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METHOD OF IMPROVING HAND OF FABRICS
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ABSTRACT OF THE DISCLOSURE

A method of treating a fabric to improve the hand thereof is disclosed and comprises applying to the fabric a film-forming cross-linkable polymeric substance and a blowing agent, and thereafter heating the fabric at a temperature sufficient to cross-link the resin while concurrently activating the blowing agent.

This invention relates to a method of finishing textiles and to the finished textiles produced thereby. More particularly, it relates to a method of treating fabrics to improve the hand of the fabric.

A good filament yarn fabric is one which is characterized as having a soft and slick hand is not readily susceptible to filament and yarn breakage. However, filament yarn fabrics have been generally characterized as being stiff and wiry to the hand, especially when the fabric is a blend of natural and synthetic fibers. Historically, the problem of the wiry hand of filament fabrics has been studied and partially solved by increasing the number of filaments in the yarn while maintaining the denier at a specific level. This results in a lowering of the value of denier per filament and an improved hand but this solution suffers several defects which are highly undesirable. For example, decreasing the denier per filament results in increased cost, filament breaks and yarn breaks. A temporary and, therefore, generally unsatisfactory solution to the problem is to treat the fabric with well known chemical softeners. However, this method of improving the hand of the fabric must be repeated almost as often as the fabric is cleaned or washed.

Accordingly, it is an object of this invention to provide a novel method of imparting improved hand to textiles.

It is another object of this invention to provide a finish for textiles which is durable and not eliminated through repeated washings of the textile fabric.

It is another object to provide a method of providing softness, luxurious hand and drape properties to fabric that are maintained throughout the life of the fabric.

These and other objects of this invention are accomplished by providing a method of treating a fabric to improve the hand thereof comprising applying to the fabric a film-forming polymeric substance and a blowing agent, and thereafter heating the treated fabric at a temperature sufficient to form a film and cause the blow-

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ing agent to release a gap or vapor concurrent with the formation of the film.

The mechanism by which the above method improves the hand of the fabric is not known. One theory which provides an explanation of the results obtained by this invention is that the fibers and filaments in the fabrics are extended and separated by the gas or vapor which is formed from the blowing agent during the process of the invention. When the fibers are in this extended and separated position, the polymeric substance permeates the spaces between the fibers and maintains the fibers in the extended positions on curing to a film. In this way, the filaments and fibers are maintained in their extended position thereby improving the hand of the filament or fabric. Another theory is that the improved hand results when the filaments are forced apart by the film-forming substance which expands on curing as a result of the gas or vapor evolved by the blowing agent. It may well be that both of these mechanisms occur in the process of the invention. The terms "textiles" and "fabrics" as used herein include materials used in the manufacture of fabrics such as filament yarns and fibers as well as the fabrics themselves. The textile fabrics which may be treated according to the method of the invention include woven, knitted, pleated, braided and felt materials such as cloth, lace, hosiery, etc.

The film-forming polymeric substance applied to the textiles may comprise monomers, polymers, copolymers, mixtures of polymers and copolymers and mixtures of prepolymers. Any monomeric or polymeric substance which will thicken and form a film at or about the time the gas or vapor is evolved from the blowing agent is useful in the process. The film may result from evaporation of solvents or from polymerization or cross-linking of prepolymers and polymers under the conditions of the invention. Among the polymer types which have been found to be useful in the method of this invention are included dimethylol alkylene ureas, melamines, melamine blends, melamine urons, dihydroxy dimethylol alkylene ureas, triazones, uron urea formaldehydes, polyurethanes, polyvinyl acetates, polyvinyl chlorides, polyalkylenes, and polyesters such as those obtained from acrylic acid, adipic acid and succinic acid, and mixtures thereof. Those polymeric substances which undergo a viscosity increase and/or film formation as a result of cross-linking are preferred. The combination of cross-linking and acrylic acid or ester resins within the molecular weight range of from about 2000 to about 200,000 is particularly preferred. Examples of such acrylic resins include the poly(methylacrylates), poly(ethylacrylates), poly(methylmethacrylates) and poly(butylmethacrylates). Although the ratio of cross-linking to acrylic resin present in the combination is not critical, especially beneficial results are obtained where the weight ratio is in the range of from 1:3 to 1:6.

Examples of a number of commercially available resin types, their trade names and sources are outlined in Table I.

TABLE I.—POLYMERIC SUBSTANCES

Resin type	Chemical composition	Trade name	Source
Acrylic	Poly(methylacrylate)	Rhoplex AC-33	Rohm and Haas.
	Poly(ethylacrylate)	Rhoplex B-15	Do.
	Poly(methylmethacrylate)	Rhoplex HA-12	Do.
	Poly(ethylmethacrylate)	Rhoplex K-3	Do.
	Poly(butylacrylate)	Phoplex B-287	Do.
Urea	Dimethylethyleneurea	Rhonite R-1	Do.
	Dihydroxy dimethylethyleneurea	Permatresh 183	Sun Chemical Corp., Warwick Chemical Division.
	Dimethylpropyleneurea	Fixapret PH	BASF Colors and Chemicals, Inc.
Melamine	Melamine	Aerotex Resin M-3	American Cyanamid.
	Melamine-uron	Aerotex Reactant 1	American Corp.
	Uron-uron-ureaformaldehyde	Aerotex Reactant 2	Do.
Urethane	Carbamate	Stanset C-35	Standard Chemical.
Triazone	Triazone	Rhomite D-12	Rohm & Haas.

The blowing agents useful in the method of this invention may be either physical or chemical blowing agents. Physical blowing agents are compounds that change their physical state during the film-forming operation. Generally, these are compounds which are liquid at or near ambient temperatures under normal pressure conditions but which vaporize easily on heating. Such blowing agents include aliphatic hydrocarbons and halogenated hydrocarbons as well as low boiling alcohols, ethers, ketones, and aromatic hydrocarbons. Specific examples include pentane, neopentane, hexane, heptane, toluene, methylene chloride, trichloroethylene, dichloroethane, and trifluoroethane.

Chemical blowing agents are inorganic or organic materials that decompose under the influence of heat to yield at least one gaseous decomposition product. The most characteristic property of these blowing agents is the temperature at which the gas is liberated, and this decomposition temperature determines the usefulness of the blowing agent in a given polymeric substance. The decomposition temperature also determines the conditions and temperature of the process. The simple inorganic and organic salts such as carbonates, bicarbonates and oxalates are useful in systems where their insolubility is not detrimental. Nitrogen releasing blowing agents are particularly useful because of their improved solubility. Examples of commercially available nitrogen-containing blowing agents are listed in Table II.

TABLE II.—BLOWING AGENTS

Chemical class	Composition	Trade name	Source
Azo-compounds	Azobisisobutyronitrile	Celogen AZ	1
	Azobisisobutyronitrile	Vazo	2
	Diazoaminobenzene	DAB	3
N-nitroso compounds	N,N'-dimethyl-N,N'-dinitrosoterephthalamide	Nitrosan	2
	(N,N'-dinitrosopentamethylenetetramine	Unicel NO	2
Sulfonyl hydrazides	Benzenesulfonyl hydrazide toluene-(4)-sulfonyl hydrazide 4,4'-oxybis (benzenesulfonyl hydrazide)	Celogen BSH	1
		Celogen TSH	1
		Celogen OT	1
Sulfonyl semicarbazides	p-Toluenesulfonyl semicarbazide	Celogen RA	1

1. Nautatuck Chemical Div., U.S. Rubber, Nautatuck, Connecticut.
2. E. I. duPont de Nemours & Co., Inc., Wilmington, Delaware.
3. National Aniline Div., Allied Chemical Corp., New York, N.Y.

Other classes of chemical blowing agents may also be used. These include the nitrososulfonamides, sulfonyl azides and the nitro derivatives of urea and related compounds.

The important criterion used in the selection of the blowing agent to be used in conjunction with the polymeric substance is the temperature at which the blowing agent will evolve a gas or vapor. As mentioned previously, this temperature must coincide with or be about the same as the temperature at which the polymeric substance thickens and forms the film. In general, the particular blowing agent may be any blowing agent that decomposes or liberates a gas within about 40° of the temperature of film formation. The preferred blowing agents are the Celogens and Nitrosans although any of the other known blowing agents can also be used as long as they are compatible with the film-forming substance, not harmful to the fabric being treated and liberate the gas in the proper temperature range. The blowing agent will usually be applied to the textiles in a ranging from about 0.01 to about 25% by weight, and more generally, from about 0.05 to about 5% by weight based on the weight of the polymeric substance applied.

The polymeric substance and blowing agent can be applied individually to the fabric or as a mixture. It is possible to apply the blowing agent to the fabric as a solid, dispersion or solution, and thereafter apply the polymeric substance to cover the blowing agent. Another method, involves preparing an intimate mixture of the polymeric substance and blowing agent which is then applied to the fabric by any of the known methods. The mixture is dried at low temperature and thereafter heated to a temperature sufficient to cause the blowing agent to release a gas or vapor at about the same time that the polymeric substance thickens to a film.

Generally, however, the polymeric substance and the blowing agent are applied to the fabric in a dispersion or solution in a suitable solvent or diluent. Suitable solvents or diluents include water, hydrocarbons and chlorinated hydrocarbons. The amount of polymeric substance in the dispersion or solution will vary from about 0.1% to about 50% by weight.

The mixture which is applied to the textiles can also contain a textile catalyst, and as much as 50% by weight of the catalyst based on the weight of the resin contained in the mixture may be incorporated. The catalyst are preferably Lewis acid catalysts such as aluminum and magnesium halides. Other catalysts which may be used to facilitate and improve the cross-linking and film-forming reactions are as follows: oxalic acid, formic acid, acetic acid, propionic acid, sulfuric acid, maleic acid, hydrochloric acid, diammonium phosphate, phosphoric acid, amine hydrochlorides such as N-propanolamine hydrochloride, lead nitrate, stannous chloride, stannic chloride, zinc chloride, zinc nitrate, ferric chloride and ammonium chloride.

Other additives may likewise be included in the mixture which is applied to the textiles. The choice of additives is determined by the nature of the textile fabric and the properties desired of the fabric. For example, well-known fabric softeners may be incorporated into the mixture to improve the hand of the fabric although the method of the present invention diminishes the neces-

sity of such softeners. Wetting agents and surface active agents are also utilized in the compositions useful in the method. These may be ionic as well as non-ionic agents. An example of such an agent is Synfac 905, a non-ionic wetting agent obtained by reacting nonyl phenol with ethylene oxide in a molar ratio of 1:9.5. Dyes and other coloring substances also can be incorporated into the mixtures when a particular colored fabric is desired. For example, fabrics treated in accordance with the method of this invention may be used in the preparation of garments where whiteness is important. In these cases, additives which are well known in the textile industry for imparting whiteness to a fabric may be included in the mixture.

The following examples illustrate mixtures which are useful in the method of this invention although the blowing agent and polymeric substances illustrated can be applied separately. The nature of the blowing agents identified by trade names is given in Table II.

Example 1

	Parts by volume
A 45% aqueous emulsion of a poly(ethylmethacrylate) having a molecular weight of 50,000	400
Magnesium chloride	20
Water	500
Celogen OT	4

Example 2

	Parts by volume
A dimethylethylene urea resin having a molecular weight of 25,000	400
Aluminum chloride	10
Celogen OT	0.4
Water	520

That which is claimed is:

1. A method of treating a fabric to improve the hand thereof comprising applying to the fabric, a mixture comprising a film-forming cross-linkable resin, a blowing agent and an acid catalyst, and thereafter concurrently cross-linking the resin and activating the blowing agent to obtain the finished fabric.

2. The process of claim 1 wherein the mixture is applied to the fabric in an aqueous dispersion or solution at ambient temperature and the treated fabric is subsequently dried and cured at a temperature of from about 25° C. to about 210° C.

3. The process of claim 2 wherein the fabric is cured under a pressure of up to about 2000 pounds per square inch.

4. The method of claim 1 wherein the mixture also contains an acrylic resin having a molecular weight within the range of from about 2000 to about 175,000.

5. The product of the process of claim 1.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,483,024 Dated December 9, 1969

Inventor(s) William T. Roff, Jr.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Table 1, line 15, "Rhomite" should read --Rhonite--.
Column 3, line 60, after "a" and before "ranging", insert
--quantity--.
Claim 4, line 1, "1" should read --3--.

SIGNED AND
SEALED
MAY 12 1970

(SEAL)

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