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# UNITED STATES PATENT OFFICE.

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## PROCESS OF MAKING PAPER FROM STRAW AND PRODUCT.

No Drawing. Application filed January 12, 1926. Serial No. 80,813.

In an application, Serial No. 81,828, filed January 12, 1926, in the name of Charles D. Wood and Edward A. Taylor, there is described and claimed a process for the production of paper pulp from straw and similar fibrous vegetable materials, which consists essentially in digesting the straw with a solution containing as the essential reagents sodium sulfid and sodium hydroxid. The process described in said application is characterized by the use of only a relatively dilute solution of the reagent, up to about one percent, and only a relatively small quantity of reagent as compared with the quantity used in the so-called Kraft process, i. e., the combined weights of the sodium sulfid and the sodium hydroxid amount to only about 4 to 6 percent of the weight of the straw treated, and by the use of the sodium sulfid and sodium hydroxid in relative proportions in the neighborhood of 3 parts by weight of sodium sulfid to 5 parts by weight of sodium hydroxid, and by the fact that the cooking operation is generally completed in 3 to 4 hours. The cooking operation is carried out by digesting the straw with the solution of the reagent in a closed digestor with steam at a pressure of 30 to 40 pounds per square inch. The process of said application gives a stock which may be beaten and washed in one to two hours as compared with five to six hours required for linne stock, and the resulting pulp may be made into paper of superior properties.

The present invention relates to the production of paper from stock such as that produced by the process of said application, and more particularly to the use of soluble constituents of the straw as a binding and sizing agent for the pulp in the production of paper therefrom.

In the manufacture of paper from pulp it is necessary in order to secure maximum strength to add sizing agents or binders. I have found that the soluble components of the straw present in the digestor liquor produced in the digestion of the straw may be used for this purpose and the supplying of sizing and binding material from an external source thus dispensed with.

In the investigation of the properties of the soluble constituents of the straw, i. e., the portion of the straw dissolved by digesting it as described with a solution of sodium sulfid and sodium hydroxid, the following properties have been determined:

(1) The digestor liquids contain 3 to 4 percent of dissolved solids.

(2) The dissolved solids are precipitated by acids, only enough acid being required to give a slightly acid reaction with methyl orange.

(3) The precipitated solids are practically insoluble in water, slightly soluble in concentrated hydrochloric acid and dilute sulfuric acid, decomposed by concentrated sulfuric acid and completely soluble in alkalies.

(4) The solids have adhesive properties and are regarded as being principally the natural binding material of the straw.

A consideration of the properties of the dissolved solids in the digestor liquors led to the conjecture that they might be made to serve as a binding or sizing and waterproofing agent in paper made from the straw pulp, which conjecture was proved to be correct.

A preferred procedure in accordance with my invention is to pulp the straw-stock directly, that is, without the usual washing and separation of the digestor liquors, and then neutralize the pulp by the addition of acid to precipitate the dissolved solids in the pulp. The pulp is then worked into paper in the usual way. This procedure is preferred because it eliminates the usual washing of the stock in the beaters, thus simplifying the conversion of the stock into pulp, and provides a binding or sizing agent for the pulp without resort to an external supply thereof, and besides disposes of the digestor liquors. It is apparent, however, that the alkali-soluble components of straw may be utilized as the binding agent for the pulp in the production of paper in other ways. For instance, the digestor liquors may be separated from the stock by draining or centrifuging the stock washed and pulped in the usual way, the dissolved solids in the digestor liquors recovered by acidification and redissolved in alkali, the resulting solution added to the pulp, and the dissolved solids precipitated in the pulp by acidification. It is also apparent that all of the dissolved solids in the digestor liquors need not be used, that is, a portion of the digestor liquors may be separated from the stock before it is pulped, or the stock may be partially washed or only a portion of the

dissolved solids recovered from the digestor liquids, as described above, returned to the pulp. It is further understood that my invention does not preclude the use of other binding or sizing agents in conjunction with the dissolved solids in the digestor liquors. Moreover, the invention is not limited, excepting as is indicated by the appended claims, to the use of stock prepared by the particular cooking method referred to, but is applicable to any paper stock prepared by a cooking process which dissolves a component of the raw fibrous material capable of reprecipitation and having sizing or binding properties. In the so-called lime-process, according to which straw is digested with lime water, the digestor liquors are practically free of dissolved solids and my process therefore is not applicable to lime-stock, but it is applicable to stocks prepared by cooking straw and the like in alkaline agents such as caustic soda, capable of dissolving the alkali-soluble natural binding agent of the fibrous material.

It is noted that in the process of the said application the quantity of reagent used in cooking the straw is limited so that at the end of the cooking operation there is practically no free reagent left in the digestor liquor, and that my preferred process of working the stock directly into pulp without separation of the liquor is applicable to such stock. In other cases, however, as in the case of stock prepared by the so-called Kraft process, in which an excess of reagent is used, a procedure involving the separation of the digestor liquor from the stock, recovery of the soluble binding material from the liquor by precipitation, resolution of the material in alkali and addition of the resulting solution to the pulp, must be resorted to in order to separate the soluble components of the fibrous material from the excess of reagent. Other variations of the process to adapt it to different conditions encountered in the preparation of the pulp will be apparent from a consideration of the foregoing disclosure of the principles of my invention, the preferred embodiment of which, as stated, is the pulping of a stock directly with the digestor liquors or a portion thereof prepared by digesting straw or similar fibrous vegetable material in a dilute solution of sodium sulfid and sodium hydroxid, in quantity amounting to only about 4 to 6 percent of the weight of the fibrous material in accordance with the process of the prior application referred to.

Paper prepared from straw stock using the soluble components as the binding or sizing agent in accordance with my invention, as compared with other straw paper, posseses a satisfactory strength, is highly sized and water-proofed and is readily colored and bleached.

I claim:

1. Process of making paper from straw and similar fibrous vegetable materials, which comprises incorporating the alkali soluble components of the fibrous material obtained by digesting the fibrous material with an alkaline reagent comprising a soluble sulfide with a pulp derived from said fibrous material.

2. Process of making paper from straw and similar fibrous vegetable materials, which comprises incorporating a solution of the alkali soluble components of the fibrous material obtained by digesting the fibrous material with an alkaline reagent comprising a soluble sulfide with a pulp derived from said material and neutralizing the resulting pulp.

3. Process of making paper from straw and similar fibrous vegetable materials, which comprises digesting said fibrous materials in an alkaline reagent comprising a soluble sulfide, working the resulting stock with a part at least of the digestor liquors into a pulp, and neutralizing the pulp.

4. Process of making pulp from straw and similar fibrous vegetable materials, which comprises digesting said materials in a solution containing sodium sulfid and sodium hydroxid, working the resulting stock and a part at least of the digestor liquors into a pulp and neutralizing the pulp.

5. Process of making paper from straw and similar fibrous vegetable materials, which comprises incorporating in a pulp of said materials alkali soluble material dissolved therefrom by digestion in a solution containing sodium sulfid and sodium hydroxid.

6. Paper comprising the fibrous structure of straw and a binding or sizing material obtained by digesting straw with an alkaline reagent comprising a soluble sulfide.

In testimony whereof, I affix my signature.

CHARLES D. WOOD.