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ACROLEIN-FORMALDEHYDE CONDENSATION PRODUCTS AND PROCESS OF APPLYING THE SAME TO CELLULOSE FABRIC

Dmitry M. Gagarine and Henry Repokis, Danville, Va., assignors to Dan River Mills, Incorporated, a corporation of Virginia

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The present invention is concerned with the treatment of textile materials with an acrolein-formaldehyde condensation product to impart novel and highly desirable characteristics, which the untreated materials do not possess, and which are not obtainable with other products heretofore used for treating textiles.

In accordance with this invention, we produce wrinkle-resistant textile materials that have, inter alia, two outstanding characteristics, namely, complete permanence as shown by resistance to commercial laundering at high alkaline pH's, and no retention of the chlorine commonly used in commercial laundering to bleach or whiten the goods. These treated materials also possess the desirable properties of permanent dimensional stability and freedom from yellowing and discoloration regardless of subsequent treatments.

Although certain compounds heretofore known and used for treating textiles will provide the desired wrinkle-resistant characteristics, they are deficient with respect to resistance to commercial laundering conditions and to chlorine retention. A good example of such a compound is the melamine-formaldehyde-urea reaction disclosed in our application Serial No. 187,854, filed October 2, 1950. That product imparts to textile materials such as cotton, rayons, etc., excellent crease-resistant or wrinkle-resistant characteristics that have long been desired, but are not obtainable with the prior art products and processes, and cloth treated with compounds disclosed in that application has been satisfactorily produced and sold on a wide commercial scale. The process is applied principally to fine gingham or other sheer cotton goods and rayons for use in making ladies' and children's dresses. Such products are normally laundered at home without the use of strong bleaches or highly alkaline soaps and therefore do not involve the problems arising from commercial laundering conditions.

However, it is equally desirable to provide wrinkle or crease-resistant characteristics to goods and garments that are commonly laundered in commercial laundries, such as, for example, sheets, pillow cases, men's shirts and table linens. It has heretofore been a major commercial problem to produce these textile products and garments with the desired crease-resistance and, concomitantly, resistance to commercial laundering conditions. The process and product of the present invention has accomplished, for the first time, that long-desired objective by properly treating the textile materials with the above acrolein-formaldehyde condensation product. Materials and garments so treated will withstand commercial launderings for the normal life thereof without losing the crease-resistant characteristics. Furthermore, they will not retain the chlorine which would be retained by crease-resistant compounds heretofore used. Chlorine-retention in the goods is a very undesirable property of the prior treating compositions because of this chlorine, upon subsequent steaming and ironing of the goods, or garments, is converted into hydrochloric

acid which deteriorates the cellulose and ruins the strength of the goods.

We are aware that formaldehyde and compounds which release formaldehyde have been utilized for producing wrinkle resistance and dimensional stability in cellulosic textile fabrics; however, these formaldehyde compounds have proven unsatisfactory because they tender textile fabrics excessively. This tenderizing is so pronounced that reaction of formaldehyde with cellulose sufficient to produce a satisfactory degree of crease resistance in the fabric will cause a loss in strength which will destroy the utility of the fabric. In contrast thereto, fabrics treated in accordance with the present invention show little decrease in tear strength, tensile strength, or abrasion resistance and, in some instances, each of these strength properties has been improved by the treatment and, at the same time, an increase in crease resistance has been noted.

Completely white fabrics may be treated according to this process without the yellowing which has been present in fabrics treated with prior art processes. Strong alkali is the known culprit which causes yellowing of fabrics treated with such materials as acetone-formaldehyde condensation products. Commercial chlorine containing bleaching agents are known to be equally guilty of yellowing fabrics treated with melamine formaldehyde type thermosetting resins. The acrolein-formaldehyde condensation product utilized in this process withstands repeated attacks by either the strong alkali or the chlorine bleach and no yellowing is noted on even the whitest goods.

The process of preparing the above acrolein-formaldehyde condensation product is shown in the following typical but non-limiting examples of its preparation given for sake of completeness of disclosure of this application.

EXAMPLE A

Constituents	Amounts, pounds	Mol Ratios
Acrolein	56	1
Formaldehyde (Formalin)—37.5%	325	4
Sodium Carbonate	1-8	¼%-2%

EXAMPLE B

Constituents	Amounts, pounds	Mol Ratios
Acrolein	56	1
Formaldehyde (Formalin)—37.5%	128	1.57
Paraformaldehyde	73	2.43
Sodium Carbonate	4-8	1%-2%

In the above two examples, utilizing four mols of formaldehyde to one mol of acrolein, the formaldehyde may be divided into two equal parts consisting of two mols each. One portion is added to the one mol of acrolein, which has been freshly distilled so as to have it present in unpolymerized, reactive state. This mixture of formaldehyde and acrolein is relatively stable and may be kept overnight at room temperature in the dark. To the other two mols of formaldehyde are added sufficient sodium carbonate to bring the pH of the mixture to about 9, and to this mixture is then added the acrolein-formaldehyde mixture. The total amount of sodium carbonate in a typical case is about 1% based on the total weight of the reaction products, and of this amount about one-half could be added at first to the formaldehyde-sodium carbonate mixture, and then the other half added to the complete reaction mixture. The amount of catalyst must be reasonably controlled and kept to less

than 10% of the entire mixture to prevent the formation of pentaerythritol.

After the exothermic reaction is completed, the reaction mixture may be neutralized with a suitable mineral acid, such as hydrochloric acid or sulfuric acid, and in sufficient amount to lower the pH of the mixture to about 2 to 2.5. The reaction mixture is now cooled to room temperature and is ready for use in treating textiles in accordance with the present invention.

Where a slower and less exothermic reaction of acrolein and formaldehyde is desired, an organic catalyst of less basicity may be used in the above-described reactions.

For example, .05% by weight of 1,5 methyl ethyl pyridine may be used as a catalyst in accordance with the above examples. In such instances, the pH of the mixture at the beginning of the reaction is about 6.7, but gradually increases until it is slightly above 7, and then appears to drop again at the end of the reaction to about 6.5 so that the finished product requires no neutralization.

The reaction product is not a heat-setting resin as are the prior art textile treating resins. Even long-continued heating in the presence of an acid producing catalyst does not cause the reaction product to harden. It is instead a cross-linking reagent in that it cross-links the cellulose molecules together to form a stronger, more rigid system than does the unreacted cellulose.

A particularly significant characteristic of the acrolein-formaldehyde condensation product is its ability to retain its general reactive properties when condensed in the presence of polyhydric alcohols. Products of this type, found particularly advantageous in the treatment of viscose rayon fabrics, may be made according to the following examples:

EXAMPLE C

A typical procedure for making an oxidized corn starch modified acrolein formaldehyde condensation product particularly adapted for the treatment of viscose rayon and rayon blend fabrics is carried out by adding 25 pounds of oxidized corn starch to 475 pounds of formalin (37% formaldehyde) in a first kettle and heating the mixture to about 160° F. with stirring until it is clear. This requires about five minutes, after which the reaction mixture is cooled to below 140° F., at which time 300 pounds of finely powdered paraformaldehyde are added with continued stirring. Simultaneously, 300 pounds of acrolein are distilled into 385 pounds of formalin in a second separate kettle to form a relatively stable mixture. In a third kettle 14 pounds of soda ash are made up to a 20% aqueous solution.

The contents of the second and third kettles are simultaneously added to the reaction mixture of the first kettle with stirring and external cooling. The condensation reaction is highly exothermic and the introduction of soda ash and the acrolein-formaldehyde mixture must be carefully regulated to prevent unreasonably high temperatures and possibly uncontrollable conditions. The reaction product is cooled to approximately room temperature and brought to pH–2 with muriatic acid. Triethyl amine is then added with stirring to bring the reaction product to pH–9. The product is now ready for storage in drums and is preferably aged before it is used in the treatment of textile fabrics.

This reaction product possesses the same general properties as that of Examples 1 and 2, but appears to have a higher molecular weight which is beneficial in the treatment of viscose rayon.

EXAMPLE D

A plain corn starch modified acrolein-formaldehyde condensation product particularly useful for the treatment of cellulose acetate fabrics may be made by adding 48 pounds of corn starch to a first kettle containing 1,260 pounds of formalin (37% formaldehyde) and heating the mixture to about 155° F. for about 10 minutes, at which time the reaction mixture becomes a clear liquid. Simultaneously, 300 pounds of acrolein are distilled into 475 pounds of formalin in a second kettle to form a homogeneous relatively stable mixture. In a third kettle, 35 pounds of soda ash are made into an aqueous solution with 187 pounds of water.

The soda ash solution and the acrolein formaldehyde mixture in the second kettlet are added simultaneously to the reaction mixture in the first kettle with stirring and external cooling. This reaction is highly exothermic, and the addition of soda ash and the acrolein-formalin mixture must be carefully regulated to prevent excessive heating and a possibly uncontrolled reaction. The thus formed reaction product is cooled to approximately room temperature, at which time the pH is adjusted to 2 by the addition of muriatic acid. The product is then preferably stored in drums for several days at approximately 0° C. before being used for treatment of textiles.

Generally, the beneficial results of the present invention are obtained by treating fabric with an acid liberating catalyst and a water soluble condensation product of acrolein and formaldehyde condensed in the ratio of approximately one mol of acrolein to one to six mols of formaldehyde, and heating the fabric sufficiently to effect drying and to cause the acrolein-formaldehyde condensation product to react with the cellulose.

More specifically, the production of crease resistant textiles which will resist laundering under relatively high alkaline conditions of the order of pH 12 and which will not retain the chlorine encountered in commercial laundry bleaching is accomplished by souring the fabric once or more to the point that less than .01% residual alkali measured as sodium hydroxide is left on the fabric, treating the fabric with an acid liberating catalyst and a water-soluble condensation product of acrolein and formaldehyde condensed in the ratio of approximately one mol of acrolein to four mols of formaldehyde, drying the thus treated textile fabric, and then heating the dried fabric sufficiently to cause the acrolein-formaldehyde condensation product to react with the cellulose and impart to the fabric the aforesaid characteristics.

Restated, the procedure for using the above-described acrolein-formaldehyde condensation product for producing the novel effects on soured textile materials in accordance with the present invention is generally as follows: The acrolein-formaldehyde product is dissolved in water using about 5% to 50% concentration, and a suitable acid forming catalyst is added such as hydrochloric acid, sodium acid sulfate, magnesium chloride, zinc nitrate, stearamido mythyl pyridinium nitrate and octadecyl oxymethyl pyridinium chloride. The amount of acid catalyst used will vary with the type of catalyst, temperature and degree of crease-resistance required. In general, the amount of catalyst may vary within a range of about 0.1% to 5%. The cloth is treated with the catalyzed aqueous solution of the above condensation product and then dried and cured at a temperature of 160° to 190° C., for a period of from one to eight minutes, depending upon the type and concentration of catalyst used.

Fabrics which contain any residual alkali should be acid soured before the application of acrolein-formaldehyde condensation product in order to obtain the best physical properties of the finished fabric. This step is particularly important in the treatment of viscose and mercerized cotton, both of which contain some alkali after even the most vigorous washings. Souring has been effected by treatment with from .1% to 25%, preferably about .25%, of acid with satisfactory results. Sulfur dioxide has been used to maintain an acid bath for mild acid treatment. Sulfuric, muriatic and phosphoric acid are examples of suitable strong acids. Organic acids such as acetic and formic acid may be used to good advantage with some fabrics, as viscose rayon. The acid treatment

may be padded on the fabric or applied in a jig, and followed by a rinse to wash out the acid.

Any neutralization of the sodium ions on the fabric appears to be sufficient. Should there be no sodium ions on the cellulosic fabric, the souring step would be unnecessary. Since most fabrics do contain sodium ions, it has been found desirable to sour all fabrics which are to be treated in accordance with the present invention. Tests for proper souring may be made by careful titration to determine the sodium ions measured as sodium hydroxide. It has been found that fabrics which have .1% alkali measured as sodium hydroxide are too alkaline for proper use in the present invention, and that fabrics which have less than .01% alkali measured as sodium hydroxide are sufficiently neutralized. Fabrics having an intermediate amount of alkali may be treated in accordance with the present invention but with less satisfactory and less uniform results than those having less than .01% residual alkali.

The actual padding of the water solution of the acrolein-formaldehyde condensation product is generally the same as conventional treatment of fabrics with aqueous solutions of resin forming materials. It has been found desirable to provide long immersion and as great a time lag as practical between the padding of the solution and drying of the fabric. This is to permit maximum penetration of the acrolein formaldehyde products and catalysts into the fabric.

Drying is preferably accomplished as one operation and heating or curing as a separate operation. However, it is within the scope of this invention to accomplish drying and curing in a single operation. Both procedures have been successfully carried out on commercial production equipment.

Various textile adjuvants may be used with the acrolein-formaldehyde condensation product in accordance with this invention to vary the "hand" and other properties of the treated fabric. A few of the suitable adjuvants are: thermoplastics such as methacrylates, polyvinyl acetates, etc.; softeners falling into the class of aliphatic quaternary ammonium compounds, as octadecyl oxymethyl triethyl ammonium chloride; polymeric polyhydric alcohols, as starch, gum, polyvinyl alcohol and hydroxy methyl cellulose.

Illustrative but non-limiting specific examples of the above-described general procedure and the products obtained thereby are as follows:

Example 1

In this example, a 100% cotton Oxford shirting having less than .01% residual alkali measured as NaOH was treated with a 12% aqueous solution to the above-described acrolein-formaldehyde condensation product of Example A, and containing ¼% of magnesium chloride catalyst. The pick-up or absorption by the cloth of this aqueous solution was 75%, the solution being applied to the cloth by padding. Following this padding or impregnating of the cloth with the solution, the cloth was substantially completely dried, and then heated in an oven for approximately 170° C. This heat treatment causes the acrolein formaldehyde condensation product, under the influence of the acid producing magnesium chloride catalyst, to react with the cellulose of the fabric and thereby produce a fabric having resistance to the alkalinity conditions characteristic of commercial laundering and without absorption of chlorine commonly used in commercial laundering.

Example 2

In this example, cotton Oxford shirting which had been soured with .25% H_2SO_4 was treated with a 12% aqueous solution of the acrolein-formaldehyde condensation product as described in Example 1 above, except for substitution of the magnesium chloride catalyst by 1% of stearamido methyl pyridinium nitrate (or octadecyl oxymethyl pyridinium chloride). The impregnated cloth was dried as in Example 1 and then heated to a temperature of 160° C. for eight minutes to produce a fabric having the characteristics described in Example 1. For this last heating step, the temperature and times may be varied as follows: 70° C.—four minutes; 180° C.—two minutes; 190° C.—one minute.

Example 3

In this example, the same type of cotton Oxford shirting was treated with a 10% aqueous solution of the acrolein-formaldehyde condensation product of Example B and 0.5% sodium bisulfate catalyst, following which the impregnated cloth was dried as before and the dried cloth then heated for about seven minutes at 310° F.

Example 4

In this example, mercerized white cotton shirting material was first soured with .25% HCl and then treated the same as in Example 1 above and, in addition, a small amount, i. e., 12 grams for each 250 lbs. of the aqueous solution, of Indanthrene Blue R. P. Z. A. was used for effecting a permanent whitening of the cloth.

Example 5

A 100% viscose rayon gabardine fabric averaging about 2.10 yards per pound, which had been previously dyed with a vat color, was first soured by rinsing 320 yards of the fabric in a conventional beck containing 600 gallons of a .25% acetic acid. The fabric was agitated for one-half hour in the beck, after which the acetic solution was drained and the cycle was repeated with another 600 gallons of .25% acetic acid. The thus soured fabric was extracted and loop dried. The soured and dried fabric was impregnated by padding with a solution containing the following:

15% of the acrolein-formaldehyde condensation product made according to Example C and aged for 22 days at room temperature
⅜% calcium chloride (anhydrous)
2½% oxidized corn starch
1% octadecyl oxymethyl triethyl ammonium chloride

The padding equipment was conventional and in this example the squeeze rolls were set at nine-tons pressure to permit a pick-up of about 70%. The impregnated fabric was forthwith dried on a clip tenter frame at about 285° F. at a speed calculated to leave about 6% moisture in the fabric. The fabric was then cured in a tight strand curer for about 70 seconds at 375° F. The cured fabric was beck washed with Igepon–T and soda ash, after which it was extracted, loop dried, and framed on a pin tenter.

A separate piece of the same viscose gabardine fabric, hereinafter referred to as a water blank, was treated in an identical manner except that it was not padded with the acrolein-formaldehyde fabric formula given above. The water blank and the treated fabric were kept under standard conditions for three days, after which they were tested with the following results:

	TBL Crease Resistance	Flex Abrasion ¼ x ¾	Warp Tensile	Filling Tear	Progressive Shrinkage in 20 Cotton Washes (CCC–T–191–a)
					Percent
Treated	3.35 x 3.1	4,136	125	11.0	1.6
Water Blank	2.5 x 2.5	3,622	125	8.0	15.2

Example 6

A 100% cellulose acetate fabric of plain weave running about two yards per pound was desized and soured in an 80 gallon beck containing 600 pounds of water to which sulphur dioxide had been added to the extent that a pH of 2.65 was obtained. The fabric was agitated for one hour, and the sulphur dioxide solution was then

dumped. The beck was refilled with water, sulphur dioxide was added to bring the pH to two, after which the fabric was again agitated for one hour. The fabric was then extracted and loop dried. The thus soured and dried fabric was impregnated by conventional padding with the following solution:

15% of the acrolein-formaldehyde condensation product prepared according to Example D and stored for seven days at 0° C.
1% stearamido methyl pyridinium nitrate
1% methyl methacrylate (35% solids)

The padding operation was conventional with about 9-tons pressure on the squeeze roll to permit a pick-up of about 50% based on the weight of the fabric. The pretreated fabric was forthwith dried in a clip tenter frame at about 230° F., the speed being so adjusted as to bring out the fabric in a slightly moist condition. The fabric was then cured in a loop drier for five minutes at 280° F., after which it was beck washed, loop dried, and framed on a pin tenter. Two pieces of the same cellulose acetate fabric, hereinafter referred to as water blanks, were treated in the same manner except that neither were impregnated with the above-described acrolein-formaldehyde fabric treating formula, and one was not soured with the sulphur dioxide solutions.

Example 7

The same cellulose acetate fabric used in Example 6 was soured and treated according to the procedure of Example 6 with the following formula:

15% of the acrolein-formaldehyde condensation product prepared according to Example D and stored for seven days at 0° C.
¼% $MgCl_2$—$6H_2O$
⅓% stearamido methyl pyridinium nitrate

The fabrics treated in accordance with Examples 11 and 12 were tested after being held at standard conditions for three days with the following results:

	Crease Resistance [1]	Flat Abrasion [2]	Flex Abrasion [3]	Warp Tensile	Filling Tear [4]
Water Blank Soured	2.9 x 2.6	502	108	81	7.8
Water Blank Not Soured	3.0 x 2.8	624	95	79	6.4
Treated According to Example 6.	3.5 x 3.1	423	111	84	10.3
Treated According to Example 7.	3.2 x 3.0	686	121	83	9.2

[1] TBL.
[2] Stoll abrasion machine.
[3] Stoll abrasion machine.
[4] Trapezoid tear.

Example 8

A 100% viscose rayon gabardine averaging about 2.0 yards to the pound was first soured with .25% acetic acid in three separate becks for 10 minutes each, dried, and then padded with an aqueous solution containing the following:

15% of the acrolein-formaldehyde condensation product made according to Example C
¾% anhydrous calcium chloride
¾% octadecyl oxymethyl triethyl ammonium chloride
1% oxidized corn starch

The padding was arranged so that the fabric picked up about 70% of its own weight of the above solution. The wet fabric was run directly into a clip tenter where it was dried and was then cured on a loop drier for 6 minutes and 30 seconds at 310° F.

Example 9

A 100% viscose rayon yarn dyed plaid averaging about 4½ yards per pound was first soured by the procedure of Example 8, and then padded with about 70% of its weight of a water solution of the following:

15% of the acrolein-formaldehyde condensation product made according to Example C
¾% anhydrous calcium chloride
3.2% oxidized corn starch

The fabric was then dried on a clip tenter and cured for 1 minute and 30 seconds at 355° F. in a tight strand curer.

Physical tests of the thus treated fabrics are listed below in comparison with control fabrics heretofore referred to as water blanks:

	Example 8 Rayon Plaid		Example 9 Gabardine	
	Control	Treated	Control	Treated
TBL Crease Resistance	2.5 x 2.4	3.0 x 2.8	3.1 x 2.7	3.4 x 3.1
Trapezoid Filling Tear Strength (in Pounds)	9.5	9.0	6.8	7.5
Tensile Strength:				
Warp (in Pounds)	70	56	122	118
Filling (in Pounds)	60	53	54	52
Flex Abrasion: Warp (Stoll)	2,362	2,533	720	633
Percent Shrinkage:				
1 Wash [2]	8.5 x 3.4	.4 x .8	[1] 5.8 x .3	[1] 1.2 x .75
20 Washes [2]	12.6 x 4.4	[1] 1.6 x .4	20.1 x 3.2	[1] 2.4 x .25

[1] Denotes a gain.
[2] CCC-T-191 (a) cotton wash.

The present invention has been described with particular reference to the treatment of cellulose in fabric form. However, it is within the scope of the invention to treat all cellulosic textile materials to produce cross-linking. In other words, the acrolein-formaldehyde condensation products of the present invention may be used to treat textile fabrics, threads, yarns, filaments, fibers, or bulk cellulose. Other permissible modifications and changes in the above-described process and product are indicated in the appended claims.

We claim:

1. A process of producing dimensionally stable, crease-resistant cellulose textile fabric that will resist laundering under relatively high alkaline conditions of the order of pH 12 and that will not retain the chlorine encountered in commercial laundry bleaching, comprising impregating substantially alkali-free cellulose fabric with an aqueous solution containing from about .1% to 5% of acidic catalyst and from about 5% to 50% of an aqueous solution of a water-soluble condensation product of acrolein and formaldehyde condensed in the presence of a small percentage less than 5% of a basic catalyst, said reactants being in the ratio of approximately one mol of acrolein to four mols of formaldehyde, drying said thus impregnated textile fabric, and then heating said dried fabric sufficiently to cause the acrolein-formaldehyde condensation product to react with the cellulose and impart to said fabric the aforesaid characteristics.

2. A process of imparting crease-resistance and dimensional stability to cellulose fabric that will withstand commercial laundering conditions of pH 12 and use of chlorine bleaches for whitening of said fabric, without loss of the crease-resistance characteristic and without retention of the chlorine, comprising impregnating substantially alkali-free cellulose fabric with an aqueous solution containing from about 5% to 50% of an aqueous solution of a water-soluble condensation product of acrolein and formaldehyde in which the acrolein is condensed with the formaldehyde in the presence of a small percentage less than 5% of a basic catalyst, said reactants being in the ratio of one mol of acrolein to one to six mols of formaldehyde, the condensation product being applied to said fabric in the presence of from about .1% to 5% based on the weight of the solution of an acidic catalyst, and heating said treated fabric to effect drying and reaction of the condensation product with the cellulose of said fabric.

3. A process of producing crease-resistant cellulose fabric as defined in claim 2 in which the acidic catalyst is magnesium chloride.

4. A process of imparting crease-resistance and dimensional stability to cellulose fabric that will withstand commercial laundering conditions of pH 12 and use of chlorine bleaches for whitening of said fabric, without loss of the crease-resistance characteristic and without retention of the chlorine, comprising souring said fabric, impregnating said cellulose fabric with an aqueous solution containing from about 5% to 50% of an aqueous solution of a water-soluble condensation product of acrolein and formaldehyde in which the acrolein is condensed with the formaldehyde in the presence of a small percentage less than 5% of a basic catalyst, said reactants being in the ratio of one mol of acrolein to one to six mols of formaldehyde, the condensation product being applied to said fabric in the presence of from about .1% to 5% based on the weight of the solution of an acidic catalyst, and heating said treated fabric to effect drying and reaction of the condensation product with the cellulose of said fabric.

5. A process of imparting crease-resistance and dimensional stability to cellulose fabric that will withstand commercial laundering conditions of pH 12 and use of chlorine bleaches for whitening of said fabric, without loss of the crease-resistance characteristic and without retention of the chlorine, comprising impregnating substantially alkali-free cellulose fabric with an aqueous solution containing from about 5% to 50% of an aqueous solution of a water-soluble material comprising the reaction product of about 1 to 10% by weight of a starch, one mol of acrolein, and from about one to six mols of formaldehyde condensed in the presence of a small amount less than 5% of a basic catalyst, said reaction product being applied to said fabric in the presence of from about .1% to 5% based on the total weight of the solution of an acidic catalyst, and heating said impregnated fabric to effect drying and reaction of the condensation product with the cellulose of said fabric.

6. A process of imparting crease-resistance and dimensional stability to cellulose fabric that will withstand commercial laundering conditions of pH 12 and use of chlorine bleaches for whitening of said fabric, without loss of the crease-resistance characteristic and without retention of the chlorine, comprising souring said fabric to the extent that less than .01% residual alkali measured as sodium hydroxide remains thereon, impregnating said cellulose fabric with an aqueous solution containing from about 5% to 50% of an aqueous solution of a water-soluble material comprising the reaction product of about 1 to 10% by weight of a starch, one mol of acrolein, and from about one to six mols of formaldehyde condensed in the presence of a small amount less than 5% of a basic catalyst, the reaction product being applied to said fabric in the presence of from about .1% to 5% based on the total weight of the solution of an acidic catalyst and heating said impregnated fabric to effect drying and reaction of the condensation product with the cellulose of said fabric.

7. A water-soluble reaction product of about 1 to 10% by weight of a starch, one mol of acrolein, and from about one to six mols of formaldehyde condensed in the presence of a small percentage less than 5% of a basic catalyst.

8. A process of producing water-soluble textile treating materials comprising condensing about 1 to 10% by weight of a starch, one mol of acrolein, and from about one to six mols of formaldehyde in the presence of a small percentage less than 5% of a basic catalyst.

9. A dimensionally stable crease-resistant cellulose textile fabric which will withstand commercial alkalinity and bleaching conditions without loss of crease-resistance and without chlorine retention, said fabric being produced by the process set forth in claim 2.

10. A dimensionally stable crease-resistant cellulose fabric which will withstand commercial alkalinity and bleaching conditions without loss of crease-resistance and without chlorine retention, said fabric being produced by the process set forth in claim 5.

11. A process of cross-linking cellulose which comprises impregnating substantially alkali-free cellulose with an aqueous solution containing from about 5% to 50% of a water-soluble reactive chemical which is the condensation product of one mol of acrolein and from about one to six mols of formaldehyde condensed in the presence of a small percentage less than 5% of a basic catalyst, said solution also containing from about .1% to 5% of an acidic catalyst, and heating the thus impregnated cellulose at a time and temperature sufficient to dry it and to cause reaction between said cellulose and said chemical.

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