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IMPREGNATED WOOL FELT AND METHOD OF MAKING SAME

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The present invention relates to the treatment of wool felts under which term is included all grades of felts containing wool fibres blended with cotton fibres or with synthetic fibres such as viscose rayon.

This application is a continuation in part of application S. N. 312,673, filed by me on October 1, 1952, and now abandoned.

Colored felts of wool or wool blended with other fibres which have been only partially felted and which exhibit a soft hand or drape are commonly known in the trade as upholstery, millinery, athletic or decorative felts. Inasmuch as these felts are non-woven, it has always been necessary to produce such felts in a minimum weight of from 7 oz. to 8 oz. per square yard in order to provide sufficient bulk and tensile strength in the lengthwise direction to permit dyeing at the boil on convention reel type kettle dyeing equipment. As there is considerable strain in the lengthwise direction on the felt during the dyeing operation, it is not unusual for pieces of felt to stretch out excessively during dyeing even sometimes with the relatively heavy weights thereof i. e. 8 oz. per square yard and above, which are regularly produced. This condition creates a defective material with thin spots which show considerable voids when perched against the light. Furthermore, the dyed shades appear open or mottled, especially in the areas where the wool or other fibres have been caused to separate during dyeing due to the excessive stretching of the felt. For these reasons, it has never been found commercially practical to produce those particular grades of felt in lighter weights than 7 oz. to 8 oz. per square yard when they are to be subjected to ordinary dyeing processes.

It is an object of the present invention to provide a new and unusual method in the manufacture of felt comprised entirely of wool fibres or of wool fibres blended with other fibres to strengthen the felt prior to the operation of dyeing it.

It is a further object of the present invention to provide a method for the treatment of felt comprised entirely of wool fibres or of wool fibres blended with other fibres during its manufacture to increase its tensile strength before dyeing it without in any way interfering with the conventional dyeing procedures.

It is a further object of the present invention to provide a method for the treatment of felt comprised entirely of wool fibres or of wool fibres blended with other fibres during its manufacture to increase its tensile strength before dyeing, but which will not in any way alter the original desirable characteristics of said felt of having a soft hand or drape.

It is a further object of the present invention to produce dyed felts comprised entirely of wool fibres or wool fibres blended with other fibres of weights lighter than those which have heretofore been practically attainable.

It is a further object of the present invention to produce dyed felts comprised entirely of wool fibres or of wool fibres blended with other fibres having weights of 6 oz. per square yard and less.

Further objects and advantages of the present invention will be obvious from the following description which includes an example of a preferred embodiment of the present invention and from the claims appended hereto.

My treatment of the felt comprises impregnating it by immersing it in an aqueous bath containing a synthetic rubber latex of acrylonitrile and butadiene copolymer in aqueous suspension and then subjecting it to heat and thereby drying it before dyeing it. The felt during the immersion will pick up rubber solids and after drying will retain from 5% minimum to 20% maximum of the weight of the original felt of such rubber solids. In most instances I have found it desirable to have the rubber particle pickup about 15% of the original weight of the felt. As a specific example which has proven very successful and which has produced a light weight dyed wool felt of outstanding qualities and which forms a preferred embodiment of my invention, I recite the following:

After the light weight wool felt has been fulled or felted to a suitable consistency, it is scoured or rinsed to remove any excess of soap or chemical used as a fulling assistant. Should acid have been used during the felting process, the felt must be neutralized by an alkali bath of any well known suitable type and thoroughly rinsed. The felt is then squeezed out with a rubber roll squeezing machine of conventional design to remove excess moisture. It has been found that if moisture of about 80% of the original weight of the felt is allowed to remain, the following process will be successfully carried out, but the amount of moisture content at this point is not critical. The felt is then impregnated by submerging it at room temperature in a bath basically comprising 20% to 30% by volume of a synthetic rubber dispersion composition of approximately 60% acrylonitrile by weight and 40% butadiene by weight having a pH index of about 8.5, a specific gravity of about 1.0, viscosity of about 12 centipoises, particle size of about 1200 Angstroms with a solids content of about 40% by volume and including an appropriate non-ionic emulsifier such as a polymerized ethylene oxide-alkyl phenol condensation product such as is commercially designated as Igepal and 80% to 70% by volume of water. Synthetic latices such as that just described with the above described non-ionic emulsifier included are manufactured and sold by B. F. Goodrich Company under trade names and designations such as Hycar Latex, type 1561, and Hycar Latex, type 1571. To this may be added ½% by weight of aryl sodium sulfate, commercially known as Alkanol WXN, which acts as a wetting agent thus insuring the even wetting out of the felt and an even distribution of the latex throughout the fabric. However, the emulsifier also acts as a wetting agent which when the felt to be impregnated is already fairly wet may in some cases be sufficient. There is also added to the bath .5 pound of sodium aluminate to each 100 pounds of dry solids of rubber in the bath to effect a slight curing of the rubber at the time of impregnation which may be designated precuring. After submersion for a few seconds, say about three, the felt is removed from the bath and again is squeezed out to remove excess of the synthetic rubber latex bath. However, at this time only as much squeezing pressure is exerted as is necessary to reduce the moisture content to approximately 100% of the original weight of the felt. The presence of this amount of moisture gives assurance that a sufficient amount of rubber solids will be picked up and retained by the felt. The felt is then dried to a natural width without excessive stretch in a tenter chain hot air dryer of conventional design at a temperature preferably in the neighborhood of 180° Fahrenheit. The amount of rubber solids remaining in the dried felt should be from a minimum of

4% to 6% to a maximum of 15% to 20% of the original weight of the felt, but in most cases and for most practical purposes nearer the top of this range than the bottom. The proper amount of rubber solids that are picked up is controlled both by the amount of pressure exerted on the felt after submersion as well as by the strength of the latex bath in which the felt is submerged.

For example, I have conducted the impregnation step of my novel process by starting with a felt carrying water equivalent to 80% of its original weight when immersed. The latex bath instead of being 20% to 30% of the latex dispersion composition with 80% to 70% of water added, as in the example described above, is used without dilution by water. The method and time of immersion are the same but the felt after immersion is squeezed to such an extent that it carries liquids equivalent to 120% of its original weight. Upon drying and partially curing at 180° Fahrenheit the felt has been found to have acquired latex particles representing about 16% of its own weight.

During the drying step, after submersion in the synthetic rubber latex bath, the heating of the felt to 180° Fahrenheit which should last about ten minutes accomplishes, particularly due to the presence of the sodium aluminate hereinbefore mentioned, a partial curing of the rubber particles now impregnating the felt. The amount of curing accomplished at this point is, however, not critical as a more complete curing as is hereinbelow stated is accomplished during the dyeing process.

The dried felt obtained as described above is now introduced into a suitable piece dye kettle of conventional design and in the usual manner at approximately normal dyestuff bath initial temperature of from 70° to 80° Fahrenheit which is raised during the dyeing process to the boiling point of the dye bath, approximately 212° Fahrenheit. By way of example, a dye kettle of suitable design for this purpose may be described as a liquid tight wooden or stainless steel lined tub of a size to hold 400 gallons to 600 gallons of dye liquid which is equipped with an overhead reel or drum wide enough to accommodate four or five strings of felt; a string of felt generally comprising two pieces of felt sewn together end to end to form a continuous loop. The drum or roll is so placed that the strings of felt extend below the level of the dye liquid and the felt is continuously kept in motion as it passes therethrough as the reel is turned.

It has been discovered that a wide variety of dyestuffs may be used and the choice of dyestuffs varies according to the blend of the felt to be treated. If the felt is all wool, straight acid types of dyestuffs are used. When exceptional fastness of color is desired the afterchrome types of dyestuffs may be used. If the felt is a blend of wool with an admixture of cotton or synthetic fibres, it is desirable to use dyestuffs which will successfully dye the component fibres. Generally this is done by using what is commonly known to the trade as acid wool dyes together with dyestuffs commonly known to the trade as direct cotton dyes or by using dyestuffs which will dye any of the fibres present. By way of further description acid wool dyes are mostly alkali salts of sulfonated or carboxylated mono-, di- or poly-azo compounds of aniline derivatives. Direct or cotton dyestuffs are generally diazotized compounds of aniline derivatives. Many of these dyestuffs have the characteristic properties of dyeing wool fibres as well as cotton or viscose fibres.

It has been discovered, however, that in all cases the addition to the dyestuff bath of about ⅛% to ¼% by weight of the felt to be dyed before the dyestuffs are added thereto of an aryl sodium sulfate such as Alkanol WXN not only facilitates the uniform wetting out of the felt in the dye bath but also creates a condition whereby the uniform absorption of the dyestuff and the affinity thereof for the felt is considerably enhanced. The felt should be immersed in the bath containing this wetting agent about ten minutes at room temperature before the dyestuffs are added.

The actual mixture of dyestuffs used is no part of the present invention and is determined by the constituents of the felt to be dyed, as hereinabove stated, the color desired and the effect upon the dyed product by its contemplated final use. However, solely by way of example and in no way limiting the scope of the present invention the following examples of dye baths are set out in detail.

Example 1.—For dyeing of felt comprised entirely of wool fibres and impregnated as above described the following is added to the dyestuff bath after the wetting out process by an aryl sodium sulfate such as Alkanol WXN as hereinbefore stated is completed, from 1% to 4% of the weight of the felt to be dyed of the actual dyestuff in a pre-dissolved condition. The exact amount of dyestuff used depends upon the depth of shade desired. During the heating of the dye bath there is also added thereto 10% to 15% by weight of the felt to be dyed of Glaubers salt and 2% to 5% by weight of the felt to be dyed of sulphuric acid (66° Baumé). The actual dyestuff may be chosen from any of the following acid dyes Acid Scarlet (79), Acid Orange II (151), Tartrazine Yellow (640), Brilliant Acid Blue (707), Acid Violet (698), Napthylamine Black (246) depending upon the color desired. In each case the number in parenthesis following the commercial name of the dye is the colour index number.

Example 2.—For dyeing of felt comprised entirely of wool fibres and impregnated as above described when an after chroming step is added choice may be made from any of the following dyes Alizarine Red (1034), Chrome Orange (40), Alizarine Yellow (36), Alizarine Blue (1085) and Diamond Black (299). In each case the number in parenthesis following the commercial name of the dye is the colour index number. In such a case the actual dyestuffs are added, after the wetting out process described in Example 1 is completed, in amounts ranging from 1% to 4% of the weight of the felt to be dyed. Here again the exact amount of dyestuff used depends upon the depth of shade desired. Further as in Example 1, during the heating of the dye bath there is also added thereto 10% to 15% by weight of the felt to be dyed of Glaubers salt and 2% to 5% by weight of the felt to be dyed of sulphuric acid (66 Baumé). In order to achieve the characteristic fastness of the chrome dyes there is added to the dye bath after dyeing from 1% to 3% of the weight of the felt to be dyed of potassium bichromate and the felt is kept in the dye bath an additional thirty minutes during which time the dye bath is kept at a boil.

Example 3.—For dyeing felt of wool fibres blended with cotton or viscose rayon and impregnated as above described, from 2% to 6% by weight of the felt to be dyed of the actual dyestuff is used. The exact amount of dyestuff used here again depends upon the depth of shade desired. Dyeing is carried out with the addition of 10% to 20% by weight of the felt to be dyed of Glaubers salt and from 1% to 2% by weight of the felt to be dyed of acetic acid. The actual dyestuff can be chosen from any of the following direct cotton dyes which also have equivalent properties of dyeing wool Benzo Purpurine 4B (448), Benzo Fast Orange (653), Chloramine Yellow (631), Benzo Blue (406), depending upon the color desired. In each case the number in parenthesis following the commercial name of the dye is the colour index number.

The dyeing procedure may now be carried out in accordance with completely conventional methods for wool dyeing or for dyeing of wool blended with other fibres. It is recommended that the impregnated felt be submerged in the dye bath for about thirty minutes while the bath is kept at the boil, i. e., about 212° Fahrenheit. This also insures the complete curing of the rubber latex impregnated in the felt. In cases of blended fibres it is desirable

to allow the felt to remain in the dye bath for a cool off period of about fifteen minutes before rinsing and drying. In the case of felt comprised entirely of wool fibres this cooling off period is not essential and the felt may be rinsed immediately.

While other synthetic latices may be used in the impregnation operation I have described above, I have found that butadiene acrylonitrile copolymer latex has two distinct advantages over other generally known synthetic latices. First, it has been found that all other presently available types of synthetic latices impart objectionable rubber odors to the felt which remain in the finished material and preclude its use for many of the end purposes for which such felts are designated unless sometime during the manufacture of the felt it is impregnated also with a substance producing a masking odor. Butadiene acrylonitrile copolymer latex is the only presently commercially available product which has been found that does not exhibit a rubber odor in the felt when produced by the method described herein. Secondly, it has been found that butadiene acrylonitrile copolymer latex when applied to a felt comprised entirely of wool fibres or of a blend of wool, cotton and synthetic fibres has a very unique property in that it penetrates the fibres to a greater degree than any other known available type of rubber product. It is common knowledge that ordinarily a rubberized fabric resists to an extreme degree the affinity for water and it follows that such resistance is also exhibited to the absorption of aniline dyestuff from conventional dye baths of the generally used range of aniline dyestuffs. Thus, the use of natural rubber latex or any of the other available synthetic latices would result in coating the outside of the wool and other fibres which would create blotchy, uneven shades in the material after dyeing.

While I have hereinabove described and given as an example a specifically designated butadiene acrylonitrile copolymer latex containing 40% butadiene particles by weight and 60% acrylonitrile particles by weight it is to be understood that specific proportions of butadiene particles and acrylonitrile particles present in the solution is not essential to the present invention so long as the other important physical characteristics, to wit, particle size, pH index, proper emulsification and the presence of a proper curing agent are maintained within the proper ranges which are particle size 600–2000 Angstroms and pH index from 8.5 to 9.4. For example where it is desired to have the product more oil resistant because of its end use, a higher percentage of acrylonitrile may be used.

Thus with the treatment by impregnation with butadiene acrylonitrile copolymer latex the normal property of the impregnated felt exhibits a tensile strength which is far greater than that of the original untreated felt. The increase in tensile strength imparted to 4 oz. to 6 oz. felt comprised entirely of wool fibres or of wool fibres blended with cotton fibres or synthetic fibres is sufficient so that it may be dyed in a reel type dye kettle as above described without excessive stretch in the lengthwise direction. The choice of a butadiene acrylonitrile copolymer latex having its desirable qualities has made this increase in tensile strength possible without undue clogging of the surface of the material or the formation of any preventive coating of the individual fibres which would resist even wetting and level absorption of the dyestuff. Furthermore, the characteristic of the butadiene acrylonitrile copolymer latex to penetrate into the fibres permits the maintenance of the soft and drapy hand in the treated felt after impregnating and dyeing. This increase in tensile strength is further enhanced by the automatic final curing of the butadiene acrylonitrile copolymer latex during the dyeing process normally carried out at the boiling point of the dye bath. This improvement in tensile strength has in several cases been found to be as great as 50%.

It has also been discovered that after dyeing and drying to conventional widths of about 72 inches, felt comprised entirely of wool fibres or of a blend of wool, cotton and synthetic fibres which has been treated in accordance with the process described herein exhibits a marked improvement in its resistance to relaxation shrinkage. Comparative samples of untreated felts and felts treated in accordance with the process described above when wet out show that the felt impregnated with butadiene acrylonitrile copolymer latex as described above shrinks only about 50% as much as untreated material. This benefit of an improvement in shrinking has also been accomplished it is believed by the completion of the curing of the butadiene acrylonitrile copolymer latex in the boiling dye bath.

What I claim is:

1. In the manufacture of light weight dyed wool felt, the impregnation thereof prior to the dyeing operation with butadiene acrylonitrile copolymer latex of approximately 60% acrylonitrile and 40% butadiene composition having a pH range between 8.4 and 9.5 compounded with a non-ionic emulsifier in aqueous suspension and the subsequent dyeing thereof wherein said dyed felt has a weight not exceeding 7.2 ounces per square yard.

2. In the manufacture of light weight dyed wool felt, the impregnation thereof prior to the dyeing operation with particles of butadiene acrylonitrile copolymer latex derived from an aqueous bath having dispersed therein 20% to 30% of a synthetic rubber latex of approximately 60% acrylonitrile and 40% butadiene composition having a pH range between 8.4 to 9.5 compounded with a non-ionic emulsifier and the heat curing of said latex in said felt and the dyeing thereof simultaneously with the completion of said heat curing but subsequent to said impregnation wherein said dyed felt has a weight not exceeding 7.2 ounces per square yard.

3. In the manufacture of light weight dyed wool felt, the impregnation thereof prior to the dyeing operation with particles of a synthetic latex derived from an aqueous bath having dispersed therein 20% to 30% of a synthetic rubber latex of approximately 60% acrylonitrile and 40% butadiene composition having a pH range between 8.4 to 9.5 compounded with a non-ionic emulsifier and having the properties of increasing the tensile strength of said felt and of penetrating the individual wool fibres thereof and the heat curing of said latex in said felt partially during the drying thereof at temperatures in the neighborhood of 180° Fahrenheit and finally during the dyeing thereof at the boiling temperature of the bath used in said dyeing operation wherein said dyed felt has a weight not exceeding 7.2 ounces per square yard.

4. In the manufacture of light weight dyed felt containing wool fibers, the impregnation thereof with butadiene acrylonitrile copolymer latex particles by the immersion of said felt in an aqueous bath in which a synthetic rubber dispersion of approximately 60% acrylonitrile and 40% butadiene composition having a pH range between 8.4 to 9.5 compounded with a non-ionic emulsifier is suspended and the dyeing thereof in which the dyeing step is performed after said impregnation wherein said dyed felt has a weight not exceeding 7.2 ounces per square yard.

5. In the manufacture of light weight dyed felt containing wool fibers, the impregnation thereof with particles of butadiene acrylonitrile copolymer latex derived from an aqueous bath having dispersed therein 20% to 30% of a synthetic rubber latex of approximately 60% acrylonitrile and 40% butadiene composition having a pH range between 8.4 and 9.5 compounded with a non-ionic emulsifier, the partial curing of said latex in said felt and the dyeing of said felt at a temperature to complete the curing of said latex, the steps of dyeing of said felt and of the completion of the curing of said latex being performed after said impregnation and said partial curing wherein said dyed felt has a weight not exceeding 7.2 ounces per square yard.

6. In the maufacture of light weight dyed felt containing wool fibers, the impregnation thereof with particles of a synthetic latex derived from an aqueous bath having dispersed therein 20% to 30% of a synthetic rubber latex of approximately 60% acrylonitriie and 40% butadiene composition having a pH range between 8.4 to 9.5 compounded with a non-ionic emulsifier and having the properties of increasing the tensile strength of said felt and of penetrating the individual wool fibers thereof, the heat curing of said latex in said felt partially during the drying thereof at temperatures in the neighborhood of 180° Fahrenheit and finally the dyeing thereof at the boiling temperature of the bath used in said dyeing operation whereby the curing of said latex is completed wherein said dyed felt has a weight not exceeding 7.2 ounces per square yard.

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