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PROCESS FOR PLACING MODIFIERS WITHIN POLYESTER FIBERS AND FILMS

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U.S. Cl. 117—119.6 14 Claims

ABSTRACT OF THE DISCLOSURE

A process for placing modifiers within a polyester fiber or film comprising:

(A) applying a modifier to the surface of the polyester fiber or film, and

(B) heating the fiber or film in a zone having a volume less than about 150 times the volume of the fiber or film.

This invention relates to a process wherein a modifier is applied to the surface of a polyester fiber or film and the fiber or film is subsequently heated in a zone having a volume less than about 150 times the volume of the fiber or film.

The modification of polyester fibers and films has assumed tremendous significance in recent years. The prior art such as U.S. 3,166,886, U.S. 190,718 and U.S. 2,855,-633 discloses that various modifiers can be applied to the surfaces of fibers or films which enhance the utility of fibers or films by rendering the fiber or film flameproof, more dyeable, soil resistant, permanently pressed, and the like.

Because of high volatilities many of these valuable and inexpensive modifiers cannot be effectively placed within the fiber because many of these inexpensive modifiers tend to vaporize at the temperatures used to place the modifiers in the fiber after the modifiers have been applied to the surface of the fiber. This invention provides a valuable advantage over the prior art in that valuable modifiers which previously could not be effectively placed within polyester fibers by applying the modifier to the surface of the fiber and subsequently heating the fiber, can now be applied to polyester fibers by the process of this invention. Another advantage of this invention is that inexpensive modifiers can be applied to polyester fibers or films.

In one embodiment this invention comprises a process wherein a modifier is applied to the surface of a polyester fiber or film and the fiber or film is subsequently heated in a zone having a volume that does not exceed certain limits in relation to the volume of the fiber or film. Specifically, the volume of the zone in which the heating occurs is less than about 150 times the volume of the fiber or film. In another embodiment the volume of the zone is less than about 50 times the volume of the fiber or film.

Accordingly, it is an object of this invention to provide a process specifically adapted to effectively place a modifier within a polyester fiber or film.

Additionally, it is an object of this invention to place a modifier within a polyester fiber or film through a process which includes applying a modifier to the surface of a polyester fiber or film and heating the fiber or film in a zone having a volume less than about 150 times the volume of the fiber or film, and preferably less than about 50 times the volume of the fiber or film.

Additionally, it is an object of this invention to place a modifier within a polyester fiber which will decrease the flammability of the fiber.

Additionally, it is an object of this invention to place

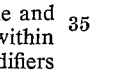
a modifier within a polyester fiber which will increase the dyeability of the fiber.

Other objects, advantages and features of this invention will be readily apparent to those skilled in the art from the following description and appended claims.

According to one embodiment of the first step of this invention any suitable modifier, or mixtures of modifiers, that will permit the invention to be practiced can be applied, preferably continuously, to the surface of a polyester fiber or film. According to this invention the modifiers can be applied to the polyester to enhance any desired property of the fiber. Modifiers which decrease the flammability of the fiber are especially applicable for use in this invention as well as are modifiers which increase the dyeability of the fiber, particularly in disperse dyes. The modifiers of this invention can be applied to the surface of a polyester fiber or film in the form of a liquid, solid dissolved in a solvent or a solid, but are in liquid form during the heating step in the zone having a volume of less than about 150 times the volume of the fiber or film.

The modifiers that can be used in this invention have a boiling point in the range of about 250–400° C. at a pressure of 760 mm. Hg, a vapor pressure of at least 0.1 mm. Hg at 200° C. and are in a liquid state during the heating step in the zone having a volume less than about 150 times the volume of the fiber or film.

In one embodiment of the invention the modifier can be an organic compound having a molecular weight of at least about 180 containing at least one aromatic ring, wherein the ratio of the number of carbon atoms which are aromatic, carbonyl

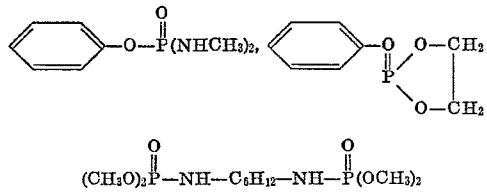


or nitrile (—C≡N) to the number of carbon atoms which are aliphatic is equal to or greater than 0.5. In another aspect of this embodiment of the invention the organic compound has a molecular weight in the range of about 250–1000 and is selected from the group consisting of aryl phosphates, aromatic lactams, chlorinated aromatic hydrocarbons and ethers, aromatic ethers, esters of aromatic carboxylic acids, aromatic esters of aliphatic carboxylic acids, aromatic halogenated ketones, esters of aromatic sulfonic acids, aromatic sulfonamides, aromatic substituted ureas, aromatic nitriles, aromatic hydrocarbons and mixtures thereof. In another aspect of this embodiment of the invention the modifier can be butyl benzyl phthalate, dibutyl terephthalate, dioctyl phthalate, diphenyl carbonate, diphenyl phthalate, phenyl butyl phthalate, diphenyl ether, dichlorodiphenyl ether, diphenyl 2-ethylhexyl phosphate, diphenyl sulfonate, phenyl benzenesulfonate, N,N-diethyl p-toluenesulfonamide, diphenyl triketone, chlorinated biphenyl, o-terephenyl, 2,4-dichloroacetophenone, and mixtures thereof.

In another embodiment of the invention the modifier can be an organic compound containing halogen or phosphorous or mixtures thereof. In one aspect of this embodiment of the invention, the weight of the halogen can be at least three times the weight of the carbon and, based on the total weight of the compound, the phosphorus can comprise at least 6 weight percent. In another aspect of this embodiment of the invention the weight of the halogen can be at least four times the weight of the carbon, and the phosphorus can be in the range of about 14–18 weight percent.

In still one other aspect of this embodiment of the invention the modifier can be ethyl tetrabromobenzoate, tribromophenol, and 1,3,5-tribromobenzene, trioctyl phos-

phate, di(2 - ethylhexyl)phenyl phosphate, tri(2 - ethylhexyl) phosphate, tridecyl phosphate,



bis(bromochloropropyl) - bromochloropropyl phosphonate, tris(2,3-dibromopropyl)phosphate, bis(2,3-dibromopropyl)tribromophenyl phosphate, bis(2-bromoethyl) 3,5-dibromophenyl phosphate, or tris(2,3-dichloropropyl) phosphate or mixtures thereof.

The amount of modifier that can be used in this invention is such that the amount of modifier placed within the fiber or film through the process of this invention is, based on the weight of the fiber or film, from about 1–25 weight percent. In one embodiment where modifiers that improve the dyeability are used, from about 3–6 weight percent of the modifier can be used. In one embodiment where modifiers that improve the flammability of the fabric or fiber are used, from about 8–18 weight percent of the modifiers can be used.

Any high-melting crystalline polyester can be used in the process of this invention.

In one embodiment aliphatic, alicyclic and aromatic dicarboxylic acids having up to 40 carbon atoms can be used to form the polyester useful in this invention. Examples of such acids include oxalic, malonic, succinic, adipic, 1,4-cyclohexanedicarboxylic, 1,3-cyclohexanedicarboxylic, terephthalic and isophthalic. Other acids include 4,4'-dicarboxydiphenyl, 4,4 - sulfonyldibenzoic, 1,2-di-(p-carboxylphenyl)ethane, naphthalenedicarboxylic and the like. Other suitable acids include those disclosed in U.S. 2,925,404. It will be understood that the corresponding esters of dicarboxylic acids can be used in this invention. Copolyesters can be prepared using at least one of these acids, and in one embodiment copolyesters can be prepared using two or more of the acids; and in a preferred embodiment a polyester containing at least 80 mole percent terephthalic acid can be used.

Suitable diols useful for preparing the polyesters of this invention are aliphatic, alicyclic and aromatic diols having up to 40 carbon atoms. Examples of such diols include ethylene glycol; diethylene glycol; 2,2 - dimethyl-1,3-propanediol; 1,4-butanediol; 1,4-cyclohexanediol; 1,4-cyclohexanedimethanol; o-, m-, and p-xylene diols; 4,4'-thiodiphenol; 4,4'-methylenediphenol; 4,4' - sulfonyldiphenol; 4,4'-(2-norbornylidene)-diphenol; 2,5-naphthalenediol; and 2,5-norbornanediol. Copolyesters may be prepared using at least one of the above diols as well as two or more of the above diols. Other dihydric phenols listed in U.S. Pats. 3,030,335 and 3,317,466 may be used. Two or more diols can be used to give copolyesters, and in a preferred embodiment, a polyester can be prepared of at least 80 mole percent ethylene glycol, tetramethylene glycol, or 1,4-cyclohexanedimethanol.

In one embodiment a composite fabric containing areas composed of polyester fiber and areas composed of other fibers, such as cellulosic, can be used in this invention.

In another embodiment a fabric derived from a blend of polyester and other material, such as cellulosic material, can be used in this invention.

According to this invention the modifier, or mixtures of modifiers, can be applied in any manner that will permit practice of the invention. In one embodiment the modifier can be applied by padding from a water or organic solvent solution, suspension, emulsion, or gell. The water or organic solvent can be removed, if desired, prior to the heating step. In another embodiment the modifier can be applied by depositing the modifier directly on the fiber surface without a vehicle.

Other materials can be added or removed from the fiber either before or after the application step, and the fiber can be subjected to other additional steps either before or after the application of the modifier to the surface of the fiber. Specifically, the modifiers of this invention can be applied to polyester fibers, filaments, fabrics, yarns and the like at any processing stage and specifically can be applied either before, during or after drafting or heat setting. If modifiers are applied to drafted, unheat-set fibers, the heat-setting and diffusion operations may be carried out simultaneously. Spun yarns constructed from staple mixtures of polyester fibers combined with fibers of cotton, rayon, wool, nylon, cellulose acetates and acrylics can be used in this invention. Woven and knitted fabrics are well suited for this process. Pile and nonwoven fabrics may also be used.

According to the second step of the process of this invention the polyester fiber or film to which the modifier has been applied is subsequently heated, preferably continuously, at about atmospheric pressure within a temperature range of about 180–220° C. for a period of time in the range of about 5 seconds to about 10 minutes in a zone having a volume less than about 150 times the volume of the fiber or film. In another embodiment of the invention the volume of the zone can be less than about 50 times the volume of the fiber.

The zone in which the heating step is performed can be of any suitable geometry. In one embodiment a tube open at both ends can be used to define the zone and thus the zone is cylindrical and the volume of the zone is the cross sectional area of the tube times the length of the tube. In this embodiment modifiers can advantageously be applied to a tow or yarn. In another embodiment the zone can be defined as the space between parallel plates and the volume of the zone is the length times the width of the plates times the distance the plates are spaced apart. In this embodiment the modifiers can be advantageously applied to a fabric or film. As will be recognized by a person skilled in the art the zone may consist of many other configurations in which the volume can be calculated by a man skilled in the art.

During the second step of the invention the modifiers which have been applied to the surface of the polyester are transferred from the surface of the fiber and placed within the fiber. Although the precise mechanism involved in the transfer of the modifiers into the fiber is not fully understood, one theory suggests that the modifiers diffuse from the surface of the fiber and become evenly dispersed through the cross-section of the fiber. In the embodiment of the invention where the modifier enhances the dyeability of the fiber it has been suggested that the modifiers become dispersed in the amorphous regions of the fibers and function as structure sufficiently to permit a more facile entry of the dye molecules.

The following examples are understood to illustrate but not limit the invention.

EXAMPLE 1

A series of runs are conducted to illustrate the practice of the invention wherein a modifier is placed within a fabric where the volume of the zone used is less than about 150 times the volume of the fabric.

In this example a poly(ethylene terephthalate) fabric (4.3 oz./sq. yd., 46 x 46 construction, density 1.38 g./cm.^{3}) is padded with a 6% (by weight) aqueous emulsion of butyl benzyl phthalate dye carrier to give 100 wt. percent wet pickup.

The emulsion is prepared by adding 40 g. of butyl benzyl phthalate and 0.4 g. of Triton X–100 (nonionic wetting agent) to 960 g. of water in a Waring Blendor with rapid stirring.

After drying at 100° C. a first sample of this fabric is loosely rolled and placed inside a glass tube open on both ends. Using the known weight of the sample and the density of the sample the volume of the sample is

calculated. The volume of the zone is calculated by multiplying the cross sectional area of the tube by the length of the tube. The volume of the fabric is divided into the volume of the open end tube defining the zone and it is determined that the volume of the zone is about 12 times the volume of the fabric. The tube, even through open at both ends, thus defines a zone with a volume about 12 times the volume of the fabric. A thermocouple is attached to the fabric so that the fabric temperature can be monitored directly by a potentiometer. The tube is placed in a forced convection oven preheated to 190° C. After the fabric temperature has reached 190° C., the sample is allowed to remain for an additional 5 min. A second sample of the above fabric is heated in the same oven at 190° C. for 5 min. in such a manner that the volume of the tube, and consequently the zone, is greater than 150 times the volume of the fabric.

By nuclear magnetic resonance spectroscopy sample one is found to contain 5.1 wt. percent butyl benzyl phthalate (before dyeing) while sample two is found to contain less than 1 wt. percent.

Samples one and two are then given an aqueous prescour which consists of 1 g./l. soda ash and 1 g./l. neutral soap heated at the boil for 30 min. Each sample is then dyed separately in an open aqueous dye bath containing 3% Eastman Polyester Blue GLF for 1 hour at the boil. No carrier is added.

A third sample of untreated polyester fabric is dyed in the same manner except that 7 g./l./o-phenylphenol carrier is added to the dye bath. A fourth sample of untreated fabric is dyed in the same manner without a carrier.

All four dyed samples are then scoured in an aqueous bath containing 2 g./l. of sodium hydroxide and 2 g./l. of nonionic detergent at 70° C. for 20 min.

The amount of dye taken up by each sample is determined by extraction of weighed portions with hot chlorobenzene and photometric comparison of the dye solutions with known standards. Eastman Polyester Blue GLF disperse dye is 17.5 wt. percent cake. The dye concentrations reported in this and the following examples are reported as the weight percentage of dye cake based on fiber weight. Thus for a 3% dyeing with Eastman Polyester Blue GLF, the theoretical maximum percentage of dye cake which can be absorbed by a fabric is calculated: 3.0 x 0.175=0.525%. Data regarding the dye content of all four samples is given below:

Sample:	Dye content, percent cake
One (volume of tube less than 150 times volume of fabric)	0.45
Two (volume of tube greater than 150 times volume of fabric)	0.15
Three (carrier-dyed)	0.46
Four (dyed without carrier)	0.12

These data clearly indicate that when the volume of the zone is less than about 150 times the volume of the fabric as in sample one, sufficient carrier is placed within the fabric to dye effectively and the dye takeup (0.45%) is at a satisfactory level for commercial dyeing and is substantially the same as sample three when the carrier is added directly to the dye bath (0.46% dye cake).

Additionally, these data demonstrate that when the volume of the zone is greater than about 150 times the volume of the fabric, as in sample two, the amount of carrier placed within the fabric results in only 0.15% dye content and the dye takeup is unsatisfactory for commercial dyeing and is substantially the same as 0.12% in sample four when no carrier is added to the dye bath.

Stated another way, these data illustrate that the process of the invention can be used to provide commercially acceptable dyeing levels only when the volume of the zone is less than about 150 times the volume of the fabric.

Similar results are obtained when fabrics of poly(1,4-cyclohexylenedimethylene terephthalate) are used in place of poly(ethylene terephthalate).

EXAMPLE 2

A series of runs are conducted to illustrate the practice of the continuous embodiment of the invention wherein a dye carrier is applied to yarns.

In this example a first poly(ethylene terephthalate) spun yarn of known denier and density is passed in a continuous operation through a solution of 4 wt. percent dibutyl phthalate in isopropyl alcohol, through a drying oven heated at 80° C., through a glass tube maintained at 200° C. having a volume, and thus defining a zone, approximately 120 times the volume of the yarn and finally onto a takeup spool. The yarn speed is 25 ft./min. so that the residence time of the yarn in the heated tube is approximately 7 seconds.

In a separate operation a second poly(ethylene terephthalate) yarn is heated at 200° C. for approximately 8 to 10 seconds in a relatively large cabinet having a volume much greater than 120 times the volume of the yarn. Both yarns are knitted into hoseleg and then scoured and dyed as described in Example 1.

The first yarn subjected to the practice of the invention wherein the volume of the zone is less than about 150 times the volume of the yarn, dyes to a deep blue shade (0.45% cake) while the second yarn processed in a zone wherein the volume of the zone is greater than about 150 times the volume of yarn dyes to an unsatisfactory light blue shade (0.18% cake).

These data indicate that the invention can be advantageously employed in a continuous embodiment.

Similar results are obtained when poly(tetramethylene terephthalate) and poly(1,4-cyclohexylenedimethylene terephthalate) are used in place of poly(ethylene terephthalate).

EXAMPLE 3

A series of runs are conducted to illustrate the practice of the invention when the ratio of the heating zone is varied when compared to the volume of the fabric.

In these runs a poly(ethylene terephthalate) fabric is treated as described in Example 1 except that the tube size and fabric sample size are varied from a volume ratio of 12:1 to about 500:1. Listed below are the dye contents (Eastman Polyester Blue GLF) of fabric samples heated at various ratios of the tube volume to fabric volume.

Volume of tube compared to volume of fabric:	Dye content, percent cake
12:1	0.47
24:1	0.48
50:1	0.45
100:1	0.42
150:1	0.40
200:1	0.35
500:1	0.31

Thus to obtain a commercially desirable dye takeup of at least 0.40% the volume of the tube compared to the volume of the fabric does not exceed 150 and to obtain a dye take substantially the same as a carrier dyed content (0.45%) the volume of the tube compared to the volume of the fabric does not exceed 50.

Similar results are obtained when poly(tetramethylene terephthalate) and poly(1,4-cyclohexylenedimethylene terephthalate) are used in place of poly(ethylene terephthalate).

EXAMPLE 4

Several runs are conducted to illustrate that the process of the invention does not substantially impair the properties of fiber.

Drafted, unheat-set poly(ethylene terephthalate) yarn is treated as follows. A first sample of this yarn is padded with a toluene solution containing 5 wt. percent of

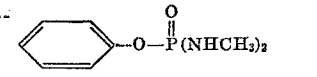
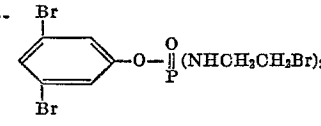
butyl benzyl phthalate. After drying in air, the first sample is placed for 1 minute between electrically heated parallel plates maintained at 190° C. which define a zone having a volume determined by multiplying the length and width of the plates by the distance the plates are spaced apart. This volume was determined to be about 100 times the volume of the yarn. A second sample is not padded with any modifier and placed in a forced convection oven heated at 180 to 190° C. for 5 minutes wherein the volume of the oven is greater than 150 times the volume of the yarn. Physical properties of fibers of Samples 1 and 2 are given below.

	Sample 1	Sample 2
Tenacity, g./den.	4.2	4.4
Elongation, percent	20.0	19.0
Elastic modulus, g./den.	35.0	39.0
Flow point (0.2 g./den. load), ° C.	249.0	255.0

These data illustrate that modifiers useful in this invention do not have an undesirable effect on the physical properties of treated fibers.

length of time wherein the volume of the oven exceeds 150 times the volume of the fabric. The heated samples are then scoured as described in Example 1 and dyed with either Eastman Polyester Blue GLF or Eastman Polyester Red FFBL disperse dyes without carriers. In each case the hoselegs which are heated between the parallel plates dye to commercially desirable deep shades while the hoseleg samples heated in the convection oven dye to commercially undesirable pale shades. In addition, hoselegs containing 5% or more of halogen are either self-extinguishing or show significant reduction in flammability when ignited with a Bunsen burner flame for 1 to 2 seconds. Those containing both halogen and phosphorus have a greater reduction in flammability at a given level of halogen content than those containing halogen only. Dyeability and flame resistance characteristics are not altered after 3 dry cleaning treatments with perchloroethylene (AATCC Test Method 85–1968) or 3 laundering cycles (AATCC Test Method 36–1969, Test III).

TABLE 1

Polyester yarn composition	Modifier	Pickup, percent	Temp., C./time, °min.
Poly(ethylene terephthalate)	Dioctyl phthalate	10	200/2
Do	o-Terphenyl	8	200/5
Do	Diphenyl carbonate	6	220/0.5
Do	N,N-diethyl p-toluene-sulfonamide	4	210/1
Do	Diphenyl 2-ethylhexyl phosphate	6	190/2
Do	Diphenyl ether	6	195/5
Do	Chlorinated biphenyl (54% Cl)	4	200/2
Do	Diphenyl sulfone	4	200/1
Poly(1,4-cyclohexylene-dimethylene terephthalate)	Phenyl benzoate	6	190/2
Do	Dichlorodiphenyl ether	2	200/10
Do	Dibutyl terephthalate	4	190/5
Do	n-Butyl p-toluenesulfonate	6	190/5
Do	4,4'-dichlorobenzophenone	3	190/2
Do	Diphenyl succinate	8	190/2
Poly(1,4-tetramethylene 4,4'-diphenyldicarboxylate)	Butyl benzyl phthalate	6	180/5
Poly(1,5-pentamethylene-4,4'-sulfonyldibenzoate)	Dibutyl phthalate	6	180/5
Poly(ethylene terephthalate)	Tris(2,3-dibromopropyl) phosphate	12	200/5
Do	Bis(2-bromoethyl) 3,5-dibromophenyl phosphate	12	200/5
Do	Bis (bromochloropropyl) bromochloropropyl phosphonate	10	200/5
Do	Trioctyl phosphate	8	190/5
Do	Di(2-ethylhexyl) phenyl phosphate	6	190/5
Do		6	190/5
Poly(1,4-cyclohexylene-dimethylene terephthalate)	1,3,5-tribromobenzene	10	190/5
Do	Ethyl tetrabromobenzoate	10	190/2
Do	Tris(2,3-dibromopropyl) phosphate	15	190/5
Do	Bis(2,3-dibromopropyl) tribromophenyl phosphate	15	190/5
Do	Bis(2-bromoethyl) 3,5-dibromophenyl phosphate	12	200/2
Do	Tri(2-ethylhexyl) phosphate	8	200/2
Do		8	200/2
Poly(1,4-tetramethylene terephthalate)	Tris(2,3-dibromopropyl) phosphate	10	180/5
Do	Bis(2-bromoethyl) 3,5-dibromophenyl phosphate	12	180/5

Films treated in a similar manner yield substantially the same result.

EXAMPLE 5

Continuous filament polyester yarns of the compositions shown in Table 1 are drafted, heat stabilized, and knitted into hoseleg. Each hoseleg is padded with one of the modifiers shown in Table 1 from a solution or emulsion in such a manner as to produce the indicated dry weight pickup. One-half of each hoseleg is placed for a period of time in a zone defined by spaced apart electrically-heated parallel metal plates maintained at various temperatures. Data regarding the temperature of the zone and the period of time the hoseleg is placed between the plates is given in Table 1. The distance between the plates is such that a volume is defined that does not exceed 100 times the volume of the fabric.

The second half of each hoseleg is heated in a forced convection oven at the same temperature for the same

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

We claim:

1. A process comprising:

(A) applying to the surface of a polyester fiber or film a suitable modifier having a boiling point in the range of about 250–400° C. at a pressure of 760 mm. Hg and a vapor pressure of at least 0.1 mm. Hg at 200° C., and

(B) heating the fiber or film at about atmospheric pressure within a temperature range of about 180–220° C. for a period of time in the range of about 5 seconds to about 10 minutes in a zone having a volume less than about 150 times the volume of the fiber or film.

2. The process of claim 1 wherein:

the modifier is applied continuously,

the volume of the zone is less than about 50 times the volume of the fiber, and

the fiber is heated continuously.

3. The process of claim 1 wherein the modifier is an organic compound having a molecular weight of at least about 180 containing at least one aromatic ring, wherein the ratio of the number of carbon atoms which are aromatic, carbonyl or nitrile to the number of carbon atoms which are aliphatic is equal to or greater than 0.5.

4. The process of claim 3 wherein the organic compound has a molecular weight in the range of about 250–1000 and is selected from the group consisting of aryl phosphates, aromatic lactams, chlorinated aromatic hydrocarbons and ethers, aromatic ethers, esters of aromatic carboxylic acids, aromatic esters of aliphatic carboxylic acids, aromatic halogenated ketones, esters of aromatic sulfonic acids, aromatic sulfonamides, aromatic substituted ureas, aromatic nitriles, aromatic hydrocarbons, and mixtures thereof.

5. The process of claim 4 wherein the organic compound is selected from the group consisting of butyl benzyl phthalate, dibutyl terephthalate, dioctyl phthalate, diphenyl phthalate, phenyl butyl phthalate, diphenyl ether, dichlorodiphenyl ether, diphenyl 2-ethylhexyl phosphate, diphenyl sulfone, phenyl benzenesulfonate, N,N-diethyl p-toluenesulfonamide, diphenyl triketone, chlorinated biphenyl, o-terphenyl, 2,4-dichloroacetophenone, and mixtures thereof.

6. The process of claim 1 wherein the modifier is an organic compound containing halogen or phosphorus or mixtures thereof, and wherein:

the weight of the halogen is at least three times the weight of the carbon, and

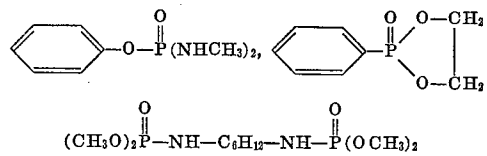
based on the total weight of the compound, the phosphorus comprises at least 6 weight percent.

7. The process of claim 6 wherein:

the weight of the halogen is at least four times the weight of the carbon, and

the phosphorus is in the range of about 14–18 weight percent.

8. The process of claim 7 wherein the modifier is ethyl tetrabromobenzoate, tribromophenol, and 1,3,5-tribromobenzene, trioctyl phosphate, di(2-ethylhexyl)phenyl phosphate, tri(2-ethylhexyl) phosphate, tridecyl phosphate,



bis(bromochloropropyl)bromochloropropyl phosphate,
tris(2,3-dibromopropyl)phosphate,
bis(2,3-dibromopropyl)tribromophenyl phosphate,
bis(2-bromoethyl-3,5-dibromophenyl phosphate, or
tris(2,3-dichloropropyl) phosphate

or mixtures thereof.

9. The process of claim 1 wherein the polyester is of at least 80 mole percent terephthalic acid, and at least 80 mole percent ethylene glycol, tetramethylene glycol or 1,4-cyclohexanedimethanol.

10. The process of claim 12 wherein the polyester is of terephthalic acid, and ethylene glycol, tetramethylene glycol or 1,4-cyclohexanedimethanol.

11. The process of claim 1 wherein an amount of modifier in the range of about 1–25 weight percent, based on the weight of the fiber, is transferred within the fiber.

12. The process of claim 11 wherein the amount of modifier is in the range of about 3–6 weight percent.

13. The process of claim 11 wherein the amount of modifier is in the range of about 6–18 weight percent.

14. The process of claim 1 wherein the modifier is a liquid when applied to the surface of the polyester fiber or film.

References Cited

UNITED STATES PATENTS

3,190,718	4/1928	Schoeneberg et al.	8—130.1
2,536,163	1/1951	Feild et al.	117—139.5 X

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U.S. Cl. X.R.

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