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(71) Applicant: **UPM-Kymmene Corporation**
00100 Helsinki (FI)

(72) Inventors:
- **Tienvieri, Taisto**
  01600 Vantaa (FI)
- **Latomaa, Ari**
  21250 Masku (FI)
- **Suojanen, Vesa**
  26100 Rauma (FI)

(74) Representative: **Tampereen Patenttitoimisto Oy**
Visiokatu 1
33720 Tampere (FI)

(54) METHOD FOR PRODUCING PULP

(57) The present application provides a method for producing chemithermomechanical pulp from wood chips, such as softwood chips, the method comprising feeding the chips into a pressurized first preheater, preheating the chips to produce softened chips, discharging the softened chips from the first preheater through a first feeding device arranged to maintain the overpressure, feeding the softened chips to a pressurized second preheater, treating the chips with steam and alkaline chemicals to produce impregnated chips, discharging the impregnated chips from the second preheater through a second feeding device arranged to maintain the overpressure, feeding the impregnated chips to a refiner, and refining the impregnated chips to produce chemithermomechanical pulp. The present application also provides a device for carrying out said method, a wood pulp product obtained with said method and paper product containing said wood pulp product.

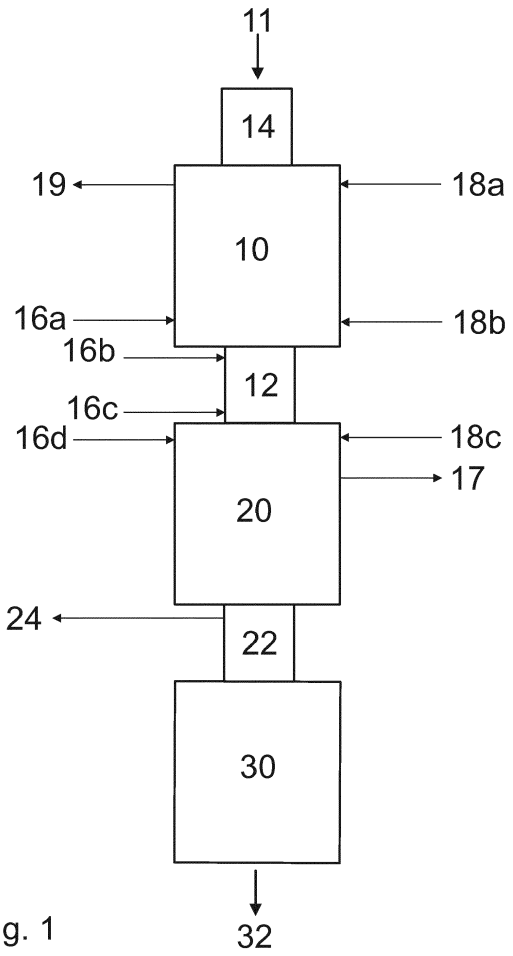

Fig. 1

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Description

Field of the application

[0001] The present application relates to a process for producing chemithermomechanical pulp. More particularly, the chemithermomechanical pulp is produced from wood chips, especially softwood chips.

Background

[0002] Thermomechanical pulp is pulp produced by processing wood chips using heat. Chemical pulp is produced by combining wood chips and chemicals in large vessels known as digesters where heat and the chemicals break down the lignin, which binds the cellulose fibers together, without seriously degrading the cellulose fibers. Chemical pulp is used for materials that need to be stronger or combined with mechanical pulps to give product different characteristics.

[0003] Pulps made using both these processes as a hybrid process are known as chemithermomechanical pulps (CTMP). When preparing chemithermomechanical pulp the wood chips are generally pretreated with chemicals, such as sodium carbonate, sodium hydroxide, sodium sulfite, and other chemicals prior to refining with equipment similar to a mechanical mill. The conditions of the chemical treatment are usually much less vigorous (lower temperature, shorter time, less extreme pH) than in a chemical pulping process since the goal is to make the fibers easier to refine, not to remove lignin as in a fully chemical process. Generally such system setups are large, complicated and very expensive.

[0004] In existing CTMP processes chips are preheated in an atmospheric bin and discharged via a chip pressing device to an impregnator where the pressed chips absorb the chemicals from the solution added in the impregnator. Then the chips are drained and fed to a pressurized preheater before refining. This process configuration decreases fiber length to a level below 1.6 mm.

[0005] In many cases it is desired to obtain pulp having high fiber content and length, especially when softwood is used as the starting material. Such pulp may be used for example as reinforcement material for replacing cellulose fibers in paper, such as magazine paper.

Summary

[0006] One embodiment provides a method for producing chemithermomechanical pulp from wood chips, the method comprising

- feeding the chips into a pressurized first preheater, which is directly connected to a second pressurized preheater via a first feeding device,
- preheating the chips to produce softened chips,
- discharging the softened chips from the first preheater through the first feeding device arranged to maintain the overpressure,
- feeding the softened chips to the pressurized second preheater,
- treating the chips with steam and alkaline chemicals to produce impregnated chips,
- discharging the impregnated chips from the second preheater through a second feeding device arranged to maintain the overpressure, and
- feeding the impregnated chips to a refiner, and
- refining the impregnated chips to produce chemithermomechanical pulp.

[0007] One embodiment provides a method for producing a paper product, the method comprising

- producing chemithermomechanical pulp with the method described herein,
- preparing a furnish by adding said pulp in an amount in the range of 6-20% (w/w) of fibers in the total furnish, and
- forming the furnish into a paper product.

[0008] One embodiment provides a device for producing chemithermomechanical pulp, said device comprising

- a first pressurized preheater,
- a second pressurized preheater,
- the pressurized first preheater being directly connected to the second pressurized preheater via a first feeding device,
- the first feeding device being arranged to maintain the overpressure while feeding wood chips from the first pressurized preheater to the second pressurized preheater,
- the second pressurized preheater being arranged to treat the chips with steam and alkaline chemicals to produce

impregnated chips,
- a refiner, and
- a second feeding device arranged to maintain the overpressure for feeding the impregnated wood chips from the second pressurized preheater to the refiner. The device or the device arrangement preferably does not contain an integrator or extruder typically used in the impregnation of the chips, but instead there are two separate interconnected pressurized preheaters.

[0009] One embodiment provides a wood pulp product, such as a softwood pulp product or a hardwood pulp product.

[0010] One embodiment provides a paper product containing said wood pulp product.

[0011] One embodiment provides a use of said method for producing a chemithermomechanical wood pulp product, such as a softwood pulp product. One embodiment provides said use for producing a paper product containing the wood pulp product.

[0012] The main embodiments are characterized in the independent claims. Various embodiments are disclosed in the dependent claims. The features recited in dependent claims and in the description are mutually freely combinable unless otherwise explicitly stated.

[0013] The process described herein provides an effect of maintaining high fiber length and providing high overall quality of the fibers during the process. The structure of the wood chips is not disrupted in the first pretreatment, which further enhances the quality of the final product. Also the chemical impregnation is improved when only pressure and temperature is used to facilitate the chemical penetration and diffusion into the chips.

[0014] The devices used in the system setup have low investment costs and may be applied to existing TMP-processes easily and with low expenses to modify them to reinforcement CTMP process

[0015] The product may be used for example in the lightweight coated (LWC) paper production where it will replace a proportion of chemical pulp in the furnish while maintaining the paper properties at the same level as when mechanical pulp is used. Also when producing market pulp it can be used in fine paper grades.

[0016] The process described herein saves energy and it provides a high freeness level of pulp. The process also saves kraft pulp demand in a wood-containing paper.

Brief description of the figures

[0017]

Figure 1 shows a schematic drawing of an exemplary device arrangement

Figure 2 shows an exemplary device arrangement

Detailed description

[0018] One embodiment provides a method for producing or manufacturing chemithermomechanical pulp from softwood chips. The softwood may be any suitable softwood, such as spruce, pine or cedar, or a mixture thereof, for example a mixture of spruce and pine. In one embodiment said softwood comprises spruce. In one embodiment said softwood is spruce.

[0019] One embodiment provides a method for producing or manufacturing chemithermomechanical pulp from hardwood chips. The hardwood may be any suitable hardwood, such as aspen, birch, eucalyptus, oak, beech, or a mixture thereof. In one embodiment said hardwood comprises aspen. In one embodiment said hardwood is aspen.

[0020] The method generally comprises first providing the chips, wherein the chips may be pretreated, for example washed. The washing may be any suitable washing process, and the excess water is usually removed from the chips. The washed and dewatered chips may have a moisture content for example in the range of 45-55% (w/w).

[0021] Figure 1 shows an example of the device arrangement which may be used in the method. Figure 1 includes several embodiments which may be alternative or combined.

[0022] One embodiment provides a device, a device arrangement or a system setup for producing said chemithermomechanical pulp, preferably with the method described herein, said device, device arrangement or system setup comprising

- a first pressurized preheater 10,
- a second pressurized preheater 20,
- a first feeding device 12 arranged to maintain the overpressure for feeding wood chips from the first pressurized preheater 10 to the second pressurized preheater 20,
- the second pressurized preheater 20 arranged to treat the chips with steam and alkaline chemicals to produce

impregnated chips,

- a refiner 30, and
- a second feeding device 22 arranged to maintain the overpressure for feeding the impregnated wood chips from the second pressurized preheater 20 to the refiner 30. The device or the device arrangement preferably does not contain an integrator or extruder typically used in the impregnation of the chips, but instead there are two separate interconnected pressurized preheaters. In one example the first pressurized preheater 10 is directly connected to the second pressurized preheater 20 via the first feeding device 12, *i.e.* there are no other devices between. In one example the device arrangement consists of said devices. The terms "device", "device arrangement" and "system setup" may be used interchangeably to refer to the devices or apparatuses required to carry out the method.

[0023] The method may comprise providing said device, device arrangement or system setup. In the method the chips 11 are fed into a pressurized first preheater 10. In one embodiment the chips are fed into the pressurized first preheater 10 through a preliminary feeding device 14 arranged to maintain the overpressure in the pressurized first preheater 10. This feeding device 14 may be for example a pocket feeder or a plug screw.

[0024] The first preheater 10 may be arranged to heat the chips at elevated pressure. In one example the first preheater 10 is arranged to convey the chips. In one example the first preheater 10 is also arranged to treat the chips with chemicals. The first preheater 10 may be a regular reactor type of preheater, or it may be a conveyor type of preheater. The first preheater 10 is a closed container and it has an inlet and an outlet for the chips. In case of a conveyer it is located inside a casing, such as an elongated container, and has a first end and a second end. The inlet may be at the first end and the outlet may be at the second end. The first preheater has means for controlling the temperature and the pressure, including means for monitoring, adjusting and/or maintaining the temperature and the pressure. For example the heating may be implemented with a heating means inside the preheater or outside the preheater, such as a jacket heating. The pressure may be applied by using a pump. In one embodiment the first preheater is a screw conveyor. Using a conveyor type of first preheater provides an effect of saving space. Further, a conveyor type of first preheater, such as the screw conveyor, does not mechanically harm the wood chips and the fiber length remains long and the color of the chips does not change, for example it does not get darker. Therefore the structure of the chips is maintained in the first preheating step. Preferably the chips are not treated mechanically in the first preheater.

[0025] The first preheater 10 is pressurized, which means that it is capable of maintaining pressure, such as overpressure or underpressure. The first pressurized preheater may be also called as pressurizable first preheater. The first preheater is arranged to be pressurized, for example by using an external pressure source, such as a pump connected to the first preheater. In one example the first preheater 10 is arranged to be overpressurized. The method may comprise pressurizing the first preheater 10. The first preheater may be pressurized after or before the chips are fed into it. In a continuous process the first preheater is usually pressurized before the chips are fed into it.

[0026] In the first preheater 10 the chips are preheated to produce softened chips. In one embodiment the temperature in the first preheater is in the range of 110-150°C. In one embodiment the temperature in the first preheater is in the range of 120-130°C. The pressure in the first preheating step is kept moderate, generally below 150 kPa. In one embodiment the pressure in the first preheater is in the range of 50-150 kPa. In one embodiment the pressure in the first preheater is in the range of 100-150 kPa. The pressure in the first preheater 10 is lower than the pressure which will be used in the second preheater 20. The lower pressure helps maintaining the structure of the chips, and also controlling the reaction with any possible chemicals present already in the first preheater. Therefore, the reaction of the chemicals with the chips preferably does not start in the first preheater. However, in one example the chips may be partly impregnated with said chemicals already in the first preheater. In one example the chips are not impregnated in the first preheater.

[0027] The first preheating step in the first preheater may generally take about 2 minutes. In one example the retention time in the first preheater is in the range of 0.5-4 minutes, such as in the range of 1-4 minutes.

[0028] Next the softened chips are discharged from the first preheater 10 through a feeding device 12 connected to the first preheater, said feeding device being arranged to maintain the overpressure while feeding the chips at a controlled or desired rate. Therefore the method comprises discharging the softened chips from the first preheater 10 through the first feeding device 12 and feeding the softened chips to the pressurized second preheater 20 while maintaining the overpressure. The overpressure is maintained in the feeding, *i.e.* in the feeding device during the feeding. Such a pressure-maintaining feeding device may be used in a continuous process as there is no loss of pressure during the feeding event, or the pressure loss is small, such as less than 50%, or less than 30%, or less than 20%, or less than 10%, or less than 5%, or less than 2%, or less than 1 %. The loss of pressure from between two devices connected to the feeding device 12, such as the two separate preheaters 10, 20, is reduced to a minimum. Such a feeding device may also be called a high-pressure feeder (HPF). In one example the high-pressure feeder is a rotary valve-type device, which transfers material at one pressure to a second, higher pressure. The transfer may be performed with the aid of circulation pumps. The high-pressure feeder may act as a pressure isolation valve by preventing the high-pressure material from escaping to the low-pressure side or to the surrounding environment. The feeding device has an inlet and an outlet for the chips. The inlet may be arranged to be connected to the outlet of the first preheater. The outlet may be

arranged to be connected to the inlet of the second preheater.

[0029] In general, a feeding device may contain means for controlling the feeding rate of the material, such as a motor for moving a movable member inside the feeding device, and optionally a control unit for controlling the speed of the motor which is arranged to move the movable member inside the feeding device, so that a desired feed or flow rate may be achieved and/or maintained.

[0030] The feeding device 12 may be for example a pocket feeder, which is also called as rotary feeder, rotary valve feeder or rotary airlock feeder. The feeding device 12 may also be a plug screw. The word "rotary" refers to the fact that during operation of a rotary airlock, vanes in the device turn or rotate. As they turn, the pockets, which are formed between the vanes, become rotating pockets. The material being handled enters the pockets through an inlet port, travels around in a rotating motion, and exits through an outlet port. As the vanes and pockets continue to turn, material continues to be moved from the inlet port to the outlet port, in a rotating motion. In one embodiment the feeding device is a pocket feeder. The pocket feeder/rotary feeder is gentler compared to a screw type of feeder and it does not mechanically harm the chips so it provides an effect of maintaining the chip structure. The pocket feeder is also a less expensive device. Such feeding devices used in the process described herein enable a continuous process thus saving energy and time, as the overpressures and temperatures in the devices can be maintained and the product may enter a subsequent step without any delays or a need to produce an overpressure starting from atmospheric pressure or to start heating a product from an ambient temperature.

[0031] In one embodiment the feeding device is a plug screw. A plug screw feeder is a compression device which is based on the principle of a screw rotating inside a cylindrical or conical cage, where the volume available at the inlet of the screw is greater than the volume available at the discharge. The cage may be equipped with holes, usually conically drilled, or slots or bars arranged in such a fashion as to provide drainage of liquor squeezed from material being compressed. The cage is usually equipped with anti-rotation devices such as bars, pins or slots to prevent the compressed material from turning with the screw. Plug screw enables feeding compressible bulk solids into a vessel at elevated pressure and/or temperature. The feed material is compressed within the screw casing, forming a low-permeability plug which itself acts as the sealing element.

[0032] The feeding device 12 is connected to a pressurized second preheater 20. From the feeding device 12 the softened chips are fed to the pressurized second preheater 20. The second preheater 20 is a closed container and it may comprise a reactor or a vessel having an inlet and an outlet for the chips.

[0033] The second preheater 20 is pressurized, which means that it is capable of maintaining pressure, such as overpressure or underpressure. The second pressurized preheater 20 may be also called as pressurizable second preheater. The second preheater is arranged to be pressurized, for example by using an external pressure source, such as a pump connected to the second preheater. In one example the second preheater 20 is arranged to be overpressurized. The method may comprise pressurizing the second preheater 20. The second preheater is pressurized before the softened chips are fed into it.

[0034] The second preheater has means for controlling the temperature and the pressure, including means for monitoring, adjusting and/or maintaining the temperature and the pressure. For example the heating may be implemented with a heating means inside the preheater or outside the preheater, such as a jacket heating. The pressure may be applied by using a pump. In the second preheater the chips are treated with steam and alkaline chemicals to produce impregnated chips. The reaction with the chemicals and the chips will occur mainly or preferably only in the second preheater as the pressure and optionally also the temperature is higher in the second preheater when compared to the first preheater. The steam may be applied to the second preheater 20 at a desired location 18c, such as at the upper part of the second preheater. The steam may also be applied to the first preheater 10 at a desired location, for example at the upper part 18a or at the lower part 18b. There are generally means for applying steam to a preheater, the means comprising for example at least one valve, tube(s) for leading steam from a steam source, and means for controlling the application of steam. The steam may have a temperature in the range of 125-150°C.

[0035] The alkaline chemicals may be any suitable alkaline chemicals used in a pulping process. Examples of alkaline chemicals include sodium hydroxide, white liquor and black liquor. White liquor is a strongly alkaline solution mainly of sodium hydroxide and sodium sulfide, containing also minor amounts of sodium sulfate, sodium carbonate and sodium thiosulfate. It may be used in a process in which lignin and hemicellulose are separated from cellulose fiber for the production of pulp. The white liquor breaks the bonds between lignin and cellulose. It is called white liquor due to its white opaque color. Black liquor is the waste product from the kraft process when digesting pulpwood into paper pulp removing lignin, hemicelluloses and other extractives from the wood to free the cellulose fibers. The equivalent material in the sulfite process is usually called brown liquor, but the terms red liquor, thick liquor and sulfite liquor are also used.

[0036] In one example said device, device arrangement or system setup comprises a first pressurized screw conveyor preheater 10, a second pressurized preheater 20, a first feeding device 12 arranged to maintain the overpressure for feeding wood chips from the first pressurized preheater 10 to the second pressurized preheater 20, the second pressurized preheater 20 arranged to treat the chips with steam and alkaline chemicals to produce impregnated chips, a refiner 30, and a second feeding device 22 arranged to maintain the overpressure for feeding the impregnated wood chips from

the second pressurized preheater 20 to the refiner 30. In one example said device, device arrangement or system setup comprises a first pressurized screw conveyor preheater 10, a second pressurized preheater 20, a pocket feeder 12 arranged to maintain the overpressure for feeding wood chips from the first pressurized preheater 10 to the second pressurized preheater 20, the second pressurized preheater 20 arranged to treat the chips with steam and alkaline chemicals to produce impregnated chips, a refiner 30, and a second feeding device 22 arranged to maintain the overpressure for feeding the impregnated wood chips from the second pressurized preheater 20 to the refiner 30.

[0037] In one example said device, device arrangement or system setup comprises a preliminary feeding device 14 arranged to maintain the overpressure in the pressurized first preheater 10, a first pressurized screw conveyor preheater 10, a second pressurized preheater 20, a first feeding device 12 arranged to maintain the overpressure for feeding wood chips from the first pressurized preheater 10 to the second pressurized preheater 20, the second pressurized preheater 20 arranged to treat the chips with steam and alkaline chemicals to produce impregnated chips, a refiner 30, and a second feeding device 22 arranged to maintain the overpressure for feeding the impregnated wood chips from the second pressurized preheater 20 to the refiner. In one example said device, device arrangement or system setup comprises a preliminary feeding device 14 arranged to maintain the overpressure in the pressurized first preheater 10, a first pressurized screw conveyor preheater 10, a second pressurized preheater 20, a pocket feeder 12 arranged to maintain the overpressure for feeding wood chips from the first pressurized preheater 10 to the second pressurized preheater 20, the second pressurized preheater 20 arranged to treat the chips with steam and alkaline chemicals to produce impregnated chips, a refiner 30, and a second feeding device 22 arranged to maintain the overpressure for feeding the impregnated wood chips from the second pressurized preheater 20 to the refiner 30.

[0038] The chemicals may be provided to a desired location or locations of the process by using means for adding the chemicals, for example a valve, which may be connected to a chemical supply, such as a container, or to the second preheater when the chemicals are recycled. There may also be means for controlling the temperature of the chemical(s), including means for monitoring, adjusting and/or maintaining the temperature. For example the heating may be implemented with a heating means inside a chemical container or outside a container, such as a jacket heating.

[0039] In one embodiment the chemicals are added to the second preheater, for example after the feeding device to a free fall. The chemicals may be added as an aqueous solution. In one embodiment the chemicals are added to the feeding device i.e. before the feeding device after the first preheater 16b. In one embodiment the chemicals are added already to the first preheater 16a, for example to the end of the conveyor type of first preheater. The chemicals may be added to the feeding device at different locations, for example near the inlet 16b or near the outlet 16c, i.e. before or after the movable member inside the feeder, such as a rotor or the like. In one example the chemicals are added in a free fall to the feeder, at the upper part 16b or at the lower part 16c, wherein in the latter case the chemicals may fall directly to the second preheater 20. In one embodiment the chemicals are added to more than one location in the process, for example to the first preheater 16a and to the feeding device 16b, 16c, or to the feeding device 16b, 16c and to the second preheater 16d, or to the first preheater 16a, to the feeding device 16b, 16c, and to the second preheater 16d. In one example the chemicals are added to several points in the first preheater 16a, for example to two, three or four points. In one example the chemicals are added also to the refiner eye. The chemicals may be preheated before the addition of any of said locations. In one embodiment the chemical solution has a temperature of less than about 100°C.

[0040] In one embodiment the concentration of the alkaline chemicals in the pulp, preferably in the second preheater, is in the range of 4-10% (w/w), preferably in the range of 5-8% (w/w), for example about 7%. This is higher than generally used chemical concentrations, which may be in the range of 2-3%. The use of higher concentration enhances the impregnation of the chemicals.

[0041] In one embodiment the temperature in the second preheater 20 is in the range of 120-135°C. The pressure in the second preheater is higher than in the first preheater. The higher pressure will facilitate the reaction of the chemicals with the material, and the reaction with the chemicals may start only in the second preheater. In one embodiment the pressure in the second preheater is in the range of 100-200 kPa. In one embodiment the pressure in the second preheater is in the range of 150-200 kPa.

[0042] In one embodiment the retention time in the second preheater 20 is in the range of 2-5 minutes. It was surprisingly found out that even a very short retention time of about 2 minutes was enough to treat the chips in the second preheater. This provides an effect of maintaining the high fiber length and the overall quality of the material. The desired parts of the lignin in the chips have already reacted during said short retention time, and the yield is high, for example in the range of 92-95%. Generally, the longer the retention time the lower the yield. Further, the short retention time further provides less load into the waste water as the content of lignin in the waste water is low.

[0043] In one embodiment the method comprises releasing pressure 19 from the first preheater 10 or releasing pressure 17 from the second preheater 20 to remove air and to facilitate the penetration of chemicals into the chips. In one embodiment the system setup comprises means for releasing pressure 19 from the first preheater 10 to remove air and to facilitate the penetration of chemicals into the chips. In one embodiment the system setup comprises means for releasing pressure 17 from the second preheater 20 to remove air and to facilitate the penetration of chemicals into the chips. Such means may comprise at least one valve and means for controlling the pressure, such as means for measuring

or detecting the pressure and means for adjusting the pressure by releasing the pressure through the valve(s) according to the measured or detected pressure information. The removal of air may be carried out at intervals.

[0044] Next the impregnated chips are discharged from the second preheater 20 through another feeding device 22 connected to the second preheater 20, which feeding device is arranged to maintain the overpressure. The feeding device 22 is connected to a refiner 30. The feeding device may be for example a pocket feeder or a plug screw. In one embodiment said feeding device is screw feeder. In one embodiment said feeding device is a pocket feeder. In one embodiment said feeding device is a plug screw. The feeding device has an inlet and an outlet for the chips. The inlet of the feeding device 22 may be arranged to be connected to the outlet of the second preheater 20. The outlet of the feeding device 22 may be arranged to be connected to the inlet of the refiner 30.

[0045] The chemicals may be recycled or recirculated. In one embodiment the method further comprises separating unimpregnated or free chemicals 24, such as spent liquor, from the second preheater 20 and feeding the separated chemicals to a previous process step 16a, 16b, 16c, 16d, for example to the first preheater 10, to the first feeding device 12 or to the upper part of the second preheater 20. In one embodiment the device is arranged to separate free chemicals 24, such as spent liquor from the second preheater 20, for example by pressing, or in any case before the refiner 30. The separated chemicals 24 may be further arranged to be fed to a previous process step, as described above.

[0046] The impregnated chips are fed to the refiner 30, and refined to produce chemithermomechanical pulp 32. The refining may be carried out using any suitable devices and process parameters.

[0047] One embodiment provides a method for producing or manufacturing paper or a paper product comprising producing chemithermomechanical pulp with the method described herein, or providing chemithermomechanical pulp produced with the method described herein, preparing a furnish by adding said pulp in an amount in the range of 6-20% (w/w) of fibers, such as fresh fibers, in the total furnish, and forming the furnish into a paper web, or more particularly into a paper product, such as a sheet of paper. To form the furnish also other pulp is provided, such as chemical pulp, for example kraft pulp, mechanical pulp, or thermomechanical pulp, or combinations thereof, and the pulps are combined and mixed. The other pulp may comprise fresh fibers, which refers to virgin fibers, generally fiber obtained from wood, *i.e.* non-recycled fibers. Further recycled fibers may also be provided. The pulp obtained by the method of the embodiments may be called as a first pulp or a first source of pulp and the other pulp may be called as a second pulp or a second source of pulp. In one example the second pulp comprises chemical pulp. In one example the second pulp comprises mechanical pulp. In one example the second pulp comprises chemical pulp and mechanical pulp. The paper may be produced from the combined furnish by using any suitable method for manufacturing paper.

[0048] The term "furnish" refers to a predetermined mixture of fibrous and optionally non-fibrous materials like fillers, sizing, and dyes in a water suspension from which paper is made. Various chemicals may be added depending on the particular specifications of the paper to be made. For example, fillers such as clay and calcium carbonate (chalk) may be added for opacity, brightness and smoothness; dyes may be added for shade control; optical brighteners may be added for whiteness and sizing agents may be added to control liquid penetration.

[0049] Figure 2 shows an exemplary setup of the device arrangement. The chips 11 are fed to a pocket feeder 14, which is connected to a screw conveyor 10 having heating and a screw for dosing chemicals. Steam 18 may be provided to several locations of the screw conveyor 10. The screw conveyor 10 is connected to a pocket feeder 12, which is connected to a preheater 20. Chemicals are fed through a line 16 to the pocket feeder 12, or alternatively to a location at the screw conveyor 10. A screw-type discharger 26 is connected to the preheater 20 and the separated chemicals 24 may be discharged from the bottom of the discharger 26. A feeding device 22 is connected to the discharger for feeding the impregnated chips to a refiner 30. The refined pulp may be further fed via a plug screw 34 to a pulper 40.

[0050] The obtained pulp has distinguishable features, as the fiber length is extraordinarily long while the freeness of the pulp, on the other hand, is low. The fiber length may be measured for example by using FiberLab (TAPPI T271-07) or with FS5 (ISO 16065-N). In general, the mean average fiber length is more than 1.8 mm, such as in the range of 1.8-2.0 mm. In one embodiment the mean average fiber length is in the range of 1.8-1.9 mm. The fiber length was measured using FiberLab fiber analyzer according to TAPPI T271 om-07. This is an automated method by which the numerical and weighted average fiber lengths and fiber length distributions of pulp and paper can be measured using light polarizing optics in the range of 0.1 mm to 7.2 mm.

[0051] In one embodiment the freeness is in the range of 100-300 measured as Canadian Standard Freeness (CSF). In one embodiment the freeness is in the range of 120-300 CSF. In one embodiment the freeness is in the range of 120-280 CSF. In one embodiment the freeness is in the range of 150-250 CSF. In one embodiment the freeness is in the range of 200-300 CSF. In one embodiment the freeness is in the range of 210-280 CSF. In one embodiment the mean average fiber length is in the range of 1.8-2.0 mm and the freeness in the range of 100-300 CSF.

[0052] CSF has been developed as a measure of groundwood quality. Generally, CSF decreases with refining, and it is sensitive to fines and water quality. Usually there is a correlation with the freeness and the length of the fibers: the lower the freeness, also the lower the fiber length. In the present method a refined pulp with high fiber length is obtained, which does not require further refining. It should be noted that even a difference of 0.05 mm in the fiber length is significant. The freeness was determined according to ISO 5267-2.

[0053] Another property of the final product is tensile index which indicates the binding ability of the fiber. High tensile index provides strength to the paper and therefore less cellulose pulp is required for making the paper product. The tensile index of the obtained pulp may be in the range of 35-80 Nm/g, for example in the range of 35-50 Nm/g. The tensile index was determined according to ISO 1924-3.

[0054] Tear index is the force required to tear a sheet of paper under standard conditions. The tear index of the obtained pulp may be in the range of 7.5-9.5 mNm^2/g. In one example the tear index is in the range of 8-9 mNm^2/g. In one example the tear index is in the range of 8-8.5 mNm^2/g. The tear index was determined according to ISO 1974.

[0055] The internal bond strength plays an important role in paper since poor bonding strength results in delamination and splitting in printing and coating operations. This property depends on the number of bonds, the average area per bond and their specific strength. It is also affected both by pulp properties and the treatments employed during the papermaking process. The bonding strength of the obtained pulp may be in the range of 100-200 J/m^2. In one example the bonding strength is in the range of 100-150 J/m^2. In one example the bonding strength is in the range of 100-135 J/m^2. The bonding strength was determined according to TAPPI 569-07

[0056] One embodiment provides a chemithermomechanical wood pulp product, such as a softwood pulp product, obtainable by the method described herein. In one embodiment the chemithermomechanical wood pulp product, such as a softwood pulp product, has a mean average fiber length in the range of 1.8-2.0 mm, and freeness in the range of 100-300 CSF. In one embodiment the chemithermomechanical wood pulp product, such as a softwood pulp product, has a mean average fiber length in the range of 1.8-2.0 mm, and freeness in the range of 200-300 CSF.

[0057] One embodiment provides a paper product containing the chemithermomechanical wood pulp product, such as a softwood pulp product, described herein in an amount in the range of 6-20% (w/w) of fresh fibers. The paper product may be for example a magazine paper, a label release base paper or a fine paper.

Examples

Summary

[0058] According to test runs the proportion of cellulose in paper could be substantially decreased by using bleached chemithermomechanical (BCTMP) spruce pulp having a high fiber length prepared by using the method described herein. The runnability of the paper remained good at the paper machine, at post processing and at the printing machine. Two test runs were conducted wherein the proportion of the cellulose was decreased by 30-49 kg/t_{paper}, depending on the type of the paper. The print quality of the printed paper had the same or even better uniformity than the normal paper. The use of BCTMP may decrease the strength in the Z direction slightly, which may lead to a slight increase in the starch usage with certain paper types.

[0059] The bleached chemithermomechanical pulp was prepared at TMP mill with one refiner line by dosing sodium sulfite to the wood chips before a preheater. Therefore the reaction time with the chemical was less than two minutes. Before a second stage HC refiner peroxide and lye were dosed into the pulp, and the pulp was peroxide bleached and refined. The prepared unwashed BCTMP had mean CSF level in the range of 200-280 ml and fiber length in the range of 1.82-1.86. Specific energy consumption was in the range of 1.60-1.64 MWh/adt. The pulp obtained tensile strength in the range of 34.5-38.9 Nm/g. The obtained brightness level in the refining bleaching was 68%.

[0060] At paper machine BCTMP was dosed 56-114 kg/tpaper depending of paper grade and paper machine. This replaced chemical pulp of 30-49 kg/tpaper and mechanical pulp 26-65 kg/tpaper. In several printing trials in a pilot printing and in a commercial printing house the runnability of the trial paper was at same levels as with reference paper and the print quality with trial paper was the same or even better than with normal paper.

Preparation of BCTMP

[0061] Several test runs were made. In all the test runs the initial process parameters were the same. The production level was 212 adt/d.

[0062] Sodium sulfite with pH about 10 and a concentration of 22% was used for preparing the BCTMP. The chemical was dosed from containers together with diluting water, and the dosing concentration was about 7%. The chemical was dosed to the wood chips before preheater of refiner line. The pressure in the preheater was maintained at about 110 kPa, and the temperature was over 120°C. The aim was to maximize the delay in the preheater by keeping the surface at 90%. The estimated delay in the preheater was less than 2 minutes.

[0063] In the refiner the specific energy consumption was 0.65-0.67 MWh/t_{90} and the amount of the dilution water was decreased to keep the refining consistency at a normal level. The CSF of the pulp was 680-710 ml and the fiber length was 1.87-2.09 mm. A small amount of gelating agent was dosed in the pulper.

[0064] Before second refining stage peroxide bleaching chemicals were dosed to the pulp. Also LC-refining with low energy consumption was used in the process. There was no washing stage in the process, but just a normal disc filter

was used.

[0065] BCTMP pulp qualities of these trials are compared in Table 1. CTMP trial pulps A-C are pulps obtained with the present method. BCTMP pulps are reference pulps obtained with traditional methods.

Table 1

Measurement	**Unit**	**CTMP trial pulp A**	**CTMP trial pulp B**	**CTMP trial pulp C**	BCTMP mill A	BCTMP mill B Pulp 1	BCTMP mill B Pulp 2	BCTMP mill C Pulp 1	BCTMP mill C Pulp 2	BCTMP mill D	BCTMP mill E
CSF (SCAN-M 4:65)	ml	270	219	121	450	345	360	300	410	380	535
FiberLab Length weighted fiber length L(l)	mm	1.88	1.84	1.88	1.46	1.50	1.59	1.67	1.55	1.38	1.69
Somerville 0.10 mm sieves	%	0.55	0.26	0.17	0.78	0.06	0.34	0.11	0.19	0.25	0.29
Apparent bulk density	kg/m^3	377	425	473	353	372	356	439	392	347	328
Tensile index	Nm/g	35.7	38.9	46.3	22.7	24.4	24.6	42.0	35.4	23.4	21.4
Tear index	mNm^2/g	8.4	8.4	7.6	5.7	5.4	6.5	7.0	6.9	6.1	6.4
Bonding strength SB Low	J/m^2	109	131	199	77	91	85	137	94	79	88
Brightness. pulp	%	67.8	70.4	67.4	75.9	77.6	77.3	82.4	71.6	70.4	74.7
Opacity	%	87.0	86.4	86.6	84.0	83.4	83.7	87.6	83.9	84.5	80.6
Y-value (C/2°)	%	80.3	82.3	81.3	82.9	84.7	83.5	81.3	83.6	82.5	83.0
Light scattering coefficient	m^2/kg	45.6	47.1	47.8	42.8	43.0	43.3	48.0	43.2	43.1	36.2
Air permeance Bendtsen	ml/min	765	343	120	1760	1740	1660	328	1090	1946	5236
Air permeance Gurley	µm/Pas	8.7	3.9	1.4	20.0	19.7	18.8	3.7	12.4	22.1	59.4
Roughness Bendtsen 150/1	ml/min	495	249	126	748	634	849	270	484	717	1192
Roughness Bendtsen 150/5	ml/min	197	123	69	290	266	350	110	214	281	418

BCTMP in a paper machine

[0066] BCTMP was used in two paper machines. In both machines offset paper grades were produced with various paper grammages. The runnability on both paper machines was normal.

Printed paper

[0067] Produced paper was printed in two different printing houses. Compared to normal paper the print quality of the trial paper was at the same level or in some properties even slightly better. The runnability of the trial paper was excellent.

Claims

1. A method for producing chemithermomechanical pulp from wood chips, the method comprising

- feeding the chips into a pressurized first preheater, which is directly connected to a second pressurized preheater via a first feeding device,
- preheating the chips to produce softened chips,
- discharging the softened chips from the first preheater through the first feeding device arranged to maintain the overpressure,
- feeding the softened chips to the pressurized second preheater,
- treating the chips with steam and alkaline chemicals to produce impregnated chips,
- discharging the impregnated chips from the second preheater through a second feeding device arranged to maintain the overpressure, and
- feeding the impregnated chips to a refiner, and
- refining the impregnated chips to produce chemithermomechanical pulp.

2. The method of claim 1, wherein the temperature in the first preheater is in the range of 110-150°C, such as in the range of 120-130°C.

3. The method of claim 1 or 2, wherein the pressure in the first preheater is in the range of 50-150 kPa, such as in the range of 100-150 kPa.

4. The method of any of the preceding claims, wherein the temperature in the second preheater is in the range of 120-135°C.

5. The method of any of the preceding claims, wherein the pressure in the second preheater is in the range of 100-200 kPa, such as in the range of 150-200 kPa.

6. The method of any of the preceding claims, comprising adding the chemicals to the first preheater.

7. The method of any of the preceding claims, comprising adding the chemicals to the first feeding device.

8. The method of any of the preceding claims, wherein the first feeding device is a pocket feeder.

9. The method of any of the preceding claims, comprising separating free chemicals from the second preheater and feeding the separated chemicals to the first preheater.

10. The method of any of the preceding claims, comprising releasing pressure from the second preheater to remove air and to facilitate the penetration of chemicals into the chips.

11. The method of any of the preceding claims, wherein the first preheater is a screw conveyor.

12. The method of any of the preceding claims, wherein the wood comprises softwood, such as spruce.

13. The method of any of the preceding claims, wherein the retention time in the second preheater is in the range of 2-5 minutes.

14. The method of any of the preceding claims, wherein the concentration of the alkaline chemicals in the pulp is in the range of 4-10% (w/w), preferably in the range of 5-8% (w/w).

15. A method for producing a paper product, the method comprising

- producing chemithermomechanical pulp with the method of any of the claims 1-14,
- preparing a furnish by adding said pulp in an amount in the range of 6-20% (w/w) of fibers in the total furnish, and
- forming the furnish into a paper product.

16. A device for producing chemithermomechanical pulp, comprising

- a first pressurized preheater,
- a second pressurized preheater,
- the pressurized first preheater being directly connected to the second pressurized preheater via a first feeding device,
- the first feeding device being arranged to maintain the overpressure while feeding wood chips from the first pressurized preheater to the second pressurized preheater,
- the second pressurized preheater being arranged to treat the chips with steam and alkaline chemicals to produce impregnated chips,
- a refiner, and
- a second feeding device, arranged to maintain the overpressure, for feeding the impregnated wood chips from the second pressurized preheater to the refiner.

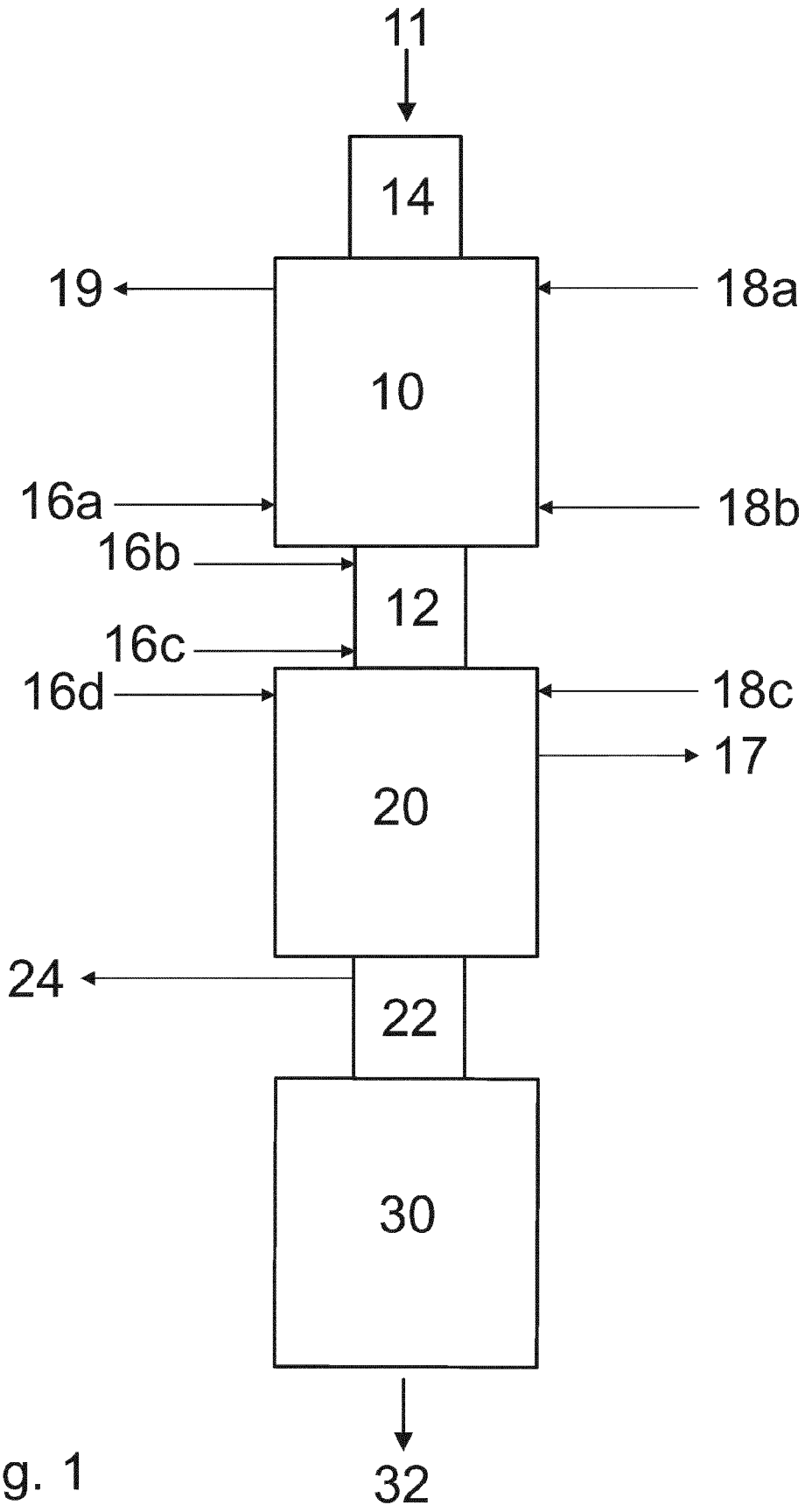

Fig. 1

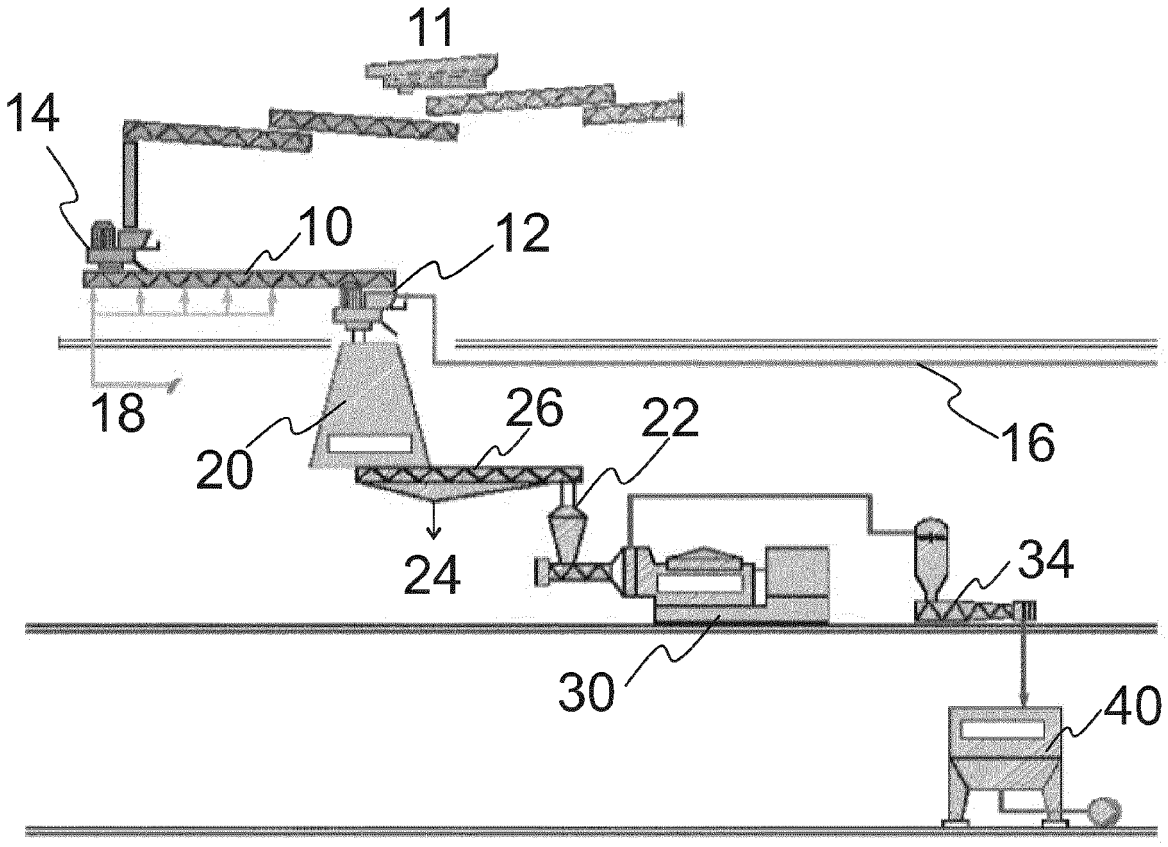

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 15 39 7535

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 February 2016	Naeslund, Per

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X : particularly relevant if taken alone
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