A product having a paper layer and a film layer is disclosed along with methods of forming such a product.
PRODUCT HAVING A PAPER LAYER AND A FILM LAYER AND METHODS OF FORMING SUCH A PRODUCT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority, as a non-provisional patent application to application Ser. No. 61/825,826, filed May 21, 2013, which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] This invention relates to a product having a paper layer and a film layer and methods of forming such a product.

BACKGROUND OF THE INVENTION

[0003] Paper products, especially paper towels and paper napkins have been manufactured for years and are used in virtually every household in the United States. Paper towels and paper napkins are manufactured to have a requisite softness, high absorbency and adequate strength. A high basis weight usually provides the required degree of softness while a predetermined bulk is used to increase absorbency. In addition, many paper towels and paper napkins need to be manufactured to a certain wet strength so as to adequately function in mopping up spills and wiping up messes.

[0004] Today, paper products are being used in ways never before contemplated. Paper products are now used to wrap food items, in hospital settings and doctor offices to wipe up various body fluids and blood, and by people cleaning up after their pets. For some tasks, a germ free, sanitized or disinfecting product is desired. For other tasks, having a liquid-impermeable barrier or a water-resistant barrier would prove to be useful. In still other applications, a visual indication that the paper product contains a barrier layer would be very advantageous.

[0005] Now, a product having a paper layer and a film layer has been invented which exhibits excellent softness, absorbency and wet strength, and also provides a liquid-impermeable barrier.

SUMMARY OF THE INVENTION

[0006] Briefly, this invention relates to a product including a first layer having a high bulk, three-dimensional structure formed from an aqueous dispersion of papermaking fibers. The first layer has a thickness of less than about 4 millimeters (mm). The product also includes a liquid-impermeable, second layer formed from a polyolefin. The second layer has a thickness which is at least 50% less than the thickness of the first layer. The first and second layers are secured together to form a product having a basis weight of greater than about 10 grams per square meter (gsm), a bulk of greater than about 10 cubic centimeters per gram (cm³/g), and a wet strength ratio of greater than about 0.70.

[0007] Various methods of making a product are also taught. One method includes forming a first layer having a high bulk, three-dimensional structure from an aqueous dispersion of papermaking fibers. The first layer has a first major surface, a second major surface and a periphery. The first layer also has a thickness of less than about 4 millimeters. The method also includes forming a liquid-impermeable, second layer from a polyolefin. The second layer has a first major surface, a second major surface and a periphery. The second layer also has a thickness which is at least 50% less than the thickness of the first layer. The method further includes elevating the temperature of the second layer and bringing the second major surface of the first layer into contact with the first major surface of the second layer to form a laminate. Lines of perforations are then formed through the laminate at predetermined intervals. Lastly, the laminate is wound up on a hollow core to form a roll of product.

[0008] An alternative method includes forming a first layer having a high bulk, three-dimensional structure from an aqueous dispersion of papermaking fibers. The first layer has a first major surface, a second major surface and a periphery. The first layer has a thickness of less than about 4 millimeters. The method also includes forming a liquid-impermeable, second layer from a polyolefin. The second layer has a first major surface, a second major surface and a periphery. The second layer also has a thickness which is at least 50% less than the thickness of the first layer. The method further includes applying a pressure sensitive adhesive to one of the major surfaces of the first or second layers and bringing the major surface containing the pressure sensitive adhesive into contact with a major surface of the other layer to form a secure attachment therebetween. Lines of perforations are then formed through at least one of the first and second layers at predetermined intervals. Lastly, the perforated product is wound up on a hollow core to form a roll of product.

[0009] The general object of this invention is to provide a product having a paper layer and a film layer. A more specific object of this invention is to provide a product having a basis weight of greater than about 10 gsm, a bulk of greater than about 10 cubic centimeters per gram (cm³/g), and a wet strength ratio of greater than 0.70.

[0010] Another object of this invention is to provide a product which exhibits excellent softness, high absorbency and wet strength, and also provides a liquid-impermeable barrier.

[0011] A further object of this invention is to provide a product having a paper layer which is thicker than a film layer, and wherein the periphery of the first layer is not coextensive with the periphery of the second layer.

[0012] Still another object of this invention is to provide a method of forming a product having a paper layer and a film layer.

[0013] Still further, an object of this invention is to provide a method of forming a product by laminating a paper layer onto a film layer.

[0014] Other objects and advantages of the present invention will become more apparent to those skilled in the art in view of the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is an exploded view of a product made with a cold laminator.

[0016] FIG. 2 is an exploded view of a product made with a hot laminator.

[0017] FIG. 3 is an exploded view of a product made with an extruder.

[0018] FIG. 4 is a top view of a product wherein the first and second layers have coextensive peripheries.

[0019] FIG. 5 is a side view of the product shown in FIG. 4 showing the thickness of the first layer is at least three times the thickness of the second layer.
FIG. 6 is a top view of a product having a first layer with a periphery which is larger than the periphery of the second layer.

FIG. 7 is a side view of the product shown in FIG. 6 showing the thickness of the first layer is at least three times the thickness of the second layer.

FIG. 8 is a top view of a product having a first layer with a periphery which is smaller than the periphery of the second layer.

FIG. 9 is a side view of the product shown in FIG. 8 showing the thickness of the first layer to be at least twice the thickness of the second layer.

FIG. 10 is a perspective view of a roll of product, partially unwound to reveal lines of perforations formed therethrough at regular intervals.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, a product 10 is shown which includes a first layer 12 and a second layer 14. The product is three-dimensional and has a longitudinal central axis X-X, a vertical central axis Y-Y, and a transverse central axis Z-Z. The first layer 12 is a high bulk, three-dimensional structure formed from an aqueous dispersion of papernaking fibers. Any suitable papernaking fibers can be used, including those produced by kraft pulping, sulfite pulping, mechanical pulping, including thermal mechanical pulping (TMP), chemical thermal mechanical pulping (CTMP), and groundwood, and so forth. Both virgin and recycled fibers may be used. The fibers can be bleached or unbleached. In addition to wood-based fiber sources, other fibers may be used such as those derived from cotton, kenaf, bagasse, hemp, milkweed, abaca, and the like. The fiber composition of the first layer 12 can have from between about 10% to about 100% wood pulp fibers. Desirably, the first layer 12 has about 70% or greater wood pulp fibers. More desirably, the first layer 12 has about 80% or greater wood pulp fibers. Even more desirably, the first layer 12 has about 90% or greater wood pulp fibers. Most desirably, the first layer 12 has about 95% or greater wood pulp fibers. Additionally, it is desirable that the fiber composition of the first layer 12 includes about 70% or greater softwood fibers. More desirably, the fiber composition of the first layer 12 includes about 80% or greater softwood fibers. Even more desirably, the fiber composition of the first layer 12 includes about 90% or greater softwood fibers.

The fiber furnish may include wet strength and dry strength additives, retention aids, starch, chemical softeners, and other chemical additives and fillers known to those skilled in the art.

The first layer 12 has a thickness of less than about 4 millimeters. A millimeter is a unit of length equal to one thousandth (10^-3) of a meter, or 0.0394 inch. Desirably, the first layer 12 has a thickness of less than about 3 millimeters. More desirably, the first layer 12 has a thickness of less than about 2.5 millimeters. Even more desirably, the first layer 12 has a thickness of less than about 2 millimeters.

The first layer 12 can be produced as a single ply, structure, as a 2-ply structure, or as a multi-ply structure having 3 or more plies.

The first layer 12 can be white in color. A whitener, such as Titanium Dioxide (TiO2), can be added to the aqueous dispersion to produce a white color. Alternatively, the first layer 12 can be of some other color, including but not limited to: pink, blue, green, yellow, beige, etc. In addition, the first layer 12 can be made to have two or more colors. Furthermore, the first layer 12 can be printed, if desired.

The first layer 12 can be embossed to give it a three-dimensional structure. By “embossed” it is meant to mold or carve in relief; to decorate with or as if with a raised design.

The first layer 12 has a basis weight of about 8 grams per square meter (gsm) or greater. Desirably, the first layer 12 has a basis weight which ranges from between about 10 gsm to about 80 gsm. More desirably, the first layer 12 has a basis weight which ranges from between about 20 gsm to about 60 gsm. Even more desirably, the first layer 12 has a basis weight which ranges from between about 30 gsm to about 50 gsm.

Still referring to FIG. 1, the second layer 14 of the product 10 adds strength to the first layer 12. The combination of the first and second layers, 12 and 14 respectively, creates a much stronger product 10, which is less susceptible to tearing or disintegrating during use. The second layer 14 is a liquid-impermeable layer. By “liquid-impermeable” it is meant that it is impossible for a liquid to permeate or pass therethrough. The second layer 14 could also be coated or treated to be water-resistant, if desired. By “water resistant” it is meant water-repellent.

The second layer 14 can be formed from various materials or films. The second layer 14 can be a polymer, a copolymer or a homopolymer. A useful polymer is polyolefin. By “polyolefin” it is meant any of a class of polymers produced from a simple olefin (also called an alkene with the general formula (CnH2n)) as a monomer. A polyolefin can be adhesively bonded after surface treatment (they inherently have very low surface energies and don’t wet-out well), and by some superglues (cyanoacrylates) and reactive (meth) acrylate glues. Polyolefins are extremely inert chemically but exhibit decreased strength at lower and higher temperatures. As a result, thermal welding is a common bonding technique. An equivalent term for polyolefin is polyalkene; this is a more modern term, although polyolefin is still used in the petrochemical industry.

Polyolefins are the largest group of thermoplastics, often referred to as commodity thermoplastics. Polyolefins are polymers of simple olefins such as ethylene, propylene, butenes, isopropenes, and pentenes, and copolymers and modifications thereof. The term “polyolefin” means “oil-like” and refers to the oily or waxy feel that these materials have. Polyolefins consist only of carbon and hydrogen atoms and they are non-aromatic. Polyolefins are usually processed by extrusion, injection molding, blow molding, and rotational molding methods. Thermoforming, calendering, and compression molding are used to a lesser degree. An inherent characteristic common to all polyolefins is a non-polar, non-porous, low-energy surface that is not receptive to inks, and lacquers without special oxidative pretreatment. The two most important and common polyolefins are polyethylene and polypropylene. These two materials are very popular due to their low cost and wide range of applications.

The second layer 14 can be formed from polyethylene, such as Low Density Polyethylene (LDPE) film or High Density Polyethylene (HDPE) film. Polyethylene is the polyolefin produced by polymerizing the olefin ethylene. By “polyethylene” it is meant a polymerized ethylene resin, used especially in the form of film and sheets. The second layer 14 can also be formed from polypropylene. Polypropylene is another common polyolefin which is made from the olefin propylene. By “polypropylene” it is meant any of various
thermoplastic resins that are polymers of polypropylene and used to make molded articles and films. In addition, the second layer 14 could be formed from a polyester. By “polyester” it is meant any of numerous synthetic polymers produced by reaction of dibasic acids with dihydric alcohols and used as light, strong, weather resistant resins in textile fibers. [0036] The second layer 4 has a thickness which is at least 50% less than the thickness of the first layer 12. In other words, the thickness of the first layer 12 is at least twice the thickness of the second layer 14. Desirably, the thickness of the second layer 14 is at least 60% less than the thickness of the first layer 12. Most desirably, the thickness of the second layer 14 is at least 75% less than the thickness of the first layer 12. Even more desirably, the thickness of the second layer 14 is at least 70% less than the thickness of the first layer 12. Most desirably, the thickness of the second layer 14 is at least 75% less than the thickness of the first layer 12.

[0037] Another way of stating the above ranges is to say that the thickness of the first layer 12 is more than twice the thickness of the second layer 14. Desirably, the thickness of the first layer 12 is at least three times the thickness of the second layer 14. More desirably, the thickness of the first layer 12 is more than three times the thickness of the second layer 14.

[0038] The second layer 14 has a thickness of less than about 1.0 millimeters (mm). Desirably, the second layer 14 has a thickness of less than about 0.5 mm. More desirably, the second layer 14 has a thickness of less than about 0.4 mm. Even more desirably, the second layer 14 has a thickness of less than about 0.3 mm.

[0039] The second layer 14 has a basis weight of from between about 0.1 grams per square meter (gsm) to about 5.0 gsm. Desirably, the second layer 14 has a basis weight which ranges from between about 0.1 gsm to about 3 gsm. More desirably, the second layer 14 has a basis weight which ranges from between about 0.2 gsm to about 2 gsm. Even more desirably, the second layer 14 has a basis weight which ranges from between about 0.3 gsm to about 1 gsm.

[0040] Still referring to FIG. 1, the first and second layers, 12 and 14 respectively, can be secured together in various ways to form the product 10. One way to secure the first and second layers, 12 and 14 respectively, together is by using an adhesive 16. The adhesive 16 can be a structural adhesive or a pressure-sensitive adhesive. To form a permanent bond, structural adhesives harden via processes such as evaporation of solvent, reaction with ultraviolet (UV) radiation, chemical reaction (such as two part epoxies), or cooling (as in hot melt).

A pressure-sensitive adhesive works very well for this invention. By “pressure-sensitive adhesive” it is meant an adhesive which forms a bond when pressure is applied to the adhesive with the adherend. No solvent, water or heat is needed to activate the adhesive. Pressure-sensitive adhesives are designed with a balance between flow and resistance to flow. The bond forms because the adhesive is soft enough to flow, or wet, the adherend. The bond has strength because the adhesive is hard enough to resist flow when stress is applied to the bond. Once the adhesive and the adherend are in proximity, there are also molecular interactions such as van der Walls forces involved in the bond, which contribute significantly to the ultimate bond strength.

[0041] As the name “pressure-sensitive” indicates, the degree of bond is influenced by the amount of pressure which is used to apply the adhesive to the surface. Surface factors, such as smoothness, surface energy, removal of contaminants, etc. are also important to proper bonding. Pressure-sensitive adhesives are usually designed to form a bond and hold properly at room temperatures. Pressure-sensitive adhesives typically reduce or lose their tack at low temperatures and reduce their shear holding ability at high temperatures. Pressure-sensitive adhesives exhibit viscoelastic (viscous and elastic) properties, both of which are used for proper bonding. In contrast, the strength of structural adhesives is evaluated as lap shear strength. Pressure-sensitive adhesives are characterized by their shear holding. The ability to hold a shear mode is related to the formulation, coating, thickness, rubdown, temperature, etc.

[0042] The adhesive 16 can be applied to either the first layer 12 or to the second layer 14 or to both of the first and second layers, 12 and 14 respectively. The adhesive 16 can be applied by spraying, brushing, wiping, immersing, etc. The amount of adhesive that is applied to one or both of the first and second layers, 12 and 14 respectively, can vary. The thickness of the adhesive 16 can also vary. Usually, the thickness of the adhesive is less than 1 millimeter (mm). Desirably, the thickness of the adhesive 16 is less than 0.5 millimeters (mm). The adhesive 16 can be applied such that it completely covers at least one major surface of one of the first or second layers, 12 or 14 respectively. Alternatively, the adhesive 16 can be applied such that it covers only a portion of at least one major surface of one of the first or second layers, 12 or 14 respectively. For example, the adhesive 16 could cover between about 25% to about 75% or at least one major surface of one of the first or second layers, 12 or 14 respectively.

[0043] Still referring to FIG. 1, the first and second layers, 12 and 14 respectively, can be secured together with an adhesive 16, especially a pressure-sensitive adhesive, in a cold laminator. The laminator, operating at about room temperature, can bind the first and second layers, 12 and 14 respectively, together to form a product 10. The product 10 can be a paper towel with a film backing, a paper napkin with a film backing, a medical garment having a paper layer with a film backing, a food wrapper made from paper and having a film backing, etc.

[0044] The product 10 has a basis weight of greater than about 10 grams per square meter (gsm). The basis weight of the product 10 depends upon the number of plies and the basis weight of each ply in the first layer 12, the basis weight of the second layer 14, and the basis weight of the adhesive 16. Desirably, the product 10 has a basis weight of greater than about 20 gsm. More desirably, the product 10 has a basis weight of greater than about 30 gsm. Even more desirably, the product 10 has a basis weight of greater than about 40 gsm. Most desirably, the product 10 has a basis weight of greater than about 50 gsm.

[0045] The product 10 also has a low dry, specific modulus, high wet strength ratio, and high bulk. These three properties can be tested as follows:

Specific Modulus

[0046] The dry, specific modulus of the product 10 is determined by dividing the geometric mean modulus of the product 10 (in kilograms) by the geometric mean tensile (in grams of force per 3 inches) (7.62 centimeters) of the product 10. As used herein, tensile strengths are reported in kilograms of force per 3 inches (7.62 centimeters) of sample width, but may be expressed simply as “kilograms” for convenience.

[0047] To determine the dry, specific modulus of the product 10, a tensile tester is utilized, such as Sintech tensile
Tester, manufactured by Sintech Research Triangle Park, N.C. 27709. In particular, under TAPPI test conditions, a sample of the product 10 is placed in the jaws of the tensile tester. The jaws are generally a pair of rectangular pieces which suspend the sample between the two pieces. The sample must be large enough to fit between the span of the jaws. Typically, the sample is about 3 inches wide and at least 4 inches long, as the span of the jaws of the Sintech tensile tester is 4 inches. After the sample is placed into the jaws, one piece of the jaw moves outward and the second piece remains stationary. The piece of the jaw that moves has a strain gauge attached to it, which measures the strain placed to the sample. In addition, the tester enters a rate into the Sintech Tensile Tester. Generally, the standard rate is 10 inches per minute.

[0048] The product 10 is tested in both directions in which it was produced, i.e., the machine direction (MD), and the direction perpendicular to that in which it was produced, i.e., the cross direction (CD). At least two samples must be tested—one for the machine direction (MD) and one for the cross direction (CD). Generally, at least five to ten samples are tested in both directions and an average is taken of all the sample values.

[0049] The Sintech Tensile Tester produces a stress-strain curve for each sample. The stress is on the y-axis, while the strain is on the x-axis. As stated above, the dry, specific modulus is determined by dividing the geometric mean modulus of the product 10 by the geometric mean tensile strength of the product 10, as shown by the following formula:

\[
\frac{\text{Dry Specific Modulus}}{\text{GM}} = \frac{\text{GM}^{\text{modulus}}}{\text{GM}^{\text{tensile}}}
\]

[0050] where \(\text{GM}^{\text{modulus}}\) is the geometric mean modulus (determined by the slope of the stress-strain curve), and where \(\text{GM}^{\text{tensile}}\) is the geometric mean tensile strength.

[0051] The geometric mean modulus is determined from the cross direction (CD) and the machine direction (MD) stress-strain curves of the product 10 by determining the least square line fit slope between the load points of 70 grams and 157 grams, using the following formula:

\[
\text{GM}^{\text{modulus}} = \frac{(\text{change in load}(\text{kilograms}))}{(\text{change in crosshead position}(\text{mm}))} \times \frac{(\text{corrected gauge length}(\text{mm}))}{(\text{corrected gauge length plus slack}(\text{mm}))}
\]

[0052] where \(\text{corrected gauge length} = \text{gauge length plus slack}, and the slack is equal to the distance in millimeters of zero tension load when the specimen is in the tensile tester grips.

[0053] The geometric mean tensile strength of the product 10 is determined by first multiplying the cross direction tensile strength by the machine direction tensile strength, and second taking the square root of that product, which can also be expressed in the following equation:

\[
\text{GM}^{\text{tensile}} = \sqrt{\left(\frac{\text{CD}^{\text{tensile}}}{\text{MD}^{\text{tensile}}}\right)^2}
\]

[0054] where CD tensile is the average cross direction tensile strength, and

[0055] where MD tensile is the average machine direction tensile strength.

Wet Strength Ratio

[0056] The wet strength ratio is determined by dividing the cross direction (CD) wet tensile strength by the cross direction (CD) dry tensile strength, as expressed by the following equation:

\[
\text{Wet strength ratio} = \frac{\text{CD}^{\text{wet}}}{\text{CD}^{\text{dry}}}
\]

[0057] where \(\text{CD}^{\text{wet}}\) is the average cross direction wet tensile strength, and

[0058] where \(\text{CD}^{\text{dry}}\) is the average cross direction dry tensile strength.

[0059] Both the cross direction (CD) wet tensile strength and the cross direction (CD) dry tensile strength are measured in the units of grams per 3 inches. In particular, the cross direction (CD) dry tensile strength is determined utilizing the Sintech tensile tester, as described above. The cross direction (CD) wet tensile strength is determined by forming a loop of the specimen and wetting it with distilled water, then inserting it into the tester grips of the Sintech tensile tester.

Bulk

[0060] The bulk is defined as the dry caliper of one sheet of the product 10 divided by its basis weight. The bulk is measured in dimensions of centimeters cubed divided by grams (cm³/g). The dry caliper is the thickness of a dry product 10 measured under a controlled load. The bulk is determined in the following manner. Generally, an instrument, such as the EMVECO model 200-A caliper tester from Emveco Company is utilized. In particular, ten samples of the product 10, each being 4 inches in length by 4 inches in width, are stacked together. Once the samples are stacked together, they are then subjected to pressure. In particular, a platen, which is a circular piece of metal, which is 2.21 inches in diameter, presses down upon the stack of samples. The pressure exerted by the platen is generally about 2 kilo Pascals (0.29 psi). Once the platen presses down upon the stack, the caliper of the stack is measured. The platen then lifts back up automatically. To determine the caliper for one sample, the caliper for the entire stack is divided by 10, the number of samples in the stack. The basis weight is determined after conditioning the sample in TAPPI—specified temperature and humidity conditions.

[0061] The product 10 has a dry, specific modulus of less than about 0.005 kilograms/grams/3 inches. Desirably, the product 10 has a dry, specific modulus of less than about 0.004 kilograms/grams/3 inches. More desirably, the product 10 has a dry, specific modulus of less than about 0.002 kilograms/grams/3 inches.

[0062] The product 10 has a wet strength ratio of greater than about 0.7. Desirably, the product 10 has a wet strength ration of greater than about 0.8. More desirably, the product 10 has a wet strength ration of greater than about 0.85. Even more desirably, the product 10 has a wet strength ration of greater than about 0.9. Most desirably, the product 10 has a wet strength ration of greater than about 1.0.

[0063] The product 10 further has a bulk of greater than about 10 cubic centimeters per gram (cm³/g). Desirably, the product 10 has a bulk of greater than about 15 cm³/g. More desirably, the product 10 has a bulk of greater than about 20 cm³/g. Even more desirably, the product 10 has a bulk of
greater than about 25 cm$^2$/g. Most desirably, the product 10 has a bulk of greater than about 30 cm$^2$/g.

Referring now to FIG. 2, a product 10' is shown which includes a first layer 12 and a second layer 14. The product 10' is three-dimensional and has a longitudinal central axis X-X, a vertical central axis Y-Y, and a transverse central axis Z-Z. The first layer 12 has a high bulk, three-dimensional structure formed from an aqueous dispersion of papermaking fibers, as was explained above. The second layer 14 is a polyolefin film, such as Low Density Polyethylene (LDPE) film, High Density Polyethylene (HDPE) film, Low Density Polypropylene (LDPP) film or High Density Polypropylene (HDPP) film. The product 10' does not include an adhesive 16. Instead the product 10' is produced on a hot laminator at a temperature ranging from about 220$^\circ$ F. to about 300$^\circ$ F. The heated film is soft and adheres to the first layer 12. Upon cooling, the product 10' is produced.

Referring now to FIG. 3, a product 10" is shown which includes a first layer 12 and a second layer 14. The product 10" is three-dimensional and has a longitudinal central axis X-X, a vertical central axis Y-Y, and a transverse central axis Z-Z. The first layer 12 has a high bulk, three-dimensional structure formed from an aqueous dispersion of papermaking fibers, as was explained above. The second layer 14 can be any of the materials recited above. Generally, the second layer 14 is a polymer, such as polyolefin. Polyethylene and polypropylene are two common polyolefins that are widely used. The polymer, in bead, pellet or resin form is introduced into a hopper and routed to an extruder. The polymer is heated to an elevated temperature such that it can flow. The exact temperature will vary depending on the composition of the polymer. The soft polymer can then flow onto the first layer 12. The thickness of the soft polymer is very thin. Generally, the thickness of the polymer is less than 0.5 millimeters (mm). The second layer 14 flows downward onto the upper surface of the first layer 12. The second layer 14 is uniform in thickness and forms a very thin film that will coat the upper surface of the first layer 12. The hot film adheres to the first layer 12 upon contact. The first and second layers, 12 and 14 respectively, are immediately cooled to form the product 10". The product can be cooled to a temperature that is above, at or below room temperature. The polymer will solidify upon cooling and form the second layer 14.

Referring to FIGS. 4 and 5, a product 11 is depicted wherein the first layer 12 has a first major surface 18, a second major surface 20 and a periphery 22. The second layer 14 has a first major surface 24, a second major surface 26 and a periphery 28. The peripheries 22 and 28 are coextensive. By “coextensive” it is meant that they have the same limits, boundaries or scope. In other words, the first and second layers, 12 and 14 respectively, are of the same size and overlap one another.

Referring to FIGS. 6 and 7, a product 11 is depicted wherein the first layer 12 has a first major surface 18, a second major surface 20 and a periphery 22. The second layer 14 has a first major surface 24, a second major surface 26 and a periphery 28. The peripheries 22 and 28 are coextensive. By “coextensive” it is meant that they have the same limits, boundaries or scope. In other words, the first and second layers, 12 and 14 respectively, are of the same size and overlap one another.

Referring now to FIG. 10, a roll of product 10" is depicted having been wound onto a hollow core 30. The hollow core 30 can be constructed of thick paper, cardboard, etc. The hollow core 30 is identical to the hollow cores currently used on rolls of paper towels, toilet paper, etc. The roll of product 10" has a width w and a thickness t. The width w of the roll of product 10" can vary. Desirably, the width w of the roll of product 10" ranges from between about 9 inches to about 12 inches. More desirably, the width of the roll of product 10" ranges from between about 10 inches to about 11.5 inches. Even more desirably, the width of the roll of product 10" is about 11 inches in dimension. The thickness t of the roll of product 10" can also vary. The thickness t of the roll of product 10" can range from between about 1.5 mm to about 6 mm. Desirably, the thickness t of the roll of product 10" can...
range from about 2 mm to about 5 mm. More desirably, the thickness of the roll of product 10 is less than about 4 mm.

As clearly exhibited in FIG. 10, the roll of product 10 is partially unwound so as to show that multiple lines of perforations 32, 32 have been formed at spaced intervals along the length of the product 10. By “perforations” it is meant a hole or series of holes punched, cut, formed or bored through something, especially a hole in a series, separating sections in a sheet or roll. The lines of perforations 32 can extend through both of the first and second layers, 12 and 14 respectively. Alternatively, the lines of perforations 32 can be formed in only one of the first or second layers, 12 or 14 respectively. For example, the lines of perforations 32 can be formed through only the second layer 14, since it is usually the stronger of the two layers 12 and 14. However, when the second layer 14 is a very thin coating, the lines of perforations 32 can be formed, through only the first layer 12.

The lines of perforations 32 can be spaced apart from one another by a length l. The length l can vary. The length l between adjacent lines of perforations 32, 32 can range from between about 9 inches to about 12 inches. Desirably, the length l between adjacent lines of perforations 32, 32 can range from between about 10 inches to about 11 inches. More desirably, the length l between adjacent lines of perforations 32, 32 can be about 10.5 inches.

It should also be noted that the lines of perforations 32, 32 are evenly spaced apart from one another. However, the lines of perforations 32, 32 can be spaced at different lengths l from one another, if desired.

Methods

Various methods can be used to make the products 10, 10', 10", 11, 11' and 11" described above. One method includes the steps of forming a product 10 having a first layer 12 with a high bulk, three-dimensional structure from an aqueous dispersion of papermaking fibers. The first layer 12 has a first major surface 18, a second major surface 20 and a periphery 22. The first layer 12 also has a thickness of less than about 4 millimeters. A second layer 14 is also formed. The second layer 14 has a first major surface 24, a second major surface 26 and a periphery 28. The second layer 14 is a liquid-impermeable layer formed from a polymer such as polyolefin, which prevents a liquid or a fluid from passing therethrough. In other words, the second layer 14 is a barrier layer. The polyolefin can be polyethylene, polypropylene or some other polyolefin. The second layer 14 also has a thickness which is at least 50% less than the thickness of the first layer 12.

The temperature of the second layer 14 can be elevated and then the first major surface 24 of the second layer 14 can be brought into contact with the second major surface 20 of the first layer 12. Alternatively, the second major surface 26 of the second layer 14 can be brought into contact with the first major surface 18 of the first layer 12. The contact between the first and second layers, 12 and 14 respectively, forms a laminate. The laminate can be cooled before multiple lines of perforations 32 are formed therethrough. The lines of perforations 32, 32 can be formed by various means known to those skilled in the art. The lines of perforations 32, 32 can be spaced at predetermined lengths l or intervals. The lines of perforations 32, 32 can be spaced apart at intervals ranging from between about 9 inches to about 12 inches. The lines of perforations 32, 32 can be formed through the first layer 12, through the second layer 14, or through both of the first and second layers, 12 and 14 respectively. Desirably, the lines of perforations 32, 32 are formed through both of the first and second layers, 12 and 14 respectively. It should be noted that for certain applications, it may not be necessary to form the lines of perforations 32, 32 in the product 10.

The method further includes winding up the laminate on a hollow core 30 to form a roll of product 10.

It should be understood that the roll of product 10, 10', 10", 11, 11' and 11" can be manufactured in large rolls spanning several feet in width. In this situation, one could slit the roll of product to form multiple smaller rolls of product 10, 10', 10", 11, 11' and 11" each having a width w of less than about 12 inches. Each of the smaller rolls of product 10, 10', 10", 11, 11' and 11" can be individually wrapped in clear plastic. The clear plastic wrapper can be printed to display a product name and well as other information. Alternatively, one could accumulate and package a number of the smaller rolls of product 10, 10', 10", 11, 11' and 11" and place them into a single package, such as a cardboard box or carton. The number of rolls of product 10, 10', 10", 11, 11' and 11" could also be packaged in a clear plastic wrapper as well. This is the way paper towels are currently marketed since the clear plastic wrapper is much cheaper than a cardboard box or carton.

An alternative method of forming a product 10 includes the steps of forming a first layer 12 having a high bulk, three-dimensional structure from an aqueous dispersion of papermaking fibers. The first layer 12 has a first major surface 18, a second major surface 20 and a periphery 22. The first layer 12 also has a thickness of less than about 4 millimeters. The method also includes forming a liquid-impermeable, second layer 14 from a polymer. The second layer 14 can be formed from any polyolefin, such as polyethylene or propylene. The second layer 14 can be a very thin film having a thickness of 1 mm or less. Alternatively, the second layer 14 can be a film coating having a thickness of about 0.5 mm or less. The second layer 14 has a first major surface 24, a second major surface 26 and a periphery 28. The second layer 14 also has a thickness which is at least 50% less than the thickness of the first layer 12. Desirably, the second layer 14 has a thickness which is 60%, 65%, 70% or 75% less than the first layer 12. An adhesive 16, such as a pressure-sensitive adhesive, is applied to one of the major surfaces 18 or 20 or 24 or 26 of the first or second layers, 12 or 14 respectively. The major surface 18 or 20 or 24 or 26, which contains the adhesive 16 is brought into contact with a major surface 18 or 20 or 24 or 26 of the other layer 12 or 14 to form a secure attachment therebetween. Multiple lines of perforations 32 can then formed through one or both of the first and second layers, 12 and 14 respectively, at predetermined intervals. The length l between adjacent lines of perforations 32, 32 can vary. Usually, the interval between the adjacent lines of perforations 32, 32 is greater than about 9 inches. Lastly, the perforated product 10 is wound up on a hollow core 30 to form a roll of product 10.

It should be understood that when manufacturing the products 10, 10', 10", 11, 11' or 11" of this invention, that a roll of product having a width of several feet can be produced. This large roll can then be slit to form multiple smaller rolls of a size that can be utilized by the ultimate consumer. Each of the multiple smaller rolls can be formed to have a predetermined width of less than about 12 inches. The smaller rolls of product 10, 10', 10", 11, 11' or 11" can be individually...
wrapped. Alternatively, a number of the smaller rolls of product 10, 10', 10", 11, 11' or 11" can be accumulated and packaged into a single package. The package can be plastic wrap, a box or a carton.

[0082] Since the products 10, 10', 10", 11, 11' or 11" contain a soft paper material on one side and a smooth, liquid-impermeable film on an opposite surface, they are capable of protecting a person's hand from the mess being cleaned up. Each of the products 10, 10', 10", 11, 11' or 11" can also be treated to prevent germs from passing through. Each of the products 10, 10', 10", 11, 11' or 11" could contain a germ limiting or germ preventing solution or compound. The germ limiting or germ preventing solution or compound could be sprayed, brushed, coated, poured, dripped, etc., onto the product during the manufacturing process or at the point of use by the ultimate consumer. It may also be possible to immerse the first layer 12, the second layer 14 or the entire product 10, 10', 10", 11, 11' or 11" in a bath containing the germ limiting or germ preventing solution or compound.

[0083] The product 10, 10', 10", 11, 11' or 11" eliminates the need for a person to wear gloves while cleaning up unsanitary messes. The product 10, 10', 10", 11, 11' or 11" also has the absorbent capacity of a normal paper towel. Furthermore, the liquid-impermeable second layer 14 allows the product 10, 10', 10", 11, 11' or 11" to be used for a wider variety of tasks. For example, it could be used to wrap food products, such as sandwiches, since the second layer 14 will prevent the food from drying out. Moisture will be prevented from entering or existing the product 10, 10', 10", 11, 11' or 11". One could also place a food item on the product 10, 10', 10", 11, 11' or 11" when snacking multiple food items. Furthermore, one could use the product 10, 10', 10", 11, 11' or 11" to keep a food item, such as a sandwich, protected during consumption and for easy clean up afterwords.

[0084] The uses for this product 10, 10', 10", 11, 11' or 11" in the health and medical fields is endless. The uses for this product 10, 10', 10", 11, 11' or 11" at home, in commercial and industrial applications is vast.

[0085] While the invention has been described in conjunction with the several specific embodiments, it is to be understood that many alternatives, modifications and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, this invention is intended to embrace all such alternatives, modifications and variations which fall within the spirit and scope of the appended claims.

1 claim:

1. A product comprising:
   a) a first layer having a high bulk, three-dimensional structure formed from an aqueous dispersion of papermaking fibers, and said first layer having a thickness of less than about 4 millimeters;
   b) a liquid-impermeable, second layer formed from polyolefin, said second layer having a thickness which is at least 50% less than the thickness of said first layer; and
   c) said first and second layers being secured together to form said product, and said product has a basis weight of greater than about 10 gsm, a bulk of greater than about 10 cm³/g, and a wet strength ratio of greater than about 0.70.

2. The product of claim 1 wherein said first layer is a single ply having a thickness of less than about 3 mm, said second layer is a polyolefin, said first layer is secured to said second layer by a pressure-sensitive adhesive, and said product has a specific modulus of less than about 0.005 kilograms/grams/3 inches.

3. The product of claim 2 wherein said first layer contains 2 plies and has a thickness of less than about 2.5 mm, said second layer is a polyethylene and has a basis weight of from between about 0.1 gsm to about 5.0 gsm, and said product has a basis weight of greater than about 20 gsm and a wet strength ratio of greater than about 0.80.

4. The product of claim 3 wherein said first layer has a thickness which is at least twice the thickness of said second layer, said second layer has a thickness of less than about 1 mm, each of said first and second layers has a periphery, and said periphery of said first layer is coextensive with said periphery of said second layer.

5. The product of claim 4 wherein said first layer contains 3 plies and has a thickness which is at least 3 times the thickness of said second layer, said second layer has a thickness of less than about 1 mm, and said product has a basis weight of greater than about 30 gsm and a wet strength ratio of greater than about 0.85.

6. The product of claim 3 wherein said first layer is embossed and printed, said second layer is polypropylene, and said product has a basis weight of greater than about 40 gsm.

7. The product of claim 1 wherein said second layer is formed from polymer beads that are heated to form a film, and said film, at an elevated temperature, is brought into contact with said first layer to form said product, and then said product is immediately cooled.

8. The product of claim 1 wherein each of said first and second layers has a periphery, and said periphery of said first layer is larger than said periphery of said second layer.

9. The product of claim 1 wherein each of said first and second layers has a periphery, and said periphery of said first layer is smaller than said periphery of said second layer.

10. A method of making a product, comprising the steps of:
   a) forming a first layer having a high bulk, three-dimensional structure from an aqueous dispersion of papermaking fibers, said first layer having a first major surface, a second major surface and a periphery, and said first layer having a thickness of less than about 4 millimeters;
   b) forming a liquid-impermeable second layer from a polyolefin, said second layer having a first major surface, a second major surface and a periphery, and said second layer having a thickness which is at least 50% less than the thickness of said first layer;
   c) elevating the temperature of said second layer;
   d) bringing said second major surface of said first layer into contact with said first major surface of said second layer to form a laminate;
   e) forming lines of perforations through said laminate at predetermined intervals; and
   f) winding up said laminate on a hollow core to form a roll of product, said product having a basis weight of greater than about 10 gsm, a bulk of greater than about 10 cm³/g, and a wet strength ratio of greater than about 0.70.

11. The method of claim 10 wherein said product is treated with a germ limiting solution or compound before use.

12. The method of claim 10 further comprising slitting said roll of product to form multiple smaller rolls, each of said multiple smaller rolls having a width of less than about 12 inches.
13. The method of claim 12 further comprising accumulating and packaging a number of said multiple smaller rolls into a single package, said package formed from a clear plastic.

14. The method of claim 10 wherein said periphery of said first and second layers are coextensive, and said lines of perforations occur at intervals ranging from between about 9 inches to about 12 inches.

15. The method of claim 10 further comprising forming said second layer using a hot laminator operating at a temperature ranging from between about 220°F to about 300°F.

16. A method of making a product, comprising the steps of:
   a) forming a first layer having a high bulk, three-dimensional structure from an aqueous dispersion of papermaking fibers, said first layer having a first major surface, a second major surface and a periphery, and said first layer having a thickness of less than about 4 millimeters;
   b) forming a liquid-impermeable second layer from a polyolefin, said second layer having a first major surface, a second major surface and a periphery, and said second layer having a thickness which is at least 60% less than said thickness of said first layer;
   c) applying a pressure-sensitive adhesive to one of said major surfaces of said first or second layers;
   d) bringing said major surface containing said pressure sensitive adhesive into contact with a major surface of said other layer to form a secure attachment therebetween;
   e) forming lines of perforations through at least one of said first and second layers at predetermined intervals; and
   f) winding up said perforated product on a hollow core to form a roll of product, said product having a basis weight of greater than about 20 gsm, a bulk of greater than about 10 cm³/g, and a wet strength ratio of greater than about 0.80.

17. The method of claim 16 wherein said lines of perforations are formed through both said first and second layers.

18. The method of claim 16 further comprising slitting said roll of product to form multiple smaller rolls, and each of said multiple smaller rolls having a width of less than about 11 inches.

19. The method of claim 18 further comprising accumulating and packaging a number of said multiple smaller rolls into a single package, said package being a cardboard box.

20. The method of claim 16 wherein said lines of perforations occur at intervals greater than about 10 inches.

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