ABSTRACT OF THE DISCLOSURE

A textile fabric, especially useful for drapery manufacture and the like, provided with a composite lining in intimate contact with the textile fabric, is disclosed. The composite liner includes a coherent layer of spunlaced nonwoven fabric and a foamed organic polymer which is in intimate contact with both the textile fabric and the spunlaced nonwoven fabric. The combination of the foamed organic polymer and the spunlaced nonwoven backing material provides the textile fabric with unusual and improved characteristics of appearance and feel.

It is known in this art to provide woven and nonwoven face fabrics with a flexible polymeric foam backing which functions to improve the face fabric for certain consumer uses. For example, when used in drapery manufacture, the foam backing adds desired amounts of weight, thermal insulation, and light resistance to a face fabric. Products of this type, and processes for producing them, are described in the following patents and applications owned by the same assignee as this application: "Foam Back Drapery Fabrics and Method of Making the Same," Pat. 3,527,654 issued Sept. 8, 1970, by Jones and Brandon; "Laminated Fabric Containing Foam Layer and Method of Making Same," Ser. No. 681,703 filed Nov. 9, 1967, now Pat. No. 3,567,565 by Jones and Provost; and "Glass Fiber Fabric for Drapery," Ser. No. 790,448 filed Jan. 10, 1969, now Pat. No. 3,615,970 in the name of May. The entire disclosure of the Jones et al. patent, the Jones et al. application and the May application are hereby incorporated by reference.

As pointed out in the above identified patent and applications, draperies have been customarily fabricated from one or more layers of textile fabric. A typical drapery is a rectangular piece of fabric whose edges are folded back and hemmed. At the top of the drapery, it is customary to provide pleats, which improve the appearance. A drapery made from a single layer of textile material is less expensive than a lined drapery, but it suffers from the difficulty that it is not fully opaque and that sunlight transmission can cause fading of dyes. A lined drapery conventionally is constructed of a relatively high quality facing fabric, which is printed or which carries a design in some other way, together with a lining which is a less expensive plain woven fabric. The lining functions to reduce the amount of light passing through the drapery, and this reduces the amount of sunlight to which the facing, or more expensive layer, is exposed in use. This decreases the light fastness requirement of the coloring material in the face fabric layer. The lining also adds opacity to the drape and makes it more difficult for outsiders to see inside a window. Moreover, the lining improves heat insulating properties of the drapery by trapping air between it and the face fabric. In addition, a lining adds a desired amount of weight to a drapery so that it hangs better. However, lined draperies are more expensive because of the cost of the lining fabric and also because of the costs involved in sewing such a lining fabric to the face fabric.

To overcome some of the fabricating costs involved, the above identified applications describe processes and products which provide for a polymeric foam liner as a backing on a face fabric, and the liner is applied and adhered to the face fabric without any of the conventional steps of sewing. For example, in the application of Jones et al. Pat. 3,527,654 there is described a drapery which is composed of a textile fabric having a foam polymeric material laminated to and in intimate contact with its reverse side. The foam-laminated fabric is supplied to a drapery manufacturer with the foam in place, thereby eliminating the need for sewing a lining to the facing fabric when the fabric is converted to a drapery. In addition, drapery fabric and foam lining, in laminate form, are cut at the same time, thus eliminating a separate cutting operation for the lining. The foam backed laminate also offers the advantage of not requiring an inventory of lining fabrics on hand during the manufacturing operation. Foam backing increases the opacity of a face fabric more effectively than a lightweight lining fabric and possesses all the other advantages of a lining. In addition, because of its low specific gravity, it adds more bulk for a given weight than a conventional lining. The product is truly washable and dry-cleanable, and there is no danger of shrinkage or distortion of the drapery or its lining material.

The May application, Ser. No. 790,448 describes another improvement in this art with respect to providing a glass fiber fabric with a foam backing layer having improved durability and fire resistance. The foam backing layer is a foamed polymer of vinyl chloride made from a vinyl chloride polymer plastisol containing a flame retardant plasticizer and a novel combination of solid fillers.

The descriptions of the above identified patent and pending applications, as stated, are incorporated herein by reference for purposes of providing additional background material on the present development. In addition, reference is made to Belgian Pat. 706,518 for further background information on the prior art relating to this subject.

BRIEF SUMMARY OF THE INVENTION

The present invention relates to a novel laminated fabric product and to a process for producing same. More specifically, the invention relates to a composite lining backing on woven or nonwoven textile fabrics, such as drapery face fabrics. The composite backing liner is made up of a foamed organic polymer in intimate contact with the textile fabric, and a coherent layer of spunlaced nonwoven fabric overlaying the foamed organic polymer and in intimate contact therewith. In a preferred embodiment, the spunlaced nonwoven fabric is adhered to the textile fabric solely by the organic polymer foam.

DESCRIPTION OF THE INVENTION

The present invention represents a departure from the prior art acknowledged above to the extent that a face fabric is provided with a composite lining backing, rather than just a single layer of polymeric foam. In accordance with the present invention, spunlaced (sometimes called tanglelaced) nonwoven fabrics can be intimately adhered to nonwoven or woven face fabrics by the use of MANUFACTURE.
backing layer on a face fabric, together with an intermediate foam layer, there is produced a final product hav- 5 ing excellent characteristics of appearance, feel, thermal insulation, opacity, weight, and durability. In addition, 10 it has been found that drapery fabrics of the present in- vention can be more easily machine washable, when desired, without leaving visible needle holes through the fabric, and this is probably a result of the high degree of coverage offered by the spunlaced nonwoven layer which is ap- plied to the foam layer on the reverse side of the face 15 fabric. Sewing also can be accomplished more easily since the fiber entanglement and foam layer to become scratched or abraded in handling.

The use of spunlaced nonwoven fabrics has the ad- 20 vantage over conventional non-woven fabrics that it may eliminate pilling and stability problems.

The process of the present invention involves steps of applying foamed or foamable, liquid polymeric material to the back side of a textile fabric intended as a face fabric in the final product. The application of foam to one side of the textile fabric forms a partial lining on that side of the face fabric, and then the lining is 25 completed by applying and adhering a spunlaced non- woven backing fabric onto the polymeric foam layer. Preferably, the process also involves steps of drying and crushing the laminate, followed by a resin treatment, and a final curing of the finished product. The entire process is conveniently carried out with running lengths of yard- age, and other treatments to the fabric or to the non- woven backing can be carried out if desired. For example, 30 certain cross-linking agents, or other finishing agents may be applied to improve final handling, durability, and crease-resistance of the completed laminate.

The product of this invention thus comprises a textile face fabric, a composite laminate in the form of an intermediate layer of organic polymeric foam and backing layer of spunlaced nonwoven fabric adhered to the foam. The organic polymeric foam is in intimate contact with both the spunlaced nonwoven backing and the face fabric and this produces a product which is easily handled and which is washable and dry-cleanable. The intermediate organic foam layer is preferably crushed to rupture the foam cells, generally to the point that the resulting crushed foam has been reduced 50 to 80% in thickness, so as to improve handling characteristics of the final product.

The nonwoven fabrics used in the practice of the present invention are in the form of fabrics comprising fibers locked into place by fiber interaction, thereby providing a strong cohesive structure without the need for chemical binders or fiber fusing. These nonwoven fabrics, some- 35 times hereinafter referred to as "spunlaced nonwovens", or "tanglelaced nonwovens", are formed from staple or other fibers of any natural, cellulose and/or wholly synthetic material, such as polyesters, e.g. polyethylene terephthalate, polyethylene terephthalate-isophthalate, poly (trimethylene terephthalate), poly (cyclohexanesedi- methanol terephthalate), cotton, viscose, cellulose acetate, cellulose acetate-butryrate, cellulose acetate-propionate, Saran, polycrylonitrile, polyethylene, polypropylene, nylon, e.g. nylon 6, nylon 6,6, nylon 11, wool, silk, pol- yvinylalcohol and the other fibers set forth in the patents mentioned in this paragraph, and may consist of blends of fibers or different types and/or sizes. For purposes of the present invention, polyester fibers are particularly preferred in giving satisfactory laminated products. The fibers of the spunlaced fabric are held together by a random entangling and interlacing without the use of any chemical fiber binders or any heat bonding of individual fibers. Such spunlaced nonwoven fabrics may be pro- 40 duced, for instance, by the use of high energy fluid jets, such as disclosed in U.S. Pat. Summers, 3,434,186; Evans 3,485,706; Ballou 3,485,708; Evans 3,485,709; Evans 3,486,168; and Evans 3,493,462; Evans 3,498,874 and Bunting 3,508,308, the disclosures of which patents are hereby incorporated by reference. Such fabric may be applied to produce desired textile appearances, or other visual appearances may be obtained as taught by the aforesaid patents.

A spunlaced nonwoven fabric may be defined as "a textile fabric consisting of fibers entangled in a predefined, repeating pattern to form a strong, unbounded structure having a tensile strength greater than one pound/inch ounce/yard".

The spunlaced nonwoven fabrics which are in the present invention have a fiber entanglement completeness of at least 0.5, this value being determined in the absence of a binder. Additionally, it is preferred that the spunlaced nonwoven fabric have a fiber interlock value, due to fiber entanglement, of at least 7, as determined in the absence of a binder; an internal bond value of at least 0.2 ft-lb, and a fiber entanglement frequency of at least 20 per inch.

Methods for testing spunlaced nonwoven fabrics to determine the aforesaid values are described in Evans U.S. Pat. 3,485,706 at column 74, line 77 to column 77, line 18, previously incorporated by reference. Preferably, the spunlaced nonwoven fabrics have at least 14 oz. per square yard, and generally, for drapery purposes, the fabric should not exceed 4 ozs. per square yard. More preferably, the fabric weight will be within the range of 0.8-.2 ozs. per square yard; most preferably, about 1.0 to about 0.5 ounces per square yard.

As identified in the aforesaid patents disclosing the spunlaced nonwoven fabrics used in the this invention, the fibers may be any type of fibrous material, whether naturally or synthetically produced, including fibrils, paper fibers, textile staple fibers and continuous filaments. Preferably, the spunlaced nonwoven fabrics are produced from textile staple fibers, especially polyester fibers and more preferably, the fibers are of polyethylene terephthal- 45 ate. For instance, the fibers sold commercially under the trade names Dacron Type 54, Dacron Type 106, or, the like, may be conveniently utilized in the spunlaced non- woven fabrics of this invention. The fibers may be of widely varying diameter and length, with lengths up to continuous filaments as indicated above. Preferably, however, the average fiber lengths will vary between 7/4" and 3", more preferably, between 1 1/2" and 2". The individual fiber density may vary widely, e.g. 0.50 to 2.00 denier per filament (hereinafter sometimes d./f.); or even higher, preferably, about 1.0 to about 3.0 d./f., and most preferably about 1.25 d./f.

The above, and other advantages and features of the present invention will be appreciated from the more de- 50 tailed discussion which follows. In that discussion, refer- ence will be made to the accompanying drawings, as briefly described below.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a schematic flow diagram of a process for forming the laminate of the present invention in accordance with a "wet" foam technique;

FIG. 2 is a schematic flow diagram of an alternative process of the present invention for forming a laminate in accordance with a "dry" (or tacky) foam technique; and

FIG. 3 represents a greatly enlarged cross-section of a textile fabric produced in accordance with the processes of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to FIG. 1, the process of this invention is il- 55 lustrated with reference to a "wet" technique for applying and adhering a spunlaced nonwoven backing fabric onto a continuous layer of foam polymer which has been applied to the reverse side of a face fabric. Reference to "wet" foam is intended to describe a technique which applies the spunlaced nonwoven backing fabric to the
foam layer before the foam layer has been cured or dried to any substantial degree. In contrast, the process which is illustrated in FIGS. 1 and 2, a textile facing fabric is drawn from a suitable source of supply in a known manner. The textile fabric is carried through the illustrated steps of treatments with its intended facing surface directly downwardly so that a layer of foam polymer and a layer of spunlace, or tangledlace, nonwoven backing can be successively applied and adhered to its reverse side.

Substantially any textile fabric can be used for the textile layer, or facing layer, of the laminated fabric of this invention. In the context of this specification, and its claims, it is intended that "textile fabric" (also referred to as face fabric) include fabrics which are woven or knitted, as well as nonwoven fabrics composed of randomly arranged fibers or filaments, paperlike materials, lace, or any other spun web fabric. For example, in a first patent, U.S. Pat. 3,030,786 the disclosure of which is hereby incorporated by reference. The spunweb fabrics described in the aforesaid patent are generally referred to in the art as "stitch bonded fabrics." The "textile fabric" may be made of any kind of fiber or filament, including natural fibers such as cotton, wool, sisal, jute, linen or silk; or man-made fibers such as regenerated cellulose rayon, polyvinyl rayon, cellulose esters, e.g. cellulose acetate, cellulose acetate-butyrate, cellulose acetate-propionate and cellulose triacetate, synthetic fibers such as the acrylics, e.g. polyacrylonitrile, modacrylics, e.g. acrylonitrile-vinyl chloride copolymers, polyamides, e.g. polyhexamethylene adipamide (nylon 66), polypropyleneamide (nylon 6) and polyurethaneamide (nylon 11), polyolefin, e.g. polyethylene and polypropylene, polyester, e.g. poly(tetrahydroxyl-ethanol terephthalate) (Kodel), polyethylene terephthalate and polyethylene-butyleneterephthalate, rubber and synthetic rubber, e.g. butadiene-styrene copolymer, poly cis isoprene, Saran, glass, etc. Blends of two or more of the above fibers or filaments may be used if desired. The fabric will generally have a weight of 2 to 16 ounces per square yard, although this is subject to variation depending upon the use for which it is intended.

As shown, the textile fabric is conveyed along an essentially horizontal path so that a running length of the textile fabric can be treated in accordance with this invention. A first step in the processes illustrated in FIGS. 1 and 2 requires the application of a continuous layer of a foamed or foammable polymeric material to the reverse side of the running length of textile fabric. The material may be mechanically or chemically foamed in accordance with known methods and delivered to the reverse face of the running length of textile fabric by a flexible conduit which is arranged to traverse back and forth across the width of the textile fabric. Thickness of application may be controlled by a doctoring blade which is fixed in its position relative to the moving textile fabric so that a predetermined thickness of foam polymer is applied to the reverse side of the textile fabric.

Foam layer which is applied is composed of foam material applied to the fabric as a fluid or a material which is capable of becoming a fluid during the process so that it can flow into intimate contact with the fabric. The organic polymer foam may be foamed prior to contacting the face fabric, or it may be applied to the fabric face after substantial foaming has occurred. In the latter case, however, the viscosity of the foam should be such as to prevent substantial penetration of the foammable organic polymer of the face fabric, such as to strike through to the opposite side thereof. It should be understood that other methods of controlling the thickness of the organic polymer foam or foammable material may be utilized, such as to achieve the desired layer thickness by applying a higher amount of foam to the organic polymer foam or foammable material such as to force same into and through the face fabric. After flowing into position, the fluid foam material is gelled (for example, by heating in a drying oven), and/or cured to assume its permanent position in intimate contact with one side of the fabric. It will be appreciated that, in the case of using an organic polymer foammable material which is applied to the face fabric in a substantially unfoamed condition, the drying oven may assist in the gas generation from a foaming agent, although in the case of urethane foams, for example, the foaming and gelation action may be solely the result of a catalytic effect causing an exothermic reaction of the polyol and the polyisocyanate.

The polymeric foam used in the foam layer may be any of those known to the art. The polymer constituting the foam may be rubber, polyurethane, polystyrene, vinyl polymers such as polyvinyl chloride, polyethylene, phenol-formaldehyde resins, urea-formaldehyde resins, melamine-formaldehyde resins, silicones and cellulose acetate or others. A very useful and preferred material is the crosslinked foamed article in which the polymer is styrene and acrylonitrile or other hydrophilic acrylic polymer described in Dunn U.S. Pat. 3,215,647, the disclosure of which is hereby incorporated by reference. This is formed from a latex containing a copolymer of styrene with another monomer having a reactive group such as acrylic acid. The latex may also contain a reactive material which cross-links the styrene polymer and which is soluble in water or water-miscible solvents. The present invention applies to either foam which is prepared from a latex containing reactive group on the base polymer or reactive within the latex itself. This also applied to a latex which may or may not require a reactant of cross-linking material added to the latex during compounding. The latex is foamed or frothed by bubbling in a gas or by decomposition of a gas-releasing material, or by vaporizing a dissolving inert gas.

Another type of foam useful in the invention is derived from a vinyl plastisol. An extensive discussion of this type of foam is provided in the Plastics Engineering Handbook of the Society of the Plastics Industry, Third Edition (1969), especially at pp. 188-193, and in Rainer Pat. 3,020,307, the entire disclosures of which are hereby incorporated by reference. In the use of a vinyl plastisol, as is more commonly referred to as polyvinyl chloride in the form of small particles, which is intimately mixed with a plasticizer, e.g. dioctyl phthalate or the plasticizers shown in Rainer. The plastics are quite fluid at room temperature, but on heating, they flux to form a gel.

It will be noted that gelation involves a different process in plastics than in latex foam systems. In the plastics, gelation is accomplished by heating, which causes the plasticizer to diffuse into the polymer particles. The plasticizer initially establishes a relatively high concentration at the surfaces of the particles, which makes them tacky so that they fuse together into a continuous film. Further heating causes the plasticizers to diffuse through the film and form a smoothly integrated plastized vinyl film.

As in the case of latex foam, gas may be supplied by mechanically dispersing the gas, e.g. carbon dioxide, Freon 12, etc., into the plastisol or by decomposition of a chemical agent such as an azo compound, e.g. azo bis(isobutyronitrile). In the mechanical process, gas is introduced into the chilled plastisol while it is under pressure. In some cases, certain solvent surfactants may be added to the plastisol compound and serve as frothing or foaming agents when gas is injected in the system. Certain silicone surfactants may be used for this purpose. Then the plastisol is dissolved, or dispersed gas is extruded through a tube. As the pressure is released, the gas ex-
pands to form interconnecting voids. Then the plastisol is ultimately gelled by heating in a drying oven, e.g. at 360° F.

In the chemical foaming process, a plastisol is mixed with a chemical agent which helps to cause generation of plastisol. Various agents of this type are available, each having a characteristic decomposition temperature. The agent for any particular system should have a decomposition temperature below the gel temperature of the plastisol. An unfoamed mixture of plastisol and chemical agent is coated onto a fabric and then ultimately heated in a drying oven. The heat in the oven causes the chemical agent to decompose, resulting in foaming, and this is followed by gelation as heating continues.

Similarly, flexible polyurethane foam may be utilized as the intermediate organic polymer layer. Such polyurethane foams are generally based on a polyester or a polyether and a polyisocyanate, generally a disocyanate, most usually toluene disocyanate or diphenyl methane disocyanate, with the blowing or foaming action caused by water and/or a volatile inert liquid, e.g. Freon 12. The foaming is caused by carbon dioxide generated by the reaction of the polyisocyanate and the water, and/or by the evaporation of the volatile inert liquid, such evaporation generally being caused by the exothermic polyol/polyisocyanate reaction. Typical flexible foamy polyurethane foams are described in Donald H. Polurethanesc, Second Edition, 1965, Reinhold Publishing Corporation, New York, especially pp. 96-134, the disclosure of which is hereby incorporated by reference. Typical starting polyesters and ethers are adipic acid-diethylene glycol-trimethylol propane (16:16:1 molar) and polypropylene glycol 2025.

Similarly, other foam systems may be used which provide flexible foams and which are obtained from a polymeric material which either is fluid when applied or becomes fluid during the process. Heating is carried out, as required, either before or after the application to the spunlaced nonwoven backing layer, depending upon whether a "dry" or "wet" technique is being practiced. The ultimate thickness of the cured, dried or set foam will vary widely, depending upon the particular effect desired. Generally, the foam thickness will be from about 0.005 to about 0.025 inch, preferably about 0.010 to about 0.015 inch.

Various conventional coating techniques may be used to apply fluid foams. These include knife over roll, roller coating, casting and doctor blade over table. Since numerous suitable polymer coating techniques are already well known, they need not be described in detail here. The foam density may vary widely, depending upon the particular characteristics of the appearance and feel desired in the draperies, or other article. Generally, the foam density will not be less than 1½ pounds per cubic foot, as otherwise the foam may be too weak to withstand handling, laundering and dry cleaning. On the other hand, foams having a density greater than 8 pounds per cubic foot generally have a poorer drape, although much higher foam densities may be used for certain applications.

The foams normally contain pigments or dyes which remain in the fabric opaque and provide an ornamental effect. Almost any dye or pigment may be used which is compatible with the polymer. Certain fillers, such as titanium dioxide, act as pigments and may be added to the foam compound. Fillers also function as extenders and provide opacity. The amount of dye or pigment usually will vary with the desired effect, but ordinarily it will vary from 0% to about 75% by weight of the foam. If chemical foaming agents are used, they should be inert with respect to the dye or pigments, but the selection of suitable materials is considered to be within the skill of the art.

After the application of a layer of foam polymer the next step in the process depends upon whether a wet or dry technique is to be followed. FIG. 1 shows the wet technique wherein spunlaced nonwoven backing fabric is delivered from a supply reel to an intimate contact with the wet foam layer which has been just applied to the running length of textile fabric. Prior to delivery of the spunlaced nonwoven backing fabric, the nonwoven may be treated to improve its handling and use characteristics, if desired. For example, the spunlaced nonwoven may be stretched or treated to reduce pilling of the spunlaced nonwoven backing layer in the final laminate product, or it may be stretched or treated to prevent puckering or to improve dimensional stability in the final product. For instance, the spunlaced nonwoven may be heat set by the procedure described in Tripplet et al., Ser. No. 65,703 filed Aug. 20, 1970.

Application and adherence of the spunlaced nonwoven backing fabric to the wet foam polymer layer must be carefully controlled so that there is no undesired penetration of the wet foam through either the spunlaced nonwoven backing fabric or the textile face fabric. Generally, the textile facing fabric is of a tighter and denser coherency than the spunlaced nonwoven backing fabrics, and therefore, it has been found that control of penetration can better be effected from the textile fabric side of the laminate structure being produced. The spunlaced nonwoven fabric, preferably, is less than about 3 ounces per square yard and more preferably, within the range of 0.8 to 1.6 ounces per square yard. Adhesives can be used with spunlaced nonwoven fabrics, but normally they are not needed for adequate adhesion of the spunlaced nonwoven to the foam. As shown in FIG. 1, an adjustable pressure roller is provided for the textile fabric layer and the foam polymer layer into intimate contact with the spunlaced nonwoven backing fabric layer. The pressure roller is vertically adjusted so that it applies only enough pressure to effect a good bond. Excessive upwardly directed pressure would result in a penetration and strike-through of the wet foam layer through the spunlaced nonwoven fabric layer. This is undesirable not only from an appearance standpoint, but also from the standpoint of transferring tacky foam to rollers associated with subsequent operations performed on the running laminate. However, by controlling pressure from the face fabric side of the laminate, accidental or occasional striking-through of the foam through the spunlaced nonwoven layer will not contact any rollers prior to the heating of the laminate in the drying oven. Of course, other arrangements for controlling pressure may be utilized, and the adjustable pressure roller of FIG. 1 is only an example of a system for preventing transmission of foam through the spunlaced nonwoven backing fabric layer.

The dry technique which is illustrated in FIG. 2 does not require the same careful control of foam penetration as discussed for the wet technique because the foam is dried to a tacky state prior to the application and adherence of the spunlaced nonwoven backing fabric thereto. As shown in FIG. 2, the spunlaced backing fabric is delivered to the running length of combined textile fabric and foam after the partial laminate has been heated in an oven. At this point, the foam is less likely to penetrate all the way through the spunlaced nonwoven backing fabric, and conventional compression rollers, A, B and C may be used to effect an intimate contacting and bonding of all layers together. The amount of drying, or moisture or other solvent removal, required to use the "dry" technique, varies with the specific organic polymer foam used. In general, however, when the "dry" technique is practiced, the moisture or solvent content of the organic polymer foam, at the time same is contacted with the spunlaced nonwoven backing fabric, will be about 0 to about 20% by weight of the foam. In the preferred organic polymer foam described in U.S. Pat. No. 3,215,647, the disclosure of which is hereby incorporated by reference, the moisture content will be about 0 to about 20% when the dry technique of FIG. 2 is used. It will be appreciated in the above described dry technique that the initial adhesion is accomplished by the tackiness of the foam surface and that such adhesion will be further increased.
by the partial curing step following foam crushing. When the preferred foam of the above identified U.S. patent is utilized, the foam desirably contains enough moisture to wet the surface of the spunlace fabric, but not enough moisture to cause the foam to flow through, or strike through, either laminate face during the crushing operation. After the crushing operation, any residual moisture is removed and the foam can be at least partially cured or set by passing over heating cans or through an oven maintained at a suitable temperature, for instance, at 300° F., for about two minutes.

In either the procedure of Fig. 1 or Fig. 2, conventional equipment for conveying and handling the textile fabric and the laminate is utilized. For example, Fig. 1 shows a typical positioning of a clip frame, or tenter frame, means, for maintaining the laminate in a taut condition while it is being heat treated in a drying oven. Equipment of this type is within the knowledge and skill of this art and will not be discussed in detail in this application.

The processing steps which have been discussed so far with respect to the two techniques shown in Figs. 1 and 2 have involved steps required to form a three-layer laminate in which the intermediate layer comprises a foam polymer that functions not only as an adhesive, but also as a part of a backing liner applied to a face fabric. The face fabric, or textile fabric layer, is coated with a foam layer, and the foam layer is gelled either before or after application of a special plastic and thermosetting polymeric foam gelation will depend upon the use of foam used, but ordinarily it will be about 250°-400° F. The foam may be applied in more than one layer with gelling between coatings, but ordinarily this is not necessary. If the foam requires curing, this also may be accomplished before proceeding to the next step of processing (foam crushing). However, in accordance with a preferred practice of the present invention, in which the foam polymer is a material of the type disclosed in Dunn U.S. Pat. 3,215,647, the polymer is not cured at this stage.

In yet another embodiment of the present invention, the organic polymer foam may be substantially completely dried or cured and then spunlace nonwoven fabric is adhered to this substantially dried, cured or set foam. For the case of thermoplastic polymer foams, flame bonding, as conventionally known to the art, may be utilized. For certain thermoplastic and thermosetting polymeric foams, the foam surface may be softened through the use of a suitable solvent which, of course, will vary according to the chemical nature of the specific organic polymer foam as known to the art. The spunlace nonwoven fabric is pressed into intimate contact with the softened foam surface, and then any residual solvent is removed through a subsequent heating or drying step. Alternatively, the spunlace nonwoven fabric can be heated sufficiently that it becomes adhesive and is thus united to the foam, or adhesives can be used such as acrylic adhesives, melamine-formaldehyde, epox resin, etc. However, one of the advantages of the spunlace nonwoven fabric is that no special adhesives or other treatments are necessary to secure the foam to the spunlace nonwoven fabric. Subsequent steps of the process are generally the same for either of the techniques shown in Figs. 1 and 2. Preferably, the intermediate foam layer is coated after the spunlace nonwoven layer has been applied to it to improve its handling characteristics for later treatment and use. This can be accomplished by passing the fabric between rolls which apply a pressure of about 10 to 100 p.s.i., but preferably within the range of about 20 to 60 p.s.i. The degree of compression should be sufficient so that the intermediate foam layer will not be further compressed to any significant degree when the final laminate product is folded, handled, packed and otherwise utilized for its intended purposes. In this sense, crushing is intended to accomplish a uniform amount of foam crush prior to subsequent handling operations, but non-uniform crushing can be carried out (for example, by embossing or calendaring rolls) if desired for special novelty effects.

The above roll pressures for foam crushing will be generally applicable to all of the foams and fabrics of the present invention, but it will be appreciated that the optimum roll pressure will vary depending upon the specific organic polymer foam used. In any event, the roll pressure will generally be sufficient to crush the foam layer to about 50% or less of the original, uncrushed, foam thickness.

After crushing, the laminate is partially cured by passing it over heated rollers or drums which are steam-heated and which are of conventional design and construction. The partial curing may also be accomplished by use of a roller cure oven or an enclosed tenter frame, or other conventional heating apparatus in the art. This assists in setting the foam in its crushed configuration. No substantial amount of heating is required, and a typical plant operation would pass the fabric over rotating steam-heated drums at 300° F. for a total contact time of approximately a minute. The partial curing toughens the foam layer and increases adhesion of the foam layer to both the face fabric and the backing fabric; thus the laminated fabric can better withstand additional physical processing without danger of delamination.

The laminate may then be carried through a padding bath for treating both exposed surfaces of the laminate with a finishing resin. Preferably, this finishing step applies a durable cross-linking type resin. The resin may be a hardenable aminoplast of a well known type in a solution or dispersion which can be applied to the laminate surfaces in a bath.

The durable crease cross-linking resin used in accordance with this invention preferably is an aminoplast, that is, a hardenable aminoplast of the well known type. This term is used herein to describe hardenable, if desired etherified, carbonamide and melamine precondensates which are either water soluble or of limited water solubility and which are obtained in the known manner of the condensation of formaldehyde or other aldehydes, e.g. acetaldehyde, or ketones, e.g. acetone, methyl ethyl ketones, with compounds such as, for example, urea, thiourea, cyanamidine, diicyandiamide, cyclic ethylenurea, biguanide, melamine, formamide, formoguanamine, ethyl carbonate, acetoguanamime, triazines, and the like, and mixtures of such compounds, as well as their alkyl and aryl derivatives. Subsequent methylation or other modification of the resulting N-methylol compounds or triazines often is beneficial. Especially good results are obtained by the use of N,N'-dimethylol cyclic ethylenurea and various other condensation products of formaldehyde with urea, e.g. sesquimethylol urea, dimethylol urea).

"Precondensates of limited, but substantial water solubility," in accordance with this invention, are those colloidal intermediates which occur by continuing condensing the product with aldehyde or ketone beyond the crystalline methylol stage. Characteristically, they are prepared from their concentrated aqueous solution by the addition of water. The condensation products of unlimited water solubility, which also may be used in accordance with this invention, are used in the form of aqueous solutions while those of limited water solubility are used either in the form of solutions or as the condensation products which have been rendered soluble with the aid of acids, or in the form of dispersions.

The amount of the cross-linking resin used varies with the type of fabric and the use intended. However, about 4-25% by weight of the laminated fabric, including the fabric layers and the foam layer, is preferred. Especially good results are obtained when the solid pick-up is about 12%. The aminoplasts or other cross-linking resins are applied from aqueous solutions or dispersions which may include various other materials normally used with them. For example, the material may contain various softeners such as emulsified polyethylene, glycerol monostearate or the like. They may also contain a water repellent silicone.
and they also contain a catalyst for curing the cross-linking resin. Typical catalyzers or cross-linking agents are formic, hydrochloric or sulfuric acids, maleic anhydride or the like. Other organic or inorganic acids or salts of strong acids with weak bases such as ammonium salts of hydrochloric, sulfuric, nitric, oxalic, lactic or other strong inorganic or organic acids, various amine hydrochlorides, or still other acid forming salts such as zinc fluoroborate, zinc nitrate, magnesium chloride as well as Lewis acids such as aluminum chloride can also be used. The catalyst can usefully be added in an amount between about 1 and 10%, preferably about 2-5% based on the weight of resin present in the bath.

After the laminated fabric is treated with the resin, as described above, it may be dried and cured. The curing step is carried out preferably at a temperature range of about 200°-400° F. for about 30 seconds to 6 minutes, although a flash cure may be carried out at a higher temperature (as high as 800° F. for example). Preferred conditions for curing are at a temperature of about 450° F. for about 2 minutes. From there the fabric may be treated in any desired manner as discussed in any of the afore-mentioned patent applications.

The order of steps described above for the wet and dry techniques of this invention are preferred. However, it will be recognized that the completed fabric can receive other treatments, or other treatments can be included in the sequence of steps described above.

The following examples illustrate the practice of the invention:

Example I

A woven fabric comprised of yarn containing 60% polyethylene terephthalate and 40% cotton fibers and having a weight of 6 ounces per square yard was coated with the foam described in Example I of Dunn, U.S. Pat. 3,215,647. This contains a copolymer derived from 30 parts styrene, 60 parts 1,3-butadiene and 10 parts acrylic acid and a cross-linking system comprising super Amide B-5, a coconut fatty acid diethanol amine condensate, and a water-soluble melamine-formaldehyde resin as well as sufficient water so that the solids content is about 50%. Small amounts of sodium and titanium dioxide and zinc oxide were added as pigments and to reduce tackiness. The latex was mechanically foamed to a gas content (air) of 75% by volume and flowed onto the fabric in a 35 mil wet layer. Then a nonwoven spunlaced polyethylene terephthalate type polyester (sold under the Du Pont trademark of Decron Type 106) was applied as a coherent backing fabric to the wet foam layer. The spunlaced nonwoven fabric comprised 100% polyester fibers, 7.25 d./f. x 75"., having about 12 evenly spaced holes, or apertures per inch (the adjacent line of holes as offset by 1/4 the distance between adjacent aperture centers, so some may consider the fabric to contain 24 holes/ inch, a weight of 1.5 ounces per square yard and a fiber entanglement completeness value of 0.45. The spunlaced fabric was mechanically interlaced and entangled with no binder or heat fusing.

Then the laminate was placed in an oven, which was maintained at about 385° F., for 1½ minutes. This caused the latex to gel. The dry solids pick-up corresponded to about 3 ounces per square yard. The foam had a density of about 6 pounds per cubic foot. Next, the laminate was crushed between rolls at about 250 p.s.i., and passed between steam-heated drums at 250° F. for less than a minute. Then the laminate was padded to a 12% solids pick-up containing N,N'-bis(dimethylethyl)ene urea 10% solids by weight, emulsified polyethylene wax 1% by weight solids, glycerol monostearate 1% by weight solids, methyl hydroxy polyisoxane 1% by weight solids, and 1% by weight solids of a catalyst containing in about 6:1 ratio zinc nitrilic hydroxyproplene, balanced with water. The fabric was dried for 2 minutes in an oven maintained at about 340° F. and then was cured for 2 minutes in an oven maintained at 340° F. Then the fabric was washed in water containing sufficient sodium perborate to adjust the pH to the range of about 7.5 and with about 0.2% nonionic detergent. The fabric was squeezed to remove excess water, dried at 250° F. for about one minute and compressively shrunk on a 2 drum double palmer with the shrinkage set at 2% and the drum temperature 280° F. (It may be mentioned that compressive shrinkage of the fabric laminate of the present invention is not necessary, but may be conveniently utilized to improve shrinkage control, for situations where the laminate is subjected to washing or home laundering and also to soften the surface of the laminated fabric.) The fabric then could be sewed into draperies, for example by the method disclosed in U.S. Pat. 3,399,714. The resulting laminate exhibited average peel strengths of 32.7 ounces per inch dry and 5.0 ounces per inch wet with perchloroethylene. Further testing showed the laminate to be resistant to delamination during five launderings and five dry cleanings. Its bond strength was unaffected by 100 hours Fade-O-meter exposure, and the liner side of the laminate had a colorfastness rating of class 5 at 80 hours and class 4 at 100 hours.

Example II

A woven fabric of which the warp portion consisted of 100% continuous filament rayon and the filling portion was composed of 100% cotton and having a weight of 7.25 ounces per square yard, was coated with a flexible polyurethane foam of the following composition:

<table>
<thead>
<tr>
<th>Compound</th>
<th>Parts by weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyester based upon adipic acid/diethylene glycol/triethylolpropane in a 16/16/1 mole ratio, respectively</td>
<td>100</td>
</tr>
<tr>
<td>Tolylene diisocyanate</td>
<td>47</td>
</tr>
<tr>
<td>Activator mixture</td>
<td>10</td>
</tr>
</tbody>
</table>

The above components were mixed together, in the so-called one-shot method, with no pre-reacting. The foamy composition, when mixed, started to undergo gelation and foaming reactions within a short period of time (the final flexible foam product had a density of 2.2 pcf.). While the foam was still fluid, and before substantial gelation had occurred, the foam was distributed over the woven fabric and then allowed to undergo the foaming reaction. Prior to the time the foam arrived at the stage known in the art as "tack free," but after substantial gelation and foaming had occurred, the spunlaced nonwoven fabric backing, polyethylene terephthalate (Decron 106, weight 1.0 oz. per sq. yd.) was applied to the foam surface. The laminate was then passed through a drying oven maintained at 350° F., with a residence time of about two minutes, to accelerate the final gelation reactions. The resulting foam had an open cell content of about 85%, and the foam crushing step described above for Example I was unecessary. A durable-grit-seal aminoplast resin finish was applied and cured, as described in Example I.

In place of the polyester type polyurethane in Example II there can be used a polyether type polyurethane by replacing the polyester by propylene glycol 2023 in an amount to provide the same amount of available hydroxyl groups.

Various modifications may be made in the invention described herein. Hence, the scope of the invention is defined in the following claims wherein what is claimed is:

A. A process for manufacturing a lined textile fabric which is especially useful for draperies and the like, said process comprising the steps of
3,748,217

(a) applying to one side of a textile fabric a wet, fluid foamed or foamable organic polymeric material to form an at least partial foam lining on the said one side of the textile fabric,
(b) thereafter applying a spunlaced nonwoven backing fabric to said polymeric material while said polymeric material is in a softened or uncured state, and
(c) thereafter curing or hardening the polymeric material to adhere the said spunlaced nonwoven backing fabric to said polymeric material to produce a stable, lined textile fabric having improved characteristics of appearance and feel.

2. A process according to claim 1 including the step of partially crushing the foam after application to the fabric and prior to curing.

3. A lined textile fabric laminate having improved characteristics of appearance and feel, and being especially useful for draperies and the like, comprising:
   (a) a layer of textile fabric having a first surface and a second surface, said first surface remaining exposed, said second surface on the opposite side of said fabric from said first surface,
   (b) a layer of foamed organic polymer in intimate contact with, an adhered to, said second surface, without substantial visible penetration of the said foamed polymer through the said first surface, and
   (c) a spunlaced nonwoven backing fabric in intimate contact with, and adhered to said layer of foamed polymer without substantially visible penetration of the foamed polymer through said spunlaced nonwoven backing fabric.

4. Draperies made of the laminate of claim 3.

5. The laminate of claim 3, wherein said foamed polymer has at least 93% open cells.

6. The laminate of claim 3 wherein said foamed polymer is a foamed vinyl chloride polymer plastisol.

7. The laminate of claim 3 wherein said foamed polymer is foamed polyurethane.

8. The laminate of claim 3 wherein the spunlaced nonwoven fabric has a fiber entanglement completeness of at least 0.5.

9. The laminate of claim 3 wherein the backing layer is cellulosic.

10. The laminate of claim 3 wherein the backing fabric is polyester.

11. The laminate of claim 3 wherein the backing fabric is a polyester-rayon blend.

12. The laminate of claim 3 wherein the spunlaced nonwoven backing fabric is a polyester containing fabric.

13. The laminate of claim 3 further including a finish resin coating applied at least to the said first surface.

14. The laminate as claimed in claim 13 wherein said finish resin is also applied to the surface of said spunlaced nonwoven backing fabric opposite said foamed polymer.

15. The laminate of claim 14 wherein said finish resin coating includes a cured cross-linkable resin.

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U.S. Cl. X.R.

156—78; 161—89, 156, 161