

UNITED STATES PATENT OFFICE.

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METHOD OF TREATING BAGASSE.

975,387.

Specification of Letters Patent.

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No Drawing.

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To all whom it may concern.

Be it known that I, THOMAS J. HUTCHINSON, analytical and consulting chemist, a subject of His Majesty the King of England, and resident of Manchester, England, whose post-office address is No. 54 Arcade Chambers, Manchester, England, have invented certain new and useful Improvements in Methods of Treating Bagasse, of which the following is a full, true, and concise specification.

My invention relates to a process of treating bagasse with the object to separate therefrom a maximum portion of its paper-making contents with the least expense of materials and time and of a quality suitable for making a commercially useful bagasse paper.

The invention rests on the discovery I have made that a bagasse cellulose excellently adapted for paper-making as well as for other purposes may be obtained by subjecting the bagasse to mild digestive action and sufficient washing, conducted in such manner as to avoid the re-combination of the dissolved gummy or disassociated non-cellulose constituents of the bagasse with the pure cellulose thereof, as will be hereinafter more fully described.

In its simplest form the process comprises two main steps or stages, the first resulting in a cellulose product of substantial purity resembling in appearance the original untreated bagasse but which can be compactly shipped in dry form and used as a paper-making fiber, and the second stage resulting in a paper-maker's half-stuff which may be converted into a commercially useful paper in substantially the same manner as half-stuff made from other materials, and such paper is found to possess all the desired qualities of texture and toughness, being also cheaply produced because of the abundance and cheapness of bagasse and the mildness of the process by which it is derived.

One of the primary considerations in the successful production of paper half-stuff from bagasse is the cost of the treatment of the raw material in proportion to the yield of paper-making cellulose. While the cellulose forms by far the greater part of the composition of the bagasse, its form or organization is such that the application of ordinary reduction processes results in such extended loss by decomposition and impoverishment of material as to render the pro-

duction of half-stuff or paper on such basis wholly impracticable from the economical and commercial standpoint.

The present improved process is essentially characterized by the employment of extremely mild or brief digestive treatment and of very low temperatures and pressures, lower than have been used in any actual paper making process of which I am aware, so that the cost of the treatment is correspondingly small, while the cellulose yield is higher than can be obtained by the use of the ordinary or any method involving more prolonged and drastic action. The ratio of the cost of treatment to the cellulose yield is ample to establish the new process as a commercially practicable and profitable means for making paper from bagasse. I am enabled to accomplish such results with mildly active solutions, working under low pressure and temperature, by reason of the manner in which I conduct the process. Briefly stated I subject the bagasse to a series of partial digestions, in the mild solution, following each digestive treatment with a particularly thorough washing with water. Thereby, the dissolved impurities (being impurities only from the paper-making standpoint) are removed from the remaining material before they can recombine therewith and such remaining material goes into the next mild digestion treatment devoid of such matters and otherwise as clean as possible. The second treatment, though mild, operates most effectively under these conditions to dissolve still more of the so-called impurities which in turn are likewise removed before they can recombine and so on, so that the delicate cellulose of bagasse is thus ultimately deprived of all its non-paper making associates without ever itself being subjected to the action of alkali of sufficient strength to injure it. The removal of dissolved impurities so that they do not become fixed in the cellulose of the remaining mass enables the weak solutions to perform effectively the impurity dissolving effect of stronger solutions and improves the character of the resulting fibers, as well as the amount of yield. While, theoretically, a great number of mild digestions, each followed by immediate thorough washing, will thus give the highest proportion of yield of pure cellulose, obvious commercial considerations, particularly that of the time consumed, make it desirable that the number of

treatments be reduced, even though it be at the expense of some increase in the strength of the alkali employed, and for this reason I prefer to conduct the process in two main steps or stages. The first step or stage results in the cellulose product above referred to as being suitable to be shipped as a paper-making fiber, and such stage may comprise a single digestive treatment, but preferably comprises two mild digestive treatments each followed by thorough washings, constituting a fractional digestion treatment. The second step or stage, results in half-stuff, and consists of a short final digestive treatment calculated to complete the mechanical disintegration but still with the use of very mild solution or solutions and little or no pressure.

In carrying out my process I may use either air-dried bagasse or the wet freshly crushed bagasse in the condition in which it comes from the crushing rolls, and I prefer the latter because of the greater convenience in handling it. For the first stage of my process when employing but a single digestive treatment, I proceed as follows: I place a quantity of the bagasse in a closed receptacle together with an alkaline solution composed either of carbonate of soda or caustic soda or a mixture of both of these alkalies in water, and then boil the mass under a moderate pressure for about an hour. In treating the ordinary or average grades of bagasse, the solution should contain an amount of carbonate of soda or of caustic soda approximately equal in weight to ten per cent. of the weight of the bagasse (air dried), and if a mixture of both alkalies is employed, a satisfactory proportion is two and a half per cent. of caustic soda with seven and a half per cent. of carbonate of soda taken with like reference to the weight of the bagasse, but the percentage of alkali in the solution may be varied somewhat, depending upon the character of the charge under treatment, and the kind of alkali, also, may be adapted to the same condition.

The operator will understand that bagasse in which the tissues are more refractory must be treated with a stronger alkaline solution, and will therefore ascertain whether the carbonate or caustic soda will give the best results, but in any case the solution employed is distinctively a weak solution as compared with the strengths of solutions commonly employed in the production of half-stuff from wood and other substances, and in practicing my process it is always best to use the weakest solution which suffices to remove the gummy constituents or impurities in about the time mentioned. The boiling of the mass in the solution is preferably carried on at a pressure which gives a boiling point of about 100° C. or slightly higher, and while it is

important that the boiling be done at some pressure, it is advisable that it should not be allowed to exceed ten pounds for any considerable period. On the question of temperature and pressure, also, the operator must exercise his judgment, taking into consideration that as a general rule the stronger the alkali the less temperature is required, and, in any event, the temperature and pressure are to be kept as low as consistent with the strength of the alkaline solution and the character of the charge. During the boiling operation it is also desirable that the solution be caused to flow or percolate through the mass uniformly in the same direction and that the mass be not agitated or disturbed during this stage, as otherwise balling of the fibrous mass and consequent imperfect reduction is found to result.

The purpose of the mild treatment carried on as above indicated is to dissolve or disassociate from the cellulose the pectosans, fats, lignins, minerals and other similar and gummy impurities, without, however, affecting the character of the cellulose itself, and this first stage of my process is completed when such undesired constituents have been liberated from the cellulose to such an extent that the greater part of them may be removed by rinsing. With the proportions as above given, this condition may be expected to arise in about an hour's time as above stated and may be observed either by analytical tests—the cellulose showing itself in substantially unaffected condition and combined with very little of the other constituents, preferably not more than about five per cent.—or, after some experience, by the appearance and feeling of the mass itself, the material still retaining its original shape without material mechanical disintegration, and the fibers remaining in a clean but not fully disintegrated condition.

In carrying out the preferred process in which the first main stage thereof comprises two digestive treatments, *i. e.* fractional digestion, I place the bagasse in the receptacle and treat it for about thirty minutes with a solution containing about from 2½ to 5 per cent. of sodium carbonate at about 100° C. or up to and under a steam pressure of ten pounds. The liquid is then run off and the charge is further treated for about thirty minutes with a solution of from 5 per cent. to 7½ per cent. of caustic soda at about the same temperature or steam pressure. Between the two stages the material should be washed for the purpose above explained by running water through it. It is not possible to sufficiently remove the digesting liquor by expressing it from the fiber without thorough washing.

After treatment in the manner above indicated, the cellulose must be again thoroughly washed either in the receptacle

in which it has been boiled, or after removing it therefrom in any suitable manner in order to remove all of the gummy constituents that have been disassociated during the previous stage of the process and to prevent said liberated impurities becoming again fixed in the cellulose. A convenient type of washing machine which may be used, is one which is somewhat similar in general principle to a known machine for washing wool. It has two or more compartments with sieves or perforated walls and the washing liquid flows through such machine in the reverse direction to the travel of the material being washed. The material being washed is always so treated that it is not packed or crushed and is transferred from one compartment to another of the machine, by suitable rakes, which allow it to remain in its open shredded condition. The washed product thus obtained contains substantially all the cellulose of the original bagasse, in a vital and unimpaired condition and constitutes a material suitable to be dried and stored, or shipped, and from which a paper half-stuff can be readily obtained by a second chemical treatment of simple nature, which constitutes the second main stage of the process. This treatment consists in boiling the washed or washed and dried mass for about one hour at a temperature not exceeding 100° C., with a solution containing from about two and a half to five per cent. by weight of caustic soda taken with reference to the weight of the cellulose. The effect of this second treatment is to disintegrate and complete the reduction of the bagasse and at the same time to liberate such remaining gummy materials or impurities as may still be associated with the cellulose, but by reason of its mildness as well as the low temperature at which it is carried on, this treatment has no depreciative effect upon the cellulose itself, and the latter is therefore obtainable at the conclusion of the process,—and after washing—in a practically pure state, unaffected by the caustic action of the alkali. I believe the remarkable purity and vitality of the cellulose fibers of my product to be due as above stated to the removal of the digesting liquor in which most of the gummy constituents have been dissolved, before the process of reduction has reached a stage in which the impurities contained dissolved in that liquor can become fixed in the cellulose fibers. The said fibers do not, therefore, require severe and injurious treatment to complete their purification, such as has hitherto been the case with fibers that have been so impregnated and which then become brittle and dead as a consequence of the caustic action and heating.

The cellulose of the pith of bagasse is extremely susceptible to the action of strong

alkali or alkaline salts under high temperatures, more so than other apparently analogous plants and the result of the severe treatment, such as has been hitherto given to bagasse, has been that the cellulose of the pith has been almost totally reduced and dissolved, while the remaining cellulose, that from the fibers and rind, has become brittle and discolored and has deteriorated through gummy and other impurities which have been only incompletely removed, becoming again fixed in the cellulose as a result of the severe and prolonged treatment. The mild treatment given to the bagasse according to my invention is of such a nature, is continued only to such an extent, and comprises washing operations so arranged, that the impurities of the pith cellulose are removed without injury to such cellulose, while the impurities are effectually removed not from the pith alone but also from the other tissues as well, without deterioration of the cellulose of such tissues.

In its preferred form my process is conducted with a somewhat stronger solution or solutions for the operations constituting the first stage of the process than for the subsequent operation which results in half-stuff, as I find it desirable to remove the gummy constituents as completely as possible without injuring the cellulose, in the first instance, but it will be understood that the less the amount of impurities removed in the first operation, the stronger will be the solution required for the final reduction to half-stuff, and in some cases it may be that substantially equal strength for both operations will be most serviceable, depending upon the kind of paper desired and the fancy of the operator, but such solutions will not vary substantially from the percentages hereinabove indicated and in the trade are weak solutions.

The apparatus suitable for use in treating bagasse according to my invention may consist simply of a receptacle such as may be already found in pulp making establishments, provided with means for heating it to the required temperature under the proper pressure and for keeping up a circulation through the mass without, however, agitating it.

Having described my invention, what I claim and desire to secure by United States Letters Patent is:

1. A process of obtaining paper-making cellulose from bagasse, which consists in a succession of mild digestive treatments of the bagasse, each treatment being terminated when a portion of the non-cellulose constituents have been disassociated from the pure bagasse cellulose and before the latter becomes appreciably impaired by such treatment, and being followed by the immediate removal of such disassociated con-

stituents by washing, substantially as described.

2. A process of obtaining cellulose suitable for paper-making from bagasse, which
5 consists in subjecting the bagasse to mild digestive and reducing treatment under moderate heat and pressure for the purpose and with the result of liberating a portion of its non-cellulose constituents without in-
10 juriously affecting the cellulose, or decomposing any substantial amount thereof, washing such liberated constituents out of the mass before the cellulose fibers become recombined or impregnated therewith and
15 thereafter repeating such mild digestive treatment and washing upon the resultant product until the said non-cellulose constituents have been sufficiently removed.

3. A process of producing half-stuff from
20 bagasse which consists in digesting the bagasse for about one hour in a solution or solutions containing less than ten per cent. of alkali, taken with reference to the weight of the bagasse, and under a pressure above
25 atmosphere of approximately ten pounds or less, until the greater part of the constituents not cellulose has become disassociated from the bagasse and removable by washing, washing out said constituents and thereafter
30 further digesting the mass in a mild digestive solution.

4. A process of obtaining cellulose suitable for paper-making from bagasse, which
35 consists in mildly digesting the bagasse under moderate heat and pressure in a suitable reducing solution or solutions for such period of time, depending upon the effect thereof upon the bagasse, as will suffice to disassociate or liberate therefrom a portion
40 of the non-cellulose constituents without impairing or destroying any substantial part of the cellulose of the bagasse and then separating such liberated constituents out of the mass by thorough washing and before
45 the said cellulose becomes recombined or impregnated with said non-cellulose constituents.

5. A process of obtaining cellulose suitable for paper-making from bagasse, which
50 consists in digesting the bagasse in a mildly active solution or solutions of moderate temperature and under a pressure above atmosphere of approximately ten pounds or less, continuing such treatment until a portion of
55 the non-cellulose constituents are disassociated from the bagasse cellulose but before the same become appreciably recombined or impregnated therein and then washing the said liberated constituents out of the mass
60 before such recombination or impregnation takes place.

6. A process of obtaining cellulose suitable for paper-making from bagasse consisting first, in digesting the bagasse in a mildly
65 reducing solution for the purpose of liberat-

ing a portion of the non-cellulose constituents thereof, but without decomposing or injuriously affecting the cellulose, second, subjecting the resultant product to a further
70 treatment in a clean, mildly reducing solution to liberate a further portion of said non-cellulose constituents, but without injuriously affecting the cellulose, and third, preventing recombination of such liberated impurities with the cellulose of the remain-
75 ing mass by washing with water.

7. A process of obtaining cellulose suitable for paper-making from bagasse, which
80 consists in digesting the bagasse in a mild alkaline solution for about one-half hour at a pressure above atmosphere of approximately 10 lbs. or less, washing the mass, further digesting the mass in a similar solution and under a similar pressure for about half an hour and further washing the mass. 85

8. A process of producing half-stuff from bagasse, which consists in fractionally digesting the bagasse in a suitable reducing
90 solution or solutions under moderate heat and pressure substantially as set forth, continuing such treatment to a point where the greater part of the non-cellulose constituents has become disassociated or dissolved therefrom but without permitting the cellulose of the bagasse to become impregnated
95 with the said dissolved constituents, washing the bagasse to remove said non-cellulose constituents, thereby leaving in the remaining mass substantially all the cellulose of the whole bagasse and thereafter further di-
100 gesting the washed mass in a clean reducing solution until reduced to the condition of half-stuff.

9. A process of producing half-stuff from bagasse, which consists in fractionally di-
105 gesting the bagasse in mild solutions until its non-cellulose constituents have become disassociated therefrom to such extent that, of the remaining combined mass about five per cent. will consist of such constituents,
110 washing the said disassociated constituents out of the mass to leave therein all the cellulose of the whole bagasse and then further digesting the washed mass until reduced to the condition of half-stuff. 115

10. The process of obtaining cellulose from bagasse, which consists in passing a mild digestive solution in one direction
120 through the bagasse under pressure of approximately ten pounds or less until the cellulose becomes disassociated from the remaining constituents, and then washing said constituents out of the same.

In testimony whereof, I have signed my name to the specification in the presence of
125 two subscribing witnesses.

THOS. J. HUTCHINSON.

Witnesses:

GEO. HEYS,

FRANK A. HEYS.