The present invention relates to a method for bleaching cellulose, whether natural or regenerated, particularly in the form of fibers and filaments. More particularly it relates to a method for bleaching such fibers and filaments with alkaline solutions containing hydrogen peroxide, or material generating hydrogen peroxide, by first subjecting the cellulose to the alkaline bleaching solution under conditions where a low liquor ratio is maintained, and then subjecting the cellulose to an alkaline bleach where a relatively high liquor ratio is maintained.

Hereinafter it has been suggested that cellulose be bleached by dampening the fibers with peroxide bleaching solutions and permitting the fibers to bleach in the dampened condition. Relatively high concentrations of hydrogen peroxide are required to produce goods of excellent white and considerable bleaching agent remains at the termination of the bleaching period. In general, bleaching in the damp condition with this type of solution is effected at room temperatures or slightly elevated temperatures. Although considerable energy is saved, the peroxide consumption is high.

It has also been proposed to bleach cellulose in order to obtain excellent white by heating the fibers in a considerable body of bleaching solution. In the cold damp bleach mentioned above, the liquor ratio is about 0.5 to 1.5. In the hot bleach using circulating hydrogen peroxide solutions, the liquor ratio is about 1:4 to 1:8. In order to obtain full whites from gray goods by this hot treatment, the goods must be treated at least twice with the hot circulating bleaching liquor and in many instances additional treatments are required. Although excellent whites are obtained by the hot procedure, the consumption of energy is relatively high.

The present invention provides a method for bleaching cellulose readily and expeditiously in equipment presently employed. The present invention also provides a method for the production of full whites with a minimum consumption of energy and with a minimum consumption of bleaching ingredient.

In accordance with the procedure of the present invention, gray goods are first treated under conditions of low liquor ratio with an alkaline hydrogen peroxide bleach. The goods are partially bleached by this procedure and the motes and shives partially bleached and loosened. The goods are then rinsed and finished off under conditions of prevailing high liquor ratio by treating the goods at an elevated temperature with a hot alkaline peroxide bleaching solution. When finished the goods possess a full white, are free of motes and shives, and possess substantially their original tensile strength. Additionally, the peroxide consumption in the hot bleaching solution is relatively low due to the fact that the goods have been treated in the damp condition with a peroxide solution and many of the catalytic effects traceable to the cellulose have there been eliminated and their action upon the hot peroxide solution reduced to a minimum.

In carrying out the initial bleaching step of the present invention, the gray or unbleached goods are treated with an alkaline solution of hydrogen peroxide at room or moderately warm temperature under conditions of low liquor ratio. The goods are dampened by any conventional method, whereby the fabric or fiber, whether raw stock, yarn, woven or knitted goods, is thoroughly wet out, or saturated with the desired bleaching solution, and contain about 60 to 150% of solution based on the weight of goods. This step will usually include saturation of the goods with bleaching solution, as, for instance, by immersion therein and elimination of the surplus bleaching solution above that necessary to saturate the same by any well known means, as, for instance, by squeezing or hydroextracting, or by any known device or method, or the goods are saturated by any other convenient method and then permitted to stand in the dampened or saturated condition until the desired bleach is obtained. This desired bleached condition is obtained after a period of a few hours to about 16 hours or more depending upon the kind of bleaching solution used and the kind of goods.

The composition of bath effective for bleaching cellulose fibers with a low liquor ratio contains an alkali in addition to water and hydrogen peroxide, or some material generating hydrogen peroxide. This alkali may include materials acting as stabilizers for the hydrogen peroxide solution and may include, among others, silicate of soda, phosphates, such as sodium pyrophosphate, trisodium phosphate, disodium phosphate, sodium bicarbonate, borax, and the like. It is preferred, however, to use the well-known alkaline substances employed in bleaching operations, namely, caustic soda, soda ash, and the like. The quantity of alkaline material used should be considerably in excess of that thought permissible in circulating solutions and the alkali, calculated as sodium hydroxide, should be between about 5 and 50 g per liter.

It will be understood of course that additional
The goods are saturated with the bleaching solution, the excess of the solution being expressed or eliminated whereby the goods retained from 60 to 150% of their original weight, or this quantity of bleaching solution is incorporated in the goods in any other fashion. The dampened goods are then permitted to stand in this saturated condition from about 2 to 16 hours. In order to obtain bleaching in this dampened condition, the goods may be stacked, piled or stored and generally covered in order to prevent evaporation or local changes in the concentration of the bleaching solution and to permit the goods to bleach in the damp condition with a liquor ratio, that is, the ratio of weight of bleaching solution to weight of goods being treated therewith, of about 0.5 to 1.5.

The temperature of the goods may be maintained at room temperature or at temperatures somewhat above room temperature and in general at temperatures below 125° F. It will be understood where the temperature is high, the time of bleaching will be correspondingly low and also where the concentration of peroxide is high, somewhat shorter times are required to obtain the desired bleaching effect than are required with lower concentration of bleaching ingredient.

After the goods have stood in the damp condition for the desired period of time, they may be rinsed and transferred to kiers for treatment under conditions of high liquor ratio. After transference to a suitable heating vessel or kier, the goods are exposed to the final bleaching operation which includes treatment of the goods at elevated temperatures with a hot alkaline circulating peroxide bleaching solution. The quantity of solution with respect to the quantity of goods is relatively high and the liquor ratio should be maintained at from about 1:4 to 1:9. The alkaline peroxide bleaching solution is circulated over and through the goods in any desired fashion and by the employment of any conventional means and in general the goods will be piled in a conventional type of kier. The time of treatment will be from about 10 hours to about 10 hours and the temperature of the circulating solution will be about 140° F. or in general form about 160° F. to 180° F.

The alkaline peroxide bleach suitable for use in the hot treatment contains in one liter approximately 5 cc. silicate and 2.5 cc. 100-volume hydrogen peroxide. At the end of this hot treatment the goods are removed, rinsed and finished in the usual manner.

As an example of the advantage of the present invention, it may be mentioned that in the bleaching of certain types of colored yarn goods the goods are desized, washed, and then subjected to two or more bleaching operations in which about 11/2% hydrogen peroxide 100-volume, based on the weight of the goods, is employed, making therefore a total peroxide consumption of 3% where two hot peroxide bleaches are necessary to obtain the desired white. In some instances substantially the desired increase in one operation by increasing the peroxide content in the bleaching solution to 8% 100-volume hydrogen peroxide, based on the weight of the goods, and by heating for a longer period of time.

In accordance with the present invention goods of the same quality and whiteness can be produced by employing from one third to one half less hydrogen peroxide. Not less than one half of the total hydrogen peroxide found necessary to obtain the desired bleach is incorporated in the solution used for bleaching with a low liquor ratio, the remainder, of course, being incorporated in the bleaching solution used for bleaching with a high liquor ratio. In most instances it will be found expedient to incorporate about 25 to 33% of the total peroxide in the first or low liquor ratio treatment and the remainder in the final bleaching step using a high liquor ratio.

In bleaching certain types of goods where two hot hydrogen peroxide bleach baths are generally used (with the high liquor ratio), the present invention makes it possible to use considerably less peroxide by employing only one high liquor ratio treatment and one low liquor ratio treatment. The low liquor ratio treatment may replace the entire desizing operation and thereby also eliminate one boil. In case only one boil is used with the regular operation, the time of this boil may be considerably shortened by applying a cold low liquor ratio step first.

Therefore in the treatment of goods requiring about 3% 100-volume hydrogen peroxide, based on the weight of the goods, the present invention makes possible the obtaining of goods of equal white and quality by employing approximately 2% hydrogen peroxide, based on the weight of the goods, and in addition gives increased kier capacity with some saving in energy.

Another example is the bleaching of heavy goods, for instance, sheeting. Sheets are usually treated first with one alkali pressure boil or a plurality of alkaline open boils, followed by a bleaching treatment. In most cases the gray goods are first subjected to a desizing operation, followed by a thorough wash. In accordance with the present invention the goods may be bleached to the same degree of white and to a better quality by subjecting the gray goods first to a low liquor ratio treatment, such as described, using approximately one third of the total amount of peroxide for bleaching. Thereafter the goods are subjected to a second alkaline open boil treatment, followed by a hydrogen peroxide bleach using two thirds of the total amount, that is to say, the quantity of peroxide in the low liquor ratio treatment is about 1/4% of 100-volume hydrogen peroxide, based on the weight of the goods, and in the second approximately 1% 100-volume hydrogen peroxide, based on the weight of the goods. To bleach this type of sheeting according to the conventional method it would require over 2% of hydrogen peroxide 100-volume.

The present invention therefore includes also a method to eliminate any desizing operation which is usually necessary before the goods are bleached to a full white or in all the cases where goods are later on dyed, printed, or finished.
ished, whereby residual impurities, especially starch, may cause difficulties or unevenness. Although hydrogen peroxide has been described as the preferred bleaching agent, it will be under-
stood that materials generating hydrogen per-
oxide may be employed and to this end alkali metal and alkaline earth metal peroxides are suit-
able as are the perborates, percarbonates, per-
phosphates, persulfates, and the like. These ma-
terials, including hydroxide peroxide, being design-
nated herein as peroxides.

It will be understood that the term “liquor ratio” refers to the relation between the weight of treating solution and the weight of goods treated therewith and that a low liquor ratio is one less than about 1.5 while a high liquor ratio is above about 4. The former is generally used in padding operations and the latter in circulating operations.

I claim:

1. A method for bleaching goods made of un-
boiled cellulose which comprises treating the goods with an alkaline peroxide solution under conditions of low liquor ratio until a partial bleach is obtained and thereafter with an alkaline peroxide solution under conditions of high liquor ratio until a complete bleach is obtained.

2. A method for bleaching goods made of un-
boiled cellulose which comprises treating the goods with an alkaline peroxide solution under conditions of low liquor ratio until a partial bleach is obtained and thereafter with an alkaline peroxide solution under conditions of high liquor ratio until a complete bleach is obtained, the alk-

3. A method for bleaching goods made of un-
boiled cellulose which comprises treating the goods with an alkaline peroxide solution under conditions of low liquor ratio until a partial bleach is obtained and thereafter with an alkaline peroxide solution under conditions of high liquor ratio until a complete bleach is obtained, the tem-

4. A method for bleaching goods made of un-
boiled cellulose which comprises incorporating in the goods from 50% to 150% of an alkaline peroxide bleaching solution based upon the weight of the goods and then permitting the goods to stand and partially bleach, thereafter heating the goods in an alkaline peroxide solution under conditions of high liquor ratio and circulating the solution over and through the goods until a complete bleach is obtained.

5. A method for bleaching goods made of un-
boiled cellulose which comprises incorporating in

HANS O. KAUFFMANN.
CERTIFICATE OF CORRECTION.

Patent No. 2,231,426. HANS O. KAUFFMANN.

February 11, 1941.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 48, claim 9, for the word "at" read --as--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of March, A. D. 1941.

Henry Van Arsdale,
Acting Commissioner of Patents.
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(Seal) Acting Commissioner of Patents.