PROCESS FOR PRODUCING TISSUE PAPER

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ABSTRACT

The invention relates to a process for producing a tissue web, which is produced from a stock suspension including fibers. In this case, the volume and the tearing length are to be improved with the lowest possible freeness by the stock suspension containing lignocellulosic fibrous material made of wood or annual plants which has a tearing length of more than 6.5 km at 12°SR or a tearing length of more than 8.0 km at 15°SR and a lignin content of at least 15%, based on the oven-dry fibrous material, for coniferous wood in the unbleached state, or a tearing length of more than 4.5 km at 20°SR and a lignin content of at least 12%, based on the oven-dry fibrous material, for deciduous wood in the unbleached state, or a tearing length of more than 3.5 km at 20°SR and a lignin content of at least 10%, based on the oven-dry fibrous material, for annual plants in the unbleached state.
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BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention
[0003] The invention relates to a process for producing a tissue web, which is produced from a stock suspension including fibers.
[0004] The invention also relates to a process for producing a stock suspension for use in particular for the production of tissue webs.
[0005] 2. Description of the Related Art
[0006] Tissue products are currently mainly produced from fully cellulosic materials, in particular kraft pulps.
[0007] Mechanically produced fibrous materials find only limited use, since here the tendency to yellowing and the poor strength properties of the stocks prevent widespread use.
[0008] Common mixture ratios between long fiber and short fiber stocks lie in the region of 50:50.
[0009] The porosity and the permeability of the tissue paper are determined critically by the freeness of the fibers in the stock suspension from which the tissue paper is produced.
[0010] Here, a high freeness necessitates a high content of fines in the suspension, which leads to lower porosity and permeability.
[0011] Furthermore, a high freeness causes a high water retention value for the fibers of the stock suspension, which means that the tissue paper is difficult to dewater during its production.
[0012] At high machine speeds, the poor dewatering ability often results in too low a dewatering during production.
[0013] For instance, before the Yankee drying cylinder a certain dryness is needed in order to prevent lifting of the tissue paper web as a result of its contact with the hot circumferential surface of the tissue drying cylinder.
[0014] In addition, the tissue must be tear-resistant. The tearing strength is determined both by the production process and by the freeness of the fibers. In order to increase the tearing strength, the tissue paper must be consolidated during its production. In order to obtain a high tearing strength, the proportion of fines must also be high.
[0015] The requirements on the tearing strength thus contradict the requirements on the water absorption capacity, the absorbency and the dewatering ability.
[0016] What is needed in the art is the production of tissue paper with a high specific volume, as high a tearing length as possible, with the lowest possible freeness.

SUMMARY OF THE INVENTION

[0017] The present invention provides that the stock suspension contains lignocellulosic fibrous material made of wood or annual plants which has a tearing length of more than 6.0 km at 12°SR (SR being the Schopper Riegler value) or a tearing length of more than 7.5 km at 15°SR and a lignin content of at least 15%, based on the oven-dry fibrous material, for coniferous wood in the unbleached state, or a tearing length of more than 4.5 km at 20°SR and a lignin content of at least 12%, based on the oven-dry fibrous material, for deciduous wood in the unbleached state, or a tearing length of more than 3.5 km at 20°SR and a lignin content of at least 10%, based on the oven-dry fibrous material, for annual plants in the unbleached state.
[0018] The fibers already exhibit high strength values at a freeness which is far lower as compared with fibers used hitherto. The fibrous material according to the invention is already capable of forming good bonds with neighboring fibers at a lower freeness and therefore also with a lower expenditure of refining energy.
[0019] The lignin content of the unbleached fibrous material in the case of coniferous wood can advantageously include at least 15%, preferably at least 19%, in particular at least 21%, of the oven-dry fibrous material, in the case of decidual wood at least 12%, preferably at least 14%, in particular at least 16%, of the oven-dry fibrous material and, in the case of annual plants, at least 10%, preferably at least 12% and in particular at least 19%, of the oven-dry fibrous material.
[0020] The higher the lignin content of the fibrous material, the lower are the losses of woody substance during production of the fibrous material.
[0021] In this case, it is entirely possible to achieve even higher strength values. Therefore, the tearing length for coniferous wood fiber stock at 12°SR should be greater than 7 km, preferably greater than 7.5 km and in particular greater than 8 km. The tearing length for coniferous wood fiber stock at 15°SR should be greater than 9 km, preferably greater than 9.5 km and in particular greater than 10 km.
[0022] The tearing length for deciduous wood fiber stock at a lignin content of at least 12% and a freeness of 20°SR should be greater than 6 km, preferably greater than 7 km and in particular greater than 7.5 km.
[0023] The tearing length for annual plant fiber stock at 20°SR should be greater than 3.5 km, preferably greater than 4 km and in particular greater than 4.5 km.
[0024] However, the fibrous material according to the invention is not just distinguished by high tearing lengths. Instead, the strength level overall is high.
[0025] If the fibrous material according to the invention is subjected to a bleaching treatment, the fiber properties are enhanced considerably. The bleaching treatment is required for many applications with higher requirements on the whiteness. However, it is also aimed at the setting and improvement of the fiber properties. With the bleaching treatment, the tearing lengths increase.
[0026] Thus, the stock suspension should contain lignocellulosic fibrous material made of wood or annual plants which has a tearing length of more than 7.5 km at 15°SR and a lignin content of at least 13%, based on the oven-dry fibrous material, for coniferous wood in the bleached state, or a tearing length of more than 5.0 km at 20°SR and a lignin content of at least 10%, based on the oven-dry fibrous material, for deciduous wood in the bleached state, or a tearing length of more than 5.5 km at 20°SR and a lignin content of at least 10%, based on the oven-dry fibrous material, for annual plants in the bleached state.
[0027] Here, too, higher tearing lengths are advantageous. Thus, the tearing length for coniferous wood fiber stock at 15°SR should be greater than 9 km, preferably greater than 10 km.
[0028] The tearing length for deciduous wood fiber stock at 20°SR should be greater than 5.5 km and the tearing length
for annual plant fiber stock at 25°SR should be greater than 5 km, preferably greater than 5.5 km and in particular greater than 6 km.

[0029] In order to be able to make optimal use of the advantages with respect to a high specific volume and high strength at the lowest possible freeness, the stock suspension should exclusively contain lignocellulosic fibrous material according to the above description.

[0030] For many applications, however, it is sufficient if the stock suspension is only partly formed from such lignocellulosic fibrous material. In this case it is advantageous if between 20 and 80%, preferably between 30 and 50%, of the fibrous material of the stock suspension is formed from lignocellulosic fibrous material according to the above description.

[0031] Following the formation of a tissue web, this is preferably led between an upper structured and permeable belt and a lower permeable belt in a dewatering step, pressure being exerted on the upper belt, the tissue web and the lower belt along a dewatering section.

[0032] The pressure exerted on the arrangement including the upper belt, tissue web and lower belt can be effected by a gas flow and/or by a mechanical pressing force.

[0033] Preferably, during the dewatering step, a gas flows firstly through the upper belt, then the tissue web and then the lower belt. In this case, the dewatering takes place in the direction of the lower belt.

[0034] Additionally or alternatively to the through-flow of gas, it may be advantageous if, during the dewatering step, the arrangement including the upper belt, tissue web and lower belt is led at least in some sections between a press belt under tension and a smooth surface, the press belt acting on the upper belt and the lower belt being supported on the smooth surface.

[0035] Preferably, the gas flows through the arrangement including the upper belt, tissue web and lower belt, at least in some sections in the region of the dewatering section, so that the dewatering is carried out simultaneously by the pressing force of the press belt and the through-flow of the gas.

[0036] Trials have shown that the gas flow through the tissue web should amount to about 150 m³ per minute and meter length along the dewatering section.

[0037] In the interests of adequate dewatering of the tissue web, the press belt should be under a tension of at least 30 kN/m, preferably at least 60 kN/m and in particular 80 kN/m.

[0038] In order to be able to achieve good dewatering of the tissue web by way of the mechanical tension of the press belt and also on account of the gas flow through the press belt, the press belt should have an open area of more than 50% and a contact area of at least 15%.

[0039] The smooth surface is preferably formed by the circumferential surface of a roll. The gas flow can advantageously be produced via a suction zone in the roll and/or a positive pressure hood arranged above the upper belt.

[0040] During the production of the lignocellulosic fibrous material according to the invention, it is important that at least a proportion of the stock suspension is produced from wood or annual plants having a lignin content of at least 15% for coniferous wood and 12% for deciduous wood and 10% for annual plants, in each case based on the oven-dry fiber mass, by the following steps:

[0041] producing a chemical solution with more than 5% of chemicals (calculated as NaOH) for coniferous wood or with more than 3.5% of chemicals (calculated as NaOH) for deciduous wood or with more than 2.5% of chemicals (calculated as NaOH), in each case based on the oven-dry quantity of the wood used,

[0042] mixing the chemical solution with the wood or annual plants in a prescribed liquor ratio,

[0043] heating the chemical solution and the wood or annual plants to a temperature above room temperature and then either (1st alternative)

[0044] removing free-flowing chemical solution and

[0045] digesting the wood or annual plants in the vapor phase or (2nd alternative)

[0046] digesting the wood or annual plants in the presence of the chemical solution in liquid phase and

[0047] separating the free-flowing chemical solution and the wood or annual plants.

[0048] The process according to the invention is based on the fact that, in order to produce high-yield fibrous materials, higher quantities of chemicals are used than were previously usual. More than 5% of chemicals for coniferous wood is considerably above the quantities of chemicals previously usual for industrial fibrous material production, likewise more than 3.5% of chemicals for deciduous wood and 2.5% for annual plants. This high use of chemicals produces fibrous materials with good yield and excellent strength properties. Thus, for coniferous wood at freenesses of only 12°SR to 15°SR, tearing lengths of more than 8 km but also tearing lengths of more than 9 km and more than 10 km are measured. For deciduous woods at only 20°SR, values of more than 5 km but also tearing lengths of more than 6 km and more than 7 km are measured. The desired high strength level is therefore achieved.

[0049] It is to be viewed as an extraordinary advantage of the process according to the invention that the strength values are already achieved at extremely low freenesses, such as were not available hitherto for high-yield fibrous materials. Fibrous materials according to the prior art do not exhibit an acceptable strength level at freenesses of 12°SR to 15°SR for coniferous wood fibrous materials or of 20°SR for deciduous wood. Known fibrous materials at these low freenesses have until now resulted in fibers which have not demonstrated adequate strength properties for economic use of such fibers.

[0050] Suitable annual plants are in particular bamboo, hemp, rice straw, bagasse, wheat, miscanthus and the like.

[0051] On the other hand, at freenesses in the range from 12°SR to 15°SR, the fibrous materials produced by the process of the invention already have tearing lengths of more than 8 km up to 11 km and tear propagation resistances of more than 70 cN up to more than 110 cN, based on a sheet weight of 100 g/m². These low freenesses are moreover achieved with a low specific requirement for refining energy, which is less than 500 kWh/t of fibrous material for coniferous wood; in the case of deciduous wood the need for refining energy can even be less than 300 kWh/t of fibrous material. The finding that the high strength level is already reached at low freenesses of 12°SR to 15°SR for coniferous wood and at 20°SR for deciduous wood and less is a substantial part of the invention.

[0052] These high strength values in combination with low freenesses for fibrous materials with a lignin content of more than 15% for coniferous wood fibrous materials, of more than 12% for deciduous wood fibrous materials or of more than 10% for annual plants, have hitherto not been known. The high strength level can, however, also be maintained for fibrous materials having an even higher lignin content. The
process according to the invention is even suitable for producing coniferous wood fibrous materials having a lignin content of more than 18%, preferably more than 21%, advantageously more than 24%, based on the oven-dry fiber mass. Deciduous wood fibrous materials having a lignin content of more than 14%, preferably more than 16%, particularly preferably more than 18%, and also annual plants having a lignin content of more than 10%, preferably more than 12%, in particular more than 19%, can likewise be produced with the process according to the invention and exhibit a high strength level.

[0053] The composition of the chemical solution used for the digestion can be defined in accordance with the wood or annual plants used for the digestion and the desired fibrous material properties. As a rule, only a sulfite component is used. Alternatively or as a supplement, a sulfide component can also be added. Digestion with a sulfite component is not disrupted by the presence of sulfide components. Industrially, sodium sulfite is normally used but the use of ammonium or potassium sulfite or of magnesium bisulfite is also possible. In particular if high quantities of sulfite are used, it is possible to dispense with the use of an alkaline component since a high pH, which encourages digestion, is established even without the addition of alkaline components.

[0054] In order to adjust the pH and to assist the delignification, an acid and/or an alkaline component can also be metered in. Industrially, the alkaline component used is normally sodium hydroxide (NaOH). However, the use of carbonates is also possible, in particular sodium carbonate. All statements relating to quantities of chemicals in the digestion process in this document, for example to total chemical used or to the subdivision of the sulfite component and the alkaline component are, if not otherwise specified, in each case calculated and stated as sodium hydroxide (NaOH).

[0055] Acids can be metered in as acid components in order to adjust the pH. However, preference is given to the addition of SO2, if appropriate in aqueous solution. It is inexpensive and easily available, in particular when the used chemical solution, for example based on sodium sulfite, is conditioned for further use following the digestion.

[0056] It is seen as an independent achievement of the invention to have recognized the advantages of the use of a quinone component for the high-yield digestion according to the invention. Quinone components, in particular anthraquinone, have until now been used in the production of pulps with a minimal lignin content, in order to prevent undesired action on the carbohydrate towards the end of the digestion. By adding quinone components it becomes possible to continue the digestion of wood further until the approximately complete breakdown of the lignin. It has emerged as a previously unknown, unexpected property of quinone components that these raise the rate of the lignin breakdown significantly during the production of high-yield pulps. The duration of the digestion, for example during the production of coniferous wood fibrous materials, can be shortened by more than a half, depending on the digestion conditions by more than three-quarters. This noticeable effect is achieved with minimal use of quinone, for example. A use of, for example, anthraquinone which is between 0.005% and 0.5% is optimal. A use of anthraquinone of up to 1% also produces the desired effect. A use of more than 3% anthraquinone is normally uneconomic.

[0057] A chemical solution is produced from an individual chemical or a plurality of the aforementioned chemicals. An aqueous solution is normally added. As an option, the use or the addition of organic solvents can also be provided. Alcohol, in particular methanol and ethanol, in a mixture with water gives particularly effective chemical solutions for the production of high-quality high-yield fibrous materials. The mixture ratio of water and alcohol can be optimized for the respective raw material in a few trials.

[0058] The quantity of chemicals to be used according to the invention for producing a fibrous material with a yield of at least 70% is at least 5% for coniferous wood, at least 3.5% for deciduous wood and at least 2.5% for annual plants, in each case based on the oven-dry wood or annual plant mass to be digested. The quality of the fibrous material produced exhibits the best results with a chemical usage of up to 15% for coniferous wood, of up to 10% for deciduous wood and up to 10% for annual plants. Preferably, between 9% and 11% of chemicals, based on the oven-dry wood used, is added in the case of coniferous wood. For deciduous wood, the use of the chemicals is somewhat lower, preferably between 4% and 10%, particularly preferably between 6% and 9%, and between 3% and 10% in the case of annual plants.

[0059] As already explained above, the setting of a specific pH is in no way required. Only when, for example, particular properties of the pulp (particularly high whiteness, a specific ratio of tearing length and tear propagation resistance) are to be achieved with the digestion may it be expedient to add acid or an alkaline component before or during the digestion. According to an advantageous refinement of the invention, irrespective of the chosen use of chemicals overall, a ratio between an alkaline component and sulfur dioxide (SO2) can be set over a wide range. Here, SO2 is named as representing the acid component mentioned above. It is therefore also possible to use an acid instead of SO2. Since the quinone component possibly added is used only in minimal quantities, normally considerably below 1%, it can be disregarded in setting this ratio. A ratio of the alkaline component versus SO2 in a range from 5:1 to 16:1 is well suited to carrying out the process of the invention and to achieving fibrous materials with high strength properties. A usual, particularly suitable range lies between 2:1 and 1.6:1. The proportional components are coordinated on the basis of the raw material to be digested and the respectively chosen process management (digestion temperature, digestion time, impregnation).

[0060] The process according to the invention can be carried out in a wide pH range. The ratio of alkaline component to acid component and the use of an acid or alkaline component can be set in such a way that at the start of the process a pH between 6 and 11, preferably between 7 and 11, particularly preferably between 7.5 and 10, is set. The rather alkaline pH values between 8 and 11, which are advantageous for the process according to the invention, also encourage the action of the quinone component. The process according to the invention is tolerant with respect to the pH; few chemicals are needed for pH adjustment. This has a beneficial effect on the costs for chemicals.

[0061] Without any further addition of acid or alkaline component, a pH between 5 and 9, normally between 6.5 and 9, for example for coniferous wood, is established in the free-flowing chemical solution at the end of the digestion and also in the organic components dissolved therein, which are liquefied by the digestion. The dissolved organic substances primarily include lignosulfates.

[0062] The liquor ratio, i.e., ratio of the quantity of oven-dry wood or annual plants to the chemical solution, is set between
1:1.5 and 1:6. A liquor ratio of 1:2 to 1:4 is preferred. In this range, good and simple mixing and impregnation of the material to be digested is ensured. For coniferous wood, a liquor ratio of 1:3.5 is preferred. For wood chips with a large surface, the liquor ratio can also be considerably higher, in order to permit rapid wetting and impregnation. At the same time, the concentration of the chemical solution can be kept so high that the quantities of liquid to be circulated do not become too large.

The mixing or impregnation of the wood or annual plant material to be digested is preferably carried out at elevated temperatures. Heating the chips and the chemical solution to up to 110°C, preferably to up to 120°C, particularly preferably to up to 130°C, leads to rapid and uniform digestion of the wood. For the mixing or impregnation of the chips, a time period of up to 30 minutes, preferably up to 60 minutes, particularly preferably up to 90 minutes, is advantageous. The respective optimal time period depends, amongst other things, on the quantity of chemicals, the liquor ratio, the chosen temperature and the type of digestion (liquid or vapor phase).

The digestion of the lignocellulosic material mixed or impregnated with the chemical solution is preferably carried out at temperatures between 120°C and 190°C, preferably between 140°C and 180°C. For most woods, digestion temperatures between 150°C and 170°C are set. Higher or lower temperatures can be set but in this temperature range the expenditure of energy for the heating and the acceleration of the digestion are in an economic relationship with each other. Higher temperatures can additionally have a detrimental effect on the strength and the whiteness of the fibrous materials. The pressure generated by the high temperatures can readily be absorbed by appropriate design of the digester. The duration of the heating is normally only a few minutes, normally up to 30 minutes, advantageously up to 10 minutes, in particular when steam heating is used. The duration of the heating can be up to 120 minutes, preferably up to 60 minutes, for example when digestion in the liquid phase is carried out and the chemical solution has to be heated together with the chips.

The duration of the digestion is primarily chosen on the basis of the desired fibrous material properties. The duration of the digestion can be shortened to up to 2 minutes, for example for the case of vapor-phase digestion of deciduous wood having a low lignin content. However, it can also be up to 180 minutes, if for example the digestion temperature is low and the natural lignin content of the wood to be digested is high. Even if the initial pH of the digestion is in the neutral range, a long digestion time can be necessary. In particular, the digestion time is up to 90 minutes, particularly in the case of coniferous wood. The digestion time is particularly preferably up to 60 minutes, advantageously up to 30 minutes. A digestion time of 60 minutes is suitable in particular in the case of deciduous woods.

In the case of annual plants, the digestion time is up to 90 minutes. The use of a quinone component, in particular anthraquinone, permits a reduction in the digestion time of up to 25% of the time required without the addition of anthraquinone. If the use of quinone components is omitted, the digestion time for comparable digestion results is lengthened by more than an hour, for example from 45 minutes to 180 minutes.

According to an advantageous embodiment of the process according to the invention, the duration of the digestion is set as a function of the chosen liquor ratio. The lower the liquor ratio, the shorter the process duration can be set.

The production of high-yield fibrous material with high chemical use of more than 5% for coniferous wood, of more than 3.5% for deciduous wood and at least 2.5% for annual plants initially appears uneconomic. However, trials have shown that only part of the chemicals is consumed during the partial digestion of the lignocellulosic material. The predominant part of the chemicals is removed unused, either before the digestion (vapor-phase digestion) or after the digestion (digestion in the liquid phase). The actual consumption of chemicals is below the quantities used in the digestion solution.

The chemical consumption is registered as the quantity of the chemicals which—assuming the quantity of chemicals originally used—is measured after the removal or separation of the chemical solution, and, if appropriate, the capture of chemical solution which is measured after the diluting or in conjunction with capture of the chemical solution. The chemical consumption depends on the absolute quantity of chemicals used for the digestion, based on the oven-dry mass of wood to be digested. The higher the use of digestion chemicals, the lower the direct conversion of chemicals. Given a use of 27.5% of chemicals, based on oven-dry mass of wood, for example only about 30% of the chemicals used are consumed. Given the use of 15% of chemicals, based on oven-dry mass of wood, 60% of the chemicals used are consumed, however, as could be verified in laboratory trials. The chemical consumption of the process according to the invention according to a preferred embodiment of the process during the digestion is up to 80%, preferably up to 60%, particularly preferably up to 40%, advantageously up to 20%, particularly advantageously up to 10%, of the chemical input at the start of the digestion.

The chemical consumption for producing a tonne of fibrous material is around 14% sulfite and/or sulfide component and also alkaline and/or acid component and also, if appropriate, quinone component, based on oven-dry fibrous material (deciduous and coniferous wood or annual plants). According to the invention, this quantity of chemicals is enough to produce a fibrous material having the prescribed properties. In order however to ensure a uniform process result and possibly to increase the biological and/or chemical stability, it may prove to be expedient to use higher quantities of chemicals for the digestion, for example the aforementioned up to 30% of chemicals based on oven-dry wood or annual plant mass.

The use of these quantities of chemicals at the start of the digestion exhibits an advantageous effect, since the fibrous materials obtained in this way have previously unavailable properties, in particular high strength properties and high whiteness. In particular, no digestion process which produces fibrous materials with high strength values over a wide pH range from neutral as far as the alkaline range has hitherto been available. It has been shown to be economically particularly attractive that the fibrous materials produced in accordance with the invention can be refined to prescribed finenesses with an energy demand far lower than known fibrous materials. In addition, they already develop the high strengths at unusually low finenesses of 12°SR to 15°SR for coniferous wood and of 20°SR for deciduous wood.

After the mixing and impregnation of the wood with the chemical solution or after the digestion, there is an excess of chemicals in the free-flowing liquid. This excess is drawn...
off before the digestion (1st alternative) or after the digestion (2nd alternative). According to an advantageous development of the process, the composition of the chemical solution removed is captured and subsequently adjusted to a prescribed composition for reuse in the production of fibers. The chemical solution which is removed before or after the digestion of the wood or the annual plants no longer has the composition set at the beginning. At least part of the chemicals used for the digestion has—as described above—penetrated into the material to be digested and/or has been consumed in the digestion. The unused chemicals can readily be used again for the next digestion. However, the invention proposes firstly determining the composition of the chemicals removed and then supplementing the used portions of the filter with sulfur, alkaline component, quinone component or else water or alcohol, in order once more to produce the prescribed composition of the next digestion. This supplementation step is also designated strengthening.

[0073] It is to be viewed as a considerable advantage of this measure that the chemical solution, in the case of removal before the digestion but also in the case of removal after the digestion, really contains no substances at all or very few substances which prove to be disruptive during renewed use of the strengthened chemical solution for the next digestion. The process according to the invention, which is based on making a surplus of digestion chemicals available during the impregnation, is also able to operate extremely economically, despite the procedure of the high chemical use, initially appearing uneconomic, for the removal or the separation and the strengthening of the chemical solution can be carried out simply and cost-effectively.

[0074] The process according to the invention is controlled specifically in such a way that only as little as possible of the starting material used is broken down or dissolved. The aim is to produce a fibrous material which, for coniferous wood, has a lignin content of at least 15%, based on the oven-dry fiber mass, preferably a lignin content of at least 18%, particularly preferably of 21%, advantageously of at least 24%. For deciduous wood, the aim is to achieve a lignin content of at least 12%, based on the oven-dry fiber mass, preferably of at least 14%, particularly preferably of at least 16%, advantageously of at least 18%. In the case of annual plants, the preferred lignin content is between 10 and 28%, in particular between 12 and 26%.

[0075] The yield of the process according to the invention is at least 70%, preferably more than 75%, advantageously more than 80%, in each case based on the wood used. This yield correlates with the lignin content of the fibrous material specified above. The original lignin content of wood is specified as the yield in the present process is predominantly represented as a loss of lignin. In the case of non-specific digestion processes, the proportion of hydrocarbons is increased considerably, for example because digestion chemicals also put cellulose or hemicelluloses into solution in a manner that is undesired per se.

[0076] A further, advantageous measure, after the defibering and possibly the refining of the lignocellulosic material, is to remove the chemical solution still remaining and to supply it to further use. In a preferred refinement of the process, the used portions of the filter are burned in order to obtain process energy. Or it is prepared in order to be used in a different manner. Secondly, the used and unused chemicals are reconditioned, so that they can be used for a renewed partial digestion of lignocellulosic material. This includes the preparation of consumed chemicals.

[0077] According to a particularly preferred variant of the process according to the invention, the chemical solution employed is used extraordinarily efficiently. After the defibering and possibly the refining, the fibrous material is washed, in order to displace the chemical solution as far as possible by way of water. The filtrate arising during this washing and displacement operation contains considerable quantities of chemical solution and organic material. According to the invention, this filtrate is supplied to the removed or separated chemical solution before the chemical solution is strengthened and fed to the next digestion. The chemicals contained in the filtrate and organic constituents do not disrupt the digestion. To the extent that they make a contribution to the delignification during the next digestion, their content of chemicals is registered and taken into account during the determination of the quantity of chemicals needed for this digestion. The chemicals further contained in the filtrate behave inertly during the impending digestion; they do not interfere. The organic constituents contained in the filtrate likewise behave inertly. They are used further during the conditioning of the chemical solution after the next digestion, either to produce process energy or in another way.

[0078] It is viewed as particularly advantageous that, as a result of this management of the filtrate, less fresh water and fewer chemicals are used for the digestion. At the same time, a maximum of dissolved organic material is captured. This improved utilization of the organic materials that have gone into solution also improves the economy of the process according to the invention.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0079] The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

[0080] FIG. 1 shows an apparatus for carrying out the inventive method; and

[0081] FIG. 2 shows a second apparatus.

**Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate embodiments of the invention, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.**

**DETAILED DESCRIPTION OF THE INVENTION**

[0083] The details of the method according to the present invention for producing the stock suspension will be explained in more detail below in exemplary embodiments.

[0084] The following trials were evaluated in accordance with the following instructions:

[0085] The yield was calculated by weighing the raw material put in and the pulp obtained after the digestion, in each case dried to constant weight at 105°C (absolutely dry).

[0086] The lignin content was determined as Klason lignin in accordance with TAPPI T 222 om-98.

[0087] The acid-soluble lignin was determined in accordance with TAPPI UM 250.
The paper technological properties were determined on test sheets which were produced in accordance with Zellcheming Note Sheet V/8/76. The freeness was registered as per Zellcheming Note Sheet V/3/62.

The bulk was determined as per Zellcheming Instruction V/11/57.

The tearing length was determined as per Zellcheming Instruction V/12/57.

The tear propagation resistance was determined as per DIN 53 128 Elmendorf.

The determination of tensile, tear and burst index was carried out in accordance with TAPPI 220 sp-96.

The whiteness was determined by producing the test sheets as per Zellcheming Note Sheet V/19/63, measured as per SCAN C 11:75 with a Datacolor elropho 450x photometer; the whiteness is specified in percent as per ISO Standard 2470.

The viscosity was determined as per Note Sheet IV/36/61 of the German Association of Pulp and Paper Chemists and Engineers (Zellcheming).

All the % statements in this document are to be read as percent by weight if not otherwise individually indicated.

The statement “o.d.” in this document refers to “oven-dry” material, which has been dried to constant weight at 105°C.

The chemicals for the digestion are specified in percent by weight as sodium hydroxide if not otherwise explained.

**EXAMPLE 1**

Coniferous Wood Digestion in the Liquid Phase

A mixture of birch wood and Douglas fir chips, after steaming (30 minutes in saturated steam at 105°C), was dosed with a sodium sulfite digestion solution with a liquor ratio of wood:digestion solution of 1:3. The total use of chemicals was less than 15%, based on o.d. wood. The pH at the start of the digestion was adjusted to pH 8.5-9 by adding SO2.

The birch wood/chips mixture impregnated with chemical solution was heated to 170°C over a time period of 90 minutes and digested at this maximum temperature over 60 minutes.

The free-flowing liquid was then removed by centrifuging, collected and analyzed and strengthened in an arrangement for feeding back unused liquid and in this way conditioned for the next digestion.

The digested chips were delivered. Partial quantities of the fibrous material produced in this way were refined for different times in order to determine the strength at different freenesses. The expenditure of energy for defibrering the partly digested chips was less than 300 kWh/t of fibrous material.

The yield in this trial was around 77%, based on the wood mass used.

This corresponds to a fibrous material having a lignin content of far above 20%. The average lignin content for birch wood is given as 28%, based on the o.d. wood mass (Wagenführ, Anatomie des Holzes [Anatomy of Wood], VEB Fachbuchverlag, Leipzig, 1980). The actual lignin content of the fibrous material is higher than 20% since, during the digestion, it is predominantly but not exclusively lignin which is broken down. Carbohydrates (cellulose and hemicelluloses) are also dissolved in small quantities. The values specified show that the digestion exhibits good selectivity with regard to the breakdown of lignin and carbohydrates.

The whiteness is unexpectedly high with values over 55% ISO and thus offers a good starting basis for possible subsequent bleaching, in which whitenesses of 75% ISO can be achieved.

With an initial freeness of 12°SR, these materials already have a 6 km tearing length at a specific weight of 1.87 cm³/g.

In order to refine the fibrous materials to a freeness of 15°SR, a refining time of 20 to 30 minutes is needed. Up to a refining time of 20 minutes (freeness 12°SR-15°SR), the freeness develops within a narrow range irrespective of the pH at the start of the digestion (pH 6 to pH 9.4).

Likewise irrespective of the initial pH of the digestion and the refining time needed to reach the freeness, a high strength level is reached at a freeness of 15°SR.

**EXAMPLE 2**

The fibrous material was produced from birch chips, the pH at the start of the digestion being 9.4.

In addition to the 15% total chemicals (sulfite and NaOH in the prescribed ratio), 0.1% anthraquinone, based on the quantity of wood used, was added.

The digestion time was 60 minutes.

The following values resulted:

| Yield (%) | 81.1 |
| Lignin content | 22.7 |
| Whiteness (% ISO) | 53.7 |
| Tearing length (km) | 9.6 |
| Tear propagation resistance (cN; 100 g/m²) | 75.9 |

As a result of the addition of 0.1% anthraquinone, the digestion time can be reduced from about 180 minutes to 60 minutes under otherwise unchanged digestion conditions. This time gain is valuable, above all because the fibrous material production plants can be dimensioned smaller. Further potential savings reside in the fact that the temperature needed for the digestion has to be maintained over only a very much shorter time period.

Furthermore, it was determined that, with a decreasing use of overall chemicals to values between 5 and 15% in the case of coniferous wood, fibrous material with largely equal good properties is produced. The results do not depend on the use of the anthraquinone. The anthraquinone has the effect of accelerating the digestion but the desired fibrous material can also be digested without the addition of anthraquinone.

**EXAMPLE 3**

Deciduous Wood Digestion in the Liquid Phase

Eucalyptus chips, after steaming, have a sodium sulfite digestion solution added at a liquor ratio of wood:digestion solution of 1:3. The use of chemicals was 10.5% here (as NaOH) on o.d. chips.

Over a time period of 90 minutes, the material to be digested was impregnated and the digestion material was heated to the maximum digestion temperature of 170°C. The digestion time was 50 minutes.
[0117] Digestions with eucalyptus wood show that these materials can be produced with a specific energy input for defibering of less than 250 kWh/t.

[0118] The yield in these trials was around 77%, based on the wood mass used. Given an initial freeness of 14°SR, these materials already have a 3.5 km tearing length with a specific weight of 2.05 cm³/g. In the subsequent bleaching these materials could be bleached to white solutions of 79% ISO.

[0119] Trials have shown that the digestions in the vapor phase exhibit a lower overall time requirement. As compared with digestion in the liquid phase, the heating to the maximum digestion temperature is carried out very much faster. The actual digestion then needs the same amount of time as a digestion in the liquid phase. During the vapor phase digestion there is no free-flowing chemical solution; this is drawn off after the impregnation and before the digestion. It therefore has less organic material added than the chemical solution which is drawn off after the digestion in the liquid phase. However, this has no significant influence on the quality of the fibrous material produced.

[0120] Whereas in the case of vapor phase digestions similar values in terms of yield can be achieved, the whiteness of the fibrous materials produced in vapor-phase digestion are considerably lower, however. A significant effect is achieved by reducing the maximum digestion temperature from 170° C. to 150° C.; the whiteness rises.

[0121] The fibrous materials produced in the vapor phase exhibit excellent strengths. The tearing length was measured as 10 km, for example, and as 11 km at 15°SR. The tear propagation resistance was measured as 82.8 cN and 91.4 cN, for example. These values correspond to the best values for fibrous materials with a high lignin content which have been achieved for digestions in the liquid phase, or are even higher. Comparable strength values are not known from the prior art for fibrous materials with a high lignin content.

[0122] From the examples it can be gathered particularly clearly that the fibrous materials according to the invention need only little expenditure of energy during refining in order to build up high tearing lengths, without the tear propagation resistance being reduced. A freeness of 12°SR was in each case reached in 0-10 minutes; a freeness of 13°SR in 5-30 minutes, normally 10-20 minutes. In order to reach a freeness of 14°SR, the Jokono mill had to operate for 30-40 minutes and for a freeness of 15°SR between 35 and 40 minutes were needed. It is obvious that refining to freenesses around 40°SR would require enormous expenditure on refining energy. A particular advantage of the process according to the invention is therefore to be seen in the fact that fibrous materials with high strengths can be refined with little expenditure of energy.

[0123] The apparatus for providing a stock suspension which is used below in the process according to the invention for producing a tissue web, includes a pulper, in which the dry raw and semifinished materials and waste paper are slushed in water and transformed into a state that can be pumped. The stock formed in this way is then fed to a mixing chest.

[0124] During the subsequent refining operation, the stock suspension is refined to a freeness of 12°SR or more.

[0125] After the machine chest, the stock suspension is diluted very highly with white water and fed to a headbox 13.

[0126] Irrespective of how the stock suspension is obtained, it is important for the production of tissue paper that the stock suspension emerging from the headbox 13 has a freeness of less than 20°SR and a tearing length of more than 4.5 km.

[0127] A stock suspension 1 having the abovementioned properties emerges from the headbox 13 in such a way that this is injected into the ingoing gap between a forming fabric 14 and a structured, in particular 3 dimensionally structured, belt 3, by which way a tissue web 1 is formed.

[0128] The forming fabric 14 has a side oriented toward the tissue web 1 which is smooth relative to that of the structured belt 3.

[0129] Here, the side of the structured belt 3 pointing toward the tissue web 1 has deepened regions and regions elevated with respect to the deepened regions, so that the tissue web 1 is formed in the deepened regions and the elevated regions of the structured belt 3. The difference in height between the deepened regions and the elevated regions is preferably between 0.07 mm and 0.6 mm. The area formed by the elevated regions is preferably 10% or more, particularly preferably 20% or more and particularly preferably 25% to 30%.

[0130] In the exemplary embodiments illustrated, the arrangement including upper belt 3, tissue web 1 and forming fabric 14 is deflected around a forming roll 15 and the tissue web 1 is dewatered substantially by the forming fabric 14, before the forming fabric 14 is taken off the tissue web 1 and the tissue web 1 is transported onward on the belt 4.

[0131] The voluminous sections of the tissue web 1 formed in the deepened regions of the belt 3 have a higher volume and a higher grammage than the sections of the tissue web 1 formed in the elevated regions of the belt 3.

[0132] Consequently, on account of its formation on the structured belt 3, the tissue web 1 already has a 3 dimensional structure.

[0133] However, the sheet formation can also take place between two smooth forming fabrics 14, so that a substantially smooth tissue web 1 without a 3 dimensional structure is formed.

[0134] During a dewatering step following the formation of the tissue web 1, the tissue web 1 is led between the structured belt 3, which is arranged on the top, and a lower, permeable belt 2 formed as a felt, pressure being exerted on the structured belt 3, the tissue web 1 and the belt 2 along a dewatering section during the dewatering step, in such a way that the tissue web 1 is dewatered in the direction of the belt 2, as indicated by the arrows in the two figures.

[0135] During the dewatering, the tissue web 1, together with the belts 2, 3, wraps around a roll 5.

[0136] Because the tissue web 1 is dewatered in the direction of the belt 2 during this dewatering step and because the tissue web 1 is dewatered on the structured belt 3 on which it has already been formed, the voluminous sections are compressed less intensely than the other sections, so that as a result the voluminous structure of these sections is maintained.

[0137] The pressure for dewatering the tissue web 1 during the dewatering step according to FIG. 1 is produced simultaneously, at least in some sections, by a gas flow and by a mechanical pressing force.

[0138] In this case, the gas flow flows first through the structured belt 3, then the tissue web 1 and then the lower belt 2 formed as a felt. The gas flow through the tissue web 1 is about 150 m³ per minute and meter web length.

[0139] In the present case, the gas flow is produced by a suction zone 10 in the roll 5, the suction zone 10 having a length in the range between 200 mm and 2500 mm, preferably
between 800 mm and 1800 mm, particularly preferably between 1200 mm and 1600 mm.

[0140] The vacuum in the suction zone 10 is between -0.2 bar and -0.8 bar, preferably between -0.4 bar and -0.6 bar.

[0141] With regard to the performance of the dewatering step carried out by way of mechanical pressing force and optionally or additionally by way of a gas flow, and also to the various configurations of apparatuses for carrying out such a dewatering step, the entire extent of PCT/EP2005/050198 is also to be incorporated into the disclosure content of the present application.

[0142] According to FIG. 1, the mechanical pressing force is produced in that, during the dewatering step, the arrangement including structured belt 3, tissue web 1 and belt 2 is guided along a dewatering section 11 between a press belt 4 under tension and a smooth surface, the press belt 4 acting on the structured belt 3 and the belt 2 being supported on the smooth surface.

[0143] Here, the smooth surface is formed by the circumferential surface of the roll 5.

[0144] The dewatering section 11 is defined substantially by the wrap region of the press belt 4 around the circumferential surface of the roll 5, the wrap region being defined by the spacing of the two deflection rollers 12.

[0145] The press belt 4 is under a tension of at least 30 kN/m, preferably at least 60 kN/m or 80 kN/m, and has an open area of at least 25% and a contact area of at least 10% of its total area pointing toward the upper belt 3.

[0146] In a specific case the press belt 4, embodied as a spiral link fabric, has an open area of between 51% and 62% and a contact area of between 38% and 49% of its total area pointing toward the upper belt 3.

[0147] With regard to the structure of the press belt, the entire extent of PCT/EP2005/050198 is to be incorporated into the disclosure content of the present application.

[0148] The tissue web 1 leaves the dewatering section 11 with a dryness of between 25% and 55%.

[0149] In a further dewatering step following the dewatering step, the tissue web 1, together with the structured belt 3, is then led through a press nip, the tissue web 1 in the press nip being arranged between the structured belt 3 and a smooth roll surface of a Yankee drying cylinder 7. Here, the press nip is an extended press nip formed by the Yankee drying cylinder 7 and a shoe press roll 8.

[0150] The tissue web 1 rests on one side with a relatively great area on the circumferential surface of the Yankee drying cylinder 7, the tissue web 1 resting on the structured belt 3 on the other side.

[0151] The deepened regions and the regions elevated relative thereto of the structured belt 3 are here formed and arranged in relation to one another in such a way that the voluminous sections are substantially not pressed in the press nip. On the other hand, the other sections are pressed, by which way the strength of the tissue web 1 is increased further.

[0152] Between the two dewatering steps described, a further dewatering step can be provided, which can be carried out by way of an apparatus 9.

[0153] Optionally, provision can be made for the tissue web 1, before it runs through the press nip, to be led together with the structured belt 3 around an evacuated deflection roll, the structured belt 3 being arranged between the tissue web 1 and the evacuated deflection roll (not illustrated).

[0154] From FIG. 2 it can be seen that the gas flow can additionally be produced by a positive pressure hood 6 arranged above the structured belt 3, the dewatering step in this case being carried out without any mechanical pressing force, i.e., as opposed to FIG. 1, no press belt 4 which wraps around some section of the roll 5 being provided.

[0155] While this invention has been described with respect to at least one embodiment, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims. What is claimed is:

1. A process for producing a tissue web, said process comprising the steps of: producing the web from a stock suspension including a plurality of fibers, wherein said stock suspension includes lignocellulosic fibrous material made of one of wood and annual plants which has one of (1) one of a tearing length of more than 6.0 km at 12°SR and a tearing length of more than 7.5 km at 15°SR and a lignin content of at least 15%, based on an oven-dry fibrous material, for a coniferous wood in an unbleached state, (2) a tearing length of more than 4.5 km at 20°SR and a lignin content of at least 12%, based on said oven-dry fibrous material, for a deciduous wood in said unbleached state, and (3) a tearing length of more than 3.5 km at 20°SR and a lignin content of at least 10%, based on said oven-dry fibrous material, for said annual plants in said unbleached state.

2. The process as claimed in claim 1, wherein said plurality of fibers forms a fibrous material, wherein said lignin content of unbleached said fibrous material (1) in the case of said coniferous wood is one of at least 15%, at least 18%, and at least 21%, of said oven-dry fibrous material, (2) in the case of said deciduous wood is one of at least 12%, at least 14%, and at least 16%, of said oven-dry fibrous material, and (3) in the case of said annual plants is one of at least 10%, at least 12%, and at least 19%, of said oven-dry fibrous material.

3. The process as claimed in claim 1, wherein said tearing length for a coniferous wood fiber stock at 12°SR is one of greater than 7 km, greater than 7.5 km, and greater than 8 km.

4. The process as claimed in claim 1, wherein said tearing length for a coniferous wood fiber stock at 15°SR is one of greater than 9 km, greater than 9.5 km, and greater than 10 km.

5. The process as claimed in claim 1, wherein said tearing length for a deciduous wood fiber stock at a freedom of 20°SR is one of greater than 6 km, greater than 7 km, and greater than 7.5 km.

6. The process as claimed in claim 1, wherein said tearing length for an annual plant fiber stock at 20°SR is one of greater than 5.5 km, greater than 4 km, and greater than 4.5 km.

7. A process for producing a tissue web, said process comprising the steps of: producing the web from a stock suspension including a plurality of fibers, wherein said stock suspension includes lignocellulosic fibrous material made of one of wood or annual plants which has one of (1) a tearing length of more than 7.5 km at 15°SR and a lignin content of at least 13%, based on an oven-dry fibrous material,
for a coniferous wood in a bleached state, (2) a tearing length of more than 5.0 km at 20°SR and a lignin content of at least 10%, based on said oven-dry fibrous material, for a deciduous wood in said bleached state, and (3) a tearing length of more than 5.5 km at 20°SR and a lignin content of at least 10%, based on said oven-dry fibrous material, for said annual plants in said bleached state.

8. The process as claimed in claim 7, wherein said tearing length for a coniferous wood fiber stock at 15°SR is one of greater than 9 km and greater than 10 km.

9. The process as claimed in claim 7, wherein said tearing length for a deciduous wood fiber stock at 20°SR is greater than 5.5 km.

10. The process as claimed in claim 7, wherein said tearing length for an annual plant fiber stock at 20°SR is one of greater than 4 km, greater than 4.5 km, and greater than 5 km.

11. The process as claimed in claim 7, wherein said stock suspension contains only said lignocellulosic fibrous material.

12. The process as claimed in claim 7, wherein said stock suspension is only partly formed from said lignocellulosic fibrous material.

13. The process as claimed in claim 12, wherein said plurality of fibers forms a fibrous material, wherein one of between 50 and 80% and between 30 and 50% of said fibrous material of said stock suspension is formed from said lignocellulosic fibrous material.

14. The process as claimed in claim 7, wherein, during a dewatering step, the tissue web is led between an upper structured and permeable belt and between a lower permeable belt, pressure being exerted on said upper belt, the tissue web, and said lower belt along a dewatering section.

15. The process as claimed in claim 14, wherein, during said dewatering step, a gas flows firstly through said upper belt, then the tissue web, and then said lower belt.

16. The process as claimed in claim 15, wherein, during said dewatering step, an arrangement including said upper belt, the tissue web, and said lower belt is led at least in some sections of said arrangement, between a press belt under tension and a smooth surface, said press belt acting on said upper belt and said lower belt being supported on said smooth surface.

17. The process as claimed in claim 16, wherein said gas flows through said arrangement, at least in some sections of said arrangement in said dewatering section.

18. The process as claimed in claim 17, wherein a gas flow of said gas through the tissue web is about 150 m² per minute and meter length along said dewatering section.

19. The process as claimed in claim 16, wherein said press belt is under a tension of one of at least 30 kN/m, at least 60 kN/m, and 80 kN/m.

20. The process as claimed in claim 16, wherein said press belt has an open area of more than 50% and a contact area of at least 15%.

21. The process as claimed in claim 16, wherein said smooth surface is formed by a circumferential surface of a roll.

22. The process as claimed in claim 21, wherein a gas flow of said gas is formed by a suction zone in said roll.

23. The process as claimed in claim 15, wherein a gas flow of said gas is produced by a positive pressure hood arranged above said upper belt.

24. A process for producing a stock suspension including a plurality of fibers for use in producing a tissue web, said process comprising the steps of:

    providing that at least a proportion of the stock suspension is produced from one of wood and annual plants having a lignin content of at least 15% for a coniferous wood, at least 12% for a deciduous wood, and at least 10% for said annual plants, in each case based on an oven-dry fiber stock, by the following steps:

    producing a chemical solution one of with more than 5% of chemicals (calculated as NaOH) for coniferous wood, with more than 3.5% of chemicals (calculated as NaOH) for deciduous wood, and with more than 2.5% of chemicals (calculated as NaOH) for annual plants, in each case based on an oven-dry quantity of said wood;

    mixing said chemical solution with one of said wood and said annual plants in a predefined liquor ratio;

    heating said chemical solution and one of said wood and said annual plants to a temperature above room temperature; and then one of:

    (1) removing a free-flowing said chemical solution and digesting one of said wood and said annual plants in a vapor phase, and

    (2) digesting one of said wood and said annual plants in a liquid phase and separating said free-flowing chemical solution and one of said wood and said annual plants.

25. The process as claimed in claim 24, wherein said fibrous material is produced one of (1) which has a lignin content of one of at least 15%, at least 18%, at least 21%, and at least 24%, based on an oven-dry fibrous material, for said coniferous wood, (2) which has a lignin content of one of at least 14%, at least 16%, and at least 18%, based on said oven-dry fibrous material, for said deciduous wood, and (3) which has a lignin content of one of at least 10%, at least 12%, and at least 19%, based on oven-dry fibrous material, for said annual plants.

26. The process as claimed in claim 24, wherein a quinine component is used to produce said chemical solution.

27. The process as claimed in claim 24, wherein, in order to digest said coniferous wood, one of at most 15% of said chemicals and between 9 and 11% of said chemicals are used.

28. The process as claimed in claim 24, wherein, in order to digest said deciduous wood, one of at most 10% of said chemicals, and between 4 and 6% of said chemicals, and between 6 and 9% of said chemicals are used.

29. The process as claimed in claim 24, wherein, in order to digest said annual plants, one of at most 10% of said chemicals and between 3 and 10% of said chemicals are used.

30. The process as claimed in claim 24, wherein, in order to produce said chemical solution, sulfites and sulfides are used, one of individually and in a mixture.

31. The process as claimed in claim 30, wherein, in order to produce said chemical solution, at least one of an acid, an alkaline component, sulfur dioxide, sodium hydroxide, and a carbonate is used.

32. The process as claimed in claim 24, wherein, for purposes of digestion, an alkaline component and an acid component are used, the acid component being SO₃, a ratio of said...
33. The process as claimed in claim 24, wherein the process is carried out at a pH of one of between 6 and 11, between 7 and 11, and between 7.5 and 10.

34. The process as claimed in claim 24, wherein a liquor ratio of said wood:said chemical solution of one of between 1:1.5 and 1:6 and between 1:2 and 1:4 is set.

35. The process as claimed in claim 24, wherein said chemical solution and one of said wood and said annual plants are heated to up to one of 130°C, 120°C, and 110°C.

36. The process as claimed in claim 24, wherein one of said wood and said annual plants are heated for up to one of 120 minutes, 60 minutes, 30 minutes, and 10 minutes.

37. The process as claimed in claim 24, wherein one of said wood and said annual plants and said chemical solution are heated for up to one of 120 minutes, 60 minutes, 30 minutes, and 10 minutes.

38. The process as claimed in claim 24, wherein one of said wood and said annual plants are digested at temperatures one of between 120°C and 190°C, between 150°C and 180°C, and between 160°C and 170°C.

39. The process as claimed in claim 24, wherein a digestion of one of said wood and said annual plants lasts for up to one of 180 minutes, 90 minutes, 60 minutes, 30 minutes, and 2 minutes.

40. The process as claimed in claim 39, wherein a digestion time is chosen as a function of said liquor ratio.

41. The process as claimed in claim 24, wherein a consumption of said chemicals during a digestion is up to one of 80%, 60%, 40%, 20%, and 10% of said chemicals put in at a start of said digestion.

42. The process as claimed in claim 24, wherein a composition of said chemical solution that is one of removed and separated is registered and subsequently adjusted to a prescribed composition for a renewed use for producing a plurality of fibers.

43. The process as claimed in claim 24, wherein said chemical solution liberated after delivering of digested lignocellulosic material is removed and supplied to further use.

44. The process as claimed in claim 24, wherein said chemical solution liberated after delivering and refining of digested lignocellulosic material is removed and supplied to further use.