

[54] SYNTHETIC SUEDE FABRICS
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[57] ABSTRACT

The disclosure describes synthetic, leathery suede-like fabrics comprising a substrate and a fiber flock surface wherein the flock fibers have a coating of an abraded polymer thereon. A process for preparing these suedes is disclosed. Such synthetic suedes have improved properties over natural suedes including washability and they can be prepared in a variety of sizes and colors.

[56] **References Cited**
UNITED STATES PATENTS
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10 Claims, No Drawings

SYNTHETIC SUEDE FABRICS

BACKGROUND OF INVENTION

This invention relates to a process for preparing synthetic, leathery, suede-like fabric materials from flocked fabrics, and more particularly, to a process whereby the flocked fabrics are coated with an abrasible polymeric coating composition and thereafter abraded.

Natural leather suedes have presented problems to the suede industry for many years. Like most natural products, the properties vary from piece to piece. It is difficult to continually produce suedes having uniform quality, and the size of pieces obtainable is, of course, limited to the size of the animals from which the skins are obtained. Soft leathery suedes obtained from natural sources are difficult to obtain in stable light and pastel colors. One of the major difficulties with natural suedes is their poor washability. This is especially important since suedes are easily soiled. Dry cleaning or washing of natural suedes generally results in removal of the natural oils which results in stiffening and drying requiring re-oiling of the suedes which is difficult and expensive.

For these reasons, the use of suedes in many applications has been limited, especially where the suede is used in combination with other fabrics and garments which have the desirable properties of washability, dry cleanability, color fastness, etc.

Attempts have been made to produce man-made soft suedes which overcome these limitations while retaining the desirable aesthetic and drape qualities. One such attempt involves treating woven or non-woven fabrics with an adhesive base and thereafter embedding flocked fibers into the adhesive. Such flocked fabrics, however, are a poor imitation of natural suede since they do not exhibit the same aesthetics. Some are inferior in abrasion resistance.

Several methods of making synthetic suedes have been utilized. One method is to coat a flexible backing, preferably a textile fabric, with a polymeric compound to which has been added with other ingredients, a sufficient amount of flock fibers so that upon abrading the surface, a suede-like texture is produced. In another process, rather than incorporating flock fibers into the polymeric compound, the textile fabric is napped to raise fibers and thereafter the nap fabrics are coated with the polymeric compound and subsequently abraded.

Another known process involves the steps of (1) coating the surface of a flexible substrate with a layer of a polymeric solution; (2) coagulating the polymeric composition to form a cellular layer by bathing the coated sheet in a liquid which is a non-solvent for the polymeric component and which is miscible with the solution solvent; (3) removing substantially all of the solvent from the sheet material; and (4) abrading the surface of the cellular layer to form a suede-like finish. U.S. Pat. No. 3,429,727 is directed to an improvement in this process in which additional steps are performed before step (4). These additional steps are reducing the non-solvent content of the sheet material to less than 90 percent by weight; applying a back-coating composition to the uncoated side of the porous substrate and drying the back-coating composition. An essential feature of both of these processes is the use of a coagula-

ble polymeric component to form porous cellular structures to produce the suede effect.

Another method previously suggested is to dust the surface of a polymeric coating with a relatively coarse grade of a water-soluble salt. After curing, the salt is removed from the polymer surface by washing to yield a suede-like finish.

In U.S. Pat. No. 3,549,398, a refinement of the above process has been proposed. The process involves applying elastomeric polymeric coatings to flexible substrates, where the polymeric coatings have incorporated therein finely divided particles of a solid substance which is insoluble in the polymeric coating. The coating is cured and then subjected to a stream of high velocity abrasive particles to produce a suede-like finish. The finely divided particles in the coating are preferably decomposable, volatile, or soluble in at least one solvent in which the polymeric coating is not soluble, so that said particles can be removed from the sueded material thereby resulting in a water-vapor permeable synthetic suede-like product. However, this process, like the above processes, involves the application of a thick coating of polymer and the subsequent removal of a substantial portion of that coating.

SUMMARY OF THE INVENTION

Synthetic, leathery, suede-like fabrics can be prepared from a flocked fabric which comprises a substrate and a fiber flocked surface, by a process comprising the steps of (a) coating the fiber flock with an abrasible polymeric coating composition while substantially retaining the integrity of the fibers, and (b) abrading the coated fibers to reduce polymer aggregates and fiber-to-fiber bonding, and to impart to the fibers a soft leathery suede finish. Synthetic suede fabrics prepared in this manner have the handle and drapability of natural suede and, depending upon the particular polymeric composition utilized in the process, additional desirable properties such as washability, dry-cleanability, abrasion resistance, etc. Such fabrics have the aesthetic requirements for manufacturing clothing such as coats and jackets, upholstery fabrics, hand bags, shoes and trim for dresses and coats, and may be made available in a variety of colors.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The suede-like fabrics of this invention are prepared from flocked fabrics. Processes for preparing flocked pile fabrics are well-known in the art and need not be described in detail in this application. Briefly, a substrate or backing material is provided, and the material which may be any material conventionally employed in flocking operations such as for instance, jute, cotton, paper, rubber sheeting, plastics, woven fabrics, knitted fabrics, and non-woven fabrics including felts of natural and synthetic fibers and filaments is coated on at least one side with the adhesive. A plurality of flock fibers are then distributed onto the adhesive layer and oriented in such position that one end portion of each of said fibers is embedded in the adhesive layer. The nature of the orientation of the fibers is dependent upon the type of flocked fiber distribution means employed and these include spraying or mechanical or electrostatic methods. The most uniform orientation of the flocked fibers is acquired through a combination of the mechanical and electrostatic methods wherein a

relatively high percentage of the fibers assumes a position substantially perpendicular to the plane of the substrate with one end portion embedded in the adhesive layer.

Any type of fiber which is normally employed in flocking operations, either natural or synthetic, may be utilized, but best results are acquired through the use of fibers with an overall length of up to about 0.030 to 0.050 inch or more depending upon the end use of the product, though the fiber should not be so long as to break during the abrading process. It is preferable to use low denier fibers to obtain the best aesthetics. Fiber deniers of about 1.5 have been found to be particularly useful although higher or lower deniers can be used depending on the end use of the product. Particularly preferred fibers are the natural fibers such as cotton and wool, and synthetic fibers such as rayon, nylon, polyesters and polyacrylics. Rayon fibers have a soft hand and are relatively inexpensive but suffer the disadvantage of being easily abraded. On the other hand, the polyamides, polyesters and polyacrylics have good resistance to abrasion but are more expensive.

The amount of adhesive applied to the substrate should be sufficiently thick to embed the fibers and obtain good adhesion desired therein. An adhesive thickness of up to about 10 to 15 mils dry has been found acceptable. The adhesive may be applied to the substrate as an aqueous emulsion or in an organic solvent either in one application or in two separate applications. In the two application procedures, the first coating is applied as a more viscous mixture in order to provide a coating with a minimum of strike-through. This is followed by a second coating to which the fibers adhere and which may be of a lower viscosity since strike-through should not present a problem.

The adhesives which are useful in preparing flocked fabrics must maintain their liquidity and tack for a sufficient period of time to allow embedment of the flock in an oriented position in the adhesive. The adhesive also must have sufficient viscosity to hold the flock in its oriented state prior to and during the drying and/or curing. Examples of adhesives which have been used in preparing flocked fabric include latices and solvent solutions of materials such as polyurethanes, polyacrylates, natural and synthetic rubbers, synthetic polymers and copolymers of butadiene and isoprene in conjunction with acrylonitrile, styrene, and many other latices. Polyvinyl chloride plastisols or organosols also can be used as adhesives for preparing flocked fabrics. The choice of a particular adhesive will be determined by the properties desired in the flocked fabric. For example, the polyurethanes are particularly useful where the fabric is to be subsequently subjected to dry cleaning. Other properties such as flexibility in the cold, and resistance to washing should be considered when selecting the adhesive.

Once the fibers have been embedded and oriented into the adhesive coating, the adhesive is solidified to fix the fibers therein. Curing is accomplished by heating the fiber-impregnated, adhesive-coated substrate. The temperature of the curing will depend upon the particular adhesive utilized and, also, on the desired rate. For example, when the flocked fabric is prepared in a continuous apparatus, shorter curing times are desirable and higher temperatures are therefore utilized.

The polymeric coating which is applied to the flocked fabric must be one that is abradable. That is,

the coating must be one which allows for the separation of the coated fibers from one another without tearing and breaking of the fibers, and it must be possible to remove the gloss and roughen or abrade the surface of the coating without stripping it from the fibers. For example, uncompounded natural rubber is not a satisfactory coating because it has a high degree of stretch and will not permit ready and practical separation of the fibers. Examples of useful polymers include the cross-linked or cured abradable polymers: polyurethanes, polyacrylates, polyamides, polyolefins, polyepoxy resins and the polyepoxy amide resins. Mixtures of the above resins can be utilized. The resins are applied to the flocked fabric as solutions in solvents which preferably are poor or non-solvents for the flock fibers. Examples of such solvents for cured polyurethane systems include dimethyl formamide, diethyl formamide, dimethyl acetamide and dimethyl sulfoxide. Other solvents such as ketones, chlorinated hydrocarbons, aromatic hydrocarbons and ester type solvents such as cellosolve acetate and butyl lactate can be used with other resins.

The polyurethane polymers useful in the invention are those having molecular weights of from 5,000 to 300,000 formed by reacting and organic diisocyanate with an active hydrogen-containing material such as polyalkylene ether glycols and hydroxy terminated polyesters to form isocyanate terminated polyurethane prepolymers which can be cross-linked or cured with known agents such as compounds having at least two amino nitrogen atoms each having at least one reactive hydrogen atom. Alternatively, the active hydrogen compound, organic diisocyanate and chain extender can be reacted in one shot to form the desired polymer.

In the preparation of polyester-urethane elastomers, there preferably are used hydroxy-terminated polyesters prepared by polycondensation of an aliphatic dicarboxylic acid and a molar excess of an aliphatic glycol, and those prepared by ring-opening polymerization of a cyclic ester in the presence of a difunctional compound as an initiator. The polyesters obtainable by polycondensation of an aliphatic dicarboxylic acid and an aliphatic glycol are exemplified by those obtained by reaction between adipic acid, sebacic acid, maleic acid and other dicarboxylic acids with ethylene-glycol, 1,2-propylene glycol, 1,4-butylene glycol, 1,3-butylene glycol, etc. Examples of the polyesters prepared by polymerization of cyclic esters are those prepared from epsilon-caprolactone, delta-methyl-epsilon-caprolactone and beta-propiolactone in the presence of an initiator such as, for example, 1,4-butylene glycol, ethylene glycol or diethylene glycol.

The polyalkylene ether urethanes are those prepared by reacting the isocyanates with polymeric polyhydroxy compounds which include polyether polyols such as polyalkylene ether glycols, polyalkylene arylene ether-thioether glycols and polyalkylene ether triols. The polyalkylene ether glycols and triols are preferred and these include glycols having the formula $\text{HO}(-\text{RO})_n\text{H}$ wherein R is an alkylene radical which need not necessarily be the same in each instance, and n is an integer. Representative glycols include polyethylene ether glycol, polypropylene ether glycol and polytetramethylene ether glycol. Representative polyalkylene ether triols are made by reacting one or more alkylene oxides with one or more low molecular weight aliphatic triols. The alkylene oxides most commonly used have

molecular weights between about 44 and 250 and these include ethylene oxide, propylene oxides, butylene oxides, 1,2-epoxybutane and 2,3-epoxybutane. The ethylene, propylene and butylene oxides are preferred. The aliphatic triols most commonly used have molecular weights between about 92 and 250. Examples include glycerol, 1,2,6-hexane triol and 1,1,1-trimethylol propane.

Representative examples of the polyalkylene ether triols include: polypropylene ether triol (molecular weight 700) made by reacting 608 parts of 1,2-propylene oxide with 92 parts of glycerin; and polypropylene ether triol (molecular weight 6,000) made by reacting 5,866 parts of 1,2-propylene oxide with 132 parts of 1,2,6-hexane triol.

Other active hydrogen-containing compounds which can be reacted with polyisocyanates to form urethanes useful in the coating compositions of the invention are long-chain polymers containing at least two groups having at least one active hydrogen atom as determined by the Zerewitinoff method. Examples of such compounds include in addition to the polyesters and polymeric polyhydroxy compounds described above, polyamides, polyepoxides, reaction products of phenols and alkylene oxides, formaldehyde resins, hydrogenation products of olefin-carbon monoxide copolymers and polyepihalohydrins.

The polyepoxides used with this invention are organic compounds having at least two epoxy groups per molecule. They may be saturated or unsaturated aliphatic, cycloaliphatic, aromatic or heterocyclic and may be substituted with non-interfering substituents such as hydroxyl groups, ether radicals, etc. Polyepoxides containing ether groups, generally designated as polyepoxide polyethers, may be prepared as is well known by reacting a polyol with a halogen-containing epoxide using at least two moles of the halogen-containing epoxide per mole of polyol. The reaction of epichlorohydrin with a polyhydric phenol in an alkaline medium is an example of the preparation of such a product.

The polyamides useful as such or in the preparation of the urethanes are those derived from polyamines and polybasic acids. Methods for preparing these polyamides by condensation are well known in the art. Useful polyamines include ethylene diamine, diethylene triamine and triethylene tetramine. Typical carboxylic acids which may be condensed with polyamines are glutaric acid, adipic acid, pimelic acid, sebacic acid, isophthalic acid and terephthalic acid.

Condensation products of phenols and an alkylene oxide which may be used include the condensation product of cresol or 4,4'-isopropylidene-diphenol with one or more of the above-mentioned alkylene oxides. Any suitable formaldehyde resin may be used such as, for example, the condensation product of formaldehyde with the condensation products of alkylene oxides to prepare polyoxymethylene compounds having terminal hydroxyl groups. The suitable hydrogenation products of olefin-carbon monoxide copolymers which may be utilized are disclosed in U.S. Pat. Nos. 2,839,478 and 2,495,292.

Among the suitable isocyanates that may be used in the preparation of the polyurethanes are included aryl diisocyanates such as 2,4-toluene diisocyanate, 2,6-toluene diisocyanate, 1,5-naphthylene diisocyanate and xylylene-1,4-diisocyanate; alicyclic diisocyanates such

as dicyclohexamethane-4,4'-diisocyanate; alkylene diisocyanate such as tetramethylene diisocyanate and hexamethylene diisocyanate; as well as mixtures thereof and including the equivalent isothiocyanates.

Chain extenders utilized in the preparation of the urethanes are substantially difunctional or polyfunctional active hydrogen-containing compounds such as ethylene glycol, 1,2-propylene glycol, neopentyl glycol, dipropylene glycol, hydrazine, ethylene diamine, N,N,N',N'-tetrakis (dihydroxy propyl) ethylene diamine, etc.

The above described abradable polymers are applied to the flock fabric in solutions, and the solutions may have incorporated therein curing agents, pigments, plasticizers, stabilizers, antioxidants, and other conventional compounding ingredients which are compatible with the polymer and the solvent.

The polymer solution can be applied to the flock fibers of the fabric by spraying, kiss-coating, transfer coating, etc. A sufficient amount of the solution is applied to the substrate to provide a solids pickup of up to about 12 percent by weight based on the weight of the flocked fabric and preferably from about 5 to 9 percent. The method of application should be such that most of the polymer is deposited on the flock fibers. The viscosity of the solution should be low enough to permit coating of the individual fiber flock hereby the integrity of the fibers substantially is retained. The coated flocked fabric is thereafter dried at a temperature ranging from room temperature to about 250°F. or higher. The higher temperatures can be utilized where the polymeric coating is a latex or a water dispersion. When solutions or dispersion of blocked urethane prepolymers are utilized, the higher temperatures are necessary to unblock the urethane for further reaction. When cross-linked polyurethanes are used in solution, a temperature of about 80°C or higher is preferred to inhibit condensation of water from the air onto the film which can be objectionable in some instances.

A subsequent step in the preparation of the suede-like fabrics of the invention involves abrading the coated fiber flock to reduce the number of polymer aggregates and any fiber-to-fiber bonding that may be present and to break up the surface of the coating on the fibers to impart to the fibers a soft leathery suede finish. If the coated fibers are not treated in this manner, the fibers have a relatively hard, smooth surface skin which does not have the desired suede-like hand or appearance. The abrasion of the coating is effected by buffing or grinding the coating with, for example, sandpaper, emery cloth or wire brushes until the desired aesthetic effect is obtained. The desired effect can also be obtained by subjecting the coated flocked fabrics to the abrasive action of high velocity abrasive particles. Such techniques are commonly referred to as sand-blasting utilizing well-known abrasive substances which include various metal, vegetable matter and inorganic compounds. A preferred abrasive is aluminum oxide on a substrate backing. As a result of the abrasive action of the various above-described abrasives, the coating on the fibers is not smooth and the fibers tend to cling together when rubbed with the fingers. This tendency to cling together is an important characteristic that contributes to the leathery suede feeling of the product.

After abrading the coating on the fibers, the fabric material of this invention can be scrubbed with water

or vacuumed to remove dust which has accumulated from the abrasion of the coating. Additional desirable properties can be imparted to the product by treating the abraded fabric material with oil, stain and water repellent chemicals, softeners to improve the handle such as cross-linkable polymeric silicones, polymeric plasticizers, various waxes and wax-like materials such as stearic acid, oily plasticizers such as the polyesters, mineral oils, castor oil, etc. It is possible, of course, to incorporate some of these additives into the coating composition before it is applied to the flocked fabrics. The choice of the particular method utilized will depend in part on the compatibility of the supplementary additives in the polymer solution of their incompatibility in the final polymer coating.

It has been found that it is possible, and in many instances preferable to utilize undyed flocked fabrics coat the fiber flock with the abradable polymer, abrade the coating and thereafter dye the abraded product with a dye which is suitable for dyeing the coating and fiber flock. Unusual results can be obtained by dyeing either the coating or the fiber alone. One of the advantages of dyeing after abrading is that more uniform and brighter colors may be obtained.

The following examples illustrate the process and the product of this invention. Unless otherwise indicated all parts and percentages are by weight.

EXAMPLE 1

A solution of a polyurethane elastomer is prepared by first mixing 228 parts of polytetramethylene ether glycol of about 1,000 molecular weight with 20 parts of toluene-2,4-diisocyanate and heating the mixture for three hours at 90°C. This dimer (248 parts) is mixed with 57 parts of methylene-bis-(4-phenyl isocyanate) and heated for one hour at 80°C. to form a prepolymer with isocyanate end groups. The prepolymer is dissolved in 1,000 parts of N-N-dimethyl formamide, and the resulting solution is added slowly with stirring to a solution consisting of 5 parts of a chain extender dissolved in 171 parts of dimethyl formamide. The chain extender consists of N-methyl amino-bis-propyl amine and hydrazine hydrate in a molar ratio of 4:6. The reaction mixture is stirred at 40°C. for 30 minutes to form a polyurethane solution having a viscosity of about 115 poises and a polymer solids content of about 20 percent.

The flocked fabric utilized in this example is a 60 in. width rayon sateen substrate (1.43 yards/pound) flocked with 1.5 denier, semi-dull random 0.03 inch cut length rayon fibers utilizing an acrylic adhesive. This fabric is sprayed with the urethane polymer solution diluted to about 10 percent solids to provide a solids pickup on the flocked fabric, after drying, of 6 percent. The fabric is dried for about 10 minutes at 110°C. and allowed to set overnight at ordinary temperatures.

The flocked fabrics coated in this manner contain a few polymer aggregates which tie the fibers into clusters and a minor amount of fiber-to-fiber bonding. In order to remove the polymer aggregates and reduce the fiber-to-fiber bonding, the coated flocked fabric is brushed with coarse sandpaper (No. 80) to remove excessive surface polymers. The coated fabric abraded in this manner exhibits a satisfactory leathery hand and resembles suede fabric. It is washable and dry cleanable.

EXAMPLE 2

The procedure of Example 1 is repeated except that the polyurethane utilized is a commercially available Warcoflex 4667 LF (a polyester urethane available from Sun Chemical Company as a 35 percent solution in dimethyl formamide) diluted to 10 percent by weight to facilitate the spraying and to obtain better wetting of the fibers and penetration between them. In this example, the flocked fabric is piece dyed prior to the polymer treatment and the amount of polymer applied is about 8.5 percent on the weight of the fabric. The product exhibits a satisfactory leathery hand and resembles suede fabric. Its abrasion resistance is improved over the original flock fabric.

EXAMPLE 3

The procedure of Example 2 is repeated except that the polyurethane solution is further diluted to 7 percent and kiss-coated onto the fabric using an applicator roll to provide a solids pickup of 8.5 percent based on the weight of the fabric. The coated fabric is dried with the flock fibers extended downward. After abrading the coating with aluminum oxide abrasive on a flexible backing, the fabric is vacuumed to remove polymer dust and treated with a silicone to improve the handle of the suede-like fabric produced.

The suede-like fabrics prepared in accordance with the process of this invention are useful as upholstery fabrics and in the production of wearing apparel. The synthetic suedes have several advantages over natural suedes since they can be prepared in a variety of colors, are oil and moisture resistant and are washable and/or dry cleanable. Accordingly, the suede may be utilized as trim fabrics for washable and dry-cleanable wearing apparel.

That which is claimed is:

1. A process for preparing a synthetic, leathery, suede-like fabric material from a flocked fabric comprising the steps of
 - a. coating the fibers of the flocked fabric with an abradable polymeric coating composition to provide a solids pickup between about 5 and 9 percent based on the weight of the fabric while substantially retaining the integrity of the fibers, and
 - b. drying and heating the applied coating to obtain a solid coating of the abradable polymer on the flocked fibers, and
 - c. abrading the coated fibers to reduce polymer aggregates and fiber-to-fiber bonding, and to impart to the fibers a soft leathery suede finish.
2. The process of claim 1 wherein the flocked fabric is a textile fabric.
3. The process of claim 2 wherein the fibers of the flocked fabric are synthetic fibers.
4. The process of claim 2 wherein the textile fabric is a woven textile fabric.
5. The process of claim 3 wherein the fibers of the flocked fabric are rayon.
6. The process of claim 1 wherein the polymer coating composition is a solution or an emulsion consisting essentially of an abradable polymer or prepolymer and a polymerization catalyst or coreactant.
7. The process of claim 6 wherein the abradable polymeric coating composition is a polyurethane, polyacrylate, polyamide, or an epoxy composition.

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8. The process of claim 7 wherein the polymeric coating composition is a cross-linked urethane polymer.

9. The process of claim 8 wherein the polymeric coating composition is a solution of a cross-linked ure-

thane in an organic solvent.

10. The process of claim 8 wherein the organic solvent is dimethyl formamide.

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