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METHOD FOR RECOVERING THE FIBROUS MATERIAL FROM SUGAR CANE

No Drawing.

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This invention relates to a method for recovering the fibrous material from sugar cane, and has for an object to provide for the production of soft, strong, fibrous material adapted for use in manufacturing paper, paper board, and analogous materials, fibrous threads adapted to be spun and woven, and other cellulose articles.

Another object consists in providing certain improvements in the method whereby advantageous results are obtained.

In the manufacture of sugar, the cane is crushed between rollers, in a well understood manner, and, as a result of this crushing operation there is left the coarse fibrous element of the sugar cane, which is known as bagasse. This substance is produced in a very large quantity and, at present, it is commonly used as fuel for firing the power plants of the sugar factories which operate upon the cane. The material is not very suitable as a fuel, largely because of its low calorific value but, the great amount produced calls for its use in such manner in the absence of a more profitable employment of it. My invention contemplates utilizing the bagasse in a much more profitable manner so that it will be economical to fire the factory furnaces with more efficient fuel, such as coal or oil, thereby bettering the manufacturing operations in this respect, in addition to obtaining the very substantial profit from the novel employment of the bagasse.

It is my belief that I have devised a method of producing the said fibrous material of high quality for use, for instance as pulp, in the manufacture of paper, paper board and analogous products, and as fibrous threads in the manufacture of textiles, bags, cordage and other analogous articles of commerce, in a manner which is commercially economical and practicable and which does not impair the native strength of the fibrous element or cellulose of the sugar cane.

Previous efforts to utilize bagasse have consisted in attempts to manufacture paper or heavy board, and have uniformly embodied, in the main, treating the bagasse to a more or less drastic digestion with a caustic alkali or other chemicals, without previous treat-

ment or preparation, and I have determined that, when the bagasse of sugar cane is subjected to such a digestion treatment, various substances bound in with the bagasse, such as the complex carbo-hydrates and the like, gelatinize, and the subsequent steps required to eliminate said gelatinized substances greatly injure the native properties of the bagasse fibers or cellulose which properties would render them appropriate for the manufacture of the products to which this invention is adapted.

The results of these previous efforts have been unsatisfactory, especially in that the quality of the products was poor, and this has been attributed mainly to the presence or action of the pith or parenchyma of the sugar cane. As a matter of fact, the defects in such previous paper or analogous material have not been due to the pith, but have been due to the presence in the pulp of varying amounts of sucrose, pentosans, and similar carbohydrates which, unless removed before the material is digested in the ordinary course of manufacturing cellulose pulp by the soda and other processes, decompose, change and combine with the alkali or acid used in such processes, thereby forming complex gelatinous masses which are very difficult to cook out of the pulp without excessive use of chemicals, and resultant low yield because of the destroying of a substantial percentage of the cellulose fibers by the violence of the treatment. The portion of the said masses which are not entirely removed from the pulp, cause brittleness, poor bending, folding and creasing qualities, and impart light, irregular spots in the paper or analogous products manufactured therefrom, and otherwise produce unsatisfactory results.

My present invention comprehends the treatment of the bagasse in such a way that the said sucrose, pentosans, and similar carbohydrates, and the like, are removed, or transformed so as to nullify their injurious effects, before the digesting of the fibrous portion or cellulose into paper pulp, this being accomplished without injury to the fibrous material. Moreover, my invention leaves the pithy cellulose portion of the fiber in a clean

state attached to the fibers, so that the paper and the like, manufactured therefrom, will not embody the defects above named, and will give better indications when tested for strength, as by Mullen tester, fold and other qualities; as well as producing a fiber which is of high quality and well adapted for textile uses and other purposes hereinbefore indicated.

Analysis of sugar cane reveals the fact that besides water and sucrose, it contains a number of complex carbo-hydrates of wholly or partially undetermined nature, and also a greater or lesser amount of cellulose and pentosans. Such analysis further discloses that the fibrous portion of the cane retains, in mechanical or chemical combination with the pith or parenchyma, and together with the cellulose cells, a substantial part of the water content of the cane, as well as sucrose, dextrose, levulose, pentosans, (xylan and araban), lignin complexes, and other substances. In either an alkaline or acid treatment, of any substantial intensity, some or all of these substances gelatinize and become measurably or highly insoluble. Subsequent treatment accomplishing the removal of such gelatinized complexes, for instance by their destruction, is also accompanied by injury of a greater or lesser degree to the fibers of the cellulose part of the bagasse, the extent of which injury may depend upon the strength of the digesting solution, or the length of time of digestion treatment or the temperature thereof, or of any two or all of these factors.

Having in mind these hitherto unsurmounted difficulties, my invention comprehends a treatment of the bagasse or fibrous elements of sugar cane which separates, or transforms so as to nullify their injurious effects, the substances other than the fibrous elements from the latter without injuring the fibrous elements by said treatment and without gelatinizing or otherwise acting upon the said substances so as to require for their separation another treatment injuring the fibers.

Broadly speaking, this invention embodies the step of subjecting the bagasse or fibrous elements of sugar cane to a substantially neutral hot water treatment at a temperature sufficient to dissolve or transform to soluble form, the said substances desired to be separated from the fibers. Such step is preferably conducted in the absence of air, and at a temperature of approximately 160° centigrade, with a pressure of approximately 6.35 kilograms per square centimeter. The water is preferably practically neutral such as, for instance, ordinary city water supply. It may, however, be slightly acid or slightly alkaline without preventing the substantial advantages of the invention from being obtained. An important distinction between this step of my invention and the previously practiced art in this respect, re-

sides in the fact that I utilize what may be called hot water hydrolysis for the separation of the above named, and analogous substances, from the fiber, instead of employing either an acid or alkaline hydrolysis. In colloquial language, it is the hot water which does the work in my invention, instead of the acid or the alkali.

I realize that, upon treating the bagasse with the hot water, a certain amount of acidity is liberated by certain of the compounds contained therein so that the condition of the treatment will be slightly acid even though the water supplied is neutral. This, however, does not defeat the characteristic feature of my invention which involves the addition to the mass of substantially neutral water as distinguished from a chemical treatment with substantial amounts of extraneous acid or alkali, and it is this characteristic step that I refer to when I mention treating the fibrous part of the cane with substantially neutral water.

In using the temperature referred to as approximately 160° centigrade, I find it desirable to go neither below nor much over that temperature. The action is not at all effective at a substantially lower temperature and, at a temperature greater than about 173° centigrade, there is liability of serious injury to the fiber.

Such hot water treatment will remove the substances desired to be separated, chiefly by directly or indirectly dissolving same without causing gelatinization or the like, and it will not injure the native properties of the fiber which are desirable for the purposes hereinbefore set forth.

The carrying out of this step in the absence of air is also a matter of importance because air, at high temperature or pressure, has a tendency to attack and injure the fibers.

In practicing the method which embodies my invention, the bagasse as it comes from the rolls of the sugar mill, usually containing about fifty percent of moisture, is preferably deposited in open tanks or vats which have suitable agitating or stirring devices, such as paddles located in the upper part. In the said tanks or vats the bagasse is washed by being agitated in warm, but not boiling, water, until a portion of the sucrose, and other easily soluble substances are dissolved, and dirt and other foreign matter loosened and precipitated in the bottom of the tanks or vats. The bagasse will float at the top. This treatment may vary in intensity according to the particular nature of the bagasse, but a treatment in water at about 90° centigrade for about one-half hour is ordinarily adequate. Any person skilled in this art can readily determine the temperature and time best suited to the particular quality of bagasse that is presented to him.

Following the above washing, which is a

preferred but not necessary step, the bagasse is removed from the tanks or vats and placed in a closed vessel, which I call an eliminator. Such vessel is quite similar to a paper pulp digester, which is a well known apparatus, and it is provided with a large opening for receiving the bagasse, relief cocks or other suitable devices for removing the air, the usual controlling and recording appurtenances, and discharge gates or outlet. After the eliminator has been filled to its substantial capacity, sufficient water is added to cover the bagasse, and the whole is raised to a temperature of approximately 160° centigrade and a pressure of approximately 6.35 kilograms per square centimeter. During this proceeding provision is made for releasing any air and gases that might be present in the eliminator, by means of suitable cocks, vents, relief valves or the like. The mass is maintained at substantially this temperature and pressure for a period of from, say, ten minutes to three or four hours. This period of time depends mainly on the quality, age and general condition of the bagasse. As remarked in connection with the preceding step, an operator skilled in this art can readily determine the best period of time for the particular bagasse he is treating.

Following this step, the bagasse is removed and thoroughly washed in open vats or tanks while being agitated. In this washing, water at ordinary temperature may be employed, and it may be continued for a matter of a few hours. The exact details of this step may, of course, be varied, within the skilled knowledge of the operator, according to the particular bagasse undergoing treatment, and, in certain cases, this step may be omitted. In case the product is intended to be used for textile and analogous purposes it may be desirable, at this time, to strip the fibers of their parenchymateous tissue by some suitable means, such as fluted rollers or strippers similar to those in common use for similar operations.

Thereafter the remaining fibrous material, which has, by the preceding steps, been freed from the objectionable substances previously mentioned, may be dried in centrifugal dryers of standard type, or other well known or approved form of drying apparatus; compressed in hydraulic presses or the like, and shipped to the points of manufacture. Another suitable course is to press the fibrous material in hay presses, without previous drying. In hydraulic presses the material must ordinarily be dry or else it will be molded by the pressure, while the hay presses do not exclude the air or pack the material hard enough to cause molding, even though the material be wet at the time of pressure. If the paper or the like is to be manufactured at a nearby place, the fibrous material, without any drying, may be at once

passed into the well known paper pulp digester. Whether or not the material be dried before it is passed into the digester, the treatment therein may be conducted in the usual manner, except that the treatment will require much less in the way of chemicals and the yield will be greatly increased.

If the material is intended to be used in the textile art it may, after it has been freed from the objectionable substances as previously described, be spread out and dried, preferably at ordinary temperature, and then carded or combed by method and apparatus well understood in the textile art.

While I have referred throughout to the employment of bagasse at the outset of my method, it will be understood that I might start with the sugar cane itself, and separate the fibers as herein set forth. Ordinarily, of course, the bagasse would be the starting material because that is a common by-product obtainable in large volume, but I do not wish to have the application of this invention limited to bagasse as the initial material since, as above indicated, the cane itself may be employed.

Furthermore, it is a feature of this invention that I may utilize sugar cane which has been damaged with respect to its adaptability for the manufacture of sugar as, for instance, by fires in the cane fields. Such damaged sugar cane is still suitable for treatment by my method and the uninjured fibers can be separated and employed as indicated.

It should be mentioned that, in the manufacture of sugar, a material percentage of the sucrose available in the cane commonly remains in the bagasse. This may even equal three percent of the total sucrose. When the bagasse is used as fuel, this sucrose is, of course, lost. The herein described invention enables the saving of a considerable part of this previously lost sucrose because the waters which I employ in washing and otherwise treating the bagasse can be employed in the process of macerating the cane in the manufacture of the sugar. Thereby these waters will carry into the macerated cane the sucrose combined with them, and the said sucrose will be recovered in the process of sugar manufacture in the usual way. The said waters, furthermore, assist in the maceration of the cane.

The immediate purpose and result of this invention is the production of a cellulose material adapted for use generally in the manufacture of articles that may be produced from such cellulose material and, therefore, when I have referred to the manufacture of paper and the like and to use in the textile art, I have merely been illustrating two particular fields of employment of my invention, and do not desire said references to limit the application of the invention, since

it is adapted to a broad range of industrial employment as above indicated.

It will be understood that various changes may be resorted to in the steps of the process, in the materials, and in the apparatus without departing from the spirit and scope of my invention, and hence I do not intend to be limited to the details herein set forth except as they may be included in the claims.

What I claim is:

1. A method for recovering the fibrous material from sugar cane, which includes the step of treating the fibrous part of the cane with substantially neutral water at a temperature sufficient to remove or transform most of the substances combined with the fibrous part, said treatment being carried out in the substantial absence of air.

2. A method for recovering the fibrous material from sugar cane, which includes the step of treating the fibrous part of the cane with substantially neutral water at a temperature sufficient to remove or transform most of the substances combined with the fibrous part, said treatment being carried out at a pressure above atmospheric pressure and in the substantial absence of air.

3. A method for recovering the fibrous material from sugar cane, which includes the step of treating the fibrous part of the cane with substantially neutral water at a temperature of substantially 160° centigrade, said treatment being carried out in the substantial absence of air.

4. A method for recovering the fibrous material from sugar cane, which includes the step of treating the fibrous part of the cane with substantially neutral water at a temperature of substantially 160° centigrade and an absolute pressure of approximately 6.35 kilograms per square centimeter, said treatment being carried out in the substantial absence of air.

In testimony, that I claim the foregoing as my invention, I have signed my name this 23rd day of March, 1926.

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