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3,264,390

PROCESS FOR PREPARING MULTI-FILAMENT YARNS

David Tanner, Wilmington, Del., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware

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This application is a continuation-in-part of my copending application Serial No. 118,291, filed June 20, 1961, now U.S. Patent 3,117,906.

This invention relates to a process for producing composite filaments and more particularly to a process for producing splittable composite filaments.

Composite filaments are well known in the art. Such filaments consist of at least two longitudinally extending components which are usually arranged in an eccentric manner with respect to one another so that the differing shrinkage propensities of the components results in the formation of a crimped fiber when the filament is appropriately treated, e.g., with hot water. Such filaments are produced by extruding the components in a side-by-side or sheath-core relationship. Recently it has been found that highly desirable fabrics may be prepared from side-by-side multicomponent filaments which split apart to give two or more filaments in place of each of the original filaments. Filaments of this type are disclosed and claimed in copending applications Serial No. 118,470, filed June 20, 1961, now U.S. Patent 3,117,362, and Serial No. 118,291, filed June 20, 1961, now U.S. Patent 3,117,906.

In order to obtain satisfactory operability in the processing of the filaments after extrusion it is highly desirable that the filament components remain adhered together during the steps of drawing and packaging of the yarn after extrusion. It is also desirable that the components remain adhered together until the yarn is woven into a fabric but that the components separate readily during the fabric finishing steps so that extraordinary measures do not have to be taken in order to achieve substantially complete splitting of the filaments. In addition, it is sometimes desirable that the filaments do not crimp due to different retractive forces when removed from the package for fabric preparation. The components in the filament should, however, shrink to a substantially different extent when exposed to hot aqueous liquids in fabric finishing and also when subjected to higher temperatures in heat setting procedures.

It is an object of this invention to provide an improved process for producing multicomponent side-by-side splittable filaments. Another object is to provide a process for producing composite splittable filaments having the characteristic that the components in the filaments remain adhered together until the yarn is woven into fabric, but are subsequently readily separated during the fabric finishing steps. A further object is to provide a process for producing composite splittable filaments which do not crimp prior to fabric preparation but in which the components exhibit a substantial shrinkage differential in fabric finishing. Other objects will become apparent from the detailed discussion which follows.

The above objects are accomplished by a process which comprises extruding at least one polyamide component having a relative viscosity measured after spinning of about 30 to 60 and at least one polyester component having a relative viscosity measured after spinning of about 15 to 24 from a spinneret orifice in side-by-side relationship to form a composite filament, the ratio of the polyamide viscosity to the polyester viscosity being from 1.5 to 2.5, attenuating the composite filament by pulling it away from the orifice at a speed at least 40 times the

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speed at which it is extruded, quenching the extruded filament, and drawing the filament from 2 to 8 times its original length. Surprisingly, it has been found that by controlling the relative viscosities of the polymer components within the specified limits, good separation of the components can be effected after a fabric has been prepared, yet premature separation, i.e., separation before the fabric has been prepared, is at a minimum. The relative viscosity of the polyester component must be more rigidly controlled than the polyamide relative viscosity. For example, if a third polymeric phase such as a polyalkylene ether anti-static agent is admixed with one or more of the components, the relative viscosity of the polyester component must be adjusted within the range from about 23 to 30 in order to prevent premature splitting.

In carrying out the process of this invention, it is preferred that the general procedure and spinning apparatus described in my copending application Serial No. 118,291 may be used with the previously mentioned being adhered to. In a preferred process, the relative viscosity of the polyester component is from 18 to 22 when no polymeric additive is included and from 23 to 27 when from 2 to 15% of a polymeric additive is included. Preferably, the filaments are drawn at a temperature above 100° C. but below their melting point and then heated at a temperature between about 80° C. and 250° C. while being permitted to retract. By so treating the drawn filaments, substantially straight filamentary structures are provided. The period of heating should be sufficient to cause a retraction in length of from 6 to 11%. Spinning speeds and attenuations within a broad range may be used. The filaments must be attenuated at least 40 times in order to prevent premature splitting; however, attenuations above about 1000 are usually unnecessary.

The expression "relative viscosity" as used herein signifies the ratio of the flow time in a viscometer of a polymer solution relative to the flow time of the solvent by itself. Measurements of relative viscosities given in the examples were made with the following solutions:

5.5 grams of polyamide in 50 ml. of 90% formic acid at 25° C., or

2.15 grams of polyester in 20 ml. of a 7/10 mixture of trichlorophenol/phenol at 25° C.

"Extrusion viscosity" refers to the relative viscosity of polymer samples which are taken before the spinneret assembly is put in place by collecting molten polymer as it is pumped in separate streams to the spinneret.

The viscosities of the polyamide and polyester components in the yarn are determined as follows:

If the yarn sample has a finish on its surface, remove the finish by washing the sample with carbon tetrachloride or other suitable solvent.

Transfer approximately 5 grams of the finish-free sample into a 250 ml. glass stoppered flask. Add 150 ml. of 90% formic acid, and shake until the nylon is in solution (2-3 hrs.). The polyester will remain in suspension. Filter the formic acid solution through a coarse fritted glass funnel. The nylon solution will go through the filter and must be saved. Rinse the sample in the funnel several times with formic acid until all the nylon is washed through. If the final washing turns cloudy upon addition of water, nylon is still present, and the above steps should be repeated. Add the washings to the nylon-formic acid solution.

The sample remaining in the funnel is polyester. Rinse thoroughly with distilled water, and dry in a vacuum oven at 60° C.—usually overnight. Determine the relative viscosity as described above.

Precipitate the nylon by adding distilled water to the formic acid solution and stirring well. Let this precipitate

stand one-half hour to be sure that precipitation is complete. Filter this preparation through a fine fritted glass funnel and then rinse the precipitate several times with distilled water. Dry the precipitated nylon in a vacuum oven at 60° C. Determine the nylon relative viscosity as described above.

Shrinkages of the individual components in the filaments, as reported in the examples, are determined as follows:

The filaments are split to separate the components. This is accomplished by flexing the end of the filament until it begins to split and then pulling the individual components apart. Next, a sufficient number of the individual component filaments are collected to provide a total denier for the filament bundle of about 85 (9.3 tex). The filament bundle is cut to a length of about 20 centimeters, the exact length being carefully observed. Each filament bundle is then boiled for 30 minutes in distilled water under a tension of 15 milligrams, this tension being applied by clamping a small weight to the lower end of the filament bundle. The filament bundle is then air dried and the length of the bundle is again measured. The percentage reduction in length of the filaments relative to the original length is referred to as the boil-off shrinkage. After the boil-off shrinkage is measured, the filament bundle is heated at 205° C. for 3 minutes in an m-cresol vapor bath under the same tension as used previously and the reduction in length of the filament bundle noted. The percentage reduction in length in the m-cresol vapor relative to the length of the bundle after the boil-off shrinkage measurement is referred to as thermal shrinkage.

The splittability of the filaments of this invention is determined by the procedure given below. Samples for determination of premature splitting in drawn yarns are taken after reeling off 10 to 15 yards of yarn to remove any damaged yarn. If a single package is used to represent a yarn lot two samples at least 100 yards apart are taken. When using two or more packages to represent a yarn lot, one sampling from each package is sufficient.

For the determination of filament splittability in the fabric, the yarn of this invention is woven as a filling in a conventional 70-denier nylon warp to form a 100 x 64 plain weave fabric. The fabric is then scoured by boiling for 60 minutes in an aqueous solution containing 10 grams per liter of Varsol (trademark for Esso Standard Oil Company's petroleum distillate), 0.5 gram per liter of Triton X-100 (trademark for Rohm & Haas Company's alkyl-aryl polyether alcohol emulsifying agent) and 0.5 gram per liter of trisodium phosphate. After rinsing and drying, 5 to 10 yarn ends of the filling yarn are removed from each edge of the fabric and discarded. A single filling yarn is then removed from each edge for measurement of splittability. Experience with this test indicates that 75 to 100% splitting in the test will give excellent, i.e., almost complete splitting when the fabric is subjected to normal fabric finishing while 40 to 75% splitting in the test gives a reasonably satisfactory level of splitting in the fabric. Less than 40% splitting in the test gives poor splittability in fabric finishing.

The degree of yarn splitting is determined on samples taken as described above, according to the following procedure:

(1) Cut a piece of the yarn bundle about 1.25 inches long, place it across a 1-inch by 3-inch glass slide and add two or three drops of cedar immersion oil to soak the yarn and wet the slide.

(2) Using a pick with a bent end, gently tease the bundle open and spread it out. Avoid using the point of the pick, as it may split an unsplit filament. When the bundle is well spread, cover the bundle with a 22 x 22 mm. cover glass and blot any excess oil from the edges.

(3) Count the filaments at five equally-spaced intervals. This can be readily accomplished by means of a microm-

eter stage mounted on either a microscope or a viewer such as the Wilder Microprojector. A straight piece of black tape is placed across the center of the view-screen. Align the upper edge of the cover glass with the tape edge with the right end of cover glass in the field. With the micrometer stage, move the slide vertically so that the upper edge moves 3 mm. up from the tape edge. Moving the slide horizontally, count the filaments across the slide, counting right at the tape edge. Move the slide vertically so that the upper edge moves 4 mm. up (7 mm. total from the tape edge) and count as before. Repeat at 4 mm. intervals to obtain five readings. This can also be done using a regular microscope, although it is much less fatiguing and time-consuming with the Wilder viewer.

(4) Repeat steps 1 to 3 on another bundle taken very close to the first for a total of 10 readings. It is possible to take 10 readings on one slide, but results are statistically better if taken over two lengths of yarn.

(5) Calculate splittability as follows:

(a) Average ten readings to obtain N_c (average number of filaments counted)

(b) Calculate percent splitting (% spl.) according to the following equation:

$$\text{Percent spl.} = \frac{N_c - N_s(100)}{N_s(S-1)}$$

where:

N_c = average number of filaments counted

N_s = number of filaments extruded

S = maximum possible number of filaments from one original filament

$S-1$ = number of interfaces between components in filament.

For filaments which split into only two components, $S-1=1$, and the equation becomes

$$\text{Percent spl.} = \frac{(N_c - N_s)(100)}{N_s}$$

The term "spinning speed," as used herein, refers to the linear speed at which the undrawn filaments are wound into a package after extrusion and quenching.

The expression "attenuation" refers to the ratio of spinning speed to the linear velocity of the filaments as they pass through the spinneret orifices, both speeds being in yards per minute.

The term "normal fabric finishing" refers to procedures used in the trade to finish polyester fabrics and includes scouring, heat setting, and bleaching. Relaxed finishing is preferable in those steps which permit it.

The following examples further illustrate the process of the present invention.

Example I

Polyhexamethylene adipamide and polyethylene terephthalate flake are prepared in the conventional manner. The relative viscosities of the flake are shown in Tables 1 to 3 which follow. The polymers are melted separately in screw melters and the melts led separately to the holes of a spinning head of the type shown in FIG. 1 of copending application Serial No. 118, 470, filed June 20, 1961, now U.S. Patent 3,117,362, in which the bottom plate is provided with Y-shaped orifices. The two polymers are fed to the spinneret holes in side-by-side relation in a ratio by weight of 37% polyamide and 63% polyester. The cross-sectional area of each spinneret orifice is 0.145 sq. in. The composite filaments have a trilobal cross-sectional shape of the type disclosed and claimed in U.S. 2,939,201, the cross-section being characterized by a modification ratio of about 2.0. The polyamide portion, designated 6-6 in the table, of the cross-section is ribbon shaped and the polyester portion bell shaped. The filaments are attenuated by winding them at 1150 y.p.m. or about 125 times the speed at which they leave the spinneret and are air quenched in the conventional manner.

The filaments are subsequently drawn on a drawtwister using a 100° C. draw pin and wound into a package in the conventional manner. The draw ratio is shown in Table 1 below. The final drawn yarn consists of 26 filaments of 2.7 denier (0.3 tex) each, the polyamide component being 1.0 denier (0.11 tex) and the polyester component 1.7 denier (0.2 tex).

The filaments are examined for premature splitting and splittability after weaving into fabric as described previously. Results are shown in Table 1 for three yarns, designated A, B, and C, in which the relative viscosity (RV) of the polyamide component at extrusion is progressively increased while the viscosity of the polyester component is held substantially constant. As can be seen, varying the polyamide viscosity within the limits previously specified has no appreciable effect on filament splittability.

TABLE 1

	A	B	C
Polymer RV (6-6/polyester)	35.9/25.2	42.3/25.3	46.9/25.3
Extrusion RV (6-6/polyester)	40.5/22.9	51.3/21.7	57.6/23.2
Yarn RV (6-6/polyester)	42.3/23.4	50.2/22.3	56.0/23.1
Viscosity Ratio, 6-6/polyester	1.80	2.25	2.42
Draw Ratio	3.2	3.2	3.0
Premature Splitting	None	None	None
Splitting in Fabric	Satisfactory	Satisfactory	Satisfactory

Table 2 shows the results obtained when the extrusion viscosity of the polyamide component is held substantially constant while the viscosity of the polyester component is lowered. As can be seen, the splittability of the filaments in fabric form is unsatisfactory for yarn D, yarn E is satisfactory in this respect, while yarn F exhibits excellent splittability.

TABLE 2

	D	E	F
Polymer RV (6-6/polyester)	34.9/26.6	34.2/26.8	34.2/21.4
Extrusion RV (6-6/polyester)	43.6/26.7	40.8/22.0	39.5/20.0
Yarn RV (6-6/polyester)	40.2/26.1	38.0/21.8	38.5/19.2
Viscosity Ratio, 6-6/polyester	1.54	1.74	2.00
Draw Ratio	3.1	3.2	3.3
Premature Splitting	None	None	None
Splitting in Fabric	Poor	Satisfactory	Excellent

Table 3 shows results obtained with yarns G, H, and I, which are prepared as the other yarns except that the polymer is melted on a grid instead of in a screw melter. These results illustrate again that at the higher polyester extrusion viscosity, splittability in the fabric is poor, while at the lower levels satisfactory splittability is obtained.

TABLE 3

	G	H	I
Polymer RV (6-6/polyester)	34.7/25.5	35.5/25.8	34.0/26.7
Extrusion RV (6-6/polyester)	51.0/25.5	48.0/24.1	47.0/23.5
Yarn RV (6-6/polyester)	49.2/25.3	47.1/23.8	45.0/22.9
Viscosity Ratio, 6-6/polyester	1.95	1.98	1.97
Draw Ratio	3.2	3.2	3.2
Premature Splitting	None	None	None
Splitting in Fabric, percent	35	58	94

When yarns D through I are woven into fabric and the fabrics given a relaxed finishing treatment followed by heat setting, bleaching, and dyeing, the fabrics from yarns E, F, H, and I are found to be superior to the other fabrics in bulk and aesthetics.

Example II

Undrawn yarns J through P are prepared as described in Example I, except that an antistatic agent is added during polymerization to the 6-6 polymer. The antistatic agent employed is polyethylene oxide capped with nonylphenol and containing about 30 ethoxy units. This compound is added as a 30% aqueous solution to the stirred autoclave in sufficient amount to give 2.5 percent based on a weight of the final polymer. The undrawn yarn is attenuated by winding at a speed of 1500 y.p.m., which is about 125 times the extrusion speed. The undrawn yarn is then drawn over a hot pin at the pin temperature and draw ratio given in Table 4. After drawing, the yarn is passed through a tube about 3 inches in length and 0.25 inch in diameter where high pressure steam is jetted onto the yarn at the tube entrance to give the temperatures shown in Table 4. The yarn is then wound into a package in the conventional manner at a speed of 750 y.p.m.

Yarn is removed from the package after winding to determine whether it develops a slight crimp due to differential retraction of the components or remains straight as desired. The results of this observation are noted in Table 4 for the various yarns. Table 4 also shows the boil-off shrinkage values for the two components and the difference in shrinkage between the two. Likewise, the thermal shrinkage values and differences are given. As can be seen from the results in Table 4, straight filaments can be obtained under a number of different conditions. However, the combination of straight filaments, together with an appreciable difference in both boil-off shrinkage and thermal shrinkage is obtained only under carefully selected conditions. Yarns N and O are the only ones having straight filaments and a satisfactory level of boil-off shrinkage.

TABLE 4

	J	K	L	M	N	O	P
Spinning Speed	1,500	1,500	1,500	1,500	1,500	1,200	1,500
Relaxation, percent	6	6	9	9	9	9	11
Relax. Temp., °C	200	150	200	150	150	165	200
Draw Pin Temp., °C	100	120	100	100	120	120	100
Draw Ratio	2.35	2.35	2.35	2.35	2.35	2.8	2.35
Yarn off Package	Cr.	Cr.	Str.	Str.	Str.	Str.	Str.
Boil-off Shrinkage, 6-6/polyester, percent	13.5/9.4	13.0/6.7	9.5/10.5	11.1/12.6	10.4/7.4	10.4/6.8	9.9/8.4
Boil off Shrinkage Difference	4.1	7.3	1.4	1.5	3.0	3.6	1.5
Thermal Shrinkage 6-6/polyester, percent	1.1/4.1	1.6/4.8	1.2/3.6	1.3/1.1	1.2/3.4	1.6/6.8	1.3/5.6
Thermal Shrinkage Difference	3.0	3.2	2.4	0.2	2.2	5.2	4.3
Yarn RV 6-6/polyester	45.5/23.6	44.0/23.1	45.5/23.6	45.5/23.6	45.5/22.8	45.7/24.5	45.3/23.2
Viscosity Ratio 6-6/polyester	2.01	1.90	1.93	1.93	1.99	1.86	1.91

Example III

Yarns Q and R are prepared following the general procedure of Example II, except that the antistatic agent is omitted. Yarn is removed from the package after winding to determine whether it crimps or remains straight. As shown in Table 5 below, yarn Q which is given 9% relaxation, remains straight while yarn R, which is given only 6% relaxation, crimps. The split-ability of the filament is satisfactory.

TABLE 5

	Q	R
Polymer RV (6-6/polyester).....	40.0/22.0	40.1/21.9
Yarn RV (6-6/polyester).....	45.1/20.2	45.0/20.3
Viscosity Ratio, 6-6/polyester.....	2.25	2.22
Draw Pin Temp., °C.....	100	100
Relaxation, percent.....	9	6
Relaxation, Temp., °C.....	200	200
Yarn off Package.....	Straight	Crimped

Example IV

Example III is repeated except that the filament cross-section is round. The results are substantially the same as found for the trilobal filament yarns Q and R of Example III.

Example V

Yarns AA, BB, CC, DD, and EE are prepared following the general procedure of Example II. The antistatic agent is omitted from yarns AA and CC. As shown in Table 6 (yarns AA and BB), when the antistatic agent is added to the 6-6 component, appreciable premature splitting is seen. The effect of the antistatic agent is also shown by a comparison of yarns CC and DD when poor splitting in the fabric is encountered with yarn CC at a polyester viscosity level of 26.2 but the splitting is satisfactory when the antistatic agent is added, as in yarn DD, at the same viscosity level.

TABLE 6

	AA	BB	CC	DD	EE
Spinning Speed.....	1,200	1,200	1,200	1,200	1,200
Antistatic agent, percent.....	None	2.5	None	2.5	2.5
Polymer RV (6-6/polyester).....	38.7/22.9	40.5/22.3	45.4/23.4	46.0/23.2	40.9/25.8
Yarn RV (6-6/polyester).....	41.0/18.8	43.4/20.1	49.1/26.2	51.2/26.4	47.5/23.9
Viscosity Ratio, 6-6/polyester.....	2.18	2.16	1.88	1.94	1.99
Draw Ratio.....	3.2	2.9	3.2	2.9	2.9
Relaxation, percent.....	9.0	9.0	9.0	9.0	9.0
Relaxation, Temp., °C.....	175	175	175	175	175
Draw Pin Temp., °C.....	120	120	120	120	120
Premature Splitting.....	None	Appreciable	None	None	None
Splitting in Fabric.....	Excellent	Excellent	Poor	Satisfactory	Excellent

Example VI

A polymer is prepared in an autoclave from 50% aqueous solution of the salt of bis-(para-aminocyclohexyl) methane and azelaic acid. The diamine consists of 70% trans-trans, 25% cis-trans, and 5% cis-cis isomers.

As a viscosity stabilizer, 17.5 millimols of acetic acid are added for every mol of the polyamide salt. The salt solution is heated under 350 lbs./sq. in. pressure for two hours while the temperature is raised to 285° C. The pressure is then reduced to atmospheric while the temperature is raised to 315° C. and the polymer held under these conditions for one hour. It is then extruded and cut to flake in the conventional manner. This polymer and polyethylene terephthalate are melted and extruded to form side-by-side composite filaments in which the polyamide and polyester components have relative viscosities of 44.8 and 19.1, respectively, as described in Example I. The filaments are attenuated, drawn and wound up as described in Example I. When tested by the procedures previously described, filaments do not exhibit any premature splitting, but split satisfactorily in the fabric.

Example VII

A mixture of p-xylylenediamine and m-xylylenediamine containing 10% of the latter diamine is combined with azelaic acid and polymerized. This copolyamide and polyethylene terephthalate are extruded to form a composite filament containing 50% of each component following the procedure of Example I. The filaments are attenuated, drawn and wound up as described in Example I. The copolymer component in the filament has a relative viscosity of 43.8, while the polyethylene terephthalate has a relative viscosity of 19.7. When the yarn is tested as previously described, the filaments are found to split satisfactorily in fabric form but exhibit no premature splitting.

Example VIII

A modified polyethylene terephthalate polymer is prepared as described in U.S. Patent 3,018,272, Example I. This polymer, having a relative viscosity of 20, is extruded in side-by-side relation with polyhexamethylene adipamide having a relative viscosity of 40 following the procedure of Example I. The filaments are attenuated, drawn and wound up as described in Example I. The polyamide component in the yarn is found to have a relative viscosity of 45.1 while the polyester component has a relative viscosity of 19.2. When the yarn is tested as previously described, it is found to be satisfactory in respect to premature splitting and splitting in the fabric.

The foregoing examples illustrate the critical control of process elements required to produce the desired split-able filament product.

The relative viscosity of the polyester component in the yarn must be held at or below 24 in order to obtain satisfactory splitting of the filaments in the fabric. When an additive such as the antistatic agent illustrated in Example II is employed, increased yarn viscosities in the range from 23-27 are desirable in order to prevent premature splitting since such additives increase the tendency

of the filament to split. In the absence of an additive of this nature, the yarn viscosity is preferably held in the range of 18-22. Viscosities below 15 lead to premature splitting and poor yarn properties.

The viscosity of the polyamide component must be adjusted to the proper level relative to the viscosity of the polyester component. Failure to do this leads to poor spinnability of the composite filament due to bending of the filament as it issues from the spinneret orifice. The polyamide relative viscosities should be held in the range of 30-60 and the ratio of polyamide to polyester viscosity should be in the range of 1.5-2.5. Some viscosity combinations within these ranges may lead to some degree of filament bending at the spinneret but minor adjustment of the viscosity will eliminate this and produce straight filaments.

As mentioned previously, the filaments must be attenuated at least 40 times in order to prevent premature splitting of the filament. Attenuations above about 1000 are usually unnecessary and may lead to difficulties in operability of the process. The attenuation, drawing temperature, and polyester viscosity levels should be adjusted relative to one another as illustrated in the examples to achieve optimum splitting characteristics. Ad-

justment in these variables may also be required depending on the area of contact between the components in the filament and upon the amount and type of additives, such as antistatic agents, delusterants, etc., employed.

The composite filaments are preferably heated to a temperature of at least about 80° C. before or during drawing or, while held at constant length, subsequent to drawing to achieve the desired splittability and also to obtain the desired shrinkage differences between the components. Heating the filaments in this manner leads to a higher shrinkage for the polyamide component when the fabric is subjected to hot aqueous treatments in finishing while the polyester component exhibits the higher shrinkage in subsequent heat-setting procedures. The shrinkage differences lead to optimum bulk and aesthetics in the fabric and also act as a driving force to promote splitting.

In order to produce a filament which does not spontaneously crimp when removed from the package for fabric preparation, the filament must be subjected to a hot relaxation or length stabilization treatment under carefully selected conditions of drawing and relaxation. To obtain uncrimped filaments, while retaining a satisfactory level of boil-off and thermal shrinkage, the filaments must be drawn at a temperature above 100° C., preferably 115–130° C., and must subsequently be permitted to relax, sufficient heat being applied during the relaxation step to cause a retraction in length of 6 to 11%. Where a steam treatment is employed, temperatures in the range of 150–200° C. are preferred. Other heating means may be used, however, and if dry heat is employed a somewhat different temperature level may be required.

Suitable fiber-forming polyamides and polyesters suitable for use in the present invention are those described in U.S. Patents 2,071,250, 2,071,253, 2,130,523, 2,130,948, 2,190,770 and 2,465,319. The preferred group of polyamides comprises polyhexamethylene adipamide, polyhexamethylene sebacamide, poly(epsilon-caproamide). Suitable polyesters besides polyethylene terephthalate include those containing recurring units derived from glycols with more than two carbons in the chain, e.g., diethylene glycol, butylene glycol, decamethylene glycol, and trans-bis-1,4-(hydroxymethyl)-cyclohexane.

The yarns and fabrics prepared by the process of this invention are useful for many purposes. The very fine deniers and various cross-sectional shapes which can be

obtained make the woven fabrics particularly desirable substitutes for silks and fine cottons.

I claim:

1. A process for preparing a splittable composite filament which comprises

(1) extruding a polyamide component having a relative viscosity, measured after extrusion, of about 30 to 60 and a polyester component having a relative viscosity, measured after extrusion, of about 22 to 30, the ratio of the viscosities of said polyamide and polyester components being from 1.5 to 2.5, and at least one of said components containing as a separate phase therein a polymeric antistatic agent,

(2) attenuating said filament by pulling it away from the orifice at a speed at least 40 times the speed at which it is extruded, and

(3) drawing said filament from 2 to 8 times its original length.

2. The process of claim 1 wherein said filament is heated after drawing in a relaxed condition at a temperature of at least 80° C.

3. The process of claim 1 wherein said polyamide is polyhexamethylene adipamide and said polyester is polyethylene terephthalate.

4. The process of claim 3 wherein the relative viscosity of the polyester is between 23 to 27.

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