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METHOD OF MAKING RANDOM DYED YARNS

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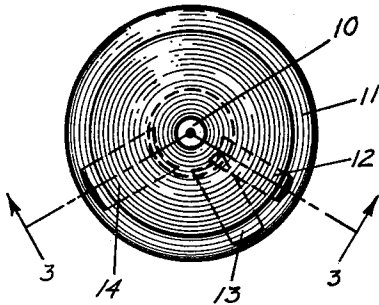


Fig. 1

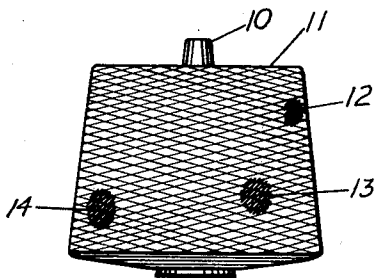


Fig. 2

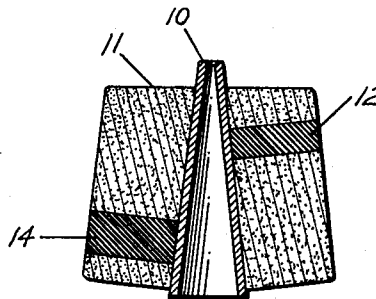


Fig. 3

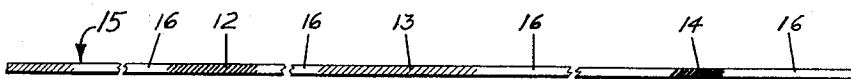


Fig. 4

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METHOD OF MAKING RANDOM DYED YARNS
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3 Claims. (Cl. 8-14)

The present invention relates to random dyed yarns, and more particularly to improved random dyed cellu-
 losic yarns and to the method of making same.

The yarns of the present invention are particularly characterized in that they are dyed in a true random manner and are fast to washing, peroxide bleaching, light and crocking.

The term "true random dyed yarn" as used herein is defined as a yarn that is dyed at various places along the yarn, with varying spaces of dyed area, in a non-repeating pattern, and in fact without any set pattern. Fabrics produced from true random dyed yarns have a random effect, or varying sized dyed areas occurring at irregular intervals, and do not have repeating patterns, recurring patterns, chevron-shaped patterns, stripes, or indeed any set pattern.

The process of the present invention is particularly characterized in that a dye composition comprising essentially fiber reactive dyestuff, alkali and solvent, such as water, is injected into a wound package of cellulosic yarn and the yarn package is allowed to stand until chemical reaction between the dyestuff and the fibers of the yarn has occurred. One or more injections of the foregoing dyestuff composition may be made into the yarn package, using various colors as desired.

The dyestuff may be injected into the yarn package by any suitable means, such as a hollow injection needle, forced air, or a perforated cone under pressure.

Dyestuffs heretofore used for random dyeing were not fast to washing, bleaching or crocking. The lack of wash and crock fastness resulted because the dyestuffs utilized did not become fixed to the fibers of the yarn, and were only insecurely adhered to the surface of the fibers. Fixation could not be carried out in the wound package by the conventional methods of oxidation and steaming. When fabrics that were produced from these non-fast random dyed yarns were washed, the dyestuff bled out into the wash water, causing fading and coloration of the entire fabric.

To overcome the above problem of lack of fastness, the industry resorted to space dyeing. One method of space dyeing comprises winding the yarn into skeins, hanging the skeins on a machine, immersing the various skeins at varying depths into the liquid dyestuff for a period of time, extracting the liquid dyestuff from the yarn, rehanging the skeins on the machine, again immersing the various skeins at varying depths into a second color, extracting the dyestuff from the yarn, and repeating the rehanging, immersing and extraction for each dyed space desired, and finally drying the yarn and rewinding the yarn into a package. The above described method of space dyeing is undesirable because of the high cost of labor involved, the length of time required, the large amount of equipment which must be utilized, and the loss of dyestuff through incomplete exhaustion of the dyestuff from the solvent onto the yarn. However, the most serious disadvantage of the above described method of space dyeing yarns is that the fabrics produced from the resulting space dyed yarns have objectionable

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striped, or repeating and chevron-shaped patterns, because the skein loops have been suspended into the dyestuff.

The most widely used process for producing space dyed yarn is a roller printing process whereby the dyestuff is printed onto the yarn in various colors at varying locations along the yarn, but in a repeating pattern. The principal disadvantage of this process is that an objectionable recurring pattern results in the yarn and in all fabrics produced therefrom, because of the repeating nature of printing rollers. This process is also objectionable because of the high cost involved in engraving or embossing the printing rollers. Each pattern change requires differently engraved or embossed printing rollers, so that it is not commercially practical to produce small quantities of any one yarn by the printing process.

The yarn and method of the present invention are described in detail below in connection with the accompanying drawings in which:

FIG. 1 is a top plan view of a cone of yarn dyed according to the present invention;

FIG. 2 is a front elevational view of the cone of yarn of FIG. 1;

FIG. 3 is a vertical sectional view taken along the line 3-3 of FIG. 1; and

FIG. 4 is a plan view of a strand of yarn dyed according to the present invention.

The method of the present invention produces yarn that overcomes the above described disadvantages and limitations of the prior art in the following manner.

The yarn 15 of the present invention has dyed areas 12-14 and undyed areas 16, and is fast to washing, light, crocking and peroxide bleaching. The dyed and undyed areas are of varying lengths and occur at true random. The fiber reactive dyestuff composition penetrates the cellulosic fibers and becomes fixed thereto and therein by chemical reaction. Thus the yarn may be washed without bleeding and coloration of the undyed areas. Fabrics produced from the yarn of the present invention, such as by tufting, knitting and weaving, do not have the objectionable, repeating, striped or chevron-shaped patterns that are characteristic of fabrics produced from the above space dyed yarns, because the yarn is dyed in a true random manner, e.g. the dyestuff has become fixed along the yarn in varying lengths of dyed area, with varying lengths of undyed areas between the dyed area. The method utilized in dyeing the yarn is inexpensive because such things as expensive printing and dyeing machinery, extensive labor in hanging and rehanging skeins of yarns, and expensive engraving and embossing of printing rollers is eliminated, and only an inexpensive means of injection, such as a syringe and needle, is required. Also, substantially all of the dyestuff utilized in the present method if exhausted onto the fibers, except for small amounts that are unreacted, resulting in a saving of dyes.

According to the process of the present invention, a dye composition comprising essentially fiber reactive dye, solvent and alkali is injected into a wound package of cellulosic yarn. A wetting agent and a mildew resist agent may be added to the dyestuff composition, and when cotton yarn is to be dyed a wetting agent is especially beneficial to insure maximum penetration of the dyestuff into the yarn. The injected package of yarn is allowed to stand at room temperature until the dyestuff has reacted chemically with the fibers; e.g. 24 hours, although some dyestuffs react completely in less time.

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The term cellulosic yarn as used herein is intended to include natural cellulose yarns such as cotton, and converted cellulose yarns, such as viscose, cuprammonium, nitro-cellulose, triacetate and acetate rayon, and blends thereof.

The term "fiber reactive dye" as used herein is defined as the group of dyes in which a dyestuff has been coupled with a chemically reactive group, and that react chemically with textile fibers. Examples of the types of fiber reactive dyes are those having the following new Color Index numbers: Reactive Yellow 1, Reactive Yellow 2, Reactive Yellow 3, Reactive Yellow 4, Reactive Yellow 5, Reactive Orange 1, Reactive Orange 2, Reactive Orange 3, Reactive Red 1, Reactive Red 2, Reactive Red 3, Reactive Red 4, Reactive Red 5, Reactive Red 6, Reactive Red 7, Reactive Red 8, Reactive Red 9, Reactive Red 10, Reactive Red 11, Reactive Red 12, Reactive Violet 1, Reactive Violet 2, Reactive Blue 1, Reactive Blue 2, Reactive Blue 3, Reactive Blue 4, Reactive Blue 5, Reactive Blue 6, Reactive Blue 7, Reactive Blue 8, Reactive Brown 1, and Reactive Black 1.

After the dyestuff has reacted with the yarn, the yarn package may be treated in one of several methods, examples of which follow:

a. The dyed package may be tufted into a fabric, while still in its damp condition, and without further treatment. The tufted fabric should be scoured to remove any unreacted dyestuff, and it may be bleached with hydrogen peroxide;

b. If the yarn package is to be stored in its damp condition, a mildew resist agent should be included in the dye composition;

c. After the chemical reaction has taken place, the yarn may be unwound; scoured, with or without peroxide bleaching; dried; and rewound; and

d. After the reaction has taken place, the yarn may be dried in any suitable manner.

In one method of drying the yarn, the yarn package may be placed on a Foster winder; simultaneously unwound and passed in single strand form through a dryer attached to the winder, said dryer being heated to 600° F. and consisting of electrically heated coils wound about a heat-resistant glass (Pyrex) tube 10" long and ½" in diameter; and rewound.

Useful and illustrative examples of the fiber reactive dyestuff composition follow. The components may be compounded in any desired order, although I prefer to have all the water at about 70° F., and to blend just enough water into the dye powder to form a smooth paste. To about 90% of the remaining water are added the wetting agent and mildew resist agent, if such are used, and the dye paste is then added to the 90% fraction. To the remaining approximately 10% of water is added the alkali, which is mixed with the aqueously carried dye just prior to use.

It is recommended that the dyestuff composition be made fresh before each use to avoid decomposition.

The following components may be added to each gallon of water in the above described manner:

Example a

Fiber reactive dye (the dyestuff obtained from the reaction of equimolar amounts of cyanuric chloride and the compound obtained by coupling diazotized 2-naphthylamine-6:8-disulphonic acid with m-toluidine)	gms.	60	70
Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)	cc.	200	
Sodium bicarbonate	gms.	60	
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)	gr.	40	75

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Example b

Fiber reactive dye (the dyestuff obtained from reacting equimolar amounts of cyanuric chloride and the compound obtained by coupling diazotized 4-chloro-5-methyl-2-aminobenzene sulphonic acid under alkaline conditions with 2-amino-5-naphthol-7-sulphonic acid (coupled in o-position to the hydroxy group)	gms.	30	
Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)	cc.	100	
Sodium bicarbonate	gms.	30	
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)	gr.	40	

Example c

Fiber reactive dye (the dyestuff formed by coupling diazotized 5-nitro-2-sulphoaniline with cresidine, diaotizing the resulting product, coupling the resulting diazotized product with N-dichlorocyanuryl-1:8-aminonaphthol-3:6 disulfonic acid, and condensing equimolar proportions of the resulting diazotized and coupled product with p-aminoacetanilide)	gms.	20	
Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)	cc.	100	
Trisodium phosphate	gms.	10	
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)	gr.	40	

Example d

Fiber reactive dye (the dyestuff obtained by coupling diazotized aniline under alkaline conditions with 2-amino-5-naphthol-7-sulphonic acid and diazotizing the monoazo compound obtained and coupling with 2-(4':6' - dichloro-s-triazin-2'-yl amino)-5-naphthol-7-sulphonic acid)	gms.	50	
Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)	cc.	75	
Sesquicarbonate of soda	gms.	25	
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)	gr.	40	

Example e

Fiber reactive dye (the dyestuff resulting when one mol of diazotized p-aminoacetanilide is coupled with one mol of 1-(2':5'-dichloro-4'-sulfophenyl)-3-methyl-5-pyrazolone, said coupled product hydrolysed and then condensed with equimolar proportions of cyanuric bromide)	gms.	100	
Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)	cc.	300	
Sesquicarbonate of soda	gms.	50	
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)	gr.	40	

Example f

Fiber reactive dye (the dyestuff obtained by coupling diazotized aniline under alkaline conditions with 2-amino-5-naphthol-7-sulphonic acid and diazotizing the monoazo compound obtained and coupling with 2-(4':6'-dichloro-s-triazin-2'-yl amino)-5-naphthol-7-sulphonic acid)	gms.	50	
Sesquicarbonate of soda	gms.	25	
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)	gr.	40	

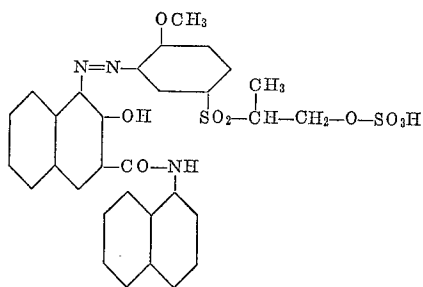
Example g

Fiber reactive dye (the dyestuff resulting when one mol of diazotized p-aminoacetanilide is coupled with one mol of 1-(2':5'-dichloro-4'-sulphophenyl)-3-methyl-5-pyrazolone, said coupled product hydrolysed and then condensed with equimolar proportions of cyanuric bromide)	gms.	100	
Sesquicarbonate of soda	gms.	50	
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)	gr.	40	

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Example h

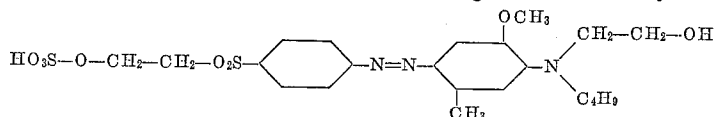
Fiber reactive dye-----gms. 100



Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)-----gms. 300
Sodium hydroxide-----gms. 35
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)-----gr. 40

Example i

Fiber reactive dye-----gms. 100



Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)-----cc. 300
Sodium bicarbonate-----gms. 100
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)-----gr. 40

Example j

Fiber reactive dye (the dye formed when one mol of 2-(4'-aminophenyl)-6-methyl-benzothiazole-disulphonic acid is diazotized and reacted with one mol of a product formed by reaction of equimolar amounts of 2-amino-5-hydroxynaphthalene-7-sulphonic acid and the resulting product is reacted with one mol of 1-aminobenzene-3-sulphonic acid)-----gms. 40
Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)-----cc. 200
Sodium carbonate-----gms. 40
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)-----gr. 40

Example k

Fiber reactive dye (the dye formed when one mol of 4-nitro-2-aminophenol is diazotized, the resulting diazotized product coupled with one mol of 2-(4'-aminophenyl)-amino-5-hydroxy-naphthalene-7:3'-disulphonic acid, the resulting product neutralized with ammonia, and the neutralized product condensed with one mol of 4-amino-2-chloro-1:3:5-triazine)-----gms. 40
Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)-----cc. 300
Sodium metasilicate-----gms. 40
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)-----gr. 40

Example l

Fiber reactive dye (the dyestuff obtained when one mol of meta-amino benzene sulfon fluoride is diazotized and coupled with one mol of 1-(4'-sulphophenyl)-3-carboxy-5-pyrazolone)-----gms. 2.5
Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)-----gms. 10
Alkali (bicarbonate of soda)-----gms. 10
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)-----gr. 2.5

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Example m

Fiber reactive dye (the dyestuff obtained when one mol of 1-amino-4-methylbenzene-3-sulfonic acid-beta-hydroxyethylamide is diazotized and coupled with 1-phenyl-3-methyl-pyrazolone-5 and the free hydroxyl group is esterified with sulfuric acid)-----gms. 2.5
Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)-----gms. 10
Alkali (bicarbonate of soda)-----gms. 10
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)-----gr. 2.5

Example n

15 Fiber reactive dye (the dyestuff formed when one mol of diazotized meta-amino-benzenesulfon-N-ethyleneimine is coupled with one mol of 1-acetyl-amino-8-hydroxy-naphthalene-3:6-disulphonic acid)-----gms. 2.5
20 Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)-----gms. 10
Alkali (bicarbonate of soda)-----gms. 10
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)-----gr. 2.5

Example o

Fiber reactive dye (the dyestuff obtained when one mol of diazotized 2-amino-8-naphthol-5-sulfonic acid is coupled with one mol of 1-phenyl-3-sulfon-beta-chlorethylamide-chloride)-----gms. 2.5
Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)-----gms. 10
Alkali (bicarbonate of soda)-----gms. 10
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)-----gr. 2.5

Example p

Fiber reactive dye (the dyestuff obtained when one mol of diazotized 1-amino-3:4-di-chlorobenzene-6-sulfonic acid is coupled with one mol of 1-methyl-2-(omega-chloro-propionyl amino)-4-hydroxy benzene)-----gms. 2.5
Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)-----gms. 10
Alkali (bicarbonate of soda)-----gms. 10
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)-----gr. 2.5

Example q

55 Fiber reactive dye (the dyestuff obtained when one mol of 1-amino-4-bromo-anthraquinone-2-sulfonic acid is condensed with one mol of 1:4-diaminobenzene-2-sulfonic acid and the resulting product is acylated with beta-chloropropionic acid chloride)-----gr. 2.5
60 Non-ionic wetting agent (ethylene oxide condensate having 9 mols of oxygen)-----gms. 10
Alkali (bicarbonate of soda)-----gms. 10
Mildew resist agent (diisobutylphenoxyethoxydimethyl ammonium chloride)-----gr. 2.5

The above listed examples of fiber reactive dye compositions are all suitable for injection into wound packages of cellulosic yarn, such as cones, tubes and beams. It will be understood that the volume of dyestuff composition injected at each location may be varied, depending on the ratio of dyed yarn to undyed yarn that is desired. It has been found that 10 cc. to 100 cc. of the above dyestuff composition per pound of yarn is desirable.

Several specific examples of the method of the present invention follow.

Example I

Five pounds of undyed cotton yarn, 8,400 yards of 4/2, is Foster wound on a cone 10. The resulting package 11 is of medium density and 7½" high, 8" diameter at the top and 9½" diameter at the base.

Fifty cc. of the dyestuff of Example *a* above is drawn into a syringe equipped with an injection needle 0.0080" in diameter, and having openings spaced along its length. The needle is inserted through the wound package of yarn until the needle point touches the cone. The dyestuff is then expelled from the syringe and into a portion 12 of the yarn.

Two hundred and fifty cc. of the dyestuff of Example *b* above is likewise injected into a second portion 13 of the yarn package.

Five hundred cc. of the dyestuff of Example *c* above is likewise injected into a third portion 14 of the yarn package.

The package of wound yarn is allowed to stand at room temperature for 24 hours, following which it may be stored or dried or tufted into a fabric.

Example II

Three pounds of undyed viscose rayon yarn, 3,150 yards of 1.25/1, is Foster wound onto a tube to form a package 8" high and 6" diameter, medium density.

Three hundred cc. of the dyestuff composition of Example *f* above is injected into the yarn package in the above described manner.

One hundred and fifty cc. of the dyestuff composition of Example *g* above is injected into a second location on the yarn package in the manner described above.

Thirty cc. of the dyestuff composition of Example *h* above is injected into a third location on the yarn package in the above described manner.

The yarn package is allowed to stand at room temperature for 24 hours; wound into skeins; scoured in a bath containing 0.015 oz. of non-ionic detergent (ethylene oxide condensate) and 0.025 oz. of 35% hydrogen peroxide per gallon of water; dried in an oven at 200° F.; and rewound onto tubes. If desired, an equivalent amount of sodium peroxide may be substituted for the hydrogen peroxide in the bleaching composition.

Example III

Eight pounds of undyed cuprammonium rayon yarn, 6,720 yards of 2/2, is Foster wound onto a cone to form a package of medium density 8" tall, 6½" diameter at the top, and 9" diameter at the base.

Ninety cc. each of the dyestuff compositions of Examples *a*, *b*, *c*, *d*, *e*, *f*, and *g* above are separately injected into the yarn package at different places on the package, in the above described manner.

The yarn is allowed to stand at room temperature for 24 hours.

Example IV

This example is identical to Example III above, except that 80 cc. each of the dyestuff compositions of Examples *h*, *i*, *j*, *k* and *l* are substituted for the dyestuffs utilized in Example III.

Example V

This example is identical to Example III above, except that 90 cc. each of the dyestuff compositions of Examples *m*, *n*, *o*, *p* and *q* above are substituted for the dyestuff compositions utilized in Example III.

Example VI

Three pounds of undyed cotton yarn, 50,400 yards of 20/1, is Foster wound onto a cone to form a package of medium density, 6" tall, 5" diameter at the top, and 8" diameter at the base.

Forty-five cc. of the dyestuff composition of Example *d*

above is injected into the yarn in the above described manner.

One hundred cc. of the dyestuff composition of Example *e* above is injected into the yarn at a second location on the package, in the above described manner.

Fifty cc. of the dyestuff composition of Example *h* above is injected into the yarn at a third location on the package, in the above described manner.

Seventy cc. of the dyestuff composition of Example *i* above is injected into the yarn at a fourth location on the cone, in the above described manner.

The wound package of yarn is allowed to stand at room temperature for 24 hours.

The cone of yarn is placed on a Foster winder; unwound; and dried by passing it in single strand form at 100 yards per minute through a heating unit at 600° F. which comprises a heat-resistant glass (Pyrex) tube, 10" long and ½" in diameter, the outside of which is wound with electric coils; and rewound onto another cone.

Example VII

Seven pounds of undyed cotton yarn, 44,100 yards of 30/2, is Foster wound onto a cone, resulting in a package of yarn 8" tall, 7" diameter at the top, 9½" diameter at the base, medium density.

Seventy cc. each of the dyestuff compositions of Examples *j*, *k*, *l*, and *m* above are separately injected into the yarn package at different areas on the package, in the above described manner.

The yarn package is allowed to stand at room temperature for 24 hours.

Example VIII

Eight pounds of undyed cotton yarn, 6,720 yards of 2/2, is Foster wound onto a cone, resulting in a yarn package 8" tall, 7½" diameter at the top, 10" diameter at the base, medium density.

Eighty cc. each of the dyestuff compositions of Examples *n*, *o*, *p*, and *q* above are separately injected into the yarn package at different areas on the package, in the above described manner.

The package of wound yarn is allowed to stand at room temperature for 24 hours.

Example IX

Eight pounds of undyed viscose rayon yarn, 16,800 yards of 5/2, is Foster wound upon a cone, resulting in a yarn package of medium density, 8" tall, 7" diameter at the top and 9" diameter at the base.

One hundred cc. each of the dyestuff compositions of Examples *a*, *b*, *c*, *d* and *e* above are separately injected into the yarn package at different places, in the above described manner.

The wound package of yarn is allowed to stand for 24 hours.

Example X

This example is identical to Example IX above, except that 80 cc. each of the dyestuff compositions of Examples *i*, *j*, *k*, *l* and *m* are substituted for the dyestuff compositions utilized in Example IX.

Example XI

This example is identical to Example IX above, except that 90 cc. each of the dyestuff compositions of Examples *n*, *o*, *p* and *q* are substituted for the dyestuff compositions utilized in Example IX.

There are numerous methods of producing fabrics having a random dyed effect from the above yarn. For example, the random dyed yarn may be utilized in the conventional manner for forming the entire pile of a tufted rug or carpet, and the resulting rug or carpet may be overdyed if desired. Woven fabrics may be produced from the above yarn, using it in the warp or filling, or both, and it may be interwoven with dyed or undyed warp and filling yarns in any desired manner;

the resulting woven fabric may be overdyed if desired. Other methods of utilizing the yarn of the present invention will become readily apparent to those skilled in the art of fabric construction.

I claim:

1. In the method for random dyeing cellulosic yarn wherein liquid dye composition is injected into at least one selected portion of a wound package of yarn to provide a yarn having dyed areas and undyed areas of varying lengths occurring at random along the yarn, the improvement comprising the steps of utilizing a dye composition comprising fiber reactive dye, water and alkali as the liquid dye composition injected into the wound package of yarn, and permitting the injected wound package of yarn to stand until the fiber reactive dye has reacted chemically with the yarn.

2. In the method according to claim 1 and further

characterized in that the dye composition utilized also contains wetting agent, and also further characterized in that the yarn is scoured and dried after said fiber reactive dye has reacted chemically with the yarn.

3. In the method according to claim 1 and further characterized in that the dye composition utilized is injected at 70° F.

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