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SHEET MATERIAL AND PRODUCTS UTILIZING SAME

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This invention relates to flexible sheet material and is particularly concerned with the provision of sheet material intended essentially for a single use, following which it will be readily disposable by flushing the same down a toilet drain without danger of clogging the plumbing system and without giving rise to difficulties in the municipal or other sewage disposal plant into which it eventually is discharged.

Numerous fibrous sheet materials in daily use are, of course, disposable in the sense referred to above, viz., they may be flushed down a toilet drain without clogging the plumbing system and without causing trouble in sewage disposal systems. Common examples of these are toilet paper, paper tissues such as those marketed under the trademark "Kleenex," and sanitary tampons such as the type sold under the trademark "Tampax." Materials such as represented by these examples meet the above-mentioned qualities of disposability because they are highly water-absorptive and hence become rather rapidly disintegrated not only by the action of the relatively large volume of water normally present in flushing a toilet bowl but also by the mechanical action of turbulence which occurs when the toilet bowl is flushed to drain its contents.

Other flexible sheet materials in wide current use but which are essentially water-insoluble, are sometimes referred to as being disposable down a toilet drain. Representative of these are sheets of regenerated cellulose of the cellophane type, foils and films made from polymer resins such as vinyl polymers and copolymers of the type sold under the trademark "Saran," polyethylene, and the like. Various of these materials are now in extensive use for wrapping foods and other articles of commerce. Because of their physical properties, including water-insolubility, surface-to-volume ratio, and inherent strength required by an unsupported film, the accumulation of any substantial volume of such sheet materials in domestic plumbing system leads to clogging of the system as well as to harmful effects in the central sewage disposal plant. Indeed, the disposal of these materials by flushing them down a toilet bowl would in all likelihood be in contravention of the sanitation codes which prevail in many municipalities.

The principal object of the present invention is to provide sheet material having the characteristics of disposability above set forth, namely, being flushable down a toilet drain without giving rise to clogging of the plumbing system and to impairment or other difficulties of operation of the conventional sewage disposal plants.

A more specific object of the invention is to provide sheet material of the character set forth, formulated so as to render it particularly suitable for use in the medical hygiene field.

Briefly stated, the objects of the invention are achieved by the provision of sheet material characterized by (1) good dry strength; (2) relatively little or even zero wet strength; (3) relatively high flexibility; and (4) having one of its surfaces resistant to penetration by water or water vapor for a substantial period of time.

The invention will herein be described with reference to a particular embodiment suitable for use as a disposable liner for bedpans utilized by bed-confined patients in homes and hospitals. It will be apparent, however, from the more detailed description herein, that the material of the present invention lends itself to use as a dis-

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posable material for purposes other than that of a bedpan liner.

The term "disposable" as used herein with reference to the sheet material of the invention means that the material is (1) sufficiently water-soluble or disintegrable when immersed in a relatively large body of water, such as that present in the conventional toilet bowl, and subjected to the influence of turbulent mechanical action such as that which occurs when flushing a toilet bowl, so as to avoid the danger of clogging the plumbing system when the material is flushed down a toilet bowl in a home or hospital; and (2) is composed of materials which will be digested in or at least not give rise to difficulties in municipal or other sewage disposal plants with which such plumbing systems are connected.

In its preferred embodiment, the sheet material of the invention comprises a base or substrate having relatively good dry strength and which is either (a) a water-soluble material or (b) so readily wettable by water and of such low wet strength, as to enable it readily to lose its structural strength (in much the same fashion and degree as characteristic of conventional toilet papers, paper tissues such as the above-mentioned "Kleenex," and the like) when immersed in a body of water, as in a toilet bowl, or in the plumbing system into which it is drained or flushed. This base or substrate, in accordance with the invention, moreover, is treated so that one of its surfaces is capable of serving as a barrier to water and, desirably also, water-vapor, for a substantial period of time, this barrier material, however, being of a character which nevertheless does not impede the above mentioned ready disintegrability of the base or substrate and which does not give rise to any difficulties when discharged into the conventional sewage disposal systems.

The base or substrate of the sheet material of the invention may desirably be composed of a cellulosic paper having a dry strength and toughness sufficiently high to resist tearing under the conditions of its use, and a flexibility and suppleness to enable it to be conformed by relatively light hand pressure into regular or irregular three-dimensional contours without tearing. Thus, in its adaptation for use specifically as a liner for bedpans, the tensile strength of the base or substrate may be in the range of from about 10 to 80 pounds, preferably about 30 to 60 pounds, per inch average, measured lengthwise and cross-wise of the fiber direction. The inherent flexibility of the paper may be enhanced if necessary or desired, by creping, creasing, crimping or other suitable mechanical deformation, either prior to or after application of the barrier component thereto.

With a base or substrate having a dry strength and flexibility of the order above stated, the sheet material of the invention, when utilized as a liner for bedpans may readily be conformed to the interior contour of conventional bedpans and will have sufficient structural strength to sustain the weight of the normal volume of urine or excrement discharged by a patient during any required use of the bedpan, and to permit lifting of the liner and such contents out of the bedpan and delivering the same to a toilet bowl for disposal thereof.

As indicated above, it is an important feature of the invention that while possessed of a dry-strength of the order stated, the base or substrate at the same time is characterized by little or zero wet strength, thus enabling it to become promptly disintegrated in water accompanied by turbulent action, such as occurs in water when a toilet bowl is flushed.

With the foregoing in view, the wet strength of the base or substrate may range from zero up to about 1.5 pounds per inch average tensile strength, measured lengthwise and cross-wise of the fiber direction.

The so-called barrier component with which one surface of the base or substrate is treated to provide the sheet material of the invention is, as indicated above, resistant to passage of water and water vapor in contact therewith for a substantial period of time, say up to the order of twelve hours. Thus, in the case of the use of the sheet material as a bedpan liner, the barrier will serve to prevent urine and excrement, emitted by a patient into a bedpan lined with the sheet material, from reaching the low wet strength base or substrate and causing its structural failure, even though a number of hours pass before a nurse or other attendant removes the liner and its contents from the bedpan and disposes of it by flushing the same down a toilet bowl.

Concomitant with its above-mentioned resistance to passage of water and vapor therethrough, the barrier component according to the invention must itself also be of low effective structural strength, viz., of a tensile strength not materially in excess of the wet strength of the base or substrate. In this way, notwithstanding its property of water-resistance, the barrier component will become disintegrated along with the base or substrate when the latter is disintegrated by the action of water, as in flushing the material down a toilet bowl.

In the preferred embodiment of the invention, the barrier component comprises a very thin film of coating applied to one surface of the base or substrate, the coating being a material which is characterized by resistance to the action of water as well as of acids, alkalis and other chemicals. The film thickness is such that it will resist the passage of water and water vapor therethrough during a period of at least several hours. In accordance with the invention, the film thickness of the coating is in the range of 0.0001 to 0.001 inch. The tensile strength, and tear strength of the applied film should be such as to enable it to be readily disintegrated along with the base when the latter, by reason of its exceedingly low wet strength properties, is flushed down a toilet drain. The coating material utilized in accordance with the invention is further characterized by being compatible with or digestible in, conventional sewage treatment systems.

The film of coating material serving as the barrier component may be applied to the base or substrate by any of the known coating processes applicable to these materials.

The coating need not in all cases be adhesively bonded to the surface of the base or substrate. For certain uses of the sheet material of the invention, exemplified by its use as a liner for a bedpan as above mentioned, sufficient adherence may be provided through the mechanical bonding of the coating to the base or substrate by the normal roughness or fuzziness of the surface of the base or substrate. In such instances, however, the coated sheet should not exhibit surface fibers of the base projecting through the film or the applied coating to an extent, in number or distribution, such as to give rise to wicking action through the coating to a degree which would cause wetting of the base over a substantial area thereof.

The base or substrate of the sheet material preferably consists of a web of cellulosic fiber having at least the normal dry strength which is characteristic of rosin sized paper. Desirably, the base or substrate may be composed of a cellulosic fiber web having an improved dry strength such as may be obtained by incorporating in the fiber furnish a small but effective quantity, usually in the range of 0.1% to 5%, based on the dry weight of the fibers, of polymers which serve to impart to the web a dry strength substantially in excess of its normal in the absence of such polymer, without however imparting wet strength to the web. Among such webs are those produced, for example, in accordance with the disclosures in U.S. Patents Nos. 2,765,228; 2,884,057; 2,890,978; 2,959,514; 2,963,396; and 3,015,605.

In a specific embodiment of the invention, there was utilized as the base or substrate, a cellulosic fiber web

produced by Knowlton Brothers, Incorporated, and designated as grade 101. This paper has a caliper of 0.005 inch and a basis weight (2 ft. x 3 ft.—500 sheets) of 40 pounds. It exhibits an Elmendorf tear value, dry, of 52 pounds lengthwise, and 65 pounds cross-wise. Its Elmendorf tear value, wet, is too low to be measured.

The coating material utilized in the practise of the invention is a thermoplastic material capable of being applied by conventional coating methods, such as extrusion coating, to the above-mentioned base or substrate, in films of the thickness above set forth, viz., 0.0001 to 0.001 inch.

The preferred type of coating material suitable for the practise of the invention are the polyethylene resins, particularly those of the low density or medium density types, since these can be readily applied to the base by extrusion coating in films of a thickness in the range above mentioned. The melt index of the polyethylene employed should be such as to provide a film whose strength will not be such as to preclude its disintegration along with the low wet strength base or substrate when the coated material is subjected to turbulent action of water as in flushing the same down a toilet drain.

In a specific embodiment of the invention, the coating material applied to the paper base above-identified as grade 101 of Knowlton Brothers, Incorporated, consisted of a polyethylene resin available commercially under the trade designation "Petrothene Resin 205-15." This polyethylene resin exhibits a density of 0.924 and a melt index of 3, and was applied to the base as a film of 0.0003 to 0.0005 inch thickness. The coated sheet material was readily flushable down a toilet drain without clogging.

Another advantage of polyethylene resin as the coating film in the practise of the invention, particularly in its adaptation for use as a liner for bedpans, lies in its resistance to the action of chemicals normally present or encountered in urine and feces, including sodium chloride, urea, ammonium hydroxide and ammonia gas, alcohol, ether, acetone, as well as soaps, detergents and mineral oil taken internally or used by or on the patient.

Another suitable and preferred material which may be utilized as the coating material in the practise of the invention is polypropylene resin of the types which can be applied by extrusion coating.

Vinyl polymer and copolymer resins, particularly polyvinyl chlorides and vinyl chloride/acetate copolymers, may also be utilized as the coating material in the practise of the invention. These, however, are not considered as desirable as the above-mentioned preferred resins, owing primarily to the fact that they are not as resistant as are the latter to the action of certain solvents, and further, because they generally entail the use of plastisol or organosol systems for application as coatings.

In the specific adaptation of the sheet material for use as a disposable liner for bedpans in accordance with the invention, the sheets may desirably be supplied in the form of pre-cut pieces or sections of rectangular or other suitably convenient outlines, dimensioned so that in use they may be readily fitted, by reason of their flexibility, down into the interior of the bedpan and permit their outer margins to extend a sufficient distance to be draped over the exterior surface of the bedpan. The marginal portion thus provides a simple and convenient means for grasping the liner to remove the same, with its content of urine and/or excrement from the bedpan for disposal by flushing down a toilet drain.

In instances where the sheet material does not exhibit a flexibility high enough to permit the flat pieces to be readily conformed to the interior of the bedpan, the material may be thermo-formed to the shape desired or formed as a bag or envelope to fit within conventional bedpans. Accordingly, unless otherwise qualified, the term "liner" herein is intended to embrace such pre-formed shapes of the sheet material herein referred to.

What is claimed is:

1. Sheet material consisting essentially of:
a paper base characterized by:

- (a) a dry strength effective to permit the same to retain its integrity when subjected to tension of the order of about 10 to about 80 pounds per inch average tensile strength measured in the long and in the short directions,
- (b) a flexibility and suppleness to enable it to be conformed by relatively light hand pressure into irregular three-dimensional shape without tearing,
- (c) ready wettability by water, and
- (d) a wet strength effective to permit ready disintegration thereof when immersed in water and subjected to turbulent action therein, said effective wet strength being of the order of zero to about 1.5 pounds per inch average tensile strength measured as above set forth,

one surface only of said paper base being provided with a layer of material possessing:

- (a) relatively high resistance to passage of water and water vapor into said base during a period of contact of at least several hours, and
- (b) sufficiently low wet strength to enable said layer to become readily disintegrated along with said paper base when said sheet material is immersed in a body of water and subjected to turbulent action therein.

2. Sheet material consisting essentially of:

- (1) a cellulosic paper base characterized by:

- (a) a dry strength effective to permit the same to retain its integrity when subjected to tension of the order of about 10 to about 80 pounds per inch average tensile strength measured in the long and in the short directions,
- (b) a flexibility and suppleness to enable it to be conformed by relatively light hand pressure into irregular three-dimensional shape without tearing,
- (c) ready wettability by water, and
- (d) a wet strength effective to permit ready disintegration thereof when immersed in water and subjected to turbulent action therein, said effective wet strength being of the order of zero to about 1.5 pounds per inch average tensile strength measured as above set forth, and

- (2) a coating on one surface only of said paper base, said coating being characterized by:

- (a) relatively high resistance to passage of water and water vapor into said paper base during a period of at least several hours,
- (b) sufficiently low wet strength to enable said coating to become readily disintegrated along with said paper base when the coated paper is flushed down a toilet drain, and
- (c) digestibility in conventional sewage treatment systems.

3. Sheet material as defined in claim 2, wherein said coating is further characterized by resistance to deterioration by chemicals normally present in urine and feces.

4. Sheet material as defined in claim 2, wherein said coating is in the form of a film of thermoplastic material of a thickness in the range of 0.0001 to 0.001 inch.

5. Sheet material as defined in claim 4, wherein said coating is a polyethylene resin.

6. Sheet material as defined in claim 4, wherein said coating is a polypropylene resin,

7. A coated sheet material disposable by flushing the same down a toilet drain, and consisting essentially of:

- (1) a base of cellulosic paper having a dry strength effective to permit the same to retain its integrity when subjected to tension in the range of about 10 to 80 pounds per inch average tensile strength, and a wet strength effective to permit ready disintegration thereof when immersed in water and subjected to turbulent action therein, said effective wet strength being of the order of up to about 1.5 pounds per inch average tensile strength, both measured lengthwise and cross-wise, and

- (2) a coating comprising a film of thermoplastic material of a thickness in the range of 0.0001 to 0.001 inch, said film having a strength sufficiently low to permit it to become disintegrated upon disintegration of said paper base by said flushing action.

8. A disposable liner for a bedpan, consisting essentially of a sheet material as defined in claim 1, dimensioned to enable the same to be fitted down into the confines of the bedpan and draped over the external surface thereof and provide a marginal portion for lifting the liner and its contents out of the bedpan.

9. A disposable liner for a bedpan, consisting essentially of a sheet material as defined in claim 2, dimensioned to enable the same to be fitted down into the confines of the bedpan and draped over the external surface thereof and provide a marginal portion for lifting the liner and its contents out of the bedpan.

10. A disposable liner for a bedpan, consisting essentially of a sheet material as defined in claim 3, dimensioned to enable the same to be fitted down into the confines of the bedpan and draped over the external surface thereof and provide a marginal portion for lifting the liner and its contents out of the bedpan.

11. A disposable liner for a bedpan, consisting essentially of a sheet material as defined in claim 4, dimensioned to enable the same to be fitted down into the confines of the bedpan and draped over the external surface thereof and provide a marginal portion for lifting the liner and its contents out of the bedpan.

12. A disposable liner for a bedpan, consisting essentially of a sheet material as defined in claim 7, formed to fit within the interior of the bedpan and to provide a portion for lifting the liner and its contents out of the bedpan.

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