FIBROUS BOARD AND SHEET FOR INSULATION AND OTHER PURPOSES OF MATTED LONG COTTON STALK FIBER

Arthur M. Spencer, Santa Fe, N. Mex., and Abner Jacobson, Cleveland, Ohio; Moe L. Spencer, executors of the estate of Arthur M. Spencer, deceased, assignors to Fibre Corporation of America, Inc., Santa Fe, N. Mex.

Application May 10, 1951, Serial No. 225,622

2 Claims. (Cl. 92—14)

This invention relates to the preparation of fibrous products from cotton stalk, and particularly the preparation of fibrous board and sheet for insulation and other purposes of matted long cotton stalk fiber without addition of extraneous binder substance.

We have found, according to the present invention, that cotton stalk fiber is unique among the several known sources of cellulose fiber in that the fiber is not only long, resilient and flexible, but in its natural state such fibers are bonded together by a resinous substance of low acid value which may be readily separated by a low, dilute alkali digestion which may be the only processing that is necessary to sufficiently solubilize this natural resinous binder to free the fibers, which may be done in a subsequent mild digest heating operation.

In contrast with prior art practices, it will be noted that wood and typical fibrous grasses such as straw or cane have a large ligno-cellulose content or a substantial waxy or acid-waxy content requiring high temperature and pressure digestion with steam or both steam and alkali in substantial concentration or with sulfite. In some instances of the prior art, suggestion has been made to digest such natural fibrous products with dilute alkali, but this has been merely a preliminary step combined with subsequent chemical treatment such as chlorination and/or high temperature digestion and severe mechanical beating.

We have found, according to the present invention, that the fiber of cotton stalk is very easily separated by digesting conveniently short lengths of chopped cotton stalk in a dilute aqueous alkali solution at a relatively low temperature for a short period of time. The weak acid resins binding the fiber are solubilized in this treatment and the alkali totally absorbed by reaction with the natural resin, whereby a substantially neutral fiber bundle is obtained which is easily separated into single, strong and flexible fibers of normal and unbroken long lengths by a mild beating. Thereafter, the fiber, without separating from suspension in the digestion bath, is deposited on a screen and subjected to heat and pressure to convert the same to a dry strong but porous fiberoard or paper, depending upon the thickness of the deposit on the screen. The product is adapted for use as insulating board or insulating paper and is particularly adaptable for the manufacture of felt or analogous uses without addition of extraneous chemical binding substance.

According to the present invention, cotton stalk is first chopped into short lengths of about one-half to five inches and placed in a dilute alkali solution in water containing from approximately 0.1 to 0.5% by weight of caustic soda or a crude caustic containing an equivalent amount of caustic soda such as soda ash or dilute alkali liquors from salt electrolysis and heated at substantially atmospheric or slightly raised pressure at a temperature ranging from 80° to 105° C. A preferred control is merely to boil the suspension of stalk in the liquid for a short period ranging from approximately 30 minutes to an hour and a half, preferably about one hour, at atmospheric pressure in approximately a 2.5% aqueous caustic solution, all proportions given being by weight.

It will be noted that larger alkaline contents tend to render the fibrous product alkali and substantially hydrated, requiring subsequent neutralization, and further tends to degrade and embrittle the fiber; hence, concentrations in excess of 1% should be avoided. Moreover, heating of the fiber at higher temperatures and pressures exceeding about 20 pounds or for longer periods of time, in addition to impairing the flexibility and strength of the fiber, tends to polymerize the resins to form insoluble bodies, which contaminate the fibrous product to reduce the utility for insulation and other uses, which likewise is undesirable. It also tends to liberate amounts of mono and dibasic acids which require larger amounts of alkali for neutralization. Similarly, addition of other chemicals, such as chlorination of the fiber after digestion, tends to embrittle the fiber and further lowers its utility as an insulation material. Following the procedure described herein, the fiber is released by solubilizing the resinous binder in the digestion liquor to leave a strong, resilient and flexible fiber in undegraded state which is outstanding as a fibrous material for insulation and felt material as described hereinafter.

After digestion of the cotton stalk in dilute alkali, it is then subjected to a mild beating such as whipping or beating with flexible mechanical elements such as whips, as described in a co-pending application of Spencer et al., Serial No. 33,696, filed June 18, 1948, now Patent No. 2,668,110, which non-abrasively separates the fiber without tearing or breaking the same into short lengths. The substantially neutral fiber suspension is then passed through a screen to mat the fibers into a coherent sheet.

This operation is further illustrated by the drawing herewith, of which the single figure shows diagrammatically a frame 10, which may be rectangular or other shape, but as shown herein is rectangular, having ends 11 and sides 12, one of which is broken away to show mounting at the bottom thereof of a screen 13. The sides and ends 11 and 12 are equipped with depth to allow filling or partial filling of a column of a relatively homogeneous pulp suspension obtained as described above. The frame is filled with the pulp suspension to a height therein depending upon the thickness of the insulating board or sheet desired, i.e., the quantity of separated fiber contained in the liquor usually ranging from 10% to 15%. Thereafter, a substantially close fitting press platen member 14, mounted to reciprocate within the frame above the pulp suspension, is lowered upon the pulp as actuated by the pressing arm 15, the total assembly diagrammatically illustrating any typical press construction having a screen at the bottom with means for applying pressure to the fluid therebene. After pouring of the liquid pulp suspension into the frame, pressure thereon is applied through press platen member 14 to force the liquid suspension of the fiber against the screen whereby the liquid fibers thereon and usually build up a cake or board 16 against the screen of desired thickness, usually ranging from .1 to 2 inches, thicker or thinner as may be desired. After filtering, pressure is directly applied against the fibrous sheet of from about 5 to 20 pounds, depending upon the compactness desired in the board, and the press is simultaneously heated either by blowing hot air or other gas thereover or by suitable jacketing (not shown) through which steam may be circulated to heat and dry the board while under pressure at any suitably low temperature of 75° to 150° C.

As indicated, the preferred procedure for producing a fibrous product of ultimate quality from cotton stalk is as described within the temperature and pressure limits given. For certain products where some sacrifice may
be made of the quality of the fiber, the digestion may be effected at slightly higher temperatures and pressures with the same or shorter periods of time. Thus, for example, the digestion kettle may be closed and a pressure as high as 15 to 20 pounds above atmosphere may be applied with a commensurate rise in temperature to the boiling point at such conditions, but, as indicated, such higher more drastic conditions are generally avoided.

Example 1

Cotton stalk, with or without bolls but without roots and generally without leaves, partially dry from field or other storage, is chopped into short lengths of approximately 1/2 to 3 inches and placed in an open kettle or vat, to which is added a 0.25% solution of caustic soda in water to make a suspension of approximately 10% by weight of cotton stalk in the liquid. The suspension is gently boiled for a period of one hour. The solution thereafter is found to be substantially neutral. The entire suspension of fiber in liquid is then passed through an attrition mill with widely separated beating surfaces or beating elements so that a minimum of fiber is broken, whereby bundles of digested fiber are gently separated into individual fibers. The suspension is thereafter immediately poured into a frame having a bottom of porous material such as a fine screen, porous stone or even a porous fibrous felt fitted upon a screen, so that the liquid readily filters therethrough, leaving the fiber in a mat or board of desired thickness. After sufficient suspension of pulp has been poured into the frame to build up a board of desired thickness, for example, one inch greater or less, as desired, pressure is applied to the liquid and then to the wet fiber after the liquid has filtered through, of the order of about 10 pounds per square inch. While maintaining this pressure, the fiberboard is heated to dryness and a strong, well matted but porous fibrous board having a fine fiber texture and substantial flexibility is obtained.

Certain modifications are possible within the scope of the present invention. For example, typical fiber beaters and digestion apparatus can be used to carry out the process described herein to separate the fiber bundles into individual fibers without destruction thereof and various fiber cooking apparatus as well as filters and presses may be substituted for that shown herein, and it is intended that the foregoing example and description to be regarded as illustrative rather than limiting except as defined in the claims appended hereto.

We claim:

1. The method of forming a flexible porous fiber sheet of cotton stalk fiber comprising heating short lengths of raw fiber stalk at a pressure ranging from atmospheric to 20 pounds per square inch and a temperature ranging from 80°F. to the boiling point in a dilute alkali solution comprising 0.1% to 0.5% by weight of caustic alkali in water for a period of approximately 1/2 to 11/4 hours, gently beating the digested fiber bundles only sufficient to separate the same into individual fibers, pressing the suspension through a porous diaphragm to deposit a wet matted fibrous sheet on said diaphragm applying a pressure of 5 to 20 pounds per square inch to said sheet and heating the wet fibrous sheet under such pressure to dry the same.

2. The method of forming a flexible porous fiber sheet of raw cotton stalk fiber comprising boiling short lengths of cotton stalk at atmospheric pressure in a dilute alkali solution in water containing approximately 25% by weight of caustic soda for a period of about one hour, gently beating the fiber suspension only sufficient to separate bundles of the fiber into individual fibers, pouring the homogeneous suspension into a porous frame to filter off the aqueous alkaline suspending medium and to deposit a wet layer, pressing said wet layer into a sheet of matted fiber of desired thickness under a pressure of approximately 10 pounds per square inch and heating the same under said pressure to dryness.

References Cited in the file of this patent

UNITED STATES PATENTS

94,131 Read Aug. 17, 1860
124,652 Stant Mar. 12, 1872
642,387 Tempest Jan. 30, 1900
1,165,689 Marsden Dec. 28, 1895
1,909,521 Bryant May 16, 1933
1,991,769 Palmer Feb. 19, 1935
2,033,485 Schur Mar. 10, 1936
2,047,130 Ratliff July 7, 1936
2,507,773 Farber May 16, 1950
2,528,349 Farber Oct. 31, 1950
2,547,997 Bowers Apr. 10, 1951
2,591,315 Stephanus Apr. 1, 1952
2,668,110 Spencer Feb. 2, 1954

OTHER REFERENCES