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HEAT CARBONIZABLE EMBROIDERY CRINOLINE AND METHOD OF MAKING THE SAME

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This application relates to normally stable, yet readily heat-carbonizable, cellulosic fabrics and methods of making the same, more particularly to so-called "embroidery crinoline." Such crinoline is pinned to sleazy fabrics, such as lightweight silks and rayons as a temporary support to enable the fabrics to be maneuvered readily under a stitching needle. After the embroidery is completed, the assembly is heated in an oven or with a flat iron to carbonize the crinoline to the extent that light brushing will suffice to remove it from the embroidered fabric. Obviously the crinoline must carbonize and crumble at a temperature which will not cause any appreciable damage to the embroidered fabric.

Embroidery crinoline is usually prepared by impregnating a starched, open-mesh, cotton fabric with dilute sulfuric acid. The acid-impregnated fabric is so susceptible to destruction by heat that continuous drying is not feasible unless done at uneconomically low temperatures and speeds. Even at ordinary room temperatures the embroidery crinoline so prepared deteriorates so rapidly that in as short a time as 24 hours it may be too weak for use. Because of the impediments to continuous processing and the very short shelf-life of the product, the trade has been generally forced to prepare its own embroidery crinoline. Not only is the small-batch method uneconomical and cumbersome for the embroiderer, but it is also highly wasteful of his time and materials. If he has prepared too much crinoline for the day's business, he must throw it away, because it will be too weak for use on the following day. If he has prepared too little, he must hold up his embroidery work until additional crinoline has been prepared.

It is the primary object of this invention to provide an embroidery crinoline which is highly resistant to deterioration for long periods of time at ordinary temperatures, yet readily carbonizable at moderately elevated temperatures, such as are used in the embroidery trade.

A further object of this invention is to supply a method of preparing embroidery crinoline which makes possible rapid commercial drying.

Despite the difficulties apparent in fulfilling these seemingly conflicting requirements, I have discovered and provided for the first time in the art an embroidery crinoline with a shelf-life of at least four months yet readily carbonizable by the usual post-embroidering heat treatments. My invention involves the treatment of a cellulose fabric with an acid-forming salt selected from the group consisting of aluminum chloride, aluminum sulfate, and mixtures thereof; an alkaline retarder; and a stiffening agent; the acid-forming salt being substantially in excess of the alkaline retarder on an equivalent weight basis.

By the term "cellulose" I mean to include natural cellulose such as cotton, linen, and ramie, and regen-

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erated cellulose, whether of the viscose or cuprammonium type.

For the purposes of this application, "alkaline retarder" is defined as any potentially alkaline substance, such as the salt of a strong base and a weak acid, or a water insoluble inorganic base, which will neutralize free acid but not interact with the acid-forming salt to any appreciable extent at ordinary temperatures and humidities. Typical of the wide variety of alkaline retarders which may be used are sodium and potassium salts of acetic, carbonic, and boric acid and iron and zinc hydroxides.

I normally use starch as the stiffening agent for my embroidery crinoline because it is cheap and readily available, but any of the common rigidizing substances may be employed such as, polyvinyl alcohol, polyvinyl acetate, sodium alginate, and carboxymethyl cellulose.

The concentration of the acid-forming salt must be sufficiently in excess of the concentration of the alkaline retarder to readily carbonize the cellulose fabric during the post-embroidery heat treatment. For reasons of economy I prefer to employ relatively low concentrations of both the acid-forming salt and the alkaline retarder. I have found that the weight-equivalent percentage excess of acid-forming salt should be within the range of 0.01% to 0.4% based on the air-dry weight of fabric plus stiffening agent and preferably between 0.03% and 0.1%. The "weight-equivalent percentage excess" may be calculated by subtracting the number of pound-equivalents of alkaline retarder from the number of pound-equivalents of acid-forming salt and dividing this result by the weight in pounds of the stiffened fabric, and multiplying by 100. The weight-equivalent percentage of alkaline retarder, based on the stiffened fabric, should be at least 0.001%, and the ratio on an equivalent weight basis, of acid-forming salt to alkaline retarder preferably between 5 to 1 and 10 to 1.

In applying the various chemicals to the cellulose fabric, I prefer first to apply starch or other stiffening agent in combination with the alkaline retarder to the fabric and dry it. The stiffened fabric is then padded with a solution of the acid-forming salt, squeezed to remove excess impregnant and dried. While, in general, the order of applying the ingredients may be varied and any combination of the ingredients applied simultaneously, the following considerations should be taken into account. Ingredients which are incompatible in the same solution should obviously be separately applied to the fabric. The separate application of the acid-forming salt and the stiffening agent is desirable for the independent reason that it is commercially convenient to dry fabrics impregnated with aqueous stiffening solutions at relatively high temperatures. If the acid-forming salt is present in the fabric at this stage, there is some danger that the fabric may become prematurely degraded. To avoid this same danger I prefer to apply the acid-forming salt to the fabric in the final padding step so that the salt will be present in the fabric during only one drying operation. It is also highly desirable that the alkaline retarder be applied to the fabric prior to, or simultaneously with, the acid-forming salt because of the protection to the fabric afforded by the retarder during the drying. In any event, it is preferable to dry the acid-salt treated fabric at temperatures below 200° F., and in the absence of alkaline retarder, below 150° F. In both cases care should be taken to avoid overdrying.

As illustrative of my invention, but not in limitation thereof, the following examples are given.

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Example 1

28 x 24 bleached cotton gauze was passed through a two-dip starch pad containing the following formulations:

First pad:

32 gals. starch solution prepared by boiling a mixture of 10 lbs. cornstarch, 35 lbs. thin-boiling starch and 17 gals. water.
0.73 lb. anhydrous sodium acetate

Second pad:

40 gals. starch solution prepared by boiling a mixture of 94 lbs. thin-boiling starch and 17 gals. water
1.52 lbs. anhydrous sodium acetate

After drying, the treated fabric was padded with the following solution:

60 lbs. aluminum chloride (aqueous solution—50% $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$)
55 gals. water
350 grams Triton X-100, a non-ionic wetting agent distributed by Rohm & Haas Company and stated to be the iso-octyl ether of polyethylene glycol.

The squeezed impregnated fabric was passed directly from the pad into a tentering oven maintained at 180° F. and run through the oven at a speed of approximately 45 yards a minute. The throughput rate was kept at the maximum which would dry the fabric in order to avoid overdrying. The weight-equivalent percentages of the acid-forming salt and alkaline retarder in the treated fabric, as calculated from solution concentrations and pickups, were 0.0548% and 0.077% respectively, representing a weight-equivalent percent excess of acid salt of 0.0471%.

Example 2

32 x 28 bleached cotton gauze was passed through a single dip starch pad containing the following formulation:

36 gallons starch solution prepared by boiling a mixture of 10 pounds cornstarch, 35 pounds thin-boiling starch and 17 gallons water.
0.87 pound anhydrous potassium acetate

After drying, the treated fabric was padded with the following solution:

91.5 pounds—aluminum sulfate— $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$
55 gallons water
350 grams non-ionic wetting agent

The squeezed impregnated fabric was dried as in Example 1. The weight-equivalent percentages of acid-forming salt and alkaline retarder were 0.1050% and 0.0080%, respectively, representing an acid-forming salt excess of 0.097%.

Example 3

The procedure of Example 1 was followed except that the acid-forming salt solution consisted of:

38 lbs. aluminum chloride (aqueous solution—50% $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$)
54 lbs. aluminum sulfate— $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$
55 gals. water

The weight-equivalent percentages of acid-forming salt and alkaline retarder were 0.0685% and 0.0077%, respectively, representing an acid-forming salt excess of 0.0608%.

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Example 4

28 x 24 unbleached cotton gauze was treated according to the procedure of Example 1 except that the following was substituted for the first pad formulation:

First pad:

32 gals. starch solution prepared by boiling a mixture of 10 lbs. cornstarch, 70 lbs. thin-boiling starch and 17 gals. water
1.29 lbs. anhydrous sodium acetate

Example 5

32 x 28 bleached cotton gauze was padded with a starch solution consisting of:

25 lbs. cornstarch
25 lbs. thin-boiling starch
5.8 lbs. sodium acetate
12.0 gals. water

After drying the treated fabric was impregnated with the following solution:

34.6 lbs. aluminum chloride (aqueous solution—50% $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$)
95.4 lbs. aluminum sulfate— $\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$
18 gals. water

The fabric was dried as in Example 1. The weight equivalent percentages of acid-forming salt and alkaline retarder were .532% and .143%, representing an acid-forming salt excess of .389%.

In my treated materials, in addition to the applied ingredients, there is necessarily present some water in the form of moisture regain of the cellulose and as water of hydration of some or all of the other ingredients. I am not aware of the precise chemical state of the various constituents in my treated cellulose materials nor the exact manner in which these constituents interact at elevated temperatures. Although my invention is not dependent upon any particular theory of operation, the most plausible explanation of the remarkable performance of my novel materials is that any free acid evolved by the acid-forming salt prior to the intentional carbonization of the yarns or fabric is absorbed by the alkaline retarder. It is believed that the acid-forming salts of my invention, unlike free acids and most acid-forming substances, can be used in concentrations effective to carbonize the cellulose at elevated temperatures without evolving free acid at ordinary temperatures in excess of that amount which can be absorbed or neutralized by the alkaline retarder. Regardless of the correctness of this theory, I have found that the alkaline retarder does serve to protect the fabric from premature degradation, both during the drying operation or operations in the preparation of my specially treated materials and during storage of the finished products before use.

In the appended claims, the description of the embroidery crinoline as "normally stable" is intended to mean that the crinoline has a shelf-life of at least one month at ordinary temperatures and humidities.

I claim:

1. As a new article of manufacture, a normally stable yet readily heat-carbonizable embroidery crinoline comprising a cellulosic fabric impregnated with a textile stiffening agent for said fabric, an alkaline retarder selected from the group consisting of water insoluble inorganic bases and water soluble salts of weak acids and strong bases, the alkaline retarder having the characteristics of being able to neutralize free acid and not interact with acid-forming salt to any appreciable extent at ordinary temperatures and humidities, the weight equivalent percent of said alkaline retarder being between 0.001 and 0.143% based on the weight of said stiffened fabric, and an acid-forming salt selected from the group consisting of aluminum chloride, aluminum sulfate and mixtures thereof, the weight equivalent percent excess of said acid

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salt over said alkaline retarder being between 0.01% and 0.4% based on the weight of the stiffened fabric.

2. The embroidery crinoline according to claim 1 in which the ratio of acid-forming salt to alkaline retarder is between 5 to 1 and 10 to 1 on an equivalent weight basis.

3. The embroidery crinoline according to claim 1 in which the alkaline retarder is sodium acetate.

4. The embroidery crinoline according to claim 1 in which the cellulose fabric comprises cotton.

5. A process for preparing a normally stable yet readily heat-carbonizable embroidery crinoline which comprises applying to a cellulose fabric from at least one aqueous solution a textile stiffening agent for said fabric, an alkaline retarder selected from the group consisting of water insoluble inorganic bases and water soluble salts of weak acids and strong bases, the alkaline retarder having the characteristic of being able to neutralize free acid while not interacting with acid-forming salt to any appreciable extent at ordinary temperatures and humidities, and an acid-forming salt selected from the group consisting of aluminum chloride, aluminum sulfate and mixtures thereof, and drying said fabric after each application of solution, the alkaline retarder being present in an amount such that the equivalent weight percent of said alkaline retarder is between 0.001% and 0.143% based on the weight of the stiffened fabric and the weight equivalent percent excess of acid-forming salt over said alkaline retarder being between 0.01% and 0.4% based on the weight of the stiffened fabric.

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6. The process according to claim 5 in which the drying is performed at a temperature in excess of 150° F.

7. The process of preparing a normally stable yet readily heat-carbonizable embroidery crinoline which comprises applying to a cellulosic fabric a textile stiffening agent for said fabric and an aqueous solution of an alkaline retarder said alkaline retarder being selected from the group consisting of water insoluble inorganic bases and water soluble salts of strong bases and weak acids, the alkaline retarder having the characteristic of being able to neutralize free acid while not interacting with acid-forming salt to any appreciable extent at ordinary temperatures and humidities, said alkaline retarder being in an amount between 0.001% and 0.143% based on the weight of the stiffened fabric, drying said fabric, applying to said fabric an aqueous solution of an acid-forming salt selected from the group consisting of aluminum chloride, aluminum sulfate and mixtures thereof, in an amount sufficient to deposit a weight equivalent percent excess of acid-forming salt over alkaline retarder of between 0.01% and 0.4%, and drying said fabric.

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