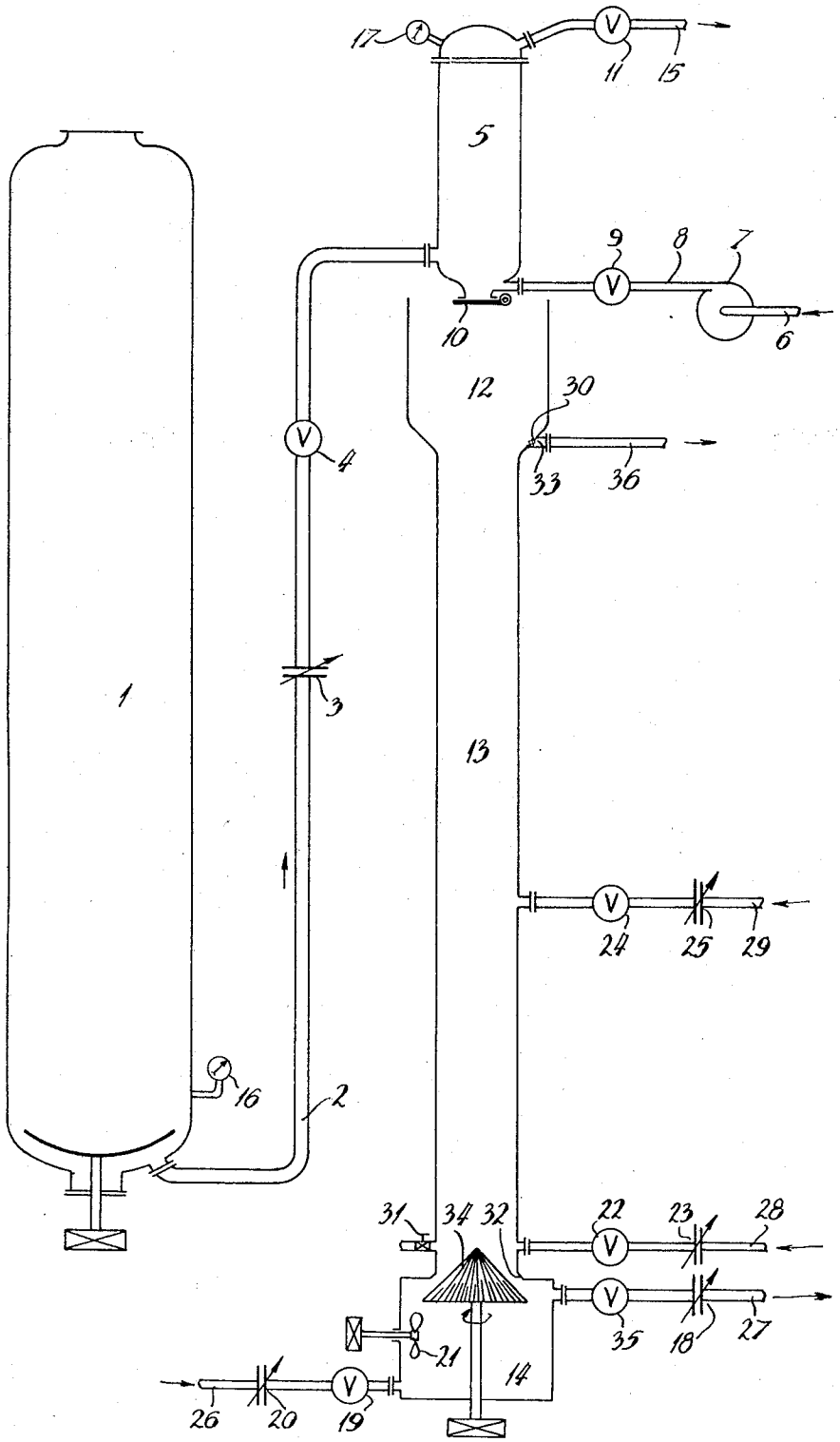
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BLEACHING TREATED WOOD CHIPS

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BLEACHING TREATED WOOD CHIPS

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This invention relates to improvements in the bleaching of chemically treated wood chips and other fibrous particles produced from fibrous raw materials by chemical cooking treatments. The invention is applicable to batch or continuous treatment and refers inter alia to improvements in the bleaching of fibrous materials poduced by so-called semi-chemical or semi-mechanical processes whether conducted as for example at atmospheric pressures and low temperatures or at superatmospheric pressures and elevated temperatures, using such chemicals as caustic soda, lime, sodium carbonate, sodium sulphite or sodium sulphide or combinations of these in one stage or several stages. In these processes it has been usual according to prior methods for the wood chips or the like to be removed from the treatment vessel and reduced to a substantially free fibre pulp by mechanical means before the bleaching process is commenced.

The invention also refers to the bleaching of fibrous materials produced by the so-called "chemical" processes in which wood or like materials are subjected to cooking at superatmospheric pressure and elevated temperatures, including acid sulphite, neutral and alkaline sulphite processes and combinations of these in multistage procedures, and the kraft and soda processes whether such processes are conducted in one stage or multiple stages or continuously, and whether the material is dicharged from the digesting vessel at high or low temperatures. In these processes, it has usually been the practice for the materials to be "blown" from the cooking vessel after completion of the cooking treatment, whereby the materials are disintegrated to individual fibres or are "pulped" prior to commencement of any bleaching treatment.

The present invention is particularly suitable for the treatment of the product from a continuous countercurrent cooking and washing system where the cooked wood chips at the point of discharge from the digester are substantially free of reaction products and cooking chemical and at a temperature less than 100° C. Such a product is produced by the process described in our copending patent application No. 57,248/60.

The object of the present invention is to provide an improved process for the bleaching of cooked wood chips or fibrous materials produced from wood whereby greater efficiency can be achieved in carrying out the bleaching process including a reduction in the amounts of bleaching chemicals required, a reduction in the amount of mechanical equipment required and an increase in the reaction rates in the bleaching processes together with improvement in the strength properties of the bleached pulp.

It has been the almost invariable practice in the past to either blow pulp from a digester and in so doing to seek to defibre the chips to individual fibres or alternatively to remove the cooked chips from the vessel and then defibre same in special machines, prior to washing the soluble products of the cooking reactions from the pulp and bleaching the pulps. Bleaching has then been carried out in aqueous suspensions of free individual fibres distributed at random. The packing density of such a distribution of fibres is relatively low so that it is common and necessary for large amounts of water to be used to transport and treat the pulp in and through the various stages of bleaching and inter-stage washing.

The development of countercurrent bleaching systems has hitherto been prohibited by the fact that it is very difficult to pass water or aqueous solution through pulp masses of the kind described. It is believed that this is due to the hydrodynamic conditions existing in the interstitial spaces between fibres and to the effect of the shape of the fibres and of aggregations thereof in their sedimentation velocity.

The present invention overcomes many of the difficulties inherent in handling wood pulps in bleaching by conventional batch or continuous methods.

The invention is based essentially on the discovery that bleaching reactions can be efficiently carried out while the fibrous material is still substantially in the form of chips or similar multi-fibred particles. In this specification, the term "chips" or "wood chips" includes chips, pieces and other multi-fibred particles of wood and like fibrous materials, prior to the subdivision or disintegration thereof into individual fibres distributed at random. We have found that if the material is maintained substantially in chip form, the difficulties inherent in handling defibred material in batch or concurrent bleaching are substantially overcome so that, for example, all stages of washing and bleaching may be carried with a packing density in the region of 6 lbs. of oven-dried fibre per cubic foot. A further feature of the invention consists in subjecting the said chips or multi-fibred particles to countercurrent treatment with aqueous solutions of bleaching chemicals, such treatment being rendered possible because of the relatively porous nature of the mass.

Penetration of the cooked multi-fibred particles by bleaching chemicals according to this method is satisfactory and the soluble reaction products can be removed between stages of bleaching by diffusion-displacement washing without the use of conventional filters such as are normally used with defibred pulps. If necessary, the wood chips or multi-fibred particles to be bleached may be subjected to washing and/or cooling treatment prior to the bleaching treatment of this invention. Material treated by the process of our patent application No. 57,248/60 normally will not require such washing or cooling.

Where the material to be discharged from a digester is at temperature greater than 100° C. flashing of steam on exposure to atmospheric pressure provides agitation sufficient to defibre chemical pulps so that the mass in such a condition must be cooled before pressure release.

In one form of the invention, washed unbleached substantially undefibred cooked wood chips are discharged into a conventional tank, chest or tower and the mass covered with water. The packing density of the fibrous material is between 4.5 and 12.0 lbs. of oven dried fibre per cubic foot and is preferably about 6 to 7 lbs. oven-dried fibre per cubic foot. Calcium hypochlorite is added and the liquor is circulated by means of an external pump through the mass until bleaching is completed.

The free liquor is drained from the mass and the bleached chips washed by covering the charge with water and circulating the water through the mass; this process may be repeated with further quantities of fresh water if necessary until the chips are substantially free of reaction products and residual chemicals. Relatively small amounts of water are necessary to wash the particles free of soluble material. When washing is completed, agitation of the mass in the presence of water with a mechanical agitator is sufficient to defibre the chips to a free fibre pulp and the pulp may then be pumped or otherwise conveyed to storage in the conventional manner.

Multi-stage bleaching procedures can be carried out in similar fashion. For example, with the mass covered with water, chlorine gas can be passed into the water and with the free liquor circulating as described in the earlier

example, chlorination carried out. After completion of this stage, water washing is conducted, followed then by extraction with caustic soda, washing, then bleaching with sodium or calcium hypochlorite, washing, further hypochlorite, washing and acid treatment and sodium chlorite or chlorine dioxide. These treatments are carried out without removing the chips from the vessel and the particles retain their original form throughout these treatments. Rates of drainage of liquor from the vessel are very high in comparison with rates of drainage of liquors from pulp masses. When fully bleached and washed the particles are disintegrated to a free fibre wood pulp.

In another form of the invention cooked wood chips substantially free of soluble reaction products are removed from a continuous digester at a temperature below 100° C. and delivered to the top of a vertically disposed tower. In order to maintain the material substantially in the form of undefibred chips it is necessary to pass the cooked wood chips together with water which in this case is substantially free of the products of cooking, into a separate vessel without mechanical agitation. A method for doing this is to discharge the cool (less than 100° C.) material from the digester into a second vessel filled with fluid which is at a pressure about equal to the pressure at the discharge point of the digester and is connected to the digester, by releasing fluid from the second vessel at a controlled rate such that the pressure drop from digester to the second vessel is not greater than 5 to 10 lbs. per square inch more than the pressure drop due to pipe friction. In this way cooked wood chips are transferred to the second vessel with substantially no defibration. When the second vessel is substantially filled with material from the digester it is isolated from the digester and pressure release is effected by allowing fluid to escape. It will be recognised that because the mass is at a temperature less than 100° C. only hydrostatic pressure is involved and release of only a small quantity of fluid is necessary to reduce the pressure to equilibrium with the atmosphere. The vessel is provided with a large door which when opened allows the cooked wood chips to be dumped from the vessel into a bin or chest with substantially no defibration occurring.

Another method for discharging the material from the digester without defibration involves the use of a rotary valve of the "star-feeder" type so arranged that hydraulic pressure is released by allowing water or other fluid to escape after the pocket is filled with material delivered from the digester but before the whole mass is freely exposed to atmospheric pressure.

The bin into which the cooked wood chips are delivered from the discharge vessel is preferably disposed directly above the bleaching tower so that transfer of the chips to the tower can be effected by gravity only. Other means for doing so may lead to defibration and this is to be avoided.

To commence the operation the bleaching tower is filled with the said cooked wood chips and water. Bleaching chemical, in this case calcium hypochlorite and water, are introduced at the bottom of the tower and this mixture allowed to upflow until the chips in the lower about one-third of the tower are bleached. Before the removal of bleached chips is commenced the point of addition of hypochlorite is changed to a point above the bottom about one-third of the tower height from the bottom of the bleaching tower and hypochlorite addition continued at the same rate. Water upflow is continued to wash the chips in the lowest portion of the tower. When the chips are washed satisfactorily discharge of chips is commenced.

Removal of bleached chips from the bleaching tower is effected by means of a suitable valve which allows chips to fall into a receptacle filled with water so that water does not flow downwards while chips are being removed. The receptacle is provided with a suitable agitator so that the chips are defibred in the water in it and the pulp so formed is continuously removed. Sufficient water is added to this receptacle continuously to provide for the outflow of pulp from the receptacle and, in addition, to provide for the water upflow required. Thus at the valve where chips are released from the bleaching tower, water flows upwards.

The process is operated with continuous addition of cooked washed chips to the top of the bleaching tower and continuous removal of bleached washed chips from the bottom of the said tower.

Control of this process is arranged by regulating the quantity of hypochlorite added and the concentration of active chemicals so that the rate of movement of chips down the column and the rate of upflow are such that the brightness of discharged pulp is at the level required and the liquor leaving the tower at or near the point of entry of unbleached chips is substantially exhausted of active chemical, and the bleached chips are removed substantially free of chemical and soluble reaction products.

The system described is one form of bleaching and washing system according to the invention, and it will be clear to those skilled in the art that other chemicals and/or water may be introduced at different points in the column so that multi-stage processes can be conducted with interstage washing of the chips with water in countercurrent.

For example, a system involving chlorination (with chlorine gas or chlorine water) followed by a water wash, alkali treatment, water wash, hypochlorite, water wash, and an acid treatment followed finally by water-washing, is practicable without defibration of the chips until the process is completed. If final washing of the defibrated pulp is necessary it can be carried out by usual means known to the art.

It will be clear that under-cooked chips and knots will be carried through the process whereas in usual pulpmill practice these are removed before bleaching. This is no disadvantage because we have discovered that such particles are substantially impenetrable by the chemicals—this is the reason why they survive the cooking process uncooked—and after gentle defibration sufficient to defibre the normal bleached chips the under-cooked and substantially unbleached knots and the like can be removed by the usual and known screening methods.

In a further example of the process washed chips prepared by continuous countercurrent cooking and washing of mixed eucalyptus woods and containing 75 parts of water and 25 parts o.d. unbleached pulp (by weight) were introduced into a tower 45 inches high and 2.25 inches in diameter until the tower was full of cooked wood chips. The chip feed was stopped and calcium hypochlorite solution containing 40 g.p.l. available chlorine was introduced at the rate of 2 mls./minute initially at the bottom together with 6 mls./minute of water. This mixture was allowed to flow upwards and water overflowed at the top for about one hour i.e., until the lowest about one-third of the pulp in the tower was bleached. The point of addition of hypochlorite solution was then transferred to a point about 15 inches above the bottom of the tower and water addition at the bottom maintained at 6 mls./minute.

Removal of bleached chips was commenced by releasing the bottom discharge valve which allowed chips to fall into the receiver in which was installed an agitator. Agitation was commenced and as the material was pulped it was released from the receptacle at the rate of one gram o.d. pulp/minute together with water so that the consistency or stock concentration was approximately one percent. Thus the rate of water removal here was 100 mls./minute. The rate of water addition to the receiver receptacle was therefore increased to 106 mls./minute to alow sufficient excess water to upflow. Cooked wood chips were added continuously to the top of the tower at a rate equivalent to 1 gm. o.d./minute and

washed bleached pulp was removed continuously from the receiver as described.

The figure of the accompanying drawings is a diagrammatic representation of apparatus for carrying out the process of the invention.

A digester **1** is arranged to be connected by means of conduit **2** to a second pressure vessel **5** the latter being disposed above a storage bin **12** connected to a bleaching vessel **13** which discharges into a receptacle or receiver **14**. A valve **4** and flow meter **3** are provided in conduit **2**.

The pressure vessel **5** is disposed vertically above the bleaching vessel **13**, which is disposed vertically above the receptacle **14**. Water or other fluid under pressure is admitted to vessel **5** through conduit **6**, pump **7**, conduit **8** and valve **9**. A door **10** is provided on the lower end of the vessel **5**. A discharge conduit **15** controlled by a valve **11** is connected to the upper end of vessel **5**.

For the purpose of this description it is assumed that the digesting vessel **1** is operated to produce washed cooked wood chips to be discharged in undefibered form through conduit **2**. Before discharge is commenced, vessel **5** is filled with water, aqueous solution or other fluid, for example air, by closing valve **4**, and door **10** and if air is used, valve **11** also. The vessel **5** is filled and the pressure of the fluid therein raised by means of pump **7** through conduit **8** and valve **9**, to a valve equal to or slightly greater than the pressure in the digester **1**. If water or aqueous solution is used for pre-filling vessel **5** then pre-filling is conducted with valve **4** and door **10** closed and valve **11** open until the air in vessel **5** is displaced by water entering through conduit **6**, pump **7**, conduit **8** and valve **9**. This is evident when water issues from valve **11** and conduit **15**. Valve **11** is then closed and the pressure in vessel **5** raised using pump **7** to that equal to or slightly greater than the pressure in digester **1**.

In either case when full pressure is attained in vessel **5** the valve **9** is shut and valve **4** opened. Valve **11** is opened gradually to allow the escape of fluid from vessel **5** and the rate of discharge of washed cooked wood chips and water or aqueous solution from the digester **1** is controlled with the assistance of flow meter **3** and pressure gauges **16** and **17** by increasing or decreasing the rate of discharge of fluid through valve **11** and conduit **15**. The volume of vessel **5** is known and sufficient material is allowed to pass to such vessel to displace the fluid initially used to fill it. When this point is reached valves **4** and **11** are closed. Hydrostatic pressure in vessel **5** is then released by slightly opening valve **11** and allowing fluid to escape until the pressure indicated by pressure gauge **17** indicates that the contents of vessel **5** are at atmospheric pressure.

The bleaching column or tower **13** is surmounted by a bin **12**. The column **13** is closed during initial filling by the discharge valve **34**, which may be of the form shown, i.e., a conical plug which may be rotated about its axis and also moved in a vertical direction so that the clearance between the plug and its seat **32** can be varied to permit control of the rate of discharge of solid material from the column **13** into receiver **14**. Receiver **14** is of approximately cubical form and is equipped with a rotatable agitator **21** and inlet conduit **26** for water or aqueous solution and an outlet conduit **27** for aqueous suspension of bleached pulp. A valve **19** and flowmeter **20** are provided in the inlet conduit **26**; and a valve **35** and flowmeter **18** are provided in the outlet conduit **27**. Calcium hypochlorite solution may be admitted to the column **13** through conduit **28**, flowmeter **23** and valve **22**, or through conduit **29**, flowmeter **25** and valve **24**.

To commence the bleaching operation the tower **13** and receiver **14** are filled with water through valve **19** and conduit **26** while valves **17**, **22**, **24** and **35** are closed. Vessel **5** is filled as described above and when column **13** is filled with water, the door **10** of vessel **5** is opened and the contents allowed to discharge under gravity into bin **12**. Valve **34** is held closed and not rotated and the washed cooked wood chips settle from the bin **12** under gravity through the water in column **13**. Any excess water in the bin **12** is allowed to overflow through conduit **36** which is equipped with a screen **30** over the entrance to prevent loss of cooked wood chips through the conduit with the excess water.

When column **13** is filled with washed cooked wood chips in water, addition of calcium hypochlorite solution is commenced through conduit **28** flowmeter **23** and valve **22** and at about the same time water is admitted through conduit **26**, flowmeter **20** and valve **19** and this mixed flow of water and bleaching reagent is allowed to flow upwards through the mass until the cooked wood chips at the level of conduit **29** are substantially bleached.

At this time the flow of calcium hypochlorite solution through conduit **28** is stopped by closing valve **22**, and valve **24** is opened to allow flow of calcium hypochlorite through conduit **29**, flowmeter **25** and valve **24** at the rate required. The flow of water through conduit **26** and valve **19** is continued. In this way bleaching reagent continues to flow upward and the water entering the bottom of column **13** then washes the bleached chips. This process is allowed to proceed until samples of bleached wood chips drawn from the sampling cock **31** are substantially free from bleaching reaction products. The column is now established and continuous treatment is commenced.

The agitator **21** is started and valve **34** is lowered slightly and rotated continuously. Bleached wood chips enter receiver **14** and are disintegrated by the agitator **21**. When the stock concentration in the receiver **14** is at a suitable value, discharge of pulp is commenced through outlet conduit **27** by opening valve **35** and regulating the flow with the aid of flowmeter **18**. At substantially the same time the flow of water into receiver **14** through conduit **26** is increased so that the flow through conduit **26** exceeds the flow through conduit **27** by the amount which is required to flow upwards in column **13** past valve **34**.

The flow of pulp leaving the column **13** is adjusted by regulating the speed of rotation of plug **34** and the clearance between this plug and the valve-seat **32**. The rate of filling and emptying of the vessel **5** is adjusted so that the level of washed cooked wood chips in the bin **12** does not fall below the level of the inlet **33** of the overflow conduit **36**.

The rate of upflow of water is adjusted so that the bleached wood chips entering receiver **14** are substantially free of soluble products of the bleaching reactions and the flow of calcium hypochlorite solution through conduit **29** into column **13** is adjusted so that the brightness of the pulp leaving through conduit **27** is at the required value. By regulation of all the variables the system can be so controlled that the rate of treatment of cooked wood chips is such that the content of active bleaching reagent in the effluent aqueous solution leaving the bleaching tower **13** is substantially zero.

It will be clear that while only one receiving pressure vessel **5** has been shown in FIGURE 1, substantially continuous discharge from the digester **1** will be obtained if a plurality of such vessels be employed and further that economies may be effected by using the fluid effluent through conduit **15** to prefill and pressurize a second or other vessel. Alternatively a "star-feeder" type of release mechanism may be used providing that the cooked wood chips must not be substantially defibred during the discharge process.

It is desirable that the chip size be carefully controlled prior to cooking. In some cases it may be necessary to screen the chips after cooking and this may be carried out with a submerged screen and/or oversize particles may be crushed gently to open the chip with substantially no separation of fibres from the chip. Very small multi-

fibred particles or fibre bundles can be treated successfully providing they settle in water at suitable a rate, for example at not less than about 2 cms./second. The size of such particles varies from one wood to another depending on the original wood density and with hardwoods of the eucalyptus species consist of at least 100 fibres per particle and generally of about 200 fibres per particle. Control of particle size is not critical and by regulating the mechanical handling of the particles the size thereof can be varied over a wide range and still achieve the results claimed.

I claim:

1. A method of bleaching wood chips which have been subjected to a chemical cooking treatment at superatmospheric pressure and elevated temperature in a first pressure vessel, which comprises pre-filling a second pressure vessel with fluid under superatmospheric pressure, transferring the said chips while under superatmospheric pressure from the first pressure vessel to said second pressure vessel, while displacing said fluid from said second pressure vessel as the wood chips are transferred thereto from the first pressure vessel; reducing the pressure in the second pressure vessel to atmospheric pressure, transferring the chips by gravity from the second pressure vessel to the upper end of a bleaching vessel, causing the chips to flow downwardly in the bleaching vessel, and causing bleaching solution to flow upwardly in the bleaching vessel countercurrent to the downflow of chips, the chips being maintained in substantially undefibered form throughout the said operations.

2. A method of bleaching wood chips according to claim 1 wherein the packing density of the wood chips in the bleaching vessel is between 4.5 and 12.0 lbs. oven-dried fibre per cubic foot.

3. A method of bleaching wood chips according to claim 1 wherein the wood chips in the bleaching vessel have a settling rate in water of at least 2 cms. per second.

4. A method of bleaching wood chips according to claim 1 wherein the wood chips in the bleaching vessel contain on the average at least 100 fibres per chip.

5. A method of bleaching wood chips according to claim 1 wherein water or aqueous washing solution is flowed upwardly in the lower part of the bleaching vessel countercurrent to the downflow of bleached chips.

6. A method of bleaching wood chips according to claim 1 which comprises transferring the bleached chips by gravity from the lower end of the bleaching vessel into a receiver, agitating the chips in the receiver to defibre said chips, and withdrawing bleached pulp from the receiver.

7. A method of bleaching wood chips according to claim 6 wherein water or aqueous solution is admitted to the receiver and part of said water or aqueous solution is withdrawn with the pulp and the remainder is caused to pass upwardly in the bleaching vessel countercurrent to the downflowing wood chips therein.

8. A method of bleaching wood chips as defined in claim 1, according to which the mass of chips is transferred from said second pressure vessel to said bleaching vessel while substantially preventing disintegration of the wood chips into individual fibres, and in which the wood chips are caused to flow through the bleaching vessel while being maintained in substantially undefibered form and under atmospheric pressure during their passage through the bleaching vessel.

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