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FIRE RETARDANT NYLON FABRIC AND METHOD OF PRODUCING THE SAME

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This application relates to procedures for enhancing the ignition-resistant properties of combustible fabrics, and also to the fabrics having enhanced flame-inhibition properties.

Although the present invention has a particular application to nylon nets and light nylon fabrics, the composition of this invention is also applicable to enhancing the flame-retardant properties of synthetic fibers such as viscose, Dacron, Orlon and acetate fibers and even such natural fibers as silk, wool or cotton.

Many of the fire-retardants developed heretofore were particularly adapted to render cellulosic fibers noncombustible and do not function effectively with the newer hydrophobic fibers such as nylon or Orlon or even with the acetate rayons. Fewer still can be employed with resins in the finishing of viscose or cotton fabrics. The resins are polymerized by the high concentration of retardants required to flameproof the material.

Ammonium salts such as the sulfates, molybdates, sulfamates and phosphates which have been suggested for inhibiting the combustibility of cellulose textiles are not satisfactorily employed in application to synthetic hydrophobic fibers. The borophosphates, boriborates and similar also are not effective in reducing the combustibility of such fabrics. Moreover, none of these repellents are durable to laundering and dry cleaning.

It is among the objects of this invention to provide a flame retarding procedure which will impart substantially durable flame retardant effects to fabrics, and be resistant to multiple launderings and dry cleanings.

Another object of this invention is the production of a flame inhibiting finishing solution which is stable even upon prolonged ageing and can be mixed or blended with conventional textile finishing agents and surface active compounds without separation or precipitation.

It is among the further objects of the present invention to provide durable fire retardants which may be applied to hydrophobic fabrics such as acetate, nylon or Orlon, and which may be used in finishing baths and also with resin finishes without disadvantageously affecting the resin finish.

A still further object of the present invention is to provide a flame proofing composition which may be combined with a resin solution without the resin undesirably affecting the flame proofing material, and without the flame proofing material undesirably affecting or destroying the adhesiveness or causing too rapid polymerization of the resin finish.

Still further objects and advantages will appear in the more detailed description set forth below, it being understood, however, that this more detailed description is given by way of illustration and explanation only and not by way of limitation, since various changes therein may be made by those skilled in the art without departing from the scope and spirit of the present invention.

In the preferred procedure the fabric is given surprisingly effective ignition retardant properties by impregnating with a volatile base bromide which is durably bound to the fiber by a permanent finish or coating.

Although ammonium or organic amine bromides may be used alone or preferably with buffers and alkalies to impart flame inhibition to textile fabrics, the effect is not durable and the inhibitor is removed completely during the first laundering or wet processing operation. The fixation of the bromide onto a fiber to durably protect it

against flaming combustion is accomplished by its joint application with resins of a suitable type, such as the urea-formaldehyde condensates.

Although it has not been definitely established that a chemical union between the resin and bromide ion occurs during the drying and fabric curing operations, there are reasons to believe that some type of chemical or physico-chemical attachment is produced.

The preferred composition consists of a mixture of organic bromide salts, a buffer, a resin and a stabilizing agent.

Among the organic amines which may be employed in the form of their bromides are triethanol amine, methyl amine, dimethyl amine and ethylene diamine as well as other lower molecular weight water soluble aliphatic amines containing 1 to 6 carbon atoms and 1 to 4 amine groups.

The preferred resinous materials desirably are alkylated (alkyl groups having 1 to 4 carbon atoms) partially condensed urea formaldehyde resins or, less preferably, melamine formaldehyde resins, or still less preferably, thiourea formaldehyde resins. Methylated, ethylated or butylated resins may be employed.

Less preferably formaldehyde resins such as unmodified urea-formaldehyde, acetone-formaldehyde and hydantoin-formaldehyde resins may be employed. Cyclic formaldehyde resins such as the phenol-formaldehyde and the cyclic urea-aldehyde resins may in special cases be substituted in whole or in part for the urea-formaldehyde condensates.

The polyvinyl acetate and alkyd resin dispersions are also effective fixatives for ammonium and amine bromides, particularly when mixed with small quantities of a formaldehyde or glyoxal resins.

It is usually desirable to stabilize resin-ammonium bromide or amine bromide solution. To prevent insolubilizing or premature polymerization of the resin in the finishing bath, stabilizers such as urea or dicyandiamide are added to the bromide-resin mixture.

Other water soluble nitrogenous compounds might also be used for stabilization purposes in amounts ranging from 5% to 10%.

Approximately equal weights of such stabilizers and the bromides are required to produce stable solutions.

Increased stability of the fire retardant compound is also secured by buffering the solution to a pH of at least 8.0 by ammonium hydroxide or volatile water soluble aliphatic amines, such as morpholine.

Although alkalies other than ammonium hydroxide act as satisfactory buffering agents, it is usually desirable, particularly when urea-formaldehyde or melamine-formaldehyde are used as the resin component, to employ an alkali which will in no way inhibit the polymerization of the resin-bromide mixture applied to textile materials.

Compositions possessed with the following formulae have been found satisfactory for durably flame-repellant textile fabrics:

	Preferred	Range
Ammonium or amine bromides	5 to 12.5	3 to 25
Binder	10 to 50	5 to 75
Stabilizer	5 to 10	2 to 20
Buffer	0 to 0.5	0 to 2
Water	80 to 27	90 to 20

All in parts by weight.

This solution is desirably applied to light open weaves and especially nylon and nylon-acetate nets and laces. Broad goods such as georgettes, marquisettes, and light crepes may also be satisfactorily processed.

Examples of this invention are given as follows:

Example 1

A nylon net was passed through a finishing solution containing the following ingredients:

	Percent
Ammonium bromide	7.5
Methylated urea-formaldehyde resin (40% active)	80
Water	12.5

Subsequent to passage of the nylon through the solution the net was hydroextracted, dried, and cured for three minutes at 300° F.

Example 2

A lace fabric union (50% nylon/50% acetate rayon) was finished with a solution containing the components shown below, dried at 200° F. and cured for five minutes at 290° C.:

	Percent
Ammonium bromide	10
Urea	10
Methylated urea-formaldehyde resin (40% active)	50
Ammonium hydroxide	0.5
Water	29.5

All of the textile materials prepared as described above were tested for flame inhibition and the durability of the inhibition to laundering and dry cleaning. The launderings and dry cleanings were conducted in accordance to methods described in the Commercial Standard 191–53, "Flammability of Clothing Textile" (U.S. Department of Commerce), which is specified under the Flammable Fabrics Act (Public Law 88, 83d Congress), which is effective on July 1, 1954.

These methods are also described under "Standard Text Method 33–52" of the American Association of Textile Chemists and Colorists.

The bromide appears to accomplish a dual function in the condensation of resinous material onto textile materials. Under the acid conditions produced after volatilization of the volatile alkalies (ammonia or morpholine) the bromide acts as a catalyst, insolubilizing the resin and also reacting with it to form a physico-chemical or pseudo-chemical union. Regardless of the type of resin-bromide attachment, the bromide ion cannot readily be leached out of the resinous coating even by repeated laundering or by dry cleaning.

In the preferred portions, the ammonium bromide is

used in amounts ranging from 5% to 35% of the respective material and desirably it is utilized in an amount ranging from 20% to 40% of the resinous material.

It has been found that a pick-up of 10% to 20% of a combination of 60% to 80% of the resinous material and 20% to 40% of the ammonium bromide, based upon solids content, gives a surprisingly effective, durable, flameproofing effect.

As many changes could be made in the above processes of enhancing the ignition resisting properties of combustible fabrics, and many widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

Having now particularly described and ascertained the nature of the invention, and in what manner the same is to be performed, what is claimed is:

1. A process for producing fire retardant nylon net fabric which comprises passing the fabric through an aqueous finishing solution having a composition of 7.5% of ammonium bromide, 80% to 40% active methylated urea-formaldehyde resin, and 12.5% of water having sufficient ammonium hydroxide to give a pH of 8.0, then hydroextracting, drying and curing for three minutes at 300° F. to give a pick-up on the fabric of 10 to 20% of the solids in said finishing solution.

2. A fire retardant nylon net fabric produced according to the process of claim 1.

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