet(s) having a lower expansion ratio or said non-expansible sheet(s) is/are inner sheet(s), while said sheet(s) having a higher expansion ratio is/are outer sheet(s), and wherein at least one said outer sheet



is overlaid on the both surfaces of said inner sheet(s) and is partly bonded to said inner sheet(s) at a plurality of adhesive parts, and at least one said outer sheet is processed to have a large number of minute or fine holes.

3. The disposable wiper sheet according to claim 1, wherein the minute or fine holes of said sheet(s) were formed by partly reducing the density of said sheet(s).

4. The disposable wiper sheet according to claim 1, wherein said adhesive parts are aligned in plural rows each at a predetermined pitch, and wherein the sheet(s) having a higher expansion ratio is/are processed to have expansions in the regions between the adjacent rows of said adhesive parts, said expansions being aligned in plural rows each at the same pitch as the alignment pitch of the rows of said adhesive parts.

5. The disposable wiper sheet according to claim 1, which is used while being folded along a plurality of folding parts, and in which at least one of said plural folding parts is partly processed to have opening(s) through which air existing inside the folded parts can escape outside the wiper sheet.

6. The disposable wiper sheet according to claim 5, which is folded in two along one folding part, and is further folded in two, totaling in four, along another folding part that is perpendicular to the previous folding part, and in which at least the part at which said two folding parts intersect is partly processed to have said opening(s).

7. The disposable wiper sheet according to claim 5, wherein at least one of said folding parts is perforated to have perforations at which the wiper sheet is cut, and wherein the length of said opening(s) is/are longer than that of said perforations, and is/are formed on the perforations or in the area not having said perforations.

8. The disposable wiper sheet according to claim 2, wherein said outer sheets as bonded to the both surfaces of one inner sheet have



different expansion ratios, and wherein one outer sheet as bonded to one surface of said inner sheet has a higher expansion ratio while the other outer sheet as bonded to the other surface of said inner sheet has an expansion ratio lower than that of the previous one outer sheet, with the result that the expansions of said one outer sheet with a higher expansion ratio as bonded to said one surface of the inner sheet are larger than those of said the other outer sheet with a lower expansion ratio than that of said one outer sheet as bonded to said the other surface of the inner sheet.

9. The disposable wiper sheet according to claim 8, wherein said adhesive parts are aligned in plural rows each at a predetermined pitch, and wherein the one outer sheets as partly bonded to the both surfaces of said inner sheet are processed to have expansions in the regions between the adjacent rows of said adhesive parts, said expansions being aligned in plural rows each at the same pitch as the alignment pitch of the rows of said adhesive parts, and the expansions of the one outer sheet having a higher expansion ratio are larger than those of the other outer sheet having a lower expansion ratio than that of said one outer sheet.

10. The disposable wiper sheet according to claim 8, wherein the difference in the expansion ratio between said inner sheet and said outer sheet having a higher expansion ratio is 20 % or more to 80 % or less, the difference in the expansion ratio between said inner sheet and said outer sheet having a lower expansion ratio is 10 % or more to 50 % or less, and the difference in the expansion ratio between said two outer sheets is not smaller than 10 %.

11. The disposable wiper sheet according to claim 8, wherein the minute or fine holes of said sheet(s) were formed by partly reducing the density of said sheet(s).

12. A method for producing a disposable wiper sheet, comprising;



a step of applying raw material fibers onto the outer surface of a paper-making cylinder having a large number of small projections formed on its surface, to thereby form a paper or fiber web having minute or fine holes formed therein in accordance with the small projections of the cylinder;

a step of applying a water-swellable or water-soluble binder to said paper or fiber web during or after said step of forming said paper or fiber web;

a step of forming a large number of crinkles on the paper or fiber web having said minute or fine holes;

a step of overlaying the sheet as prepared in the previous step to have minute or fine holes and crinkles, on a sheet which has crinkles but has a lower expansion ratio to expand more poorly than the former sheet when impregnated with liquids, or on a non-expansible sheet having no crinkles, followed by partly bonding the two sheets together; and

a step of impregnating the thus-bonded sheets with liquid chemicals to spread the crinkles of the sheet having a larger expansion ratio, thereby forming expansions in the areas between the adjacent adhesive parts in said sheet having a larger expansion ratio.

13. The method for producing a disposable wiper sheet according to claim 12, wherein the sheet having a lower expansion or the non-expansible sheet is used as the inner sheet, while the sheet having minute or fine holes and crinkles is used as the outer sheet and attached to the both surfaces of the inner sheet, and wherein the thus-attached outer sheets are made to have expansions due to the difference in the expansion ratio between the inner sheet and the outer sheets that expand when their crinkles are spread, to thereby give a disposable wiper sheet having expansions on its both surfaces.

14. The method for producing a disposable wiper sheet according to claim 12, wherein the sheets as processed on the cylinder to have



minute or fine holes are crinkled with a blade as applied to the surface of a drum having a high rotation speed while it is transferred from said drum having a high rotation speed to another drum having a low rotation speed.