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CONTINUOUS BLEACHING PROCESS

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This invention relates to bleaching processes, and more particularly to continuous bleaching processes as applied especially to cotton goods, although not specifically limited thereto.

It is a general object of the present invention to provide a novel and improved bleaching process.

More particularly it is an object of the invention to provide an improved continuous bleaching process.

A further object of the invention consists in the provision of a novel and improved continuous bleaching process in which the bleaching takes place with great rapidity, is entirely permanent, uses a minimum of equipment and reagents, and which in most cases entirely eliminates the boil-out, degumming, desizing or similar operations which are time-consuming, require costly and space-consuming equipment, and supervision of operation, which add materially to the expense of the bleaching steps.

Other and further objects of the invention will be more apparent to those skilled in the art upon a consideration of the following specification, wherein are disclosed several examples of the invention with the understanding that such changes and variations may be made therein as fall within the scope of the appended claims without departing from the spirit of the invention.

Various methods of bleaching fabric are known and used, and substantially all of them at the present time are open to various objections among which may be mentioned the following:

1. A great amount of time is consumed which may reach to forty or fifty hours in some cases.

2. A large amount of equipment is required, particularly where the process consumes much time since vats or kiers must be provided for retaining the fabric and the reagents and must be emptied of liquid and refilled several times, or provision made to have a series of kiers in which case the fabric must be transferred, which is a laborious and time-consuming job.

3. Most bleaching processes, whether of the reducing or oxidizing type, require a preliminary treatment known variously as "boil-out", "degumming", "desizing" and the like, and comprising briefly a method of reducing the natural constituents of the cotton or other fabric, such as waxy, fatty and resinous matters, as well as mineral matters, sizing and ordinary dirt introduced during the process of manufacture which sizing is usually a composition of starch, tallow or other saponified fat or wax, to such a condition that they can be washed out in subsequent treatment. If these various foreign matters are not reduced or removed prior to bleaching, as carried out by heretofore known processes, they cause either imperfect or spotty bleaching or seriously affect the quality of the dyeing subsequently done to the fabric, since they repel the dye and cause it to strike unevenly into the fabric.

4. Most of the processes are not continuous and require that large quantities of fabrics be removed from use for the whole time that they are being treated; further, such batch processes by virtue of their irregular time-consumption disrupt the time schedules of the plant and require overtime on the part of some employees.

Briefly outlining a prior process, it may be mentioned that the fabric is first wetted by some suitable wetting agent, after the singeing operation if required, then treated with a dilute caustic followed by boiling under a steam pressure of several atmospheres in dilute caustic or other chemicals. This takes place in a large vat or kier and the two operations may require the transfer of the fabric from one vat to another. The treating and boiling require maybe twenty-four hours and sometimes a second boiling is required, taking an additional eight to twelve hours. Following the boiling the fabric is removed from the kier, washed with water, soured to neutralize the caustic and to further dissolve foreign matters not attacked by the caustic, then washed in water, bleached by treatment in a kier with a chlorine solution requiring from eight to twelve hours, then again washed, and dried, all prior to mercerizing and dyeing.

In contradistinction to the above lengthy and time-consuming process, the present invention contemplates a rapid, continuous bleach with a minimum number of steps. It may be described as a continuous oxidizing type of bleaching and broadly is effected by introducing the fabric in the dry state without any previous boiling out, degumming, or desizing into a cold solution of proper strength hydrogen peroxide which of itself does not do the bleaching as in known prior peroxide bleaching processes which, while sometimes more effective than reducing processes, are not much more rapid. The excess hydrogen peroxide is removed from the fabric and it is passed rapidly through a chamber containing ammonia vapor, where a reaction between the H_2O_2 and the NH_3 takes place, releasing oxygen, producing some heat and considerable foaming. Following this ammonia treatment the cloth is thoroughly washed and may be tentered and dried in the customary manner or may be im-

mediately dyed, mercerized, or otherwise treated without drying.

The process starts with a dry fabric, previously singed if required, which is directly immersed in the solution of hydrogen peroxide, and since it is dry causes no dilution of the solution, which can be continuously used without being strengthened and need only be replenished by the same strength solution to take care of that which is used to wet the fabric.

The hydrogen peroxide bath is preferably a 25 to 30 volume solution although a 50 volume solution has been used. Stronger baths may possibly be used but seem to cause such strong oxidation on subsequent treatment that tendering results. If much less strength than 25 volume is used, the oxidation is slow and apparently insufficient, but it is believed that it can be used satisfactorily if adequate time is given in the following step.

The temperature of the hydrogen peroxide bath is kept relatively low, such, for instance, as atmospheric temperature or lower, or say a range of from 15° C. to 25° C. This is a great advantage since heat causes hydrogen peroxide baths to decompose with consequent loss. The sole purpose of the bath is to wet the fabric with a sufficient quantity of the solution of sufficient strength so that when exposed to NH_3 the reaction releases oxygen and the bleaching action occurs. Improvements and ramifications of the wetting can be made if desired; for instance, different wetting agents may be used to carry the hydrogen peroxide in order to decrease the time of wetting, but adequate results have been had with nothing but water to dilute the hydrogen peroxide, using 100 volume hydrogen peroxide to add to the water to bring up the strength of the bath to that required. The cotton must be immersed until wet and this wetting can be facilitated by increasing the length of travel through the bath, or by running the fabric through rollers submerged in the bath, or by any other adequate method which suggests itself.

When having the temperature of the bath at approximately room temperature, it is likely that impurities, brought in by the cotton or otherwise, may start decomposition, although not as readily as with higher temperature baths, which is not desirable, and still lower temperatures may be used to prevent this or stabilizers may be introduced which will not interfere with subsequent reaction. Cooling can be effected in any desired manner. A stabilizer, if desired, may be something of the nature of 1% of tin sulphate.

The fabric being removed from the bath has the excess liquid squeezed out to reduce the cost, since any excess bath on the fabric would only be wasted. The fabric is thus taken from the bath with only a sufficient quantity of bath absorbed therein to give it an adequate wetting.

The fabric is immediately and continuously introduced into the ammonia chamber from the peroxide bath. The temperature of this chamber and the gas therein is preferably about 20° C., although the heat of reaction may cause it to go up some. Various temperatures may be found desirable to produce different results and sometimes it is advantageous to maintain a low temperature by adequate cooling means to carry away the heat of reaction. The reaction will take place at quite low temperatures and is believed to be safer under these conditions than under higher temperatures where it is more rapid and violent.

It has been found advantageous to govern the concentration of the ammonia gas in the chamber through which the fabric is passing, such as, for instance, by using approximately 165 cc. of 26° B. NH_4OH for each cubic meter of space in the chamber and heating this quantity of liquid on a steam coil. This quantity of NH_4OH contains about 43.7 grams of NH_3 which is equivalent to about 60 liters of the gas per cubic meter of air at maximum, but since all of the gas is probably not released at once and some never released, the concentration will undoubtedly be less. This will give an average concentration of around 6%. The quantity of ammonia must be maintained by replenishing it as more cloth containing the peroxide solution enters, since the reaction requires a quantity of NH_3 which is used up. Another method is to use a tank of liquid NH_3, the gas from which is released into the chamber under automatic control regulated by the rate of movement of the fabric or even manually by watching through a suitable window the rate at which the foam forms on the fabric.

Nearly as soon as the wet cloth enters the gas chamber, a slight foam starts and in a very short time, in fact in a very few minutes, the reaction is complete and further exposure of the fabric to the relatively strong gas is inadvisable.

The length of travel of the fabric in the gas chamber is governed by the rate of reaction. Some fabrics and gas strengths require three minutes and others up to as much as fifteen minutes. This can all be regulated by suitable simple machinery and the rate of movement of the fabric as a whole through all of the apparatus can be as rapid or as slow as desired, the relative times for wetting and gas reaction being controlled by the length of passage of the fabric through the respective portions of the apparatus.

It is desirable that the size of the chamber in which the gas reaction takes place be kept as small as possible in order to reduce the amount of dilution of the NH_3 in the air of the chamber.

It is not certain at this stage of development whether the gas causing the reaction is NH_3 or NH_4OH, since there is a considerable quantity of moisture present forming a vapor which probably combines with the NH_3.

Following the treatment with ammonia gas, any suitable washing process takes place, preferably of the continuous type, and if the fabric is to be sold as white goods subsequent stretching or tentering, drying and pressing follows, but if the fabric is to be dyed or mercerized, it can be introduced into the appropriate vats while still wet from the washing.

It will be seen that the process can be continuous from the singeing through the dyeing if so desired without any stop in the movement of the fabric, which can be introduced as a completed web, as a warp skein, and in either flat or rope form.

The present process is not dependent for its operation upon any particular type of apparatus, and it will be evident that it can be carried out satisfactorily with apparatus of known form and of greater simplicity since the only function of the apparatus is to maintain the fabric web in continuous motion and at a proper rate of speed while passing, first, into and out of the liquid hydrogen peroxide bath and, second, while passing through the chamber in which the saturated fabric is exposed to ammonia vapor. If the process is to be combined with singeing and subsequent washing and tentering, well-known apparatus for these additional purposes is available. Washing equipment can be had which will wash continuously at a rate higher than one hundred feet per

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minute, and the process can be carried on at least at that rate with proper attention to reagent concentrations and length of passage therethrough.

It will be appreciated that the process can be reversed, that is, that the fabric can be wetted with ammonium hydroxide and then passed through a vapor of hydrogen peroxide, although the method first described is preferable since it is easier to obtain a satisfactory ammonia vapor without decomposition than it is a vapor of hydrogen peroxide.

Bleaching can also be carried out by using two liquids rather than a liquid and a gas, that is, after wetting the fabric in a suitable strength hydrogen peroxide and wringing out the excess liquid, the fabric can then be passed through a bath of ammonium hydroxide, but the main objection to this method is that the liquid of the ammonium hydroxide bath tends to dilute and wash out the hydrogen peroxide so that the reaction which takes place between it and the ammonium hydroxide may not all take place in the fabric. At the same time the considerable heat of reaction is carried away in the solution so that some of the beneficial de-gumming resulting from applicant's process may not be derived from this two-liquid process.

It has been found by experiment that when the hydrogen peroxide and the ammonia are brought into proximity in the fabric, certain reactions take place with the natural impurities thereof as well as with the introduced sizing in the fabric so that these undesirable materials are reduced to either of two general forms, one such that complete elimination thereof takes place in the washing and the other such that the residual after washing has no detrimental effect on subsequent treatments of the fabric. Thus the fabric can be processed and dyed following this treatment equally as well as fabrics subjected to the inferior and time-consuming processes heretofore used. This reaction is believed to result from the presence of heat and alkali. In the old boil-out system for removing waxes, gums, sizes and the like, heat and alkali were used for the purpose. In the present system the ammonia gas, or rather its vapors forming probably NH_4OH, supplies the alkali and the heat is present from the reaction between this gas and the hydrogen peroxide resulting in the liberation of oxygen. Anyhow it has been found that whatever the reaction it is such that waxes, gums, and sizes are rendered innocuous or easily removable in the subsequent washing. The whole process, therefore, may be said to comprise the simultaneous bleaching and de-gumming of the fabric without the application of extraneous heat and in a manner which can be performed continuously on webs of fabric moving uniformly through the apparatus.

Under certain circumstances it may be highly desirable to use added heat in the reaction chamber where the ammonia vapor is brought into contact with the wetted fabric in order to obtain better results in the removal or rendering innocuous of the waxes or gums. It is well-known, as stated previously, that waxes, gums, sizes, and the like are best treated with alkali and high temperature so that temperatures in excess of those resulting from the reaction of the present process will be valuable where fabrics are heavily impregnated with such extraneous materials and where they are required to be as completely free as possible of them for subsequent treatment or use. Under certain conditions the fabric may be made tender by too much heat or too strong a reaction, but this can be controlled in other ways, for instance, by changing the concentration of one of the two reagents or both of them or by making additions to one or both of them of substances which will permit the high reaction temperature better to effect the elimination of waxes, gums, and sizes without detrimental effect on the fabric.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A process of bleaching comprising subjecting a continuously travelling dry fabric to a cold hydrogen peroxide solution only sufficiently long to thoroughly wet it, removing the excess liquid, subjecting the wet fabric briefly to the action of cold ammonia vapor, and immediately washing the fabric.

2. A process of bleaching comprising subjecting a continuously travelling web of dry fabric to the following treatments: subjection to in a least a 20 volume solution of hydrogen peroxide at a temperature of approximately 20° C. just sufficiently long to thoroughly wet it; removal of excess liquid; exposure to dilute ammonia fumes until reaction ceases; and washing to remove reaction products.

3. The process of bleaching fabrics comprising treating the fabric with a cold solution of hydrogen peroxide only sufficiently long to thoroughly wet it, removing the excess liquid, then exposing the wet fabric to ammonia gas of a concentration substantially that obtained by heating approximately 165 cc. of 26° NH_4OH to approximately 100° C. and allowing the gas to mingle with the air in a volume of about one cubic meter and then removing the reagents and reaction products from the fabric.

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