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METHOD OF FUGITIVELY TINTING AND
LUBRICATING YARNS

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This invention relates to a method of fugitively tinting and lubricating yarns, especially those composed of or containing organic derivatives of cellulose such as cellulose acetate, cellulose propionate, cellulose acetate propionate, cellulose acetate butyrate and the like, and more particularly to a method of treating such yarns to adapt them for use in half hose and other types of knitting operations.

As is well-known, it is customary in the textile art to temporarily color yarns with an easily removable dye or fugitive tint for the purpose of identification as to number of filaments, twist, denier, type of material employed in the yarn, number of ends in warping, weaving and similar processes. This method of identification is of especial importance in half hose knitting, particularly where, as is frequently the case, two different types of yarn such as cellulose acetate and regenerated cellulose or cotton yarns, are employed and the knitting machine is designed to throw one of the yarns as it is being knit from one face to the other of the knit socklet, thus producing a plaited material having a definite pattern. In order to discern if the pattern has been properly arranged by the knitting machine, one of the yarns is tinted while the other is untinted thus producing a colored face on a white background or vice versa. It is also customary to apply a lubricant to yarns to reduce the tendency toward breakage of the individual filaments or fibers when they are subjected to various mechanical strains incident to such operations as spinning, twisting, winding, reeling, weaving, knitting and the like, and to reduce friction. Hence, the essential treatment of a yarn prior to its use on a knitting machine embodies the application of a fugitive tint for purposes of identification and the application of a lubricant to reduce friction between the yarn and guides, needles, and other parts of the machinery with which it may come in contact.

Although fugitive dyestuffs soluble in oils are available, experience has shown that generally they have insufficient tinctorial power and therefore water-soluble tints may be used to greater advantage. However, aqueous solutions or dispersions of fugitive dyes as heretofore known and used have been unsatisfactory in many respects in practical application. For example, such aqueous solutions or suspensions may not be continuously applied by means of a wick due to the filtering action of the wick on the dye. Again, such compositions have not proved satisfactory

for roll application because of insufficient wetting action.

This invention has as its principal object to overcome the above-mentioned defects and to provide a highly efficient and satisfactory method for fugitively tinting and lubricating yarns, particularly those composed of or containing organic derivatives of cellulose, such as cellulose acetate, cellulose propionate, cellulose acetate propionate, cellulose acetate butyrate and the like. A further object is to provide a method for the tinting and lubricating of such yarns without the introduction and retention of excessive moisture in the material. A still further object is to improve the character of tinting solutions designed for the fugitive tinting of cellulose acetate and other yarns so that such solutions may be satisfactorily applied by roll or other method of application. Another object is to provide a tinted and lubricated yarn capable of being woven or knit into a fabric with a minimum of defects in the fabric and susceptible of having the fugitive tint readily removed therefrom by ordinary scour baths. Other objects will appear hereinafter.

Many of the tints used for the purpose indicated here contain appreciable quantities of salts, such as sodium sulfate and sodium chloride, which crystallize on the yarn and tend to increase the friction or drag, thus making it more difficult to carry out winding and knitting operations. This increase in friction is not uniform along the length of the treated yarn which adds further to the difficulties of knitting. In some cases the tint itself may give rise to undesirable crystalline formations upon evaporation of the solvent. The specific advantage possessed by the method of treatment to be more fully set forth hereinafter over all existing processes lies in the fact that a film of lubricant is applied over the tint, thus covering whatever crystals may be present with an oily layer and thus maintaining a smoother, more uniform surface on the yarn filament.

The above objects are accomplished by the following invention which, in its broader aspects, comprises a multi-stage process in which the yarn is first fugitively tinted by applying thereto a special type of aqueous tinting solution having a fairly low surface tension, drying the fugitively tinted yarn to a moisture content of approximately 8% and not over 25%, based on the dry weight of the yarn, and thereafter applying a textile lubricant to the yarn. The tinting fluid is conveniently applied to the yarn during the spinning operation, preferably as the yarn emerges from the spinning cabinet. The fluid

may be applied in any convenient manner, either by roll, spray or immersion application. The conditions of application are controlled so that the treated yarn contains immediately after treatment about 20 to 25% moisture, of which approximately 3 to 7%, and preferably 5%, is lost during the ballooning stage and prior to the winding operation, resulting in a moisture content of 15 to 20%, and preferably 18%, when wound on the spinning bobbin. This step is then followed by the application, preferably during the twisting of the yarn or the thread of a few per cent of a suitable textile lubricant, such as a coning oil, for example, a light mineral oil, blown or unblown, drying or semi-drying, saponified or unsaponified, sulphonated or acetylated, oxidized or unoxidized, vegetable or animal oil and the like. In addition to such oils we may apply a polyhydric alcohol, such as ethylene glycol, diethylene glycol and ester or ether derivatives of glycols, polyglycols, oleic acid, stearic acid and fatty alcohols.

Among the lubricants which we have found of particular value may be mentioned synthetic esters produced from fatty acids of high molecular weight and saturated fatty alcohols of low molecular weight such as esters produced from fatty acids having from 12 to 22 carbon atoms in the chain and aliphatic alcohols containing less than 9 carbon atoms in the chain. Specific examples of such esters are ethyl oleate, amyl laurate, butyl stearate and octyl oleate.

The esters just referred to may be employed alone or in conjunction with emulsifying agents such as soaps, sulfated or sulfonated derivatives of natural oils and fats, ethanolamine salts of sulfated fatty alcohols and other emulsifying agents. The proportion of emulsifying material employed may vary within rather wide limits. Usually about 10% of the emulsifying agent is employed, but as much as 50% or even more may be desirable under some circumstances. The fatty acids may be pure or may be mixtures of two or more high molecular weight fatty acids, as mentioned above.

Referring now to the aqueous tinting fluid itself. We have found that the aqueous solutions or suspensions of fugitive dyes customarily employed may not be satisfactorily applied by the usual method of roll application. This we have found is primarily due to the fact that such compositions do not have a sufficiently low surface tension to make roll application possible. After extensive work with these solutions and their application to yarns of various types, particularly those composed of or containing organic derivatives of cellulose, such as cellulose acetate, we have discovered that if one employs a soft soap, that is, a soap produced by the action of potassium or ammonium hydroxide upon higher aliphatic acids, such as stearic, oleic, palmitic, lauric, etc., in the aqueous tinting solution, the surface tension is sufficiently reduced to permit such compositions to be satisfactorily applied as yarn lubricants in the customary way. Other surface tension active materials which may be applied to advantage in this process are saponamines, quaternary ammonium derivatives, igepons and other representatives of cation-active and anion-active compounds. The amount of the soft soap or other surface tension agent which may be added to the tinting fluid may vary within rather wide limits, but, under ordinary circumstances of use, we prefer to employ from 0.5% to 5%, based on the weight of the

solution. In general, it may be said that the surface tension of the tinting solution should be such that it readily wets a suitable metal roll and experience has shown that the optimum value for the surface tension lies approximately within the limits of 20 and 40 dynes per centimeter.

Between 15 and 30% of the tinting fluid, based on the weight of yarn, may be applied in the spinning operation, depending upon the exact composition of the fluid which is employed and the depth of color desired on the yarn. In general, it is preferable to keep the total moisture deposited at or below approximately 25%, based on the dry weight of the yarn, immediately after application. Application of the tinting fluid is preferably carried out by means of a sand-blasted metal roll dipping into a bath of the fluid, the roll being rotated at the point of contact in the same direction as the movement of the yarn. However, these fluids may also be applied by means of wicks, atomizing and other standard methods.

Specific examples of our aqueous tinting compositions are as follows:

Example I

	Parts
Oleic acid-----	1.00
Ammonia-----	0.05
Dyestuffs-----	0.95
Distilled water-----	98.00

Example II

	Parts
Olive-fig soap-----	1.00
Dyestuffs-----	0.80
Water-----	98.20

Example III

	Parts
Stearic acid-----	1.00
Ammonia-----	0.05
Dyestuffs-----	0.95
Water-----	98.00

Example IV

	Parts
Potassium laurate-----	0.99
Xylene Brilliant Blue B. C.-----	0.91
Acid Violet 4 BNS-----	0.40
Water-----	97.70

One of the specific advantages of the use of compositions of the type above illustrated is the fact that they are easily removable by the usual scour baths. Inasmuch as both the soap and the dyestuff are water-soluble, both can be readily removed by washing in water or solutions of soap or mild alkalies. The soft soap and moisture give sufficient lubrication to permit the yarn to withstand the normal abrasion encountered in the spinning operation.

It might be supposed that the yarn tinted as just described could be employed directly in knitting or other textile operations without further treatment. We have found, however, that it is necessary to lubricate the yarn by the application of one of the lubricants above referred to, since otherwise defects in the fabric are liable to result as previously discussed. We accordingly lubricate the tinted material, thus producing a yarn, the individual filaments of which are tinted and may be regarded as having a coating or impregnation of dyestuffs, over which is a layer or coating of lubricant. Inasmuch as the yarn is usually dried to a residual moisture content of about eight percent before application of the

lubricating layer, it is in a satisfactory condition for storage or immediate use in a desired knitting or other textile operation, a result which is unattainable when one employs a tinted aqueous oil emulsion of the customary type, or applies the aqueous tinting fluid from one bath and then immediately follows this with a lubricating dressing without some intermediate drying.

Our invention will be more fully understood by reference to the following example:

Cellulose acetate yarn of 150 denier and containing 40 filaments is fugitively tinted as it leaves the spinning cabinet by passing in contact with an applicator roll dipping in a bath of a tinting composition comprising 1.0 parts by weight of oleic acid, .05 part ammonia, 1.0 parts of acid blue RBF Ex, Conc. Dye stuff (Index 696), 100 parts water. The yarn then passes to a conventional type of winding device where it is wound on a bobbin. The yarn as wound on the bobbin contains about 17% residual moisture based on the dry weight of the yarn. The yarn may then be stored for future use or it may be unwound from the bobbin when the moisture content is further reduced to about 8%, and lubricated by means of roll, spray, immersion or other type of application with butyl stearate.

Under such circumstances no positive drying of the yarn will be necessary to reduce the residual moisture content to the desired amount, since as the yarn passes from the fugitive dye application to the bobbin some aeration takes place and moisture is considerably reduced thereby. In addition, when the yarn is unwound from the bobbin and passes to the lubrication step, even though it contains considerable moisture, additional aeration takes place with a further reduction in moisture. In any event, whether the moisture is removed incidentally in the operations through which the yarn passes before it reaches the lubricating step or is positively removed by a separate drying operation, the eventual moisture content of the yarn prior to lubricating and twisting is preferably within the range of 6-12% and preferably 8%. An especially convenient technique for the fugitive tinting and lubrication of yarn in accordance with our invention is to apply the tint during spinning and, after reduction of residual moisture to the desired figure, to apply the lubricant in twisting.

Although in the above examples we have described a process in which the yarn is tinted, then wound on bobbins and finally unwound and lubricated, both the tinting and lubricating of the yarn may be carried out as part of a continuous process if provision is made for reducing the residual moisture content to at least 25%, and preferably to 8% before application of the lubricant.

In order further to clarify the matter of moisture content of the yarn at the various stages of spinning, winding, and twisting, it may be said that there are two principal procedures which may be followed in treating yarn in accordance with our invention. The first procedure is to apply the aqueous tinting solution to the yarn during spinning, that is, either within the cabinet, or just after the yarn emerges therefrom and prior to winding on a bobbin or similar device, followed by storage of the yarn and then application of the lubricant during or just prior to twisting. With this procedure, as previously indicated, the moisture content of the yarn as it leaves the tinting roll is approximately 20-25%,

based on the dry weight of the yarn. Anywhere from 3% to 7% of this moisture is lost in the ballooning incident to winding, so that the average moisture content of the yarn on the bobbin is approximately 17% or 18%. When the yarn is unwound from the bobbin it undergoes further reduction and finally arrives at the lubricating roll with a moisture content of preferably 8%. This method of treating the yarn is thus seen to be discontinuous. The other method involves treating the yarn in a continuous manner by applying the aqueous tint, for example, just as the yarn emerges from the spinning cabinet, and then conveying it directly to a twister. In this case the yarn is lubricated just prior to twisting and under the aerating influence of the ballooning incident to twisting the yarn undergoes reduction of moisture to below 25%, and preferably to about 8%, just prior to the instant it contacts the lubricant.

It has also been found that yarn when produced according to either of the above procedures, and particularly where the moisture is reduced to about 8% before application of the lubricant, undergoes a further slight reduction of moisture after the lubricating step so that the moisture in the yarn package ranges from about 5% to 7%. The finished yarn thus has approximately the ideal moisture content which is in the vicinity of 6%.

It will thus be seen that we have provided a definitely improved technique for the fugitive tinting and lubrication of yarns. By our method, it is now possible to control the amount of residual moisture in the lubricated material, first by the use of tinting compositions which do not tend to entrain moisture in the material and second, by a drying step which reduces the moisture to the desired degree before the lubricant is applied. By employing this technique with yarn intended for half hose knitting, we have found that the yarn knits much more evenly and with a clearer pattern than is the case if the fugitive dyestuff is employed in conjunction with the oil as is customary practice. Another outstanding advantage of our invention is that it permits application of the aqueous tinting fluid by means of a sand blasted or similar roll, a result, at the high speeds encountered in spinning, hitherto not readily attainable.

As illustrating the salutary effect which our process has in improving the knitting quality of cellulose derivative yarns, the following results of tests made under actual knitting conditions are given: Fourteen dozen pairs of socks were knitted from each of three samples of cellulose acetate yarns. The sample designated A was composed of yarn tinted and lubricated in accordance with the method herein described, while those designated as B and C were standard acetate yarns obtained in the open market. Examination of each sock was made and every sock which showed any defect which could in any way be attributed to the condition of the yarn itself was rejected. Of the three samples there were 33% rejects for sample B, 38% for sample C, while for sample A there were only 19% rejects. It will thus be seen that an outstanding and unexpected improvement in the knitting qualities of yarns is obtained by the use of our invention. These improved characteristics of yarn treated in accordance with our invention are, we believe, largely due to the fact that any surface irregularities (due to crystalline formations) which may be present in the dye coating are covered or

coated with a layer of lubricant. It will thus be apparent that we have, in effect, actually produced a new type of yarn especially well adapted for half hose knitting and other textile operations.

What we claim and desire to secure by Letters Patent of the United States is:

1. The method of treating yarn composed of or containing an organic acid ester of cellulose to render it capable of running freely to and from yarn packages and over guides, needles, and other parts of textile machinery with a minimum of friction and a uniform "drag" or tension, which comprises applying to the yarn an aqueous solution or suspension of a water-soluble fugitive dye which may contain substances tending to produce crystalline deposits on the yarn upon evaporation, reducing the residual moisture content of the yarn to not over about 8%, and thereafter applying over the fugitive dye a thin layer of a textile lubricant composed of an ester of an acid of 12-22 carbon atoms and an alcohol of less than 9 carbon atoms, said layer providing a protective coating which eliminates the tendency of any crystalline deposits present in the fugitive dye to cause increased and non-uniform friction or "drag."

2. The method of treating yarn composed of or containing an organic acid ester of cellulose to render it capable of running freely to and from yarn packages and over guides, needles, and other parts of textile machinery with a minimum of friction and a uniform "drag" or tension, which comprises applying to the yarn an aqueous solution or suspension of a water-soluble fugitive dye which may contain substances tending to produce crystalline deposits on the yarn upon evaporation, reducing the residual moisture content of the yarn to not over about 8%, and thereafter applying over the fugitive dye a thin layer of a textile lubricant composed of butyl stearate, said layer providing a protective coating which eliminates the tendency of any crystalline deposits present in the fugitive dye to cause increased and non-uniform friction or "drag."

3. The method of treating yarn composed of or containing cellulose acetate to render it capable of running freely to and from yarn packages and over guides, needles, and other parts of textile machinery with a minimum of friction and a uni-

form "drag" or tension, which comprises applying to the yarn an aqueous solution composed of:

	Parts by weight	
Oleic acid	1.0	5
Ammonia	0.05	
Acid blue RBF Ex. Conc. Dyestuff (Index 696)	1.00	
Water	100	10

drying the yarn to a residual moisture content of not over about 8%, and thereafter applying over the fugitive dye a thin layer of a textile lubricant composed of butyl stearate, said layer providing a protective coating which eliminates the tendency of any crystalline deposits present in the dye to cause increased and non-uniform friction or "drag."

4. The method of treating yarn composed of or containing cellulose acetate to render it capable of running freely to and from yarn packages and over guides, needles, and other parts of textile machinery with a minimum of friction and a uniform "drag" or tension, which comprises applying to the yarn an aqueous solution composed of:

	Parts	
Potassium laurate	0.99	
Xylene Brilliant Blue B. C.	0.91	
Acid Violet 4 BNS	0.40	30
Water	97.70	

drying the yarn to a residual moisture content of not over about 8%, and thereafter applying over the fugitive dye a thin layer of a textile lubricant composed of butyl stearate, said layer providing a protective coating which eliminates the tendency of any crystalline deposits present in the dye to cause increased and non-uniform friction or "drag."

5. A synthetic yarn composed of or containing an organic derivative of cellulose tinted on its surface with a water-soluble fugitive dye and which is capable of running freely to and from yarn packages and over guides, needles and other parts of textile machinery with a minimum of friction and a uniform "drag" or tension, said yarn having deposited over the fugitive dye a coating of butyl stearate.

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