

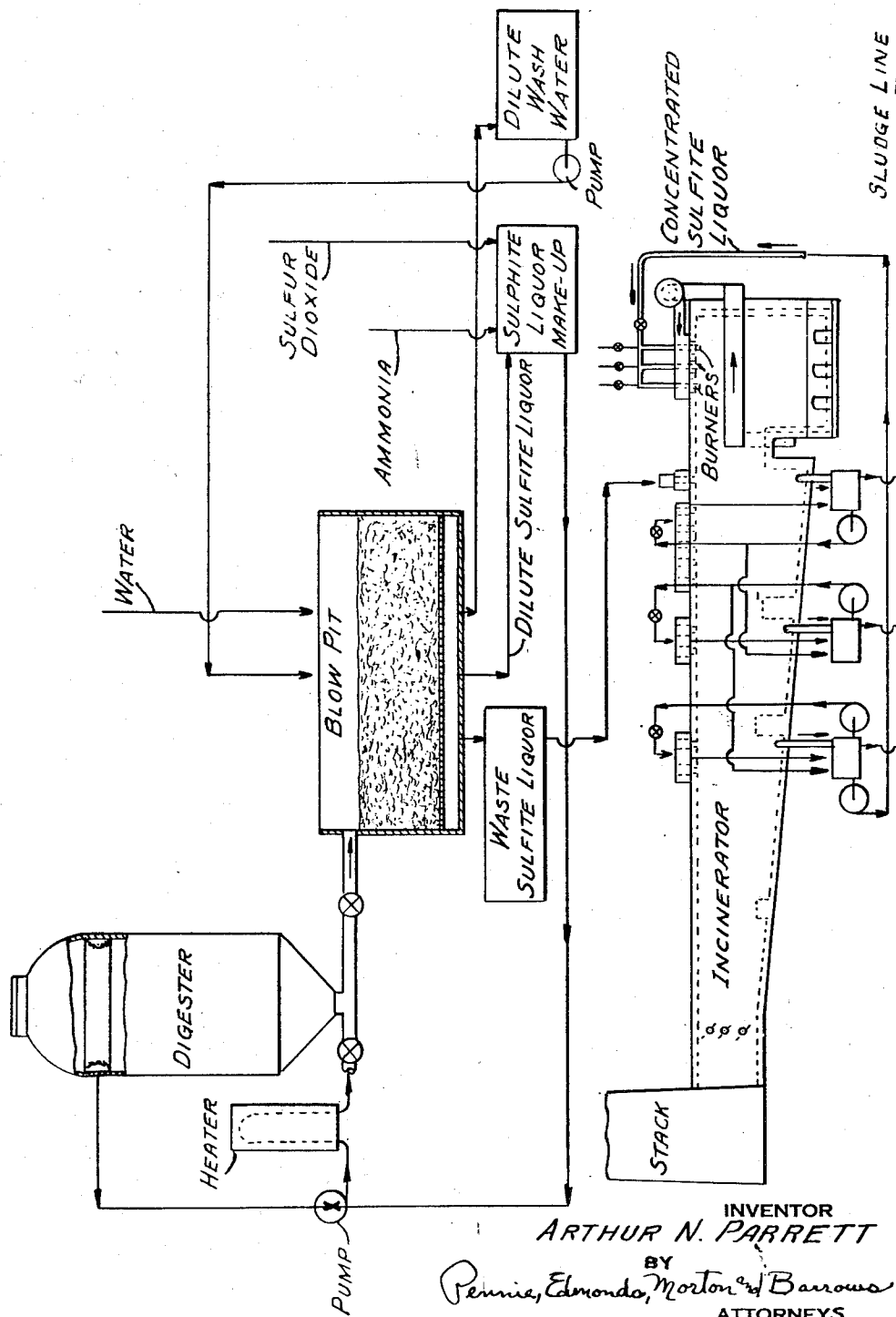
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WOOD PULP DIGESTION

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WOOD PULP DIGESTION

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This invention relates to wood pulp digestion, and has for its object the provision of an improved method of digesting wood for the production of cellulose fiber. More particularly, the invention aims to provide an improved sulfite process for wood digestion capable of producing widely different types of sulfite wood pulp, and especially adapted to produce a special type of pulp for use in the production of cellophane.

In the manufacture of chemical wood pulp by the sulfite process, the digesting liquor (usually called cooking acid) consists of an aqueous solution of sulfur dioxide (or sulfurous acid) and a bisulfite which may be the bisulfite of calcium, sodium, ammonia or some other less common metallic bisulfite. The sulfur dioxide combined in the form of bisulfite is termed the "combined SO_2 " (but is actually expressed as $\frac{1}{2}$ of the amount of sulfur dioxide combined as bisulfite), and the sulfur dioxide dissolved or present as sulfurous acid is termed the "free SO_2 ." Sulfite digesting liquors may vary from 0.3 to 2% "combined SO_2 " and from 3 to 15% "free SO_2 ." In commercial practice, the "free SO_2 " usually lies between 5 and 14% and the "combined SO_2 " between 0.8 and 1.8% depending on the type of pulp being made.

In normal commercial sulfite digester operation, it is common practice to "relieve" the digester during the cook. The "top" relief is to permit sulfur dioxide gas to pass off as the temperature is increased. The "side" relief is to permit removal of a portion of the acid during the latter part of the cook for several purposes, one of which is to permit more complete "gassing off." Since the acid relieved through the side relief contains a considerable amount of dissolved organic matter (mostly lignin sulfurous acids and sugars) and since this acid is added to the acid recovery tanks, cooking acid normally contains from .3% to 1.2% organic matter in addition to the free and combined sulfur dioxide.

The residual liquor associated with the digested or cooked pulp is commonly known in the industry as "waste sulfite liquor," and while various attempts have been made to utilize this liquor, it is generally run to waste in streams or rivers. A particular object of the present invention is the provision of an improved method of manufacturing sulfite wood pulp in which the waste liquor is economically disposed of by combustion or incineration. A further object of the invention is to effect waste sulfite liquor recovery and disposal with a minimum amount of equipment. Other objects of the invention will

appear in the course of the following description:

In accordance with the invention, wood chips are digested or cooked with an ammonium base sulfite liquor containing from 10 to 40%, and preferably at least 20%, of the total solids present in the waste sulfite liquor from a prior similar digestion. To this end, such an amount of waste sulfite liquor is first recovered or separated from the digested wood pulp that from 10 to 40% (preferably at least 20%) of the solids of the total waste liquor remains associated with the digested pulp. The waste liquor thus first recovered or separated from the digested pulp is subjected to concentration by evaporation in which the required heat is furnished by combustion of concentrated liquor. Following the recovery or separation of such waste liquor, the digested pulp is washed, preferably first with a final weak wash water from a prior similar operation, and then with fresh water. The dilute waste sulfite wash liquor, resulting from the first washing step, is utilized in making up ammonium base sulfite cooking acid for a subsequent similar digestion, and the final weak wash water is utilized for the first washing of the digested pulp from a subsequent similar digestion. The waste sulfite liquor (of digester strength) may advantageously contain from 12 to 17%, and preferably around 14%, of total solids. The solids content of the first recovered waste liquor usually suffers from dilution with water in the course of blow pit washing since such operations are rarely if ever 100% efficient. Consequently the solids content of the first waste liquor recovered for evaporation and subsequent combustion will usually be from 11 to 15%, and preferably around 13%. The freshly "made-up" ammonium base sulfite cooking acid may contain 2 to 9%, and preferably 3 to 7%, of solids derived from the dilute waste sulfite wash liquor of a prior similar digestion. The total solids of cooking acid or of waste sulfite liquor may be defined as the dry residue which remains after heating a liquor sample to constant weight at 105° C. The total solids content naturally will contain some inorganic matter such as ammonium salts and inorganic compounds liberated from the wood.

The invention, in its preferred and complete aspect, is thus characterized by (1) digestion of the wood chips with an ammonium base sulfite cooking liquor or acid, (2) the inclusion in that liquor of a predetermined amount of ammonium base waste sulfite liquor solids, and (3) disposal of the ammonium base waste sulfite liquor by

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combustion or incineration. More specifically, the method of the invention comprises the following sequence of steps:

1. Preparation of an ammonium base sulfite cooking acid containing at least 20% of the total waste sulfite liquor solids resulting from a preceding sulfite pulping operation.

2. Digestion of wood chips in a digester with this ammonium base cooking acid according to conventional or desired sulfite pulping practice.

3. Recovery of ammonium base waste sulfite liquor at the highest possible solids content, as, for example, by draining off digester-strength liquor from the digested pulp in a blow pit, and by replacing the residual liquor in the bed of the pulp in the blow pit successively by weak wash water, and finally by fresh water.

4. Evaporation of the recovered waste sulfite liquor in a breeching type evaporator to a solids content between 25 and 70%.

5. Combustion of the evaporated (concentrated) waste sulfite liquor in a refractory furnace into which the liquor is sprayed, the gaseous products of combustion being used to supply the required heat for the evaporator.

While the foregoing sequence of steps contemplates the recovery of the waste sulfite liquor at a concentration close to that at which it occurs in the digester as in step 3, the recovery may be effected in other suitable ways, as for example by the conventional practice of using counter-current vacuum washers. The choice of washing equipment will usually be dictated by the prevailing conditions at any particular location. Concentration by evaporation of the recovered waste liquor may likewise be effected in other than a breeching type evaporator. Moreover, the practice of the invention is not intended to limit or restrict variations in sulfite pulping practice as established in the industry to produce sulfite pulps of widely different characteristics as required commercially for many different purposes. Likewise, the operation of making an ammonium base sulfite cooking acid may be practiced in equipment commonly used for making calcium base sulfite cooking acid, except of course, that no other base, such as calcium, is deliberately introduced into the ammonium base sulfite cooking acid of the invention.

The amount of ammonium base waste sulfite liquor solids included in the digesting or cooking acid of the invention is determined by the desired heat balance in the subsequent operation of washing the ammonium base waste sulfite liquor from the pulp and evaporating the waste liquor by the heat evolved in the combustion of the concentrated liquor. The amount of waste liquor added to the cooking acid determines the total solids in the waste liquor as it is blown from the digester. The efficiency of the washing operation must then be such that the recovered waste liquor will, after evaporation, provide enough heat to concentrate the recovered waste liquor to a solids content practical for combustion. Thus, it is important that the ammonium base waste sulfite liquor be recovered at a concentration such that the heat of combustion of the evaporated or concentrated liquor provides a flow of hot gases sufficient to evaporate all of the recovered liquor. Under such conditions no waste liquor remains to be otherwise disposed of. To accomplish this purpose, the solids content of the blow liquor is built up by including waste liquor solids in the cooking acid, and the desired heat balance is obtained by the proper

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adjustment of the amount of waste liquor solids added to the cooking acid. The ammonium base makes it possible to carry out this sequence of steps without encountering the difficult problem of disposing of large quantities of ash such as would be formed in the combustion of the conventional waste sulfite liquor resulting from the use of a calcium base sulfite cooking acid.

In practicing the method of the invention, liquid ammonia, as received in tank cars, is run as a liquid into water and absorbed to form a strong solution of ammonia which is stored in a tank under a slight pressure. The strong solution of ammonia is injected into the dilute waste sulfite wash liquor (recovered from the blow pit and containing from 10 to 40% of the total solids present in the waste liquor of a preceding pulping operation), as that liquor is pumped to the sulphur dioxide absorption towers, where sulphur dioxide is absorbed to form a cooking acid with the desired ratio of "free" and "combined" SO_2 . This cooking acid will have a relatively high content of organic solids, because of the inclusion therein of a predetermined amount of waste sulfite liquor from a prior digestion. I have found that cooking acids made in this way serve effectively for the manufacture of high grade sulfite pulps, and that cooking practices can be varied as desired to produce pulps of varied quality and characteristics, and in particular a special type of pulp for use in the production of cellophane.

Since the waste sulfite liquor must be recovered for evaporation and combustion as an integral part of the process, it is necessary to provide suitable means for so doing. This may advantageously be accomplished by draining the waste sulfite liquor (of digester strength) from the pulp in a conventional type of blow pit, washing the bed of pulp in the blow pit, first, with dilute wash water, and, finally, with fresh water. The volume of fresh water and hence the volume of dilute wash water will be approximately the same as the volume of cooking acid introduced into the digester, due account being taken of the volume of water used for absorption of liquid ammonia and of the volume of liquor returned to the cooking acid storage tanks by way of "wet relief" or liquor drawn from the digesters during the course of cooking. The drainings from the blow pit are separately collected so that the strong waste sulfite liquor may be diverted directly to the evaporator, and the dilute waste sulfite wash liquor used in making-up cooking acid for the deliberate purpose of increasing the total organic solids of the waste sulfite liquor as it comes from the digester.

The strong waste sulfite liquor is pumped to a horizontal spray evaporator, which may consist of any desired combination of disk or cascade evaporators and/or spray chambers. The liquor is evaporated to a solids content of 25 to 70%, a liquor of 35% solids content burning very satisfactorily. The evaporated liquor is burned in a refractory furnace in which the liquor is introduced as a spray together with the required quantity of air for combustion, and the resulting hot products of combustion pass through the evaporator. Finally, the gases passing from the evaporator are disposed of through a chimney, preferably of a height sufficient to disseminate the gases in the atmosphere without nuisance to the surrounding community. Thus, the waste sulfite liquor is completely disposed of in a practical and economical manner.

The single figure of the accompanying draw-

ing is a diagrammatic flow sheet of an equipment suitable for the practice of the invention. The arrangement of the equipment and its operation will be clear from the legends on the drawing taken in conjunction with the following description.

The digester may be of conventional design. A pump serves to introduce the required amount of ammonium base sulfite cooking liquor into the digester, suitably filled with wood chips, and subsequently to circulate the cooking liquor through a heater and the digester. In general, the incinerator is an elongated furnace structure interiorly divided by transverse bridges into a combustion chamber and a plurality of successive spray evaporating chambers. The combustion chamber is fired by downwardly directed fuel burners provided with steam jets adapted to spray the concentrated sulfite liquor into the combustion chamber. The strong waste sulfite liquor recovered from the blow pit is delivered to a transverse head box having a perforated bottom above and registering with a transverse slot in the roof of the furnace, and showers downwardly through the first or hottest evaporating chamber approximate its hottest end. In the operation of the evaporator liquor falls as a spray through each evaporating chamber, collects in a pool at the bottom of each chamber and flows into an external sump from whence it is pumped to transverse head boxes with perforated bottoms above and registering with transverse slots in the roof of the respective chambers. From the sump of the last or coolest evaporating chamber, the resulting evaporated or concentrated liquor is pumped to the burners and sprayed into the combustion chamber, where it burns much like fuel oil in an atmosphere of preheated air blown into the chamber along with the liquor spray.

The following examples illustrate practices of the invention:

An ammonium base sulfite cooking acid was prepared as hereinbefore described from dilute sulfite wash liquor recovered from the blow pit washing system. This dilute liquor contained about 20% of the total solids present in the waste sulfite liquor from a prior pulping operation, and was of approximately the volume required as cooking liquor for a pulping operation. The cooking liquor so prepared contained about 3.7% of solids. Wood chips of Western Hemlock were cooked with this liquor, and the digested pulp was blown into the blow pit. The solids content of the waste sulfite blow liquor was 14%. In the recovery of waste liquor from the blow pit, some dilution occurred and the waste sulfite liquor recovered for diversion to the evaporator contained about 13% solids. This recovered liquor was pumped to the evaporator for evaporation to a solids content of about 40% and the concentrated liquor was burned to furnish the heat required for evaporation.

In another example, the ammonium base sulfite cooking acid, similarly prepared, contained about 35% of the total solids present in the waste sulfite liquor of a prior pulping operation. The solids content of this cooking acid was about 6.7%. Wood chips of Western Hemlock were cooked with this liquor as in the previous example, and the blow liquor of digester strength contained about 15.5% solids. Some dilution of this liquor occurred in the act of washing the pulp in the blow pit so that the recovered waste sulfite liquor diverted to the evaporator con-

tained about 14% solids. This recovered liquor was pumped to the evaporator for evaporation to a solids content of 45%, and the concentrated liquor was burned to furnish the heat required for evaporation.

The total volume of dilute waste sulfite liquor used in acid make-up cannot be greater than the volume of the made-up cooking acid. Under conditions where total waste liquor disposal is desired, it is necessary to use all of the dilute liquor for acid make-up unless the heat balance permits inclusion of some of the dilute liquor in the strong liquor pumped to the evaporator and combustion unit. The total solids contained in the dilute liquor will depend partly on the efficiency of washing in the blow pits, and, in turn, on the amount of waste liquor solids returned to the acid make-up. This amount may lie between 10 and 40% of the total solids in the blow liquor which would occur if a cooking acid were used which did not contain any liquor solids. At the start-up of such an operation, water must be used for acid making if no ammonium base dilute waste sulfite wash liquor is available. The waste liquor produced on the start-up cooks are relatively low in solids content because (1) no side-relief has functioned to add solids to the cooking acid and (2) no dilute waste liquor has been used as acid make-up. As the operation proceeds, the side-relief and dilute waste liquor usage start to build up solids in the cooking acid, and, by the same token, in the blow liquor. This continues until an equilibrium value is reached. For example, the addition to the acid make-up of 20% of the total volume of the blow liquor as dilute waste liquor would add 2.0% solids to the blow liquor from the first digester blown, assuming that the blow liquor from the start-up blow contains 10% solids. Two factors would then work to increase the solids of the blow liquor to a certain equilibrium value, namely (1) a gradual increase in the solids contained in 20% of the total volume of blow liquor produced and used for making cooking acid, and (2) a gradual increase in the solids content of the liquor returned to the cooking acid storage tanks by way of "wet relief" or liquor drawn from the digesters during the course of cooking. After equilibrium has been reached, the total solids of the blow liquor would rise to about 13.0% with the continued use for acid make-up of the dilute waste liquor containing 20% of the solids of the preceding blow liquor and the continued removal of liquor from the digesters during the course of cooking and addition of this liquor to the cooking acid storage tanks. With blow liquor of about 13% of solids, the solids content of the recovered liquor for diversion to the evaporators would be somewhat lower depending on the efficiency of the blow pit washing operation hereinbefore described.

I claim:

1. The method of wood pulp digestion which comprises digesting wood chips with an ammonium base sulfite cooking acid containing from 10 to 40% of the total solids present in the waste liquor from a prior similar digestion, the waste liquor at the end of digestion containing from 12% to 17% of total solids, separating from the digested pulp from 60% to 90% of the waste liquor at substantially digester strength, washing the digested pulp containing the balance of the waste liquor to recover in the resulting wash liquor the bulk of the residual waste liquor remaining associated with the pulp, utiliz-

ing said wash liquor in making up ammonium base sulfite cooking acid for a subsequent similar digestion, subjecting said separated waste liquor to concentration by evaporation, burning concentrated waste liquor from a preceding like digesting operation, and utilizing the heat of said burning operation to supply the total heat for said evaporation.

2. The method of wood pulp digestion which comprises digesting wood chips with an ammonium base sulfite cooking acid containing at least 20% of the total solids present in the waste liquor from a prior similar digestion, the waste liquor at the end of digestion containing from 12% to 17% of total solids, separating from the digested pulp up to a maximum of 80% of the waste liquor at substantially digester strength, washing the digested pulp containing the balance of the waste liquor to recover in the resulting wash liquor the bulk of the residual waste liquor remaining associated with the pulp, utilizing said wash liquor in making up ammonium base sulfite cooking acid for a subsequent similar digestion, subjecting said separated waste liquor to concentration by evaporation, burning concentrated waste liquor from a preceding like digesting operation, and utilizing the heat of said burning operation to supply the total heat for said evaporation.

3. The method of claim 1 in which the separated waste liquor is concentrated to a solids content of from 35 to 70%.

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