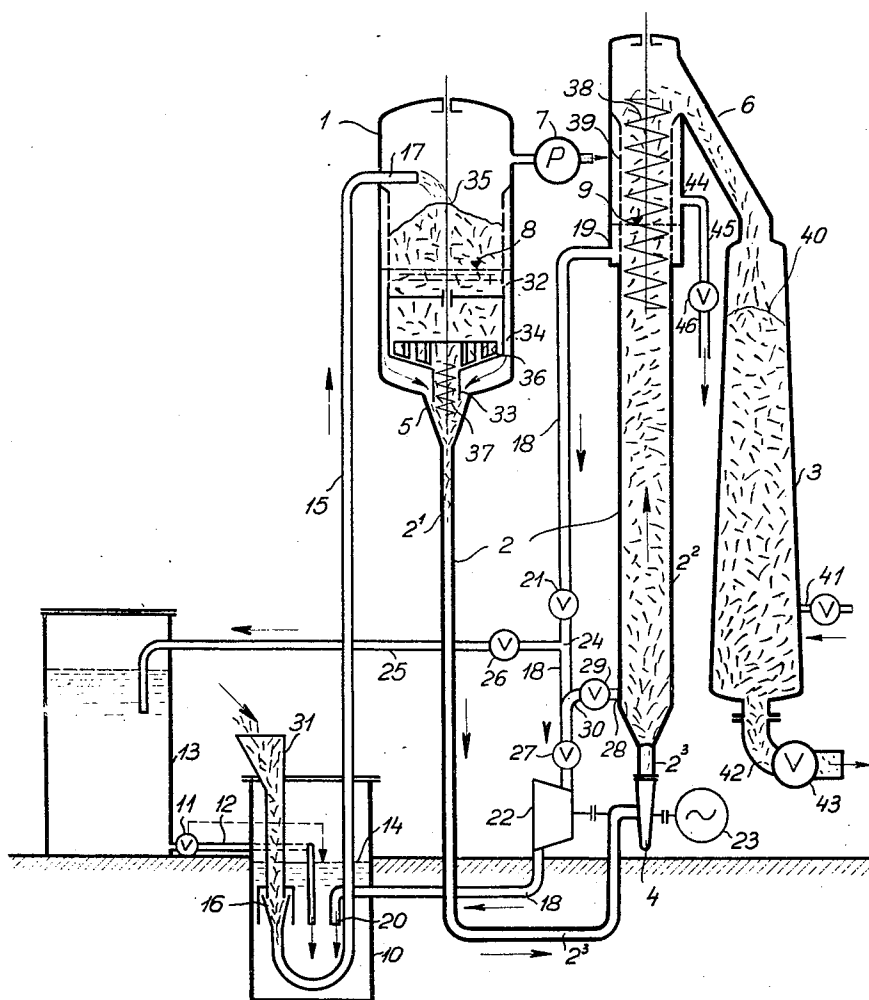


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PROCESS AND APPARATUS FOR THE TREATMENT OF FIBROUS
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CELLULOSE OR SEMI-CELLULOSE
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1

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PROCESS AND APPARATUS FOR THE TREATMENT OF FIBROUS MATERIALS IN THE PRODUCTION OF CELLULOSE OR SEMI-CELLULOSE

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The process for the treatment of fibrous materials in the production of cellulose or semi-cellulose is known, in which the fibrous materials are impregnated with digesting liquid and digested under superatmospheric pressure in a digesting chamber with an addition of heating steam after separation from the surrounding digesting liquid. In this known process, the fibrous materials to be treated, for example wood chips, are introduced in a continuous process into an impregnating chamber under superatmospheric pressure, in which they are impregnated with a hot sulphite liquor not exceeding a temperature of 120° C., which serves as digesting liquid. The substances thus impregnated are thereafter separated from the surrounding digesting liquid in this chamber and introduced into a digesting chamber which is under a higher superatmospheric pressure, and in which they are digested at a temperature of 160° to 205° C. with a supply of heat steam.

In addition, a known discontinuous process comprises the step of exposing the fibrous materials to a vacuum for the purpose of driving off the air contained therein before the addition of the digesting liquid. The fibrous materials are thereafter digested in the liquid under superatmospheric pressure.

The invention relates to a process for the treatment of fibrous materials in the production of cellulose or semi-cellulose in which the fibrous materials are impregnated with digesting liquid and, after separation from the surrounding digesting liquid, are digested under superatmospheric pressure in a digesting chamber with a supply of heating steam, and has for its object to provide an improvement in the impregnating operation with a simultaneous simplification of the entire process. In accordance with the invention, an excess of digesting liquid is constantly circulated in a circuit extending through a vacuum chamber and a pressure chamber under the digesting pressure, the fibrous materials to be treated being continuously fed to the said circuit, carried along with the digesting liquid and impregnated therewith in its travel from the vacuum chamber to the pressure chamber, and finally separated from the surrounding digesting liquid before the digesting operation in the pressure chamber.

As a result of the vacuum treatment, a good expulsion of the air from the fibrous materials is effected. The impregnating operation commences directly in the vacuum and is continued until the materials are brought to the disintegrating pressure of the digesting chamber. The materials thus do not come into contact with air between the vacuum treatment and the digesting process. The pressure increase during the impregnating operation furthermore gives a good penetration of the liquid into the fibrous materials. Owing to the good preceding air extraction in the vacuum, however, an increased temperature of the impregnating liquid is not necessary.

The invention further relates to an apparatus for carrying out the process according to the invention. In the drawing a constructional example of such an arrangement is illustrated in simplified form, with reference to which the process will also be described by way of example.

Essential component parts of the apparatus are: a vacu-

2

um chamber 1, an impregnating vessel 2 having two upwardly extending limbs 2¹ 2² connected together at the bottom by a duct 2³, a digesting vessel 3 and a pump 4 disposed in the connecting duct 2³. The limb 2¹ of the impregnating vessel is connected at its upper end through a funnel-shaped pipe section 5 to the vacuum chamber 1, and the limb 2² is connected through an inclined descending pipe 6 to the upper end of the digesting vessel 3.

A vacuum pump 7 connected to the upper part of the vacuum chamber 1 serves to extract the air and to maintain a pressure below atmospheric in this container.

The impregnating vessel 2 contains digesting liquid. The level of the liquid on the side of the limb 2¹ is situated at a point 8 in the vacuum chamber 1 and at a point 9 in the limb 2². The liquid level 8 is exposed to the vacuum of the chamber 1 and the liquid level 9 is exposed to the digesting pressure prevailing in the digester 3. The pump 4 provided in the duct 2³, which is preferably a centrifugal pump, continuously conveys digesting liquid from the limb 2¹ into the limb 2² of the impregnating vessel against the action of the pressure difference existing between the digester 3 and the vacuum chamber 1.

An introduction container 10 is disposed at a lower level than the vacuum chamber and communicates through a duct 12 and valve 11 with a storage container 13 containing digesting liquid. The valve 11 is so regulated that the introduction container is always filled with digesting liquid to a certain level. The liquid level in the introduction container is then situated at a point 14 at which it is exposed to atmospheric pressure.

A substantially vertically arranged duct 15 extends at its lower end 16 into the liquid contained in the introduction container 10 and opens at its upper end 17 into the vacuum chamber 1 above the liquid level 8. The liquid is sucked up from the introduction container 10 into the vacuum chamber 1 by the vacuum effect. The upper end 17 of the duct 15 may lie, for example, about 8 m. above the liquid level 14. The vacuum in the chamber 1 then corresponds to this liquid column plus the pressure loss of the flow in the duct 15. The vacuum is so regulated by means of the pump 7 that a quantity corresponding to the liquid conveyed by the pump 4 from the vacuum chamber into the limb 2² of the impregnating vessel is constantly supplied through the duct 15, whereby the liquid level 8 is constantly maintained at the same level.

A further duct 18 serves to return digesting liquid from the limb 2² of the impregnating vessel in order here also to maintain the liquid level 9 at a constant height. The duct 18 is connected at one end to the limb 2² at a point 19 and opens at its other end into the introduction container 10 at a point 20. A valve 21 serves to regulate the reflux quantity. In order to utilise with advantage the pressure difference under which the liquid flows back into the introduction container 10, there is provided in the reflux duct 18 a turbine 22 which thus supplies a part of the driving energy for the pump 4. The remainder is supplied by an electric motor 23 coupled to the pump 4.

The pump 4 thus continuously circulates an excess of digesting liquid in a circuit extending through the vacuum chamber 1, the limb 2¹ of the impregnating vessel, the connecting duct 2³, the pressure chamber subjected to the digesting pressure and formed by the limb 2² of the impregnating vessel, the duct 18, the introduction container 10 and the duct 15.

A further duct 25 connected to a point 24 of the duct 18 and having a valve 26 disposed therein and which, when open, permits digesting liquid to flow from the limb 2² of the impregnating vessel into the storage container 13 instead of into the introduction container 10. The last-mentioned container is then also included in the

circuit. The admission to the turbine 22 can be cut off by a further valve 27 arranged in the duct 18. A further duct 30 which connects a point 28 situated in the lower part of the limb 2² of the impregnating vessel with the duct 18 and which is adapted to be closed off by a valve 29 furthermore permits of extracting the returning liquid from this lower point 28 instead of from the point 19.

The fibrous materials to be treated, for example wood chips, are introduced into a charging hopper 31 which extends at its lower end into the digesting liquid contained in the introduction container 10. The lower part of the duct 15, also dipping into the said liquid, is bent upward at about 180°. The lower end 16 of the duct widens in the form of a funnel and lies directly below the charging hopper 31, the clearance between the two being such, however, that digesting liquid can enter the duct 15. The fibrous materials then pass continuously from the charging hopper 31 into the duct 15 forming a component part of the liquid circuit and are carried along therein by the liquid stream and conveyed into the vacuum chamber 1.

The liquid delivery of the pump 4 and thus also the further quantity fed through the duct 15, is so great in relation to the entering quantity of fibrous materials that the concentration of the latter in the liquid rising through the duct 15 is relatively low. However, it is desirable for the fibrous materials to remain for a relatively long period in the vacuum chamber 1. The vacuum chamber 1 therefore comprises an inner container 32 below the point at which the duct 15 enters it. The bottom of the said container is provided with a central delivery branch 33 which opens into the funnel-shaped pipe section 5 connecting the limb 2¹ of the impregnation vessel with the vacuum chamber 1. A clearance 34 is left between the inner container 32 and the delivery branch 33 on the one hand, and the jacket of the vacuum chamber 1 and the pipe section 5 on the other hand.

The fibrous materials entering the vacuum chamber 1 are trapped in the inner container 32 up to a point 35 situated slightly below the mouth 17 of the duct 15. The upper part of the inner container 32 is formed with apertures, so that the surplus liquid can escape into the clearance 34 and can pass through the latter directly into the pipe section 5 and into the limb 2¹ of the impregnation vessel. A delivery stirrer 36 provided at the bottom of the inner container 32 and driven by means not shown, and a conveyor worm 37 disposed in the delivery branch 33 ensure a uniform ejection of the momentarily lowermost fibrous materials into the pipe section 5, so that the materials contained in the inner container 32 always remain heaped up to the same level.

The fibrous materials delivered into the pipe section 5 pass into the limb 2¹ of the impregnation vessel 2, and are carried along by the liquid sucked in by the pump 4, and entrained and impregnated thereby along the path leading through the connecting duct 2³ from the vacuum chamber of the chamber 1 into the space exposed to the digesting pressure in the limb 2² of the impregnation vessel.

The impregnation chamber extends from the liquid level 8 in the vacuum chamber 1 to the liquid level 9 in the limb 2² of the impregnation vessel. Thus, in the described apparatus, the fibrous materials are continuously brought, after the vacuum treatment, from a vacuum to the digesting pressure during the process of impregnation with the surrounding digesting liquid.

The fibrous materials rising in the limb 2² of the impregnation vessel are taken up in the upper part of the latter by a conveyor worm 38 driven by means not shown and conveyed to the point to which the obliquely descending pipe 6 is connected. They are thereby lifted above the liquid level 9 and thus separated from the surrounding digesting liquid before falling through the pipe 6 into the digesting chamber of the digesting vessel 3.

In the region of the point 19 of the limb 2² of the impregnation vessel, at which the surrounding surplus

digesting liquid is discharged through the duct 18, the vessel is provided with a perforated inner jacket 39 which retains the impregnated fibrous materials, but allows the liquid to pass through.

The fibrous materials impregnated with digesting liquid are heaped up to a point 40 in the digesting vessel 3. By admission of heating steam through a duct 41 adjoining the lower part of the digesting vessel 3, the materials are brought to the necessary digesting temperature. The delivery of the completely digested material takes place continuously through a delivery branch 42 having a gate valve 43.

For discharging any condensate which may be formed above the level 9 of the digesting liquid in the limb 2² of the impregnating vessel by the heating steam supplied, a further duct 45 having a valve 46 disposed therein is connected to a point 44 above the point 19 at which the reflux duct 18 for the digesting liquid is connected.

It may prove advantageous to return the surplus digesting liquid from a lower point, for example from the point 28 of the limb 2² of the impregnation vessel, in order that the digesting liquid to be returned may not be heated by heating steam coming from the digesting chamber. The temperature of the digesting liquid which must be reintroduced into the vacuum chamber is limited by the vacuum which must be maintained therein. If desired, cooling of the liquid returned through the duct 18 into the introduction container 10 may be considered.

What is claimed is:

1. In a process for the treatment of fibrous materials in the production of cellulose or semi-cellulose in which the fibrous materials are impregnated with digesting liquid and digested at superatmospheric pressure and elevated temperature, the method of impregnating said materials comprising the steps: continuously circulating an excess quantity of digesting liquid in a closed flow path which includes first, second and third portions; subjecting said liquid to atmospheric pressure in said first portion of said flow path, to vacuum in said second portion of said flow path and to at least atmospheric pressure in said third portion of said flow path; continuously admixing the material to be impregnated with the circulating digesting liquid in said first portion; leading the so-obtained mixture to said second portion; separating part of the circulating material and liquid from one another during circulation through the second portion; recombining the material just separated and the circulating liquid as the material leaves the second portion; separating the material from the circulating liquid in said third portion of the path and replacing with new liquid the liquid which is absorbed and adsorbed by the material; and recirculating the liquid through the flow path.

2. The method defined in claim 1 in which said third portion of the flow path is subjected to the digesting pressure of the process.

3. In apparatus for the treatment of fibrous materials in the production of cellulose or semi-cellulose, an impregnating device comprising an introduction container for the fibrous materials to be treated; a vacuum chamber; a separation chamber; flow connections arranged so as to define a closed circuit for digesting liquid which leads serially through said introduction container, through said vacuum chamber, through said separation chamber and again through the introduction container; means in said circuit for circulating the digesting liquid; means for continuously introducing the fibrous materials into the introduction container and admixing them with the circulating digesting liquid; means in the vacuum chamber for separating digesting liquid from the entering mixture of fibrous materials and circulating liquid; a by-pass for reintroducing the so-separated liquid into the flow connection between the vacuum chamber and the separation chamber; means arranged in said separation chamber for separating the treated material together with digesting liquid absorbed and adsorbed by it from the

5

circulating liquid; and a storage container for digesting liquid connected with the circuit to supply digesting liquid thereto.

4. The combination defined in claim 3 including a discharge conveyor arranged within the vacuum chamber to discharge the fibrous materials continuously into the flow connection which leads from the vacuum chamber to the separation chamber.

5. The combination defined in claim 3 including a digesting vessel operating at superatmospheric pressure, and means affording an open connection from the separation chamber to said digesting vessel; and in which the means for circulating digesting liquid is in the flow connection between the vacuum chamber and the separation chamber.

6. An apparatus for impregnating fibrous materials with digesting liquid in the production of cellulose or semi-cellulose comprising a vacuum chamber in which the said materials are deaerated, said vacuum chamber having a supply conduit for the materials to be deaerated and a discharge conduit for the deaerated materials; an introduction container subject to atmospheric pressure situated well below the bottom of said vacuum chamber; a separation chamber, said supply conduit being connected at one end to said introduction container and opening at its other end into the vacuum chamber at a point near the top thereof, said discharge conduit extending from the bottom of said vacuum chamber and opening into the separation chamber, at least a portion of the said discharge conduit extending downward from the vacuum chamber; a flow connection connecting the separation chamber with the introduction container, a flow circuit being formed thereby which leads serially through the introduction container, the supply conduit, the vacuum chamber, the discharge conduit, the separation chamber, said last-named flow connection, and again through the introduction container; means for supplying digesting liquid to said circuit; pump means arranged in said circuit for circulating the supplied digesting liquid through said circuit; means for continuously supplying the materials to be impregnated and deaerated to said introduction container and for admixing them with the circulating liquid; means arranged in said separation chamber for separating the deaerated and impregnated materials from the circulating liquid with the liquid absorbed and adsorbed thereby and for discharging them from the separation chamber; a vacuum pump connected to the vacuum chamber and serving to remove air which separates from the fibrous materials; and means arranged in the vacuum chamber for regulating the discharge of the

6

fibrous materials independently of the rate of flow of the circulating liquid.

7. The combination defined in claim 6 in which the means in the vacuum chamber regulating the discharge of fibrous materials comprises sieve means for separating at least a part of the liquid from the mixture of digesting liquid and fibrous materials entering the vacuum chamber through the supply conduit; a by-pass channel through which the so-separated liquid is fed to the discharge conduit so as to serve as transport liquid and impregnating liquid for the materials leaving the vacuum chamber; and a conveyor for discharging the remaining material and liquid into the discharge conduit.

8. The combination defined in claim 6 in which the means in the vacuum chamber regulating the discharge of fibrous materials comprises an inner sieve jacket so arranged that the mixture of digesting liquid and fibrous materials flowing through the supply conduit is fed into the interior of the sieve jacket, the sieve jacket being spaced from the wall of the vacuum chamber to define a space that communicates with the discharge conduit; and a conveyor arranged to discharge material and liquid from the interior of the sieve jacket to the discharge conduit.

9. The combination defined in claim 6 including a digesting vessel in open communication with the separation chamber, whereby the separation chamber is subjected to digesting pressure; and said pump means is in the discharge conduit and raises the pressure of the circulating liquid to the digesting pressure.

10. The combination defined in claim 9 including a fluid pressure motor in the flow connection between the separation chamber and the introduction container, in which fluid pressure motor the circulating liquid is allowed to expand from digestion pressure to substantially atmospheric pressure while doing work.

11. The combination defined in claim 10 in which the fluid pressure motor is connected to drive the pump means.

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