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PROCESS OF TREATING VEGETABLE FIBERS

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This invention relates to textiles and particularly to the manufacture of textiles from vegetable fibers such as cotton, linen, jute, and the like.

The invention is particularly directed to the treatment of the vegetable fibers for the purpose of removing the natural impurities with which the fibers are contaminated.

Since cotton is the most widely used vegetable fiber, and since the impurities associated with the cotton fiber and the methods of removing these impurities are typical of most of the vegetable fibers, a consideration of the nature of the impurities present in the cotton fiber and the difficulties encountered in their removal, will serve admirably to illustrate the utility of the treating process which is herein disclosed.

The vegetable fibers in their natural state consist of filaments of cellulose and modified cellulose impregnated and coated with protective material consisting mostly of fatty, waxy and pectinous substances. There are also present certain pigments, and in the cotton, tiny particles known as motes and shives. All of these materials must be removed from the cellulose fibers prior to the time the fabric is completed in the sense of being ready for sale and use.

Generally speaking, the fatty and waxy materials are useful on the fiber during the processes which it undergoes in being manufactured into a fabric. These materials protect the cellulose itself during the spinning, weaving, knitting, etc., from abrasion or physical injury and further tend to lubricate the fiber, thus assisting rather than hindering these operations. However, after the textile fabric has been constituted the presence of the fatty or waxy matters is highly undesirable for the reason that most textiles are either bleached or dyed or printed and the fatty or waxy material protects the fiber from the bleaching or dyeing solutions or from the printing pastes.

It is well known that water or aqueous solutions and waxy or fatty matter are repellant to each other so the difficulties of treating a fabric covered with waxy or fatty matter with a water solution can be readily appreciated. Now, this fatty and waxy matter not only coats but impregnates the cellulose filaments or fibers and it is very difficult to remove completely all of this fatty or waxy material.

The speed with which the bleaching, dyeing and printing operations can be carried on depends to a very great extent on the completeness with which this fatty or waxy material is removed from the fabric for the reason that the solution does not and cannot wet or wet out the fabric unless a substantial portion of the wax is removed. In fact the removal of this wax or fatty material is one of the most difficult problems in the industry for the reason that a short treatment which removes but part of the wax necessitates a very long bleaching or dyeing treatment.

It has therefore been customary in the past to subject the fabric to what is known as kier boiling. This kier boiling operation is carried out by boiling the cotton in closed vessels (kiers) under pressure, with dilute alkalies such as sodium carbonate, sodium hydroxide and lime. The time of kier boiling varies according to the concentration of the alkali used, the pressure employed and the quality of cotton being treated. From 0.5 to 5.0% alkali solutions may be used, the pressure may range from 0 to 60 pounds, and the time required from 4 to 16 hours.

Certain of the impurities which contaminate the cotton fiber, such as the pectin compounds, oil and coloring matter, are fairly easily removed by the kier boiling and subsequent bleaching treatments, while the removal of the waxes, shives and mineral oil stains is rather difficult.

The pectin compounds, which form a large portion of the impurities, are very complex in nature, and their chemical composition and properties are not well understood. The pectin compounds are easily removed by treatment with warm alkaline solutions in the form of salts, and therefore they are easily removed by the ordinary kier operations.

The oil present in the cotton fiber appears to be identical with cottonseed oil, and is probably obtained from the seed to which the fiber is attached. It is saponified and rendered soluble by the alkaline kier liquors.

The coloring matter which is usually present in only small amounts is removed to some extent in the ordinary kier boiling operation, and entirely removed by bleaching.

The motes, or shives, wax and mineral stains, constitute those impurities whose removal makes necessary the long continued pressure boil to which cotton must be subjected in order to render it suitable for the finishing operations which follow.

The shives are only slowly decomposed by hot caustic solutions, and if they are not thoroughly decomposed, they may remain in the goods after the bleaching operation, and show up as brown or yellowish spots in the finished goods.

Mineral oils are not saponifiable, and can best be removed by long continued treatment, and even then are apt to cause trouble in the bleaching process.

The cotton wax which coats the cotton fiber is very difficult to saponify, and it is removed only by long continued boiling under pressure. The complete removal of the wax is very necessary, as it renders the goods water repellant. The presence of wax makes bleaching more difficult, but exerts a more deleterious effect on the final finishing operations such as the dyeing, sizing and especially printing operations.

The prolonged boiling necessary for complete purification is undesirable, not only with regard to the time and additional equipment and power needed, but also as regards the bad effect of a long continued treatment at high temperatures upon the appearance, elasticity, tensile strength and chemical properties, of the cotton fiber.

The object of this invention is to provide a process which is quick and relatively cheap, for removing impurities from cotton or other vegetable fibers in any form but particularly cotton and other vegetable fiber fabrics.

Another object of the invention is to provide the process of removing impurities from fabrics manufactured from cotton, linen, jute, and the like, which is sufficiently rapid and simple to permit continuous treatment as distinguished from batch boiling.

The invention resides in the determination that an aqueous solution of mineral oil sulphonates possesses the requisite power of dissolving and removing the natural impurities from the fibers or fabrics which permits complete removal to be effected without the use of temperatures, pressures or periods which inhibit a continuous process and the economies attendant thereto. The mineral oil sulphonates are a class of bodies which are derived from the treatment of mineral oils with strong sulphuric acid, fuming sulphuric acid or sulphur trioxide. These bodies are commercially available at present as a result of the practice of the Petroff-Humphreys process of refining medicinal and technical white oils or light colored oils. The sulphonates available fall under two general headings, the A layer or oil soluble sulphonates, and the B layer or readily water soluble sulphontes. The A layer sulphonates are known as mahogany sulphonates and are recovered from the oil layer in the Petroff-Humphreys process, whereas the B layer sulphonate are recovered from the sludge layer in the practice of said process. The mahogany sulphonates, as a class, are preferred in this process of dewaxing cotton through the sludge layer sulphonates can be used.

It is further preferable that the mahogany sulphonates be relatively free from entrained oil, particularly if they are obtained from American petroleums or similar oils. One method of obtaining these pure sulphonates is disclosed in Fischer and Reddish Patent No. 1,703,838 issued February 26, 1929. These sulphonates so purified are possessed of peculiar and unexpected dewaxing powers as compared with the properties they exhibit with entrained oil present, and have, therefore, been designated true mahogany as a term distinguishing them from the commercial mahogany sulphonates.

When cotton goods are boiled in alkaline solutions containing only small amounts of mineral oil sulphonates (.1 to .5%) for only a comparatively short period of time, the goods lose entirely their water repellant nature, and become very absorbent. In this condition they are very readily bleached, and are entirely suitable for further finishing operations, such as dyeing, printing and sizing, as they are readily penetrated by the various solutions used in these operations. The shives are also more easily disintegrated by the solutions containing mineral oil sulphonates and any remaining traces are very readily removed by the bleach solutions. Mineral oil stains are removed and cause no bleaching difficulties. The fabrics are easily wet out by solutions containing mineral oil sulphonates, and as a result the solutions penetrate quickly and uniformly.

The mineral oil sulphonates also possess other properties which recommend their use in treating vegetable fibers. The mineral oil sulphonates are extremely stable towards the action of boiling alkaline solutions, and the sulphonic groups are not split off by this treatment. The mineral oil sulphonates are also resistant to the action of hard water, so that difficulties due to the formation of insoluble magnesium or calcium soaps are entirely obviated.

This process which greatly reduces the treating time or kier boiling time without increasing the concentration of the caustic and bleaching solutions, and still produces a cotton which is completely dewaxed and easily bleached and finished, is advantageous not only as regards the reduction in time required—and accordingly greater production per unit of equipment and reduced power costs, but also in regard to the improvement in the feel and resiliency of the cotton, which is harshened and rendered less resilient by long boiling. However, as the time of boiling can be greatly reduced, and since the operation can be conducted successfully under ordinary pressures, it becomes possible to carry out the operation as a continuous process. Using mineral oil sulphonates as boiling assistants and avoiding the use of excessive strengths of caustic and bleach solutions such as might injure the fiber, I have successfully boiled and bleached eight ounce duck to a pure white, free from shives, in one hour, allowing one-half hour for a boil and one-half an hour for bleaching. Accelerating these operations to the point where continuous operation is possible results in a great saving in labor costs.

I have also investigated the use of mineral oil sulphonates in conjunction with those processes in which the kier boiling and bleaching is carried out in one operation with the aid of oxygen producing bleaching agents, such as sodium and hydrogen peroxide. The mineral oil sulphonates also aid in these processes by accelerating the decomposition of the shives and removing the waxy material. The bleach is also whiter and the material extremely water absorbent.

The following examples illustrate the use of the process:

Example 1

Samples of 8 oz. duck and light muslin were boiled for one hour at atmospheric pressure in .25%, .5%, 1.0% and 2.0% solutions of sodium hydroxide. The samples were then thoroughly rinsed and immersed for a few minutes in a 2° Tw. bleaching powder solution and then exposed to the air for one hour. After rinsing, they were given a sour in 1% hydrochloric acid, then rinsed and dried.

A second set of samples were boiled in similar

caustic solutions to which had been added from .25% to 2% of mineral oil sulphonates. The rinsing and bleaching treatments were carried out in the same manner.

The dried samples were examined for absorbency by placing drops of water on the surface of the cloth. Those samples which were boiled with caustic alone were very water repellant, and the drops of water were not absorbed even after 15 minutes. The samples boiled with mineral oil sulphonate were extremely absorbent, the water being absorbed instantly. These samples also dyed readily in the cold with direct cotton dyestuffs, while the samples boiled without the aid of the mineral oil sulphonates required a hot bath and a longer time—and did not dye evenly. The same action was observed in attempting to apply a printing paste.

No shives were noticeable in those samples boiled with the aid of sulphonates, while shives were quite apparent in those samples boiled without the aid of sulphonates.

Example 2

An experimental continuous boiling and bleaching machine was constructed such that cotton cloth samples cut in the form of strips were drawn through a series of baths as follows: First, a boiling bath containing 1% sodium hydroxide and 1% true sulphonate; second, a rinse bath; third, a 3° Tw. bleaching powder solution; fourth, a rinse bath; fifth, a 1% hydrochloric acid solution, and, sixth, a rinse bath. The samples were drawn through at such a rate that each portion of the cloth received a thirty minute boil.

The resulting material was white, free from shives, and very absorbent.

Example 3

A sample of 8 oz. cotton duck was boiled for one-half hour in a bath containing .2% of sodium peroxide, .1% of sodium hydroxide and 1% of true sulphonate, and a second sample in a similar bath without mineral oil sulphonate. The sample boiled with the aid of the true sulphonate took a noticeably whiter bleach than the sample boiled without the true sulphonate. The latter sample was also very water repellant, and the former extremely absorbent.

Although the discussion and examples given above refer specifically to cotton, I have found that the mineral oil sulphonates can also be used to accelerate the boiling out operations on other vegetable fibers. These fibers are similar to cotton in that they are contaminated with similar impurities, but differ in that the fibers are composed mainly of alteration products of cellulose. Linen for example, is made up principally of a material called pecto cellulose, while jute is composed mainly of ligno cellulose. The other vegetable fibers generally contain a greater percentage of impurities, in the case of flax or linen amounting to 25 to 30%, and they are usually more difficult to penetrate than cotton, and therefore they are usually subjected to longer and more vigorous boiling out treatments. The property of mineral oil sulphonates of increasing the penetration of kier liquors, and at the same time emulsifying the fatty and waxy impurities, assists greatly in accelerating the boiling out operation.

Example 4

Samples of jute were boiled in 1% caustic and in 1% caustic containing 1% of true sulphonate. Both samples bleached to a light yellow after 8 hours in a 3° Tw. bleaching powder solution. The jute boiled with the aid of true sulphonate, had a better feel and was very easily penetrated by a .2% solution of a direct black cotton dye. The jute boiled without the aid of the sulphonates was harsher, and dyed only after long immersion in the dye bath.

In all cases the mineral oil sulphonates are applicable to the now used kier boiling operations under pressure and their use results in much greater speed and efficiency. Therefore the use of pressures above atmospheric may be used when desired in practicing the above disclosed dewaxing process though one of its advantages is that the high pressures may be omitted without prolonging the time of treatment to an impractical length.

The term "natural impurities" employed in the following claims, is used to denote the products of nature such as wax, oil, shives, motes, pectin, etc. on a textile fiber of vegetable origin such as cotton, linen, jute or the like.

The examples given above are only intended to illustrate the application of the process, and I do not wish to limit the invention except as stated in the following claims.

Having described my invention I desire to be limited only by the ensuing claims:

1. The process of removing natural impurities from vegetable fiber, which comprises, subjecting said fiber to a boil at atmospheric pressure in an aqueous solution containing approximately 1% sodium hydroxide, and .1–2.% true mahogany sulphonates for a period of substantially 30 minutes.

2. The process of removing natural impurities from vegetable fiber, which comprises, subjecting said fiber to a boil in an aqueous solution containing approximately 1% sodium hydroxide, and .1–2.% true mahogany sulphonates.

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