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REFINED CELLULOSE FIBER

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3 Claims. (Cl. 92—3)

This invention relates to refined cellulose fiber derived from raw cellulosic materials of the character of hemp, jute, china grass, ramie, manila, and sisal. Its object is the securement from the raw material or from a raw pulp into which the raw material has been converted, of a refined fiber which by virtue of its physical and chemical properties not only better serves in old spheres of use, but advantageously fulfills new and important fields of use.

Paper made from raw fiber, such as hemp, is characterized by its excellent folding endurance, high strength and tear resistance, but it is comparatively non-absorptive and possesses a pronounced harshness or stiffness, which militates against its usefulness for certain important products. The harshness and non-absorbency of such paper is traceable to its high percentage of non-alpha cellulose components, and more especially to its high content of pentosans.

I have found that if such raw fiber is treated for a considerable period of time and under the proper temperature conditions with a strong solution of caustic soda, sufficient non-alpha cellulose components, and more especially pentosans, are removed therefrom to lead to a much softer and purer fiber, from which may be made soft and highly absorbent papers valuable for certain uses which require these properties. The treated fiber retains or is in fact enhanced in its original desirable characteristics, such as tear resistance, and is adapted for conversion into so-called cable papers employed for the insulation of electric cables, for conversion into papers from which may be fabricated artificial reed fiber, which goes into baby carriages, furniture, and the like. Such paper, in addition to possessing in enhanced measure the desirable characteristics of the original fiber, is soft and has sufficient absorbency and porosity to permit quick and uniform impregnation with glue, varnish, or other waterproofing and stiffening agents. The treated or refined fiber is also highly valuable for use in yarns or rovings, which are produced by initially forming pulp ribbons on machinery of the paper-making type and then furling or rolling the moistened ribbons into round form. The yarns or rovings containing the refined fiber can be twisted into yarns or strings having wet and dry strengths comparable to those made with textile machinery.

A procedure which may be adapted in modifying a raw fiber, such as hemp, into the product of the present invention may be substantially as follows. The raw hemp fiber, liberated from the stock by a suitable process of retting or fiber liberation and recovered as pulp, is treated under slow agitation as, say, a 10% suspension in a solution of caustic soda of about 4% to 10% at temperatures below 70° C., preferably from 0° to 30° C. The raw fiber, having a pentosan content as high as, say, 12%, may be treated until such content has been reduced to about 4% or lower, at which time the fiber is much softer and more absorbent than the raw fiber. The treatment may require from about one to six hours. The refined fiber is then washed free of alkaline solution. The washed fiber yield amounts to about 80% to 90% of the weight of the raw fiber, depending upon severity of the refining treatment and the characteristics of the raw fiber. The resulting fiber has a higher tear resistance and is much softer and more absorbent than the raw fiber, which characteristics are, of course, attributable to the solution and removal of a considerable proportion of non-alpha cellulose components, especially pentosans, from the raw fiber. The resulting fiber has a higher tear resistance and is much softer and more absorbent than the raw fiber, which characteristics are, of course, attributable to the solution and removal of a considerable proportion of non-alpha cellulose components, especially pentosans, from the raw fiber. The resulting fiber is particularly suitable for use in the manufacture of papers when high strength, tear resistance, and folding endurance, as well as high softness and absorbency, are desired. The color of the resulting fiber may be improved by treating the raw fiber with a comparatively dilute solution of a lignin reactive reagent, such as chlorine or bleach solution. This result may also be attained by using bleach or a like oxidant in the caustic soda solution used for refining the pulp. The use of a lignin-reactive chemical before or simultaneously with the caustic soda solution promotes a removal of non-alpha cellulose components other than ligneous and coloring matter from the raw fiber. The alkali-refined fiber may be further improved in color by a bleaching treatment conducted under conditions to preserve the physical characteristics and alpha cellulose content previously attained. This may be accomplished by bleaching the alkali-refined fiber in a bleach liquor maintained distinctly alkaline throughout the bleaching operation, as disclosed and claimed in application for Patent Serial No. 716,154, filed May 27, 1924, by Milton O. Schur and myself.

When raw jute fiber is treated as hereinbefore described, its characteristics are also modified in

the same way as is raw hemp fiber. Other raw fibers of similar description may be treated as hereinbefore described, but each fiber may require particular treating conditions to yield best results.

The conditions of alkaline treatment and the chemical employed therefor may be varied. Thus, a solution of sodium sulphide or of sodium sulphide and caustic soda may be used for refining the raw pulp. In any event, however, it is essential that the alkaline solution be sufficiently concentrated to accomplish the removal of sufficient non-alpha cellulose components from the pulp to soften it materially and to increase its tear resistance, but the concentration should not reach or exceed the concentration at which mercerization and injury to the papermaking characteristics of the pulp takes place. The limiting concentration of alkali to be employed depends upon the temperature of treatment. The lower the temperature, the lower is the caustic soda concentration which must be maintained in order to avoid mercerization and injury to the papermaking characteristics of the pulp. Inasmuch as sodium sulphide does not effect a mercerization of the pulp, it may be used at higher concentration, either alone or together with the caustic soda, than when caustic soda alone is used. When sodium sulphide is employed, however, bleach or similar oxidizing chemical cannot be added to the solution.

The principles of the present invention extend to fibers of the class of manila and sisal. A normal grade of raw manila fiber, designated as "G" grade and used to a considerable extent in the cordage industry, contains from 10% to 12% pentosans and but from 12% to 15% lignin. Raw sisal fiber of the usual character has a pentosan content of from 13% to 16% and a lignin content of from 10% to 12%. So, too, ramie and china grass are characterized by high pentosan contents. Many of these raw fibers are from one to three feet long, although the finished pulp of the present invention is made up of fiber units of only from ⅛ to ½ inches in length, as the ultimate fibers have been isolated from the original fiber bundles making up the long raw fibers.

Specific examples of procedure involving the conversion of raw manila fiber into the product of the present invention may be practiced substantially as follows. The raw manila fiber may initially be cooked in a liquor containing about 1.0% of active caustic soda, calculated as Na_2O, for about three to four hours, at 335° F. The pulp resulting from such cooking has a lignin content of about 1.8%, a pentosan content of about 9.3%, and an alpha cellulose content of about 88%. The pulped manila may then be steeped in chlorine water containing 3% chlorine, based on the weight of pulp at room temperature for about two to three hours.

The chlorinated pulp may then be washed and finally digested in an 8% caustic soda solution at 20° C. The alkali-digested product, when washed, has an alpha cellulose content of about 95.8% and a pentosan content of about 1.3. Such a refined product has remarkably good papermaking characteristics. Thus, when beaten and made into paper, not only has the paper good Mullen and tensile strength, but it has unusually high tear resistance and folding endurance. Indeed, the tear resistance of the paper excels that of paper fabricated from the raw beaten manila fiber.

Rather than actually liberating pulp from the raw manila fiber, the initial treatment may simply modify the pentosans so that they are readily soluble when the fiber contacts with the cold, concentrated caustic soda solution. To this end, the initial treatment may be one with a suitable hydrolyzing solution, preferably a solution of mineral acid. Thus, the initial treatment may consist in steeping the raw fiber for four hours in a 0.5% sulphuric acid solution at 100° C. The fiber may then be washed free of acid solution and treated with a 10% caustic soda solution containing, say, 10% sodium hypochlorite bleach, based on the dry weight of fiber. This alkaline treatment may be conducted at about 25° C. for about six to twelve hours, at the end of which time the pulp may be washed. The washed pulp has an alpha cellulose content of about 95%, a pentosan content of about 2.4%, and has unusually good papermaking characteristics.

Rather than using the raw fiber as the starting material, I may use old rope, twine, or bagging containing the fiber. In such event, one may initially digest the raw material in a chemical designed to bring about pulping or fiber liberation, whereupon the pulped material may then be refined in the cold, concentrated alkaline liquor as hereinbefore described. The concentrated alkaline liquor may serve a double use. Thus, it may first be applied to the raw material at elevated temperature, say, 100° C., and then at lower temperatures, say, downwards of 30° C. The initial high temperature treatment functions to dissolve ligneous matter and thus to promote fiber liberation; whereas the low temperature treatment is designed to dissolve out pentosans from the pulp and thus to produce a soft and absorbent finished product of high alpha cellulose content. The use of the concentrated alkaline solution at both elevated and low temperatures may be combined with other treatments, including chlorination of the fiber and/or steeping in hydrolyzing liquors, such as acid solutions.

The concentrated alkaline liquor preferably contains sodium sulphide when optimum papermaking characteristics are desired in the finished product. On the other hand, when it is desired to attain a white product, hypochlorites or other oxidants are added to a straight caustic soda solution, as this facilitates the final bleaching operation to which the refined pulp is subjected.

So far as I am aware, there is no generic term covering the various raw fibers from which I produce my finished product. Some of the raw fibers, like hemp, are bast fibers, whereas others, like manila and sisal, are derived from the leaves of the plants. Nevertheless, all of these raw materials are of high pentosan content and are convertible into finished products which are closely analogous in their physical and chemical properties.

So far as subject matter is concerned, this is a continuation of my application Serial No. 174,719, filed March 11, 1927.

I claim:

1. A bleached, refined, soft and absorbent cellulose pulp in unmercerized condition derived from long raw fibers of the character of hemp, jute, china grass, ramie, manila, and sisal, and having an alpha cellulose content of at least about 93%, said refined pulp consisting essentially of the ultimate fibers and yet being convertible into stable papers having a higher tear resistance than papers prepared from the raw fibers.

2. A refined, soft and absorbent cellulose pulp in unmercerized condition derived from long raw fibers of the character of hemp, jute, china grass, ramie, manila, and sisal, and having an alpha cellulose content of at least about 93%, said refined pulp consisting essentially of the ultimate fibers and yet, after beating, being convertible into stable papers having a higher tear resistance than papers prepared from the raw fibers beaten to the same extent.

3. A refined, soft and absorbent cellulose pulp in unmercerized condition derived from long raw fibers of the character of hemp, jute, china grass, ramie, manila, and sisal and having an alpha cellulose content of at least about 93%, said refined pulp consisting essentially of the ultimate fibers capable of being hydrated upon beating so as to be convertible into stable papers of high strength and tear resistance.

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