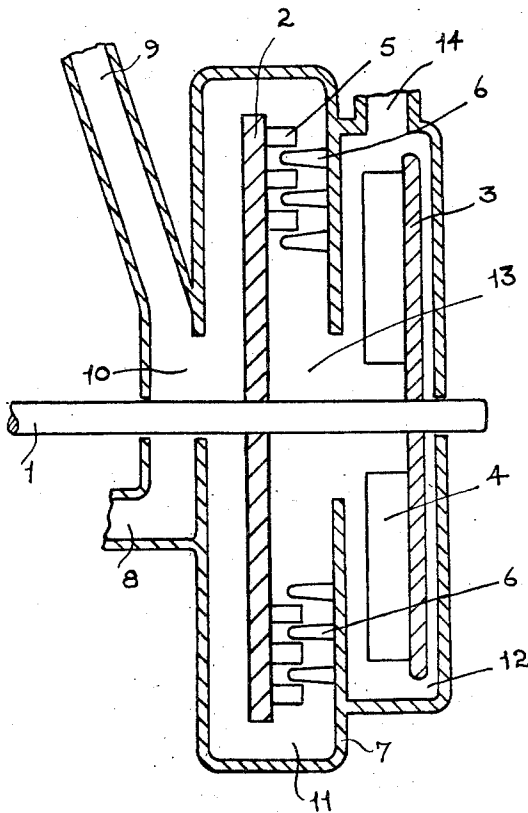


Dec. 25, 1962

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PREPARATION OF WOOD PULP

3,069,784

Filed April 23, 1959



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PREPARATION OF WOOD PULP

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Filed Apr. 23, 1959, Ser. No. 808,452

Claims priority, application Great Britain May 19, 1958

1 Claim. (Cl. 34—13.8)

This invention relates to the preparation of wood pulp and is concerned with the drying stage.

In the manufacture of a chemical pulp such as is used in the viscose industry, the wood pulp is usually obtained in sheet form. In the production of these sheets, non-cellulosic material is removed by chemical processes, e.g. by the sulphite, sulphate or soda process, and excess of the pulping agent is removed. After further extraction and purifying processes, the aqueous wood pulp slurry is converted into sheet form and the sheet is dried by passing it through a drying chamber. In the manufacture of viscose, these sheets are thereafter shredded, either before or after the conversion of the cellulose into alkali cellulose.

A disadvantage of this sequence of operations lies in the drying stage, where the pulp is dried in sheet form. Drying sheets of pulp is a relatively slow operation involving, as a consequence, fairly large machines.

In other industries, such as the paper industry, in which the presence of non-cellulosic material may not be detrimental to the product, the pulp employed is produced by mechanical means and the chemical pulping is omitted. However, the subsequent drying operation is usually still the relatively slow sheet-drying process.

To reduce the drying time, we have proposed in the specification of U.S. Patent 2,974,420 issued March 14, 1961 to produce dried wood pulp in a discrete form by fluidising the pulp in hot air supplied under a fluctuating pressure sufficient to cause the fluidised pulp particles to vibrate.

We have now found that a rapid drying is possible if pulp containing 15 to 75 percent of liquid, based on the weight of wet pulp, is brought into contact with air which is initially at a temperature of 300° C. to 550° C. and finally at a temperature of 90° C. to 120° C., under a degree of turbulence sufficient to prevent charring of the pulp.

The invention is particularly applicable to the drying of pulp containing 40 to 60 percent of liquid, in particular 45 to 50 percent of liquid, which liquid will normally be the water remaining from an earlier washing stage. The wet pulp may be prepared from a dilute aqueous stock by removing water from the stock by mechanical means, for example using a screw press, a slurry press or a centrifuge. Before drying, the pulp should be in a coarsely lumpy form, for example lumps having a diameter of about 1 to 2 inches. The breaking down, if the pulp is not already in that form, may be effected by using a screw conveyor. The upper limit of the size of the lumps is, within reasonable practical limits, dictated by the size of the inlet aperture of the machine in which the turbulence is to be produced.

While the temperature of the air when it is originally brought into contact with the pulp may be anywhere within the range 300° C. to 550° C., it is preferably below 515° C. A particularly convenient air temperature drop for wood pulp is from about 500° C. cooling down to about 120° C. The air may be heated by heat-devices burning oil, coal or coke or by any other means.

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In order to avoid charring of the pulp during treatment, a high degree of turbulence of the pulp and air is desirable, so that the air is cooled from its initial temperature to its lower temperature in a very short time, for example in less than five seconds or even in a fraction of a second.

In a preferred form of the present invention, the pulp is subjected to a breaking down of particle size while in contact with the hot air, using mechanical means to effect the breaking down. In this way, not only is the "fluffing" resulting from the rapid evaporation of the liquid assisted by the simultaneous reduction in particle size, but also the high rate of cooling is encouraged by the breaking down.

The conveying of the pulp through the machine in which conditions of turbulence are produced is achieved by the flow of the hot air through the machine. The product issuing from the machine is therefore a mixture of air with a pulp of low bulk density, e.g. of the order of 1.5 lb./cu. ft. The pulp may be separated from the air by using a cyclone, from which the pulp may be conveyed to the equipment for compressing the pulp to bulk densities more appropriate to economical transportation, e.g. to bulk densities in the range of 20 to 60 lb./cu. ft. For this latter purpose, a baling press may be employed, for example.

The exhaust air after separation from the pulp may, if desired, be recycled to ensure high thermal efficiency of the operation or the sensible and latent heat may be extracted from the air using conventional heat-exchange apparatus.

The preferred machine for producing the high degree of turbulence under which the process of this invention is carried out comprises relatively contra-rotating members which intermesh on rotation. Such a machine will now be described by reference to the accompanying drawing, which illustrates the machine in vertical section.

Referring to the drawing, a shaft 1 carries a rotor 2 and a fan 3, the latter having radial vanes 4. The rotor 2 carries teeth 5 disposed in concentric circles on one of its faces. A further series of teeth 6 projects from the housing 7 of the machine in concentric circles located between the circles of teeth 5.

An air inlet passage 8 joins a pulp inlet passage 9 before passing through an inlet aperture 10 into the interior of the drying machine. Communication between the rotor chamber 11 and the fan chamber 12 is provided by an aperture 13. Egress from the fan chamber is via an exit passage 14.

In operation of the machine, the air at a temperature of 300° C. to 550° C. is introduced via the passage 8, into which it is drawn by the fan 3. The air meets pulp introduced via the passage 9 and carries it through the inlet aperture 10 into the rotor chamber 11. The pulp and air pass out to the radial limits of the chamber and then, after passing around the edge of the rotor 2, are drawn between the teeth 5 and 6. Since the rotor is rotating at a rate of about 900 revolutions per minute or even higher, considerable turbulence is produced between the teeth. Simultaneously, the lumps of pulp are broken down by the teeth to a much smaller particle size.

As a result, intimate mixing of the pulp and air is obtained and rapid liquid evaporation takes place. Since the high degree of turbulence effects rapid cooling of the air, the pulp particles are not charred by contact in the dry state with very hot air. The air carries the pulp through the aperture 13 and fan chamber 12 and

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subsequently passes out of the machine via the exit passage 14 at a temperature in the range 90° C. to 120° C.

Using the machine described above, the five sets of observations set forth in the following examples were made. The examples are given by way of illustration only. The moisture content observations are expressed in every case as a percentage based on the weight of wet pulp. The moisture content was reduced before drying using a slurry press. The air flow is expressed as a volume per minute calculated at 20° C. The pulp flow is based on bone dry pulp.

Example 1

Moisture content of pulp fed to plant	94 percent.
Moisture content of pulp after pressing	48 percent.
Temperature of air at dryer inlet	430° C.
Temperature of air at dryer outlet	115° C.
Air flow through dryer	2700 cu. ft./min.
Pulp flow through dryer	1381 lb./hour.
Residence time of air in dryer	about 1½ secs.
Moisture content of pulp after drying	8.5 percent.
Heat consumption per lb. of water evaporated	1700 B.t.u.

Example 2

Moisture content of pulp fed to plant	95 percent.
Moisture content of pulp after pressing	51.5 percent.
Temperature of air at dryer inlet	314.5° C.
Temperature of air at dryer outlet	109° C.
Air flow through dryer	3650 cu. ft./min.
Pulp flow through dryer	1491 lb./hour.
Residence time of air in dryer	about 1 sec.
Moisture content of pulp after drying	7.4 percent.
Heat consumption per lb. of water evaporated	1655 B.t.u.

Example 3

Moisture content of pulp fed to plant	94.5 percent.
Moisture content of pulp after pressing	51.0 percent.
Temperature of air at dryer inlet	480° C.
Temperature of air at dryer outlet	100° C.
Air flow through dryer	3810 cu. ft./min.
Pulp flow through dryer	2060 lb./hour.
Residence time of air in dryer	c. 1 sec.
Moisture content of pulp after drying	6.8 percent.
Heat consumption per lb. of water evaporated	1655 B.t.u.

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Example 4

Moisture content of pulp fed to plant	93 percent.
Moisture content of pulp after pressing	58.0 percent.
Temperature of air at dryer inlet	376° C.
Temperature of air at dryer outlet	106° C.
Air flow through dryer	3480 cu. ft./min.
Pulp flow through dryer	1400 lb./hour.
Residence time of air in dryer	c. 1 sec.
Moisture content of pulp after drying	7.2 percent.
Heat consumption per lb. of water evaporated	1640 B.t.u.

Example 5

Moisture content of pulp fed to plant	95 percent.
Moisture content of pulp after pressing	45 percent.
Temperature of air at dryer inlet	498° C.
Temperature of air at dryer outlet	102° C.
Air flow through dryer	3500 cu. ft./min.
Pulp flow through dryer	3000 lb./hour.
Residence time of air in dryer	c. 1 sec.
Moisture content of pulp after drying	6.2 percent.
Heat consumption per lb. of water evaporated	1670 B.t.u.

What we claim is:

A process for drying wood pulp which comprises mixing the pulp, containing 15 to 75 percent liquid, with a stream of air at a temperature of between about 300° C. and about 550° C., in an enclosure, to form a turbulent suspension, passing said suspension between at least two relatively moving surfaces in said enclosure to reduce the particle size of said pulp, and then positively moving the suspension out of said enclosure, and separating from the suspension pulp having a bulk density of the order of about 1.5 pounds/cu. ft., the total elapsed time in said enclosure being less than about 5 seconds and the temperature of the suspension as it is moved out of said enclosure being between about 90° C. and about 120° C.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,069,784

December 25, 1962

Fred Crowther Aldred et al.

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

Column 1, line 68, for "heat-" read -- heating --;
column 3, line 25, Example 1, before "evaporated" insert
-- Heat consumption per lb. of water --.

Signed and sealed this 27th day of August 1963.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents