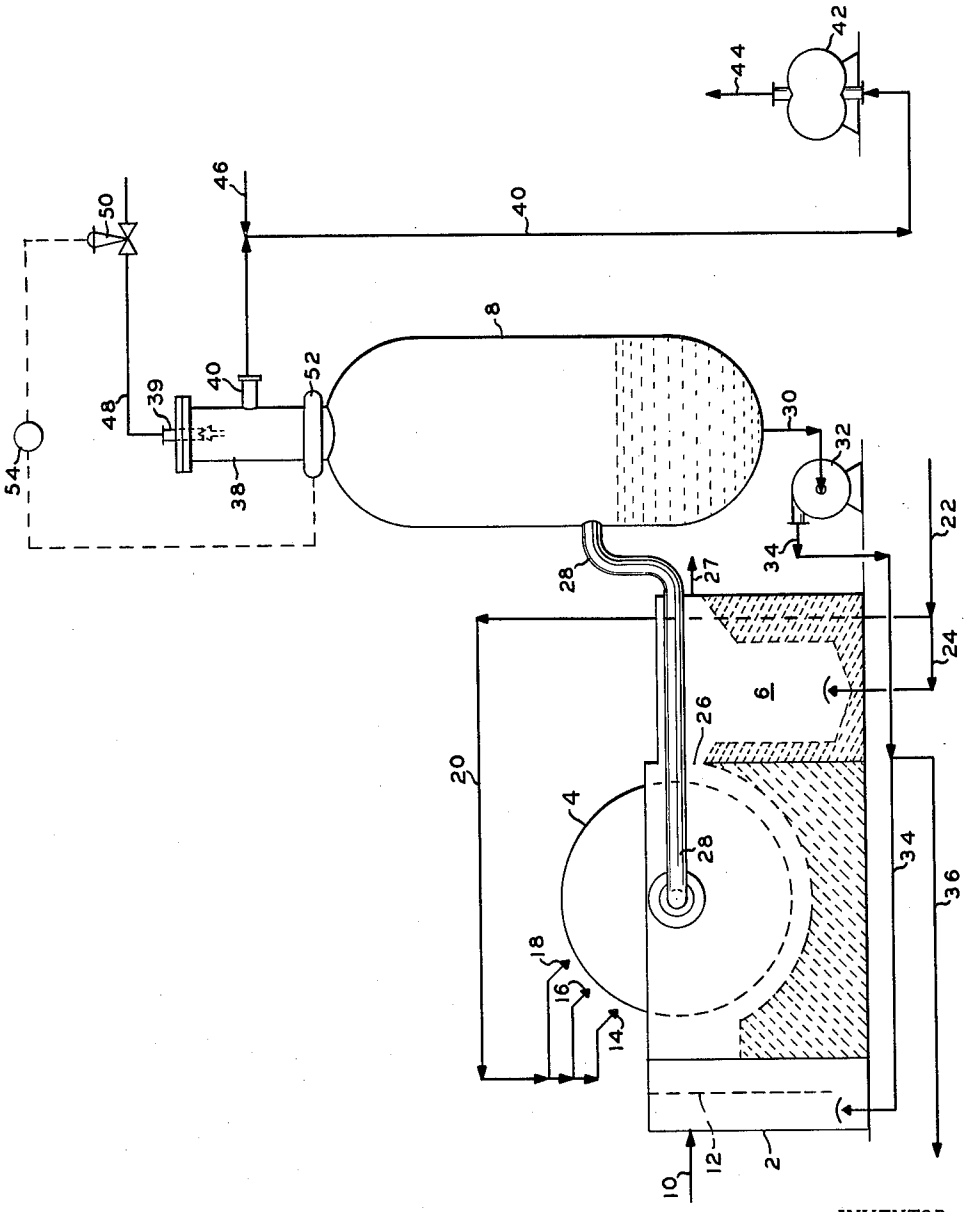
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DEAERATION OF WASHER FILTRATE

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DEAERATION OF WASHER FILTRATE

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This invention relates to processes employed in the pulping of cellulose material and particularly the preparation of pulp from wood. More particularly, the invention is concerned with improvements in the chemical process known as the kraft or alkaline process of producing pulp. In a specific aspect the invention is directed to the degasification of a liquid and the breaking of foam to recover liquid therefrom and gaseous material.

It is an object of this invention to provide an improved method and means for removing entrained gases from liquid material.

A more specific object of this invention is directed to the method and means for degasifying liquid filtrate and foam recovered from the washers of a chemical pulping process.

Other objects and advantages of the present invention will become more apparent from the following description.

In the chemical process for preparing pulp from wood, the digester contents are blown into a blow tank wherein everything initially charged into the digester is present with the exception of a small quantity of flash steam and volatile material such as turpentine. The material in the blow tank includes the cellulose fiber, wood waste material, cooking chemicals and any condensate from direct steaming. The wood waste materials are primarily lignin, resin and fats, all in chemical combination with sodium base cooking chemicals. Accordingly, washing is required to isolate and clean the desired cellulose fibers discharged from the digester, as well as to clean the fibers for color reasons and minimize the amount of bleaching chemicals required in the process. The black liquor which is drained from the cellulose fibers contains, not only the organic material from the wood which is combustible after drying, but all of the original chemicals. In order to restore these chemicals to their active condition the black liquor must be evaporated to a much higher solids content which may be accomplished as hereinafter described.

The black liquor from the washers is recovered at a solids content of about 15 to about 16 percent and the black liquor thereafter is efficiently concentrated in an evaporator or a plurality of evaporators which increase the solids content to about 50 percent through the evaporation of most of the water content. This evaporation, however, requires a substantial amount of costly steam which may be effectively reduced by using multiple-effect evaporators in a manner not forming a part of this invention. In addition to the above, the solids concentration of the black liquor removed from the washers must be kept as high as possible which requires the minimum use of hot clean water for washing. Maintaining the solids concentration of the black liquor at a desired high value has been achieved through the use of displacement washing wherein a vacuum filter, ordinarily a wire, cloth covered cylinder, is rotated very slowly in a vat of the thin brown stock to be washed. Vacuum is applied through suitable valves to the interior of the cylinder to draw black liquor inward through the wire cloth, thereby forming a sheet or mat of cellulose fiber on the surface of the cylinder. As the cylinder rotates and a sheet or mat of cellulose fibers separates from the liquid in the vat onto the wire cloth, additional vacuum continues to dewater the mat until it reaches a desired consistency. At this point the mat passes under a battery of shower nozzles which gently spray a sheet of water

or cleaner black liquor on the surface of the mat. The thus-sprayed water or cleaner liquor is soaked into the mat displacing the dirtier black liquor in the mat. Accordingly, shower liquid is actually drawn through the mat into the cylinder entering the black liquor in the cylinder and thereby diluting it. The mat formed as explained in the above operation is then lifted off of the vacuum cylinder and this relatively dry mat of cellulose fiber is then dropped into a repulper or vat containing rather violent mechanical agitation wherein it is diluted and thoroughly dispersed in relatively thin black liquor which has been recovered from the succeeding stage of washing to form thin stock. Thereafter the thin stock is passed into the vat of the next stage of washing wherein the above cycle is repeated. It is the general practice to employ several stages of washing in series with the washing liquid being passed countercurrent to the stock or cellulose fiber being washed for maximum washing efficiency.

The washer or filtrate cylinder is divided into a plurality of radially extending segmental compartments with vacuum controlled on various compartments with a suitable valve arrangement such as a ring valve mounted on the axis of the washer or washer journal. This arrangement permits controlling the arc of the cylinder influenced by the vacuum imposed thereon so that the black liquor is sucked into the cylinder and flows axially out through the journal at one end of the vacuum filter cylinder. The journal of the vacuum filter cylinder is connected in the prior art to a standpipe or barometric-leg through which the withdrawn black liquor flows downwardly to a black liquor filtrate or seal tank. Generally, the seal tank is positioned approximately 35 or more feet below the cylindrical washers and a liquid level is maintained therein sufficient to cover the bottom open end of the standpipe or barometric-leg. The seal tank serves as a reservoir for filtrate before it is pumped to serve as shower and repulper liquid ahead of the filter cylinder from which withdrawn. The passage of black liquor through the standpipe or barometric-leg induces a vacuum in the filter cylinder by the head of pressure developed by the withdrawn liquor.

One major problem encountered in the above method of operation resides in the entrainment of air in the liquor withdrawn from the filter cylinder, which in many instances causes excessive foaming of the liquor to occur. The air enters the system by several sources including air being sucked through the cellulose mat on the surface of the filter as the mat becomes drier, and the minor air leaks in the seals of the system. However, the liquor pumped from the filtrate seal tank must be substantially free of air before it is employed as shower liquid or passed to the repulper, otherwise it will induce an aggravated foaming action at these points and the air bubbles entering the fiber mat with the wash liquid will substantially inhibit thorough washing, thereby substantially reducing washer efficiency. The filtrate is ordinarily full of air bubbles and prior practice has established that a maximum escape surface should be provided on the liquor in the filtrate tank and maximum residence time of the liquor in the filtrate tank should exist for deaeration of the foam and liquor. To accomplish the above, relatively large separate foam tanks have been provided in conjunction with the filtrate tanks to provide additional residence time for collapse of the foam. This system, however, has not been completely satisfactory due to the number of relatively large tanks required, the area required to house the tanks and the problems associated with breaking of the foam. In many instances the seal and foam tanks have been inadequate to handle the amount of foam produced in the process. Accordingly in the prior art systems employing, for example, three

vacuum filters or washers in series, each is provided with its respective barometric-leg, some 35 or more feet in length with filtrate or seal tank and foam tanks positioned below. In this system employing a plurality of washers in series fresh hot water is introduced as shower liquid to the final or third stage washer and part of this water passes through the mat as described hereinbefore, thereby entering the black liquor filtrate in the third cycle and eventually passing to the seal tank. From the seal tank this very thin black liquor is then pumped countercurrent to pulp flow through the plurality of washers as shower liquid to the second stage washer and to the repulper between the second and third stage washers. The filtrate from the second stage washer is passed to the second stage filtrate or seal tank and then pumped as shower liquid to the first stage washer and the repulper between the first stage and the second stage washer cylinder. The filtrate from the first stage washer passes to the first stage filtrate or seal tank from which the greatest portion of this liquor is pumped to dilute the incoming pulp stock and liquor being passed to the first stage washer. Also a quantity of this filtrate is pumped to the blow pit hereinbefore discussed to dilute the digester contents to a readily pumpable consistency. As a result of this method of operation a surplus of black liquor is obtained in the first filtrate tank associated with the first washer and it is this surplus liquor which is then passed to the evaporators for concentration and recovery of chemicals therefrom.

The present invention is directed to an improved method and arrangement of process steps for recovering black liquor from the plurality of washers over that discussed hereinbefore whereby the relatively large area to house the large and expensive seal tanks, as well as foam tanks associated therewith may be eliminated or substantially reduced and the elaborate and costly structure to mount the plurality of washer vats at a suitable elevation to provide the necessary standpipes or barometric-legs is eliminated. More importantly, however, applicant's invention is directed to the method and means for removing gaseous material from liquids and breaking of foam particularly encountered in wood pulping processes and overcoming the problems associated therewith. That is, in accordance with this invention more efficient separation of the air entrained in the liquor is achieved and the foam formed during recovery of the black liquor from the washers is efficiently and more quickly broken down. It is to this end that the method and means of this invention is directed.

In accordance with this invention, the washers are located substantially at grade level with the seal tanks or filtrate recovery tanks and a suitable connecting conduit is provided between the washer journal and the seal or filtrate recovery tank. A vacuum is imposed on the washer by maintaining the seal tank at sub-atmospheric pressure with a suitable vacuum pump thereby eliminating the standpipe or seal leg previously employed. In the arrangement of apparatus specifically shown and described with respect to the invention, the seal tank is provided with a relatively large-diameter conduit extending upwardly from the top of the tank a suitable distance for the withdrawal of gaseous material such as air induced by a vacuum pump connected thereto. Means are provided in the upper portion of the relatively large conduit and preferably above a gaseous material withdrawal conduit connected thereto for imposing relatively high frequency pulsations or vibrations such as sonic vibrations on the foam encountered in the seal tank and the gaseous material being withdrawn upwardly through the relatively large conduit. In a specific embodiment of this invention employing the above arrangement of apparatus, black liquor is withdrawn at sub-atmospheric pressure from the washer journal and passed by the conduit provided to the seal or filtrate tank maintained under subatmospheric pressure. The reduced pressure imposed on the filtrate liquor greatly improves and facilitates separation of entrained air from the black liquor passed to the seal tank. It is contemplated, however, in an embodiment of this invention of maintaining the seal tank or separator drum under a higher vacuum than that required for the washer operation and this may be accomplished by placing a variable restriction or orifice in the black liquor filtrate withdrawal conduit between the washer and separator drum. Accordingly, separation of air from the liquor may be accomplished more efficiently and at a much faster rate in a much smaller sized separator drum or seal tank than previously employed, however, the more rapid and concentrated release of air from the liquor has a tendency to aggravate foaming conditions. Applicant's invention includes destruction of the foam produced by employing a novel method and means for breaking the foam as it tends to accumulate or build up in the upper portion of the seal tank above the liquor filtrate collected in the lower portion thereof. That is, means are provided in the upper portion of the seal tank to impose high frequency pulsations or vibrations such as sonic type shock wave vibrations on the foam in the seal tank to break the foam down rapidly thereby releasing the air entrapped therein. Accordingly, it is contemplated installing one or more of the high frequency pulsating means in the upper portion or top of the separator drum or as more fully described hereinafter it may be installed in the upper portion of the relatively large conduit through which separated air is withdrawn. The high frequency pulsating or sonic wave vibrating means may be made to operate continuously or a sensing device such as a photoelectric cell may be used to actuate its operation when the foam builds up to a given level in the separator drum.

Having thus given a general description of the improved method and means of this invention, reference is now had to the drawing which is a diagrammatic illustration in elevation of one arrangement of apparatus for practicing the method of this invention.

The drawing shows in diagrammatic arrangement a washer mat **2** containing cylindrical drum **4**, a repulper tank **6** and separator drum **8**. It is to be understood that a plurality of washer drums with separator drums are generally employed in series, however, for purposes of simplification only one is shown. In the specific example herein presented the first of the series of washers is shown and described wherein liquid feed comprising digested wood material, cellulose fiber and liquor is recovered from a blow tank at a suitable concentration and passed by conduit **10** into washer tank **2**. The liquid feed passed to the washer by conduit **10** passes downwardly under transverse baffle member **12** wherein it is mixed with additional recycle liquor filtrate to form a mixture of desired consistency. Thereafter the mixture is passed to the rotating cylinder **4** provided with a wire screen for recovery of the cellulose fiber mat upon the screen of the cylinder and washing of the mat is accomplished as the cylinder slowly rotates as hereinbefore described. In the apparatus shown the cylinder rotates clockwise and the mat formed on the screen of the cylinder is sprayed with liquor filtrate obtained from the next washing step as generally described hereinbefore. The washing liquor is supplied to a plurality of spray nozzles **14**, **16** and **18** by suitably connected conduits **20** and **22** with a portion of the liquor in conduit **22** being passed to repulper **6** by conduit **24** proceeding the next washing stage. The mat formed on cylinder **4** is removed at **26** by a suitable device not shown and passed to repulper **6**. From repulper **6** the thin stock is passed to the next of the series of washing stages, not shown, by means **27**. The liquor in washer **2** is withdrawn through segmented partitions in the cylinder to the cylinder journal and then passed by conduit **28** to separator drum **8** due to a vacuum imposed upon the cylinder by maintaining separator drum **8** at subatmospheric pressure in the manner

hereinafter described. It is to be understood that the filtrate may be introduced tangentially into separator drum 8 to facilitate removal of entrained air from the filtrate. The liquor filtrate is collected in the lower portion of separator drum 8 and this liquor filtrate is withdrawn from the bottom thereof by conduit 30 for recycle as herein described. The filtrate in conduit 30 is passed to pump 32 with a portion of the filtrate thereafter passed by conduit 34 for admixture with the feed introduced to the washer by conduit 10. The remaining portion of the filtrate is passed from pump 32 by conduit 36 for further use and distribution as required in the blow tank and digester with the remaining unused portion being passed to suitable evaporator recovery equipment not shown. The separator drum 8 is arranged in the upper portion thereof to facilitate breaking of foam as herein described and the removal of air or gaseous material entrained with and separated from the liquor filtrate. That is, means are provided in the upper portion of separator drum 8 for imposing high frequency pulsation or sonic vibrations on the foam accumulating in the separator drum above the liquid filtrate. In the specific embodiment shown herein the separator drum 8 is provided with a relatively large conduit 38 extending upwardly therefrom and provided with a gaseous material withdrawal conduit 40 connected thereto. Conduit 40 is connected to vacuum pump 42 with the evacuated gases and air being discharged from pump 42 by conduit 44. Conduit 46 is provided for connecting additional stages of washers and separators normally employed in series which are substantially identical to the arrangement shown herein. That is, as discussed hereinbefore a plurality of washer-separator arrangements are employed in series such that the mat to be washed passes through the series of washers countercurrent to washing liquid employed therein. In a specific embodiment, the upper end of conduit 38 above withdrawal conduit 40 is provided with a removable cap member to which is attached a sonic type shock wave transducer 39 activated by conduit 48 containing valve 50. A sensing device 52 is provided and connected to a valve actuator 54 in series with valve 50. In the operation of the specific apparatus hereinbefore described, separator drum 8 is maintained under subatmospheric pressure conditions by vacuum pump 42, which in turn imposes a vacuum on cylindrical drum 4 by conduit 28. The liquor filtrate reaching the journal of drum 4 with entrained air is caused to flow through conduit 28 into separator drum 8 wherein due to the subatmospheric pressure maintained therein entrained air is readily separated from the liquor filtrate and withdrawn through conduits 38 and 40 by vacuum pump 42 for discharge to the atmosphere by conduit 44. As hereinbefore discussed this method of operation, however, tends to aggravate the formation of foam which collects in the upper portion of separator drum 8 and must be rapidly broken down to exclude the flow of foam to vacuum pump 42. To accomplish this end, applicant has provided means for imposing high frequency vibrations such as shock waves upon the foam in the upper portion of separator drum 8 which shock waves may be continuously applied or intermittently applied depending upon the amount of foam produced and the level of the foam in separator drum 8. In addition, applicant has provided a sensing device for actuating the shock wave transducer when the foam reaches a predetermined level in the separator drum 8.

Having thus given a general description of the improved method and means of this invention and described a specific embodiment thereof by way of example, it is to be understood that no undue restrictions are to be imposed thereon by reasons thereof except as recited in the claims.

I claim:

1. A process for the deaeration of liquor recovered from pulp produced in a chemical pulping process which comprises providing a washer containing a pulp recovery drum, and a filtrate recovery drum, flowing the filtrate from the pulp recovery drum into the filtrate recovery drum under subatmospheric pressure, generating said subatmospheric pressure by imposing a vacuum on said filtrate recovery drum, deaerating the filtrate in said filtrate recovery drum by imposing sonic wave vibrations, and withdrawing deaerated liquor filtrate from said filtrate recovery drum.

2. A process for the deaeration of liquor recovered from pulp produced in a chemical pulping process which comprises providing a washer at grade level and in association with a filtrate recovery drum, said washer comprising a pulp recovery drum, maintaining said pulp recovery drum and said filtrate recovery drum at subatmospheric pressure by imposing a vacuum on said filtrate recovery drum, flowing liquor filtrate under subatmospheric pressure from said pulp recovery drum to said filtrate recovery drum, in said filtrate recovery drum deaerating foam above the liquor filtrate under subatmospheric pressure conditions by imposing sonic shock wave vibrations, withdrawing released air from the upper portion of said filtrate recovery drum and withdrawing deaerated liquor filtrate from the lower portion of said filtrate recovery drum.

3. The process of claim 2 in which said filtrate recovery drum is under a higher vacuum than the pulp recovery drum.

References Cited in the file of this patent

UNITED STATES PATENTS

2,357,445	Baker	Sept. 5, 1944
2,478,150	Young	Aug. 2, 1949
2,620,894	Peterson	Dec. 9, 1952
2,745,712	Burling	May 15, 1956

OTHER REFERENCES

American Dyestuff Reporter, March 3, 1952, 41:5, p. 151, 8–156.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,154,465 October 27, 1964

William J. Degnen

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, line 2, and in the heading to the printed specification, lines 3 and 4, strike out ", by mesne assignments,", each occurrence.

Signed and sealed this 15th day of March 1966.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents