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PROCESS FOR DYEING BLENDS OF NYLON 6 AND NYLON 66

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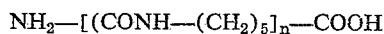
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6 Claims. (Cl. 8—21)

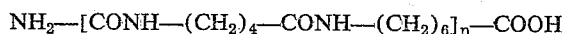
The present invention relates to certain improvements in the dyeing of nylon.

One of the principal objects of the invention is to provide a novel dyeing procedure for obtaining maximum shade contrast between two different types of nylon fibers, namely the so-called nylon 6 and nylon 66, when these fibers are dyed together. It is also an object of the invention to provide a process for avoiding "barré effect" in the dyeing of nylon fabric. Other objects will also be hereinafter apparent.

It is a well known fact that nylon 6 dyes much deeper than nylon 66 when these two materials are dyed together in the same dyebath. This difference is not apparently due to any chemical differences between these two types of nylon fibers since, from a strictly chemical viewpoint, the fibers are, in fact, quite similar. Thus, nylon 6 is characterized by the general formula



while nylon 66 may be illustrated as



n representing a whole number in both instances.

If it were possible to segregate an individual molecule of each of these types of nylon and dye these two molecules together, it is probable that an identical dyeing effect could be obtained. However, as a practical matter, these nylons do not dye to the same shade when dyed together presumably because of physical differences which occur as a result of the procedures used in manufacturing same. The customary step of stretching these fibers so that the molecules are oriented and lay in bundles side by side and end to end on their long axes, is believed to have a particular effect in physically differentiating these two types of nylon. Thus, in the case of nylon 66, there is apparently a high geometric orientation, the passways between the molecules are of a definite size and only dye particles equal to or smaller than the size of these passways may penetrate the fiber.

V. N. Nikitin (J.S.D.C. 69,227) (1953) found by infrared spectrum that different maxima in the NH bond existed for nylon 6 than nylon 66. Ortheil (Dissertation 1955, Stgt.) found nylon 6 has different electrostatic areas due to preferable concentration of amino or carboxyl groups. This may indicate that nylon 6 is less subject to a geometrical orientation. Due to the volume of atoms and steric hindering (space blocking), more and some larger passways exist in nylon 6 than in nylon 66.

As understood in the art, dyestuffs attach themselves to the nylon molecule at the NH_2 (amino) site at one end of the linear chain molecule, at the CONH (amide) site in the center of the chain, and at the COOH (carboxyl) site at the other end of the chain. In the latter case, this is done only in an alkaline medium.

By virtue of the physical differences discussed above, it is possible that dye molecules which are very slightly larger than the passways between the molecules of nylon 66 will not get into the passways so that they can attach themselves to the amide group on the nylon molecule. However, this same molecule may enter the passageways between nylon 6 molecules as these passways are larger than the nylon 66 passways, and the molecule of dye may thus attach itself to the nylon 6 amide groups. Presum-

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ably, this is why nylon 66 dyes more lightly than nylon 6 when these two types of nylons are dyed together.

In any event, and despite the shade differences which can be obtained when dyeing nylon 6 and nylon 66, there are times, e.g. for styling purposes, when it may be desirable to obtain a product comprising an even greater shade contrast, i.e. where the nylon 66 fibers are essentially undyed with substantially full dyeing of the nylon 6 fibers. The present invention makes it possible to accomplish this result for the first time in a straightforward and highly effective manner.

According to the present invention, it has been found that optimum shade contrast can be obtained between nylon 6 and nylon 66 fibers by dyeing a mixture of these fibers in an essentially neutral dyebath (pH between about 6.5 and 7.5) which contains, in addition to the nylon dyestuff or dyestuffs, polyvinylpyrrolidone or the like and ethoxylated tallow alcohol or the equivalent thereof.

The exact reason for the success of the present invention is not fully understood. However, it is believed that the unique results of the invention are due to the following factors although it is not intended that the invention should be limited to this explanation:

(a) The neutral or slightly acid dyebath appears to prevent dyeing of the carboxyl (COOH) group at one end of the nylon molecules;

(b) The polyvinylpyrrolidone has a greater affinity for the nylon dyestuff than either nylon 6 or nylon 66 and, in a sense, preferentially absorbs the dyestuffs or forms a complex thereof thereby preventing the dye molecule from attaching to the amino (NH_2) group of the nylons; and

(c) The ethoxylated tallow alcohol or the equivalent partially disperses the polyvinylpyrrolidone-dye complex and because of the large micelle structure which this dispersing agent builds into the solution, the resulting polyvinylpyrrolidone-dye-ethoxylated tallow alcohol system is confined to a particle size which is larger than the passways between the nylon 66 molecules but smaller than the passways between the nylon 6 molecule so that the dye molecules can attach itself to the amide groups of the nylon 6 but not those of the nylon 66.

While polyvinylpyrrolidone is preferred, it is possible to use in lieu thereof, or in addition thereto, some other water-soluble compound of like characteristics which has a higher affinity for the dyestuff than the nylon and will form an equivalent complex therewith. Typical alternatives are oxazolidiones such as polyvinylloxazolidione and hydantoin.

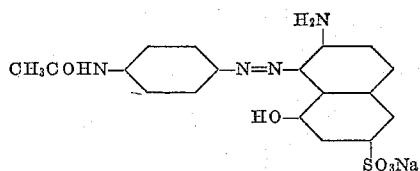
The amount of polyvinylpyrrolidone or the like utilized herein may vary considerably. The more of this agent that is used, the more slowly the dyebath will exhaust. Amounts ranging from 0.5% to 1% on the weight of the fiber, using about a 20 to 1 water/fiber ratio, are generally satisfactory. Preferred conditions would involve the use of essentially equal amounts of polyvinylpyrrolidone and dyestuff required to develop the shade.

Ethoxylated tallow alcohol is the preferred dispersing agent for use herein but other materials may also be used, e.g. partially sulfonated long chain saturated fatty acids, such as partially sulfonated stearic, lauric or palmitic acid or essentially similar dispersing agents which build in solution a large micelle structure.

The amount of ethoxylated tallow alcohol and/or other dispersing agent used herein may be varied as desired. Usually, however, from 0.5% to 2% by weight of the fibers being dyed will give satisfactory results with about 1% representing the preferred amount.

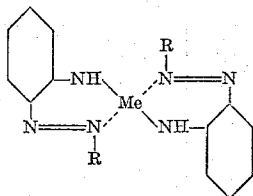
Any of the conventional dyestuffs for nylon can be used in the present invention. These are usually anionic dyestuffs and as suitable there may be mentioned the following representative groups: acetate dyes, acid dyes

and metallized dyes. Typical specific examples of such dyestuffs are:



(C.I. Acid Red 231)

Premetallized neutral dyeing dyestuffs, which are generally known as the 1:2 metal-complex dyes, are preferred. Specific examples of this preferred group of dyes are:



wherein Me stands for Cu, Co, etc., and R is an organic radical, e.g. methyl or other alkyl.

The nylon 6 and nylon 66 fibers as dyed herein may be in either fabric or non-fabric form. The fabric or other mixture of these fibers may include additional fibers such as cellulose, wool, Dacron, Orlon and/or other natural or synthetic textile materials. These other fibers, e.g. cellulosic, may be dyed with direct dyes while simultaneously dyeing the nylon. Due to the retarding action of the polyvinylpyrrolidone or the equivalent on the ability of direct dyes to stain nylon, it is not necessary to incorporate in the bath a direct dye inhibitor for nylon such as an alkyl naphthalene sulfonate.

The dyebath of the invention may include conventional amounts of the nylon dyestuff or dyestuffs. Usually, this will amount to from 0.5 to 6.0% by weight of the fibers being dyed. Generally, the dyebath water to fibers ratio is such as to provide from 12 to 40 parts water, preferably 20 parts, per part fibers, on a weight basis.

The dyeing time and temperature may be widely varied. Usually, however, satisfactory dyeings can be obtained by operating at 180 to 200° F. for from 60 to 300 minutes at atmospheric pressure. Slight variations in pressure may be used as desired.

The invention is illustrated, but not limited, by the following examples wherein parts and percentages are by weight unless otherwise indicated:

Example I

Woven fabric consisting of 10.7% nylon 6; 10.7% nylon 66; 15.6% viscose rayon and 63% cotton was scoured thoroughly in a dyebeck in conventional manner using an alkaline scour with a non-ionic detergent (i.e. Triton X-100) until all size and oil were removed. The thus scoured cloth was then well rinsed in water.

Water was then fed into the dyebeck in an amount sufficient to give a 20:1 ratio by weight of water to fabric. The water was heated to 100° F. and there was then added 1% of the weight of the cloth of ethoxylated tallow alcohol (previously dispersed in water). The cloth was then run in the beck for 10 minutes at 100° F.

Thereafter 1% of polyvinylpyrrolidone (previously dissolved in water) was added to the dyebeck followed by 4% of previously dissolved direct dyestuffs (specifically Lumicrase Grey 3 LBN and Superlite Orange LLLWF) and 1% of previously dissolved 1:2 metal-complex dyestuffs (i.e. Irgalan Grey BL Capracyl Yellow NW), these percentages being based on the weight of the fabric.

The dyeing was run for 10 minutes at 100° F. and then 10% (on the weight of the cloth) of previously dissolved sodium chloride was added and the dyeing run for an additional 10 minutes at 100° F. The sodium chlo-

ride was used for the purpose of increasing the exhaustion rate of the direct dyes. Only 10% thereof was used to prevent excessive decharging of the nylon surface.

The dyebath was heated to 200° F. in one hour and dyeing was continued at 200° F. for an additional hour after which the fabric was rinsed well, dried and finished.

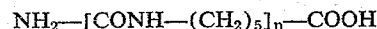
The above procedure was carried out on two separate dyeings of four yards each and compared to conventional dyeings using the same fabric and shade. The degree of contrast achieved between the nylon 6 and nylon 66 was much greater using the present process than was the case with the conventional dyeings. In other dyeings of nylon piece fabric, it was also apparent that the present process could be used to reduce "barrè" effect.

Example II

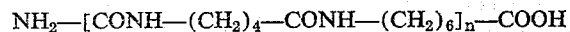
The process of Example I was repeated using hydantoin in lieu of polyvinylpyrrolidone and partially sulfonated stearic acid instead of ethoxylated tallow alcohol with essentially equivalent results.

It will be appreciated that various modifications may be made in the invention described herein without deviating from the scope thereof as set forth in the following claims wherein I claim:

1. In a process for dyeing textile materials containing fibers of a first nylon characterized by the general formula

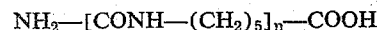


and containing fibers of a second nylon characterized by the general formula

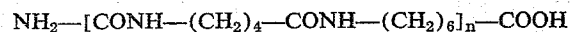


n representing a whole number in both instances, the improvement which comprises dyeing said materials in an essentially neutral dyebath which contains polyvinylpyrrolidone and ethoxylated tallow alcohol.

2. In a process for dyeing textile materials containing fibers of a first nylon characterized by the general formula

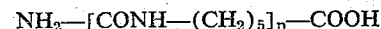


and containing fibers of a second nylon characterized by the general formula

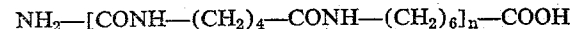


n representing a whole number in both instances, the improvement which comprises dyeing said materials in an essentially neutral aqueous dyebath containing a nylon dyestuff, a water-soluble agent which has a greater affinity for said dyestuff than for nylon and forms a complex therewith thereby preventing the dyestuff from binding with nylon through the amino group therein; and a dispersing agent for said complex which builds in solution a large micelle structure.

3. In a process for dyeing textile materials containing fibers of a first nylon characterized by the general formula



and containing fibers of a second nylon characterized by the general formula



n representing a whole number in both instances, the improvement for obtaining maximum shade contrast between said first nylon and said second nylon which comprises dyeing said mixture in an essentially neutral dyebath including an anionic dyestuff for nylon, a complex-forming member selected from the group consisting of polyvinylpyrrolidone, hydantoin and polyvinylloxazolidinone, and dispersing agent selected from the group consisting of ethoxylated tallow alcohol and a partially sulfonated long chain saturated fatty acid.

4. The process of claim 3 wherein the amount of said complex-forming member is from 0.5% to 1%, and the

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amount of said dispersing agent is from 0.5% to 2%, said percentages being based on the weight of material being dyed.

5. The process of claim 4 wherein the water content of said dyebath is such as to provide about a 20 to 1 ratio between the water therein and the material being dyed. 5

6. The process of claim 5 wherein the dyestuff is a 1:2 metal-complex dye.

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