Patented Sept. 4, 1928. 1,682,834

UNITED STATES PATENT OFFICE.

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METHOD OF MANUFACTURING STRAW PULP AND PAPER.

No Drawing. Application filed January 6, 1925. Serial No. 803.

This invention relates to the paper making art and especially to an improved method of making and treating the pulp whereby to secure certain advantages to the process as a whole as well as to the resulting paper. It is particularly useful in the manufacture of paper from straws, such as rye, wheat or oat straws, or from any other suitable vegetable fibre.

It has for its principal objects the provision of a method which will yield a maximum amount of paper from a given amount of straw while at the same time keeping the chemical cost within a reasonable figure; which will lend or adapt itself with great flexibility and consequent economy to the limitations of individual plants; which will be productive of a saving in the time required to produce a paper; which will eliminate certain of the steps heretofore essential in the manufacture of paper; which will reduce the quantity of objectionable effluent from the pulp making process and simplify the problem of disposing of the waste water; and, in general, one which will improve the efficiency of the plant and the quality of the product.

Heretofore, the usual procedure in manufacturing pulp from straw has involved cooking the straw with lime and the necessary amount of water. Subsequently the lime had to be washed from the pulp before beating was begun and at frequent intervals the process has had to be interrupted to permit washing of the apparatus with hydrochloric acid due to certain objectionable characteristics of the lime with which those skilled in this art will be entirely familiar. Furthermore, in washing out the lime all of the dissolved organic matter or intercullular substance of the straw has heretofore been removed.

As contrasted with this customary procedure I provide a method in which all or a large proportion of the washing before beating may be dispensed with and in which no interruptions for washing with hydrochloric acid are necessary. I also make it possible to use part or all of the actual cooking liquor in the beater thereby permitting retention of dissolved organic matter from the straw which, in combination with the residual quantity of the active agent in the cooking liquor, (as will appear hereinafter) can be subsequently set to act as a sizing for the paper.

With the foregoing in mind more specific objects of the invention are the provision of a method of manufacturing pulp and paper which will yield a harder, stronger paper than heretofore possible, which will be capable of a high finish and be exceptionally water-resistant; the provision of a method which prevents loss of fibre due to washing of the pulp; and the provision of a method which will increase the beater capacity of a plant.

In obtaining all of the foregoing advantages and results I proceed as follows: Instead of using lime I prepare the pulp by cooking the straw with a solution of silicate of soda. Silicate of soda alone is preferable but its benefits may be secured in association with other alkaline or neutral compounds such as caustic soda or sodium carbonate. After the cooking is completed the mass is drained to remove any excess quantity of the cooking liquor and then placed in any one of the well known devices known to the art for beating or preparing the pulp. To this is added the necessary water and some of the cooking liquor. Beating or preparation of the pulp is then begun and it will be noted that washing prior to beating is not necessary as it is with the lime process. Of course, if preferred the cooked mass may be washed just enough to remove the excess cooking liquor but it is not necessary to wash at all as draining alone will suffice, the purpose being simply to make it possible to more easily and accurately proportion the batch for the beater since water and some of the cooking liquor are to be added. The step described as draining may in some cases be omitted altogether and the pulp transferred directly from the cooking vessel to the beater without the removal of any of the cooking liquor.

When beating is complete or nearly so a quantity of paper-maker's alum somewhat more than sufficient to react with the silicate in the pulp is added to the beater and thoroughly mixed after which the mass may be diluted with water and formed into paper in accordance with the usual practices in this art.

It will thus be seen that by my process I am enabled to dispense with washing prior to beating, a feature which is of immense value because it saves fibre as well as much time and increases the beater capacity of a plant, the usual custom heretofore having been to wash in the beater prior to beating.

Furthermore, because of the fact that I can make use of some of the cooking liquor in the beater I am enabled to retain a portion of the dissolved organic matter of the straw, the intercellular stuffs or materials from the straw having been carried into the solution during cooking with the silicate of soda.

This dissolved organic matter plus the residual silicate are precipitated on the fibre acting as a sizing for the paper which is set by the paper-maker's alum ($Al_2(SO_4)_3$). This renders the paper water-resistant and tough without interfering with its flexibility. A water resistant paper can, therefore, be obtained by my process at a slight cost for alum and by dispensing with the washing before beating and using the alum in the beater it is possible to effect a large saving of the finer fibre and at the same time to greatly reduce the quantity of objectionable organic matter going into the effluent.

While I prefer to use alum as the precipitating material other equivalent substances might be used for some papers, for instance the sulphates of iron. Certain acids and acid salts have been proposed for precipitation of size and my invention is not to be considered as limited to the use of paper maker's alum only.

By preparing the pulp in the manner herein disclosed the fibre produced is short and hard with much of the intercellular stuff of the straw removed but with sufficient having been retained to aid in lending to the paper the desirable characteristics above mentioned. It is highly hydrated and capable of a higher finish when made into paper than when made by the old lime process. Furthermore, by my method, I have found that it is possible to substantially reduce the average cooking time.

While a great variety of silicates might be used in producing my improved results I have found that a silicate of approximately the following composition is preferable, namely, $Na_2O3.25SiO_2$.

An important advantage of my process resides in its elimination of the necessity for washing the machines with hydrochloric acid. In the old lime process certain objectionable characteristics of the lime, well known in this art, required such washings with their incidental expense and loss of time. I, therefore, increase plant economy and efficiency in this way also.

In carrying out my invention a very great latitude is permissible in the amount of silicate used and the time allowed for cooking and beating. Cooking temperatures also may vary considerably. In general it may be said that the time for cooking varies inversely with the quantity of silicate. If chemical consumption happens to be a factor of major importance at the time less than the average amount of silicate might be used with a certain corresponding increase in the length of the cooking period but when time happens to be of more value than the cost of the reagent a greater amount of silicate with a shorter cooking period would be desirable. Also, the cooking may be accomplished by open boiling or by steam at various pressures. No definite times or figures are believed to be necessary and, indeed, it would be almost impossible to lay down any fixed rules for individual conditions and requirements are so widely variant. A determination in each instance must fall as usual within the personal judgment of each individual. In a long series of experiments involving many differences in time and materials, I was able to produce many papers of excellent quality and as an example I cite the following which gave a very hard, flexible and water-resistant sheet: 50 parts by weight of straw were mixed with 500 parts by weight of water and 5 parts by weight of silicate of soda and then steam cooked for eight hours at a pressure of 40 lbs. The silicate used was a 40 percent solution of the preferred composition and the cooking temperature was 130° centigrade. The pulp thus produced was beaten for 5¼ hours and after the addition of the alum a paper was made.

A pulp made in accordance with this invention is especially fitted for making corrugated paper and other forms of paper used in the shipping container industry where rigidity and low cost are important.

I claim:—

1. In the manufacture of paper the method of preparing the pulp which comprises cooking with silicate of soda, beating with cooking liquor, and then sizing.

2. In the manufacture of paper the method which includes cooking the fibre with silicate of soda and beating without washing.

3. In the manufacture of paper the method which includes cooking the fibre with silicate of soda, in removing the excess liquor but not necessarily eliminating all of it, in beating with water and a portion of the liquor, and in sizing by precipitating on the fibre the residual silicate with its contained organic matter.

4. In the manufacture of paper the method which includes cooking the fibre with silicate of soda and beating with cooking liquor.

5. The method of manufacturing paper which includes cooking straw with silicate of soda, in beating the pulp with cooking liquor, and in adding paper maker's alum.

6. In the manufacture of paper the method of preparing the pulp which comprises cooking with silicate of soda, beating with cooking liquor and treating with paper-maker's alum.

7. In the manufacture of paper the method which includes cooking the fibre with silicate of soda, beating with cooking liquor and siz-

ing by precipitating with alum the residual silicate.

8. In the manufacture of paper the method which includes cooking the fibre with silicate of soda, beating with cooking liquor and sizing by precipitating with alum the residual silicate with its dissolved organic content.

9. In the manufacture of paper the method which includes cooking the fibre with silicate of soda, beating with cooking liquor and sizing by precipitating on the fibre the residual silicate with its contained organic matter.

10. As a new article of manufacture, a paper prepared from pulp cooked with silicate of soda and beaten with a portion of the cooking liquor.

11. As a new article of manufacture, a paper prepared from straw pulp cooked with silicate of soda, and sized by precipitation of the residual silicate plus the contained organic matter.

In testimony whereof, I have hereunto signed my name.

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