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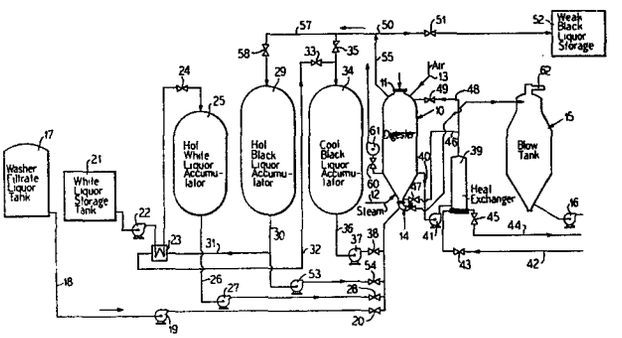
(54) Improvement in batch processes for digesting wood chips.

(57) Improvement in processes for digesting wood chips to improve the efficiency of the process and the effective utilization of heat, the process consisting in cooking the chips under pressure in a digester at relatively high temperatures to produce cooked chips and a hot black liquor, discharging or displacing the hot black liquor from the digester for reuse in subsequent treatment cycles.

The improvement comprising the step of establishing a blanket of air over the mass of cooked chips in said digester at sufficient pressure to discharge the mass of cooked chips from said digester.



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IMPROVEMENT IN BATCH PROCESSES FOR DIGESTING WOOD CHIPS

The present invention is in the field of cooking wood chips under alkaline conditions and seeks to improve the economy of the process and the heat utilization by pressurizing the cooked chips in the digester under a curtain of relatively cool air to discharge the same from the digester effectively.

The prior art contains numerous examples of digesting wood chips in a batch type process. Such digestion usually takes place in a digester specifically built for that purpose, the digester being partially filled with the wood chips and then charged with hot solutions of sodium hydroxide alone or in admixture with sodium sulfide. In a typical prior-art process, the temperature of the digester is controlled through the introduction of steam and after maintaining the chips in contact with the cooking liquor for a predetermined period of time, a blow-valve in the digester is opened, to dump the contents thereof into a blow-tank. It was determined that there is a great deal of heat loss associated with the dumping of the contents. While various systems were attempted for minimizing this heat loss, none to my knowledge was particularly effective. Indeed, some paper manufacturers have gone to continuous digesting processes in order to avoid this drawback of a batch process, but the equipment costs for a continuous digesting system are very high.

More recently, an improved type of batch process has been designed for overcoming these difficulties. In this new process, the wood chips are cooked in the digester and the hot black liquor which results is removed by displacement with a filtrate from the washing section. This filtrate is added to the bottom of the digester and pushes up the hot spent liquor through the chips column without a substantial intermingling of the two liquids. The displaced hot black liquor is then directed into a pressurized accumulator. The digester is then emptied by adding steam to the top of the digester which forces the pulp out through a blow valve into a blow tank. After the pulp has been blown from the digester, it is filled with chips to

provide a uniform density layer of chips within the digester.

Hot black liquor from the accumulator is pumped into the bottom of the digester where it heats the chips. In this stage, an excess of black liquor is employed, more than the capacity of the digester so that excess black liquor is discharged from the top of the digester and is transferred to a weak black liquor tank. Fresh white liquor is then used to displace the black liquor from the bottom of the digester and the resulting spent liquor is passed to a weak black liquor storage space. The contents of the digester are then heated with steam to the desired cooking temperatures and held there for the required cooking times. When the contents of the digester have reached the cooking temperature, the steam introduction stops. After cooking, the hot liquor is removed as in the originally described step, and the cycle starts over again.

Experimental runs using the type of process mentioned above made it apparent that the use of steam for discharging cooked wood chips from the digester had problems. First of all, it was impossible to maintain a steam pressure in the top of the digester sufficient to sustain a constant flow of pulp from the digester to the blow tank. In an attempt to build up pressure in the digester, the blow valve was closed intermittently. This, however, resulted in erratic flow of pulp to the blow tank and plugging of the blow line. The steam flow rates were very high, considerably above that which had been expected to achieve blowing of the pulp.

The present invention provides an improved, more efficient means of treating wood chips with strong cooking solutions. In the process of the present invention the digester, after the cooking operation is completed, is emptied by providing a curtain of compressed, relatively cool air at the top of the digester to force the pulp out through a blow valve and into a blow tank. Particularly effective results are obtained when the air curtain is

introduced at an initial pressure of from 0.5 to 1.0 MPa. Surprisingly, the curtain of air has been found to be capable of discharging the cooked chips at a rate which is significantly faster than could be achieved with steam as the blowing agent. What is more, the operation proceeds very smoothly, without the hammering or erratic operation that was frequently noticed using steam as a blowing agent. It is found that the pressure in the digester could be maintained above the desired five atmospheres (0.49 MPa) without closing the blow valve. It was not uncommon to complete a blow approximately 10 minutes after opening of the blow valve. This compares to approximately 20 minutes for blowing of the material in a more conventional manner. All of this is accomplished under conditions of significant energy saving.

The subject invention can be used to improve the processes for wood chips digesting referred to above, namely:

In a process for cooking wood chips in which said chips are cooked under pressure in a digester at relatively high temperatures and the spent cooking liquor is discharged from said digester leaving a mass of pulp chips at temperatues and pressures substantially reduced from those employed during cooking, the improvement according to the invention comprises blowing air under pressure through said digester to discharge said pulped chips therefrom.

In a process for cooking wood chips which comprises cooking said chips in a digester with a cooking liquor to produce cooked chips and a hot black liquor, displacing the hot black liquor from said digester with a separate liquid, leaving a mass of cooked chips in said digester, the improvement according to the invention comprises establishing a blanket of air over the mass of cooked chips in said digester at sufficient pressure to discharge the mass of cooked chips from said digester.

The single figure in the drawings is a somewhat schematic illustration of the improved process of the

present invention.

In the single figure of the drawings, reference numeral 10 has been applied to a digester of the conventional type including a removable lid 11. A steam line 12 is provided for introducing steam into the base of the digester in order to achieve the appropriate cooking temperature. In accordance with the present invention, an air curtain is provided to discharge the chips through an air inlet conduit 13.

The chips are discharged from the digester through a conventional blow valve 14 which directs the blown pulp into a conventional blow tank identified at reference numeral 15. Discharge from the blow tank is controlled by means of a pump 16 in the usual manner.

Various liquids are fed to the digester 10 selectively as illustrated in the drawings. Specifically, there is provided a washer filtrate liquor tank 17 which contains a filtrate from one of the washing steps of the pulp making operation. This filtrate is used as a displacement liquid during operation of the digester and proceeds by means of a conduit 18, a pump 19 and a valve 20 into an inlet point at the base of the digester 10.

There is also provided a white liquor storage tank 21 which houses the concentrated cooking solution consisting normally of a mixture of sodium hydroxide and sodium sulfide in concentrated aqueous solution. This white liquor from the tank 21 is delivered by means of a pump 22 through a heat exchanger 23 and a valve 24 into a hot white liquor accumulator 25. At the appropriate time, the contents of the hot white liquor accumulator 25 are delivered through a conduit 26 by means of a pump 27 and a valve 28 into the lower inlet end of the digester 10.

There is also provided a hot black liquor accumulator 29 in which hot black liquor is kept under pressure. A portion of the hot black liquor contained in the accumulator 29 is delivered by means of a discharge line 30 into heat exchange relationship with the white liquor circulat-

ing through heat exchanger 23 by means of a line 31. Cooled black liquor is then delivered by means of a conduit 32 and a valve 33 into a cool black liquor accumulator 34. A valve 35 is provided to control the input to the cool black liquid accumulator 34.

The discharge of the cool black liquor accumulator 34 is taken through a discharge conduit 36 through a pump 37 and a valve 38 for introduction into the lower end of the digester 10.

Additionally there is provided a heat exchanger 39 to keep the cooking liquor at a substantially uniform temperature. The cooking liquor going to the digester 10 is preferably subjected to a forced liquid circulation. As the cooking is going on , a portion of the cooking liquor is continuously withdrawn by means of a discharge line 40 and passed by means of a pump 41 into the heat exchanger 39 where it comes into heat exchange relationship with steam delivered from a steam line 42 through a valve 43. A condensate line 44 controlled by a valve 45 recirculates condensate to the steam generating source. The output of the heat exchanger 39 is split with one portion going by means of a branch line 46 and a valve 47 into the lower end of the digester 10, and another portion going by means of line 48 and a valve 49 into the upper end of the digester 10.

A weak black liquor may be discharged from the digester through a line 50 and a valve 51 to a weak black liquor storage tank 52. Alternatively, the weak black liquor may be discharged as an overflow from the cool black liquor accumulator 34.

The operation of the system proceeds substantially as follows. An appropriate amount of wood chips is introduced into the digester 10 through the removable lid 11. These chips may be compacted as required to provide a uniform density throughout the portion of the digester in which the chips are located. The digester 10 is first filled from the bottom with cool black liquor from the accumulator 34 through conduit 36, pump 37 and valve 38.

This cool black liquor serves to preheat and to condition the chips.

The cool black liquor is then displaced by hot black liquor from the accumulator 29 which is pumped by means of a pump 53 and valve 54 into the lower end of digester 10. The amount of hot black liquor introduced at this time is in excess of the capacity of the digester 10, the excess passing to the cool black liquor accumulator 34 through valve 35.

Toward the end of the treatment with the hot black liquor, white liquor from accumulator 25 is introduced into the base of the digester 10 by means of pump 27 and valve 28. The fresh white liquor serves to displace the remaining black liquor without substantial intermixing of the liquids. The contents of the digester are heated by steam introduced through line 12 to a cooking temperature of about 160° to 171 °C. The cooking liquor is circulated in a forced circulation path, being introduced into the bottom of the digester 10 by means of the line 46, and into the top of the digester by means of the line 48. The cooking liquor is withdrawn by means of the line 40 and is circulated by the pump 41 through the heat exchanger 39 which serves to keep the cooking liquor up to temperature.

When the contents of the digester have reached the appropriate cooking temperature, the steam introduction through the line 12 is terminated. The digester is held at the cooking temperature for the required time which may run from 30 to 90 minutes. After the cooking has been carried out, the hot black liquor which has resulted in the digester is discharged threfrom by displacing it with the washer filtrate from the liquor tank 17, the discharge line 18, pump 19, and valve 20. This hot spent liquor is pushed up through the chip column and is directed into the pressurized hot black liquor accumulator through a line 57 and a valve 58. The digester 10 is then closed and relatively cool air at approximately room temperature is injected into the top of the digester 10

by means of the air inlet line 13. Initially, the air blanket which is thus introduced is preferably at a pressure of about 0.5 to 1 MPa. The blow valve 14 is opened and the pressure of the air quickly serves to force the pulp through the blow valve 14 into the blow tank 15. The air is exhausted through flow valve 14 into blow tank 15 and out through a vent 62 at the top of the blow tank.

The following table lists the general conditions achieved for the conventional kraft cook using the improved process of the present invention.

TABLE I

Digester volume	60 m^3
Digester wood charge (o.d.)	10300 kg
Degree of packing	170-172 kg/m^3
Dry solids content of wood	50 %
White liquor volume	17 m^3 (approx. 19 tons)
White liquor concentration, eff. alkali	108 g/dm^3 eff. NaOH
White liquor sulfidity	38 %
White liquor charge, effective alkali	1850 kg eff. NaOH
Black liquor volume	11 m^3
Total amount of liquor	41 m^3 (approx. 44 tons)
Liquor -wood ratio	4 m^3 liquor/ton o.d. wood
Initial air pressure	0.75 - 0.8 MPa
Blow time	15 minutes
Final kappa number	32
Pulp yield	47.5 % of wood
Produced amount of o.d. pulp	4.9 ton_{100}
Produced amount of pulp (90%)	5.4 ton_{90}

It should be evident that various modifications can be made to the described embodiments without departing from the scope of the present invention.

CLAIMS:

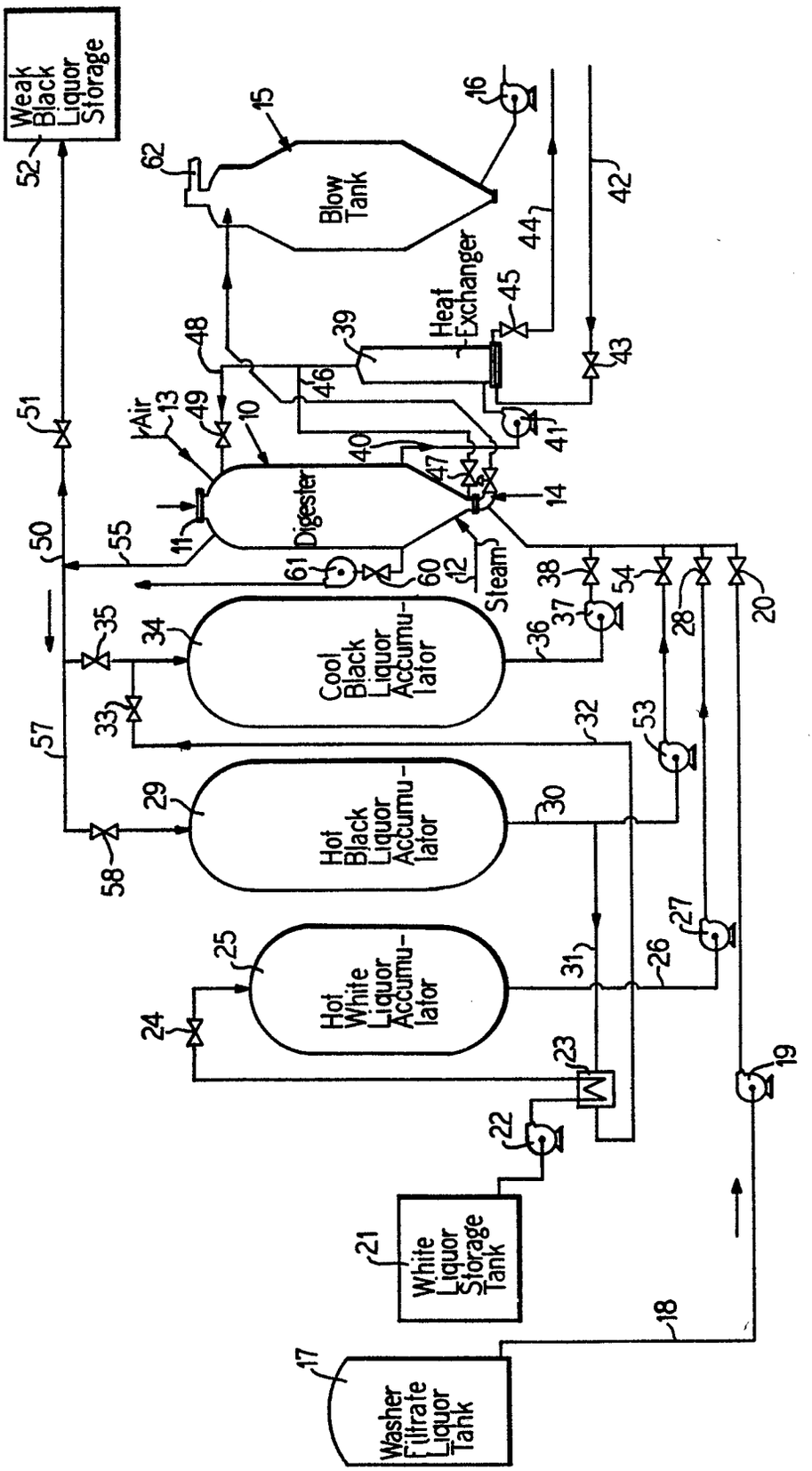
1. Improvement in a process for digesting wood chips in which said chips are cooked under pressure in a digester at relatively high temperatures and the spent cooking liquor is discharged from said digester leaving a mass of pulp chips at temperatures and pressures substantially reduced from those employed during cooking, characterized in comprising establishing a blanket of air over the mass of cooked chips in said digester at sufficient pressure to discharge the mass of cooked chips from said digester.

2. The improvement according to claim 1, characterized in that said air is at substantially room temperature.

3. The improvement according to claim 1, characterized in that said air is blown into said digester at an initial pressure of from 0.5 to 1.0 MPa.

4. Improvement in a process for digesting wood chips which comprises cooking said chips in a digester with a cooking liquor to produce cooked chips and a hot black liquor, displacing the hot black liquor from said digester with a separate liquid , and leaving a mass of cooked chips in said digester, characterized in further comprising: establishing a blanket of air over the mass of cooked chips in said digester at sufficient pressure to discharge the mass of cooked chips from said digester.

5. The improvement according to claim 4, characterized in that said blanket of air is introduced at a pressure of from 0.5 to 1.0 MPa.


Weak Black Liquor Storage
Blow Tank
Heat Exchanger
Air
Digester
Steam
Cool Black Liquor Accumulator
Hot Black Liquor Accumulator
Hot White Liquor Accumulator
White Liquor Storage Tank
Washer Filtrate Liquor Tank

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EUROPEAN SEARCH REPORT

Application number

EP 83 63 0112

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	GB-A- 900 880 (A.E. CHITTENDEN) * Whole document *	1-5	D 21 C 3/22 D 21 C 7/08
A	US-A-1 872 548 (W. ZUR LÖWEN) * Whole document *	1,2	
A	DE-C- 898 707 (ZELLSTOFFFABRIK WALDHOF) * Whole document *	1,2	
A	DE-C- 388 215 (S. WINSNES et al.)		
A	TAPPI J. TECHN. ASS. PULP PAPER INDUSTRY, vol. 63, no. 9, September 1980, pages 65-68, Atlanta, Georgia, USA J.T. MILLER et al.: "Methods for managing batch digesters"		TECHNICAL FIELDS SEARCHED (Int. Cl. ³) D 21 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25-10-1983	NESTBY K.

CATEGORY OF CITED DOCUMENTS

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