

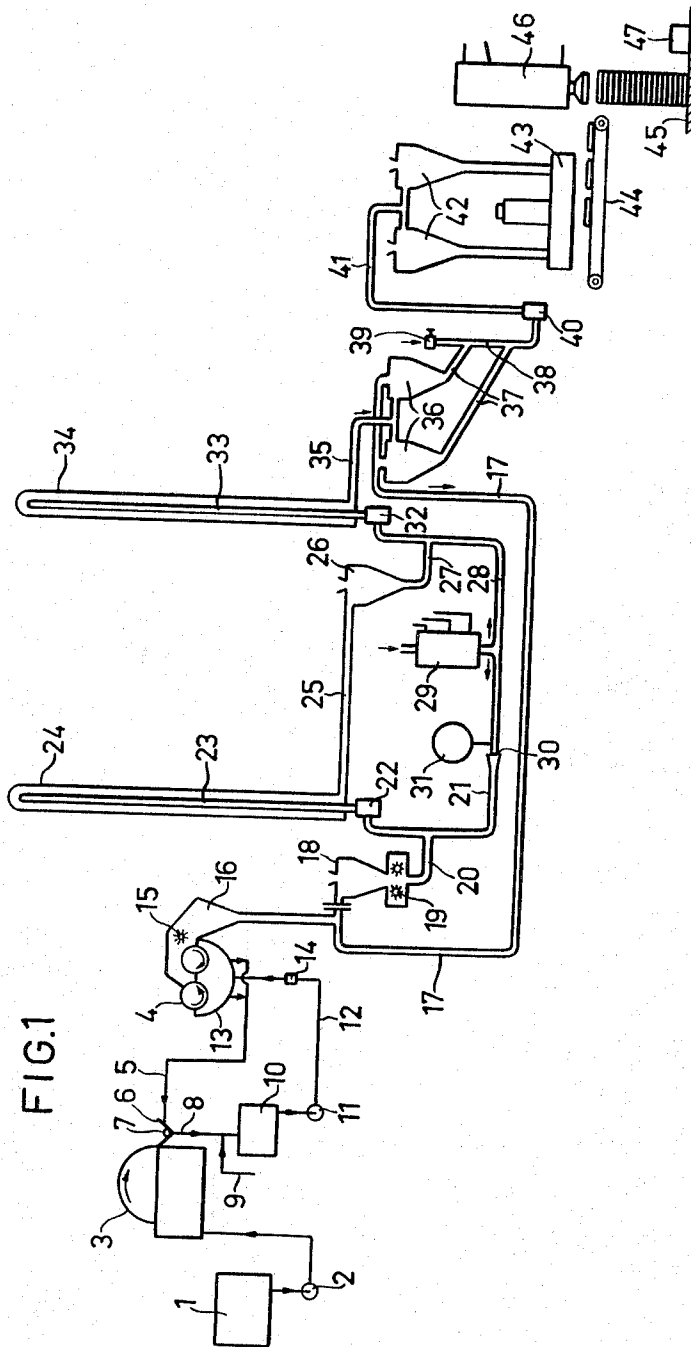
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CONTAIN LESS SHIVES THEREIN

3,316,141

2 Sheets-Sheet 1



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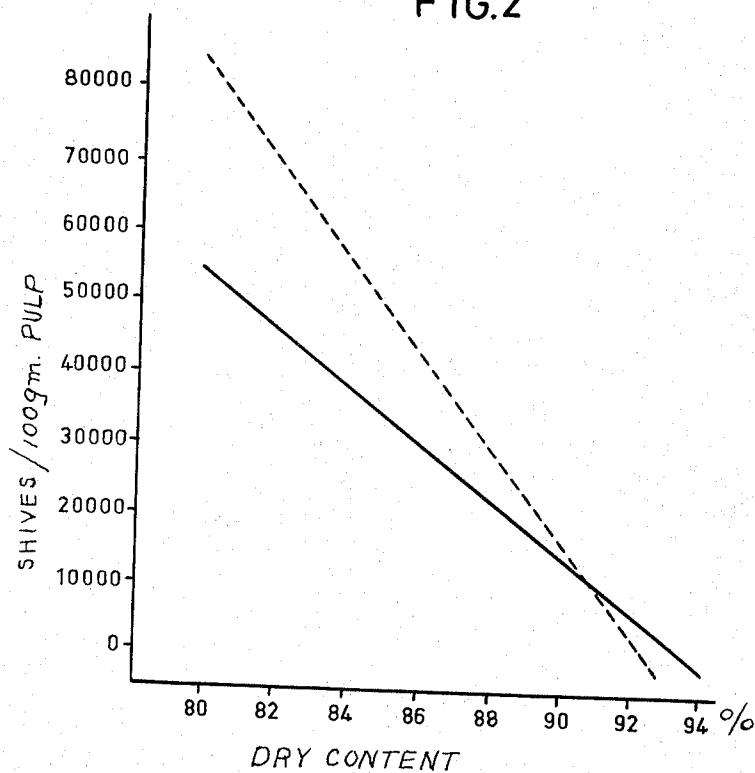
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2 Sheets-Sheet 2

FIG. 2



3,316,141

PROCESS OF DEWATERING SULPHATE PULP TO CONTAIN LESS SHIVES THEREIN

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2 Claims. (Cl. 162—100)

So-called flash dried cellulose pulp, in the state in which it is delivered from the mill, like pulp dried in the conventional manner, always contains small bundles of fibers, so-called shives, which are more or less difficult to defiber in connection with the pulping of the pulp in the paper mill. Depending upon the dimensions and the compressibility of the shives and also depending on the thickness of the paper the shives are the cause of more or less conspicuous spots in the uncalendered paper, such spots, under unfavorable conditions, showing up in the calendered paper as greasy blotches, so-called "fish eyes." Due to the fact that the method of flash drying pulp is a comparatively recent one, it has not, of course, been possible as yet to work out the solutions of the shives problem in connection with the flash drying method in the same thorough way as has been done in connection with the conventional drying method.

By the present invention, which relates to a method of dewatering cellulose pulp, especially unbleached sulphate pulp, it is possible to produce a flash dried pulp having a shives level which is acceptable to exacting customers. This is achieved by dewatering, in one step in a press, a pulp of at least 1% concentration, in such a manner that the pressed pulp will have a dry content of 40–60, preferentially 47–52, percent by weight, that the pressed material is subjected to a fluffing operation and that the fluffed material is caused, in at least one step, to accompany a heated gas until its average dry content amounts to 90–95, preferentially to 91.5–93.5, percent by weight.

A detailed description of the invention will be given below, reference being had therein to the accompanying drawings, in which

FIGURE 1 shows, diagrammatically, a flash drying plant and

FIGURE 2 shows a diagram of the number of shives in evenly and unevenly dried pulps.

The pulp consists of a sulphite-, a sulphate- or a semi-chemical pulp, produced in any conventional manner. After washing and screening the pulp is subjected to mechanical treatment in Kollergangs or other equivalent devices. After dilution the pulp is transferred to a vat 1, from where it is, by means of a pump 2, caused to flow to a rotary drum filter 3. After the filter 3 the pulp is diluted with backwater from a press 4 of any optional kind. The backwater, which immediately after the press has a temperature of 50–70° C., through a conduit 5 is transferred to a trough 6 arranged beside the filter 3, a feed screw 7 in said trough causing the pulp to move to a pipe 8. Within the pipe 8 the pulp is acidified by means of, for instance, a water solution of SO₂, which is supplied through a conduit 9. The pulp is then transferred to a vat 10 from where it is, by means of a pump 11 and through a conduit 12 transferred to the trough 13 of the press. A device (not shown) keeps the concentration of the pulp in the conduit 12 at the desired value. In the conduit 12 there is, moreover, provided a flow meter 14, which controls the motor of the pump 11 in such a manner that a predetermined amount of pulp is, per unit of time, supplied to the trough 13 of the press.

In the press 4, which in FIGURE 1 is designed as a calender, the rolls are tight against the trough 13 in such a manner that the pulp suspension in the trough 13 will be under pressure. The pressure of liquid in the trough 13 and the lineal pressure between the rolls of the press 4 are adjusted automatically to the desired values by means of adjusting means (not shown).

After the dewatering step the web of pulp coming from the press 4 is roughly shredded by a rough shredder, such as a spike roll 15. After the shredding the pulp is conveyed to a vertical pipe 16—which conveying operation may be carried out by means of an endless belt (not shown)—and at the bottom opening of said pipe 16 the pulp is suspended in air coming from a pipe 17, said air having been heated up to a temperature of 110°–160° C., preferentially to 130°–150° C. A fan (not shown) transfers the material, suspended in air, to a separator 18, in which the main part (90–95%) of the moist transportation air is separated from the pulp, which is then fluffed by means of rotating fluffing rolls 19.

After the fluffing operation the pulp is conveyed through a pipe 20 and is caused to travel together with a current of gas, which comes from a pipe 21 and which has been heated up to a temperature of between 250°–400° C., preferably to 275°–315° C., preferentially to 280°–300° C. A fan 22 transfers the pulp, suspended in the heated air, to a vertical pipe 23, which is surrounded by a pipe 24 closed at its upper end. The suspended pulp is conveyed upwards within the pipe 23 until it is deflected by the upper closed end of the pipe 24 and caused to descend through the annular space between the two concentric pipes 23 and 24. Through the pipe 20 there is conveyed 1.5–3.75 tons of pulp (calculated as 90% dry) per hour. This amount of pulp is suspended in 20,000–60,000 cu. m. of gas per hour, said quantity of gas being conveyed through the pipe 21.

After having passed through the drying tower, consisting of the pipes 23 and 24, the suspended pulp is conveyed through a pipe 25 to a separator 26, in which the major part (90–95%) of the gas is separated. The gas leaves the separator 26 at a temperature of 125°–160° C.

From the separator 26 the pulp is conveyed through a pipe 27, at the mouth of which the pulp is suspended in air, heated up to 100°–250° C., preferably to 160°–180° C., which is supplied in an amount of 20,000–60,000 cu. m./hr. and which comes from a pipe 28. This quantity of air is heated by vapor in a heat exchanger 29. The quantity of gas conveyed through the pipe 21 is obtained partly from the heat exchanger 29, partly from a burner 30 which is fed with oil from a tank 31.

A fan 32 conveys the air-suspended pulp to a drying tower, consisting of two concentric pipes 33 and 34, from where the pulp, through a pipe 35, is conveyed to separators 36, where part (40–60%) of the air is separated at a temperature of 110°–160° C., preferably at 130°–150° C. The separated air is conveyed through the pipe 17 to the lower part of the pipe 16 where it will then serve as transportation air for the freely falling pulp coming from the pipe 16.

From the separators 36 the pulp, through pipes 37, is conveyed into a pipe 38 the free end of which is provided with a valve 39, controlling a supply of cold air to the pipe 38. The mixture of pulp and air is then, by means of a fan 40, conveyed through a pipe 41 to separators 42. During its transportation from the separators 36 to the separators 42 the pulp is cooled in such a manner that during the pressing operation in a sheet press 43 the temperature of the pulp is 25°–95° C., preferably 30°–60° C. Should the pulp become too voluminous because of cooling by the cold air from the valve 39, said valve

ould be wholly or partly shut. In case the valve is shut, the temperature of the air leaving the separators 42 amounts to 20–90° C. From the sheet press 43, producing sheets weighing about 25 kgs., the sheets are, by means of a conveyor 44, transported to a receptacle 45 in which ix or seven sheets are automatically stacked, one on the other to form a pile, which after weighing is compressed by a baling press 46. Having been provided with a cover, which is fixed by straps, the bale of pulp 47 is moved out of the mill.

A shive, occurring in flash-dried cellulose pulp, consists of a number of curved fibers which, because of the pressing operation, lie more or less parallel to each other. Moreover, the fibers forming a shive are more or less tightly packed. When a shive causes a "fish eye" in the calendered paper it possesses a certain incompressibility and a certain thickness in relation to the thickness of the paper. In case a shive is thick enough and incompressible in relation to the thickness of the paper, it will fall out and make a hole in the calendered paper. In a bale of flash dried pulp the shives are more or less uniformly distributed in the bale. During the drying in the pipes 23, 24 and 33, 34 the shives dry more slowly than the disengaged fibers. In storage there will take place, within the bale, an equalization of moisture between fibers and bundles of fibers (shives) of differing dry content. During such equalization of moisture the number of shives in the bale of pulp will increase.

There are several ways of handling the shives problem. These ways may be divided into measures resulting in that the formation of shives is avoided, and measures, resulting in already formed shives becoming broken up. Among the measures, resulting in that the formation of shives is avoided, the following may be mentioned:

(1) The pulp in the press trough 13 is freed from shives by screening et cetera. The shives are not formed until in connection with the dewatering by pressing. On cooking the pulp care should be taken that the chlorine number of the pulp will be as low as possible. As a matter of fact the binding power between the fibers, forming a shive and extending substantially parallel to each other due to the pressing operation, will decrease with a sinking chlorine number of the pulp in the press trough 13. For example, in case of unbleached sulphate pulp, it has been found suitable to keep the chlorine number at a value of 2–10, preferably at 5.0–5.6.

(2) A pulp which is, practically speaking, free from shives will be obtained after the pressing, if the concentration of the pulp in the press trough 13 is so low that the flow of pulp is laminar. This happens when the concentration of the pulp is below 1.0 percent by weight. However, the capacity of the press will become insufficient, if the concentration of the pulp is allowed to go below 1.0 percent by weight. In addition, the fiber losses in connection with the pressing will increase with decreasing concentration. Therefore, for reasons of capacity and economy, it is suitable to give to the pulp in the press trough 13 a concentration of 2.5–4.5%.

(3) The orientation of the fibers in connection with the pressing and, hence, also the level of shives is influenced in a favorable manner, if the stored pulp shows an acid reaction, i.e. if the concentration of hydrogen ions in an aqueous suspension of a baled pulp, which has been stored to a sufficient extent, is within the limits 5.0–7.0, preferably 6.3–6.7. The degree of acidity of the baled pulp is adjusted preferably so that the pH-value of the backwater coming from the press 4 and conveyed through the pipe 5 is kept within the limits 3.0–7.0. In that case the less thorough the wash of the pulp, the lower should be the pH-value of the backwater.

(4) The amount of shives in the finished pulp varies in relation to the temperature of the pulp while the same is being subjected to dewatering in the press 4. If the temperature of the pulp in the press trough 13 is increased then a higher dry content of the pulp will be obtained after the press 4. In case of one and the same

dry content of the pulp after the press 4 this means that the lineal pressure and, hence, also the formation of shives between the rolls of the press 4 may be reduced according as the temperature of the pulp in the press trough 13 is increased. The temperature of the pulp in the press trough 13 of the press 4 is kept at a temperature of 60°–100° C., preferably at 75°–85° C.

(5) The amount of shives in the finished pulp will be less, if the pulp is evenly distributed at the moment of pressing than if it were unevenly distributed. At the press 4 said even distribution may be obtained by the use of certain insets controlling the flow of pulp in the nip between the rolls, or by subjecting the pulp in the press nip to vibrations, ultrasonics etc.

(6) The amount of shives in the finished pulp increases in relation to the dry content of the pulp coming from the press 4. If the pulp is dewatered in the press 4 to such a high degree that after the pressing operation the dry content will be above 60% then there is obtained such a considerable amount of shives in the finished pulp that subsequent treatments of the pulp will not be able to reduce the number of shives to an acceptable level. In the press 4, shown in FIGURE 1, the dry content of the pulp immediately after the press is kept at 40–60, preferably at 47–52, percent by weight.

(7) During the storing there takes place an equalization of moisture between moist and dry parts, shives et cetera in the pulp. By this equalization of moisture (ageing) the amount of shives in the pulp will increase. The amount of shives will increase still further if the pulp is stored in an atmosphere of an abnormally increased temperature and/or humidity. Consequently, the pulp should not be stored in a place having a higher temperature and/or humidity than what corresponds to the local climate. Moreover, the pulp should be protected against rain and snow.

Among measures leading to the breaking up of already existing shives in the pulp the following may be mentioned:

(1) Part of the shives are broken up during the fluffing of the pulp, said fluffing being required in order to make it possible to flash dry the pulp. However, the fluffing rolls 19, hitherto used, fluff the coherent mat or web of pulp coming from the press 4 so insufficiently that only 1.5–2.5% of the web of pulp fluffed by the fluffing rolls 19 consists of disengaged fibers, which means that a great number of shives have remained uninfluenced by the fluffing parts of the rolls 19. The better the rolls 19 are able to disengage the fibers the lower can be kept the final average dry content of the pulp.

The fluffing of the pulp may also be combined with a separation treatment. As a matter of fact, if the pulp, coming from a fluffer (not shown), is led away tangentially in a path, which is horizontal from the beginning, those fibers which are disengaged in a higher degree fall down into a hopper located beside the fluffer and the fibers which are not disengaged in such a high degree fall into a hopper, which is located farther on in the direction of said path and which is, moreover, located quite near said first-mentioned fluffer. The fibers which are disengaged in a higher degree are subjected to flash drying, the less disengaged fibers being returned to the inlet opening of the fluffer.

(2) Most of the shives are dissolved, if the pulp is given a sufficiently high average dry content. The higher the average dry content, given to the pulp on account of the flash drying, the greater the tendency of the fibers of a shive to become disengaged or separated from each other. The number of shives in a fluffed pulp containing 1.5–2.5% of disengaged fibers will sink to an acceptable level, if the flash drying is carried out in such manner that the average dry content of the pulp amounts to 90–95, preferably to 91.5–93.5, percent by weight. This average dry content may be lowered to a considerable degree if the fiber disengaging effect of the fluffing roll 19

is increased or if the shives are removed before the pulp is flash dried.

The maximum shives dissolving effect at each average dry content of the finally dried pulp is obtained, if the pulp is dried as evenly as possible. The results of, inter alia, the following tests may serve as examples.

A. Samples of varying dry contents were taken from a flash dried unbleached sulphate pulp. Then the samples were dried in such a manner that all fibers of each sample receive the same dry content. The following values were then obtained.

Dry content, percent	Amount of shives, number/100 gm. of pulp	Shives weight, mg./100 g. of pulp	Shives weight, mg./apiece
80	52,400	7,932	0.151
84	35,500	5,314	0.150
86	32,000	5,022	0.157
88	21,300	1,428	0.067
90	14,500	1,246	0.086
92	6,800	690	0.099

B. 80 parts by weight of an 86 percent dry pulp and one 92 percent dry pulp were added to 20 parts by weight of a pulp having a varying dry content. The following values were then obtained:

Dry content, percent 80 parts	Dry content, percent 20 parts	Average dry content of the mixture	Estimated amount of shives acc. to the above table	Found amount of shives, number/100 gm. of mixture	Shives weight, mg./100 gm. of mixture	Shives weight, mg./apiece
86	80	84.8	36,100	54,100	8,092	0.150
86	84	85.6	32,700	43,900	5,786	0.132
86	88	86.4	29,850	40,600	5,384	0.133
86	90	86.8	28,500	39,200	5,150	0.131
92	92	87.2	26,960	33,500	4,888	0.146
92	80	89.6	15,950	19,500	1,790	0.101
92	84	90.4	12,550	15,600	1,800	0.115
92	86	90.8	11,850	14,700	1,756	0.120
92	88	91.2	9,700	10,100	1,170	0.116
92	90	91.6	8,350	6,000	700	0.117

FIGURE 2 illustrates the relationship between the number of shives per 100 gm. of pulp and the average dry content of the final pulp. The unbroken line indicates the values of pulps produced in accordance with point A and the dashed line indicates pulps produced in accordance with point B. From FIGURE 2 it will appear, inter alia, that the lower the average dry content of the pulp the greater the risks of having a great difference between the moistest and the driest parts of the pulp, which means that the pulp should be dried as evenly as possible. This can be done by drying the pulp, before pressing, or before storing the pulp without having been pressed, in an apparatus of the kind disclosed in, for instance, the Swedish patent specification No. 131,307, or also so that the bundles of fibers in the pulp coming from the drying towers are separated and dried, or by

subjecting the bundles of fibers to a selective, electric drying, preferably dielectric drying, drying by radiation et cetera. Moreover, it may be convenient, immediately before pressing the pulp or storing the pulp without having subjected it to pressing, to transfer the pulp onto an endless, perforated belt on which it is subjected to a moisture equalizing drying operation by means of conditioned air, which preferably is, entirely or partly, taken from the separator 26 and which preferably is led in counter-current to the pulp. Thus the temperature of the air, its humidity et cetera may be adjusted in such a manner that either the average dry content of the pulp is increased or also in such a manner that both the dry content of the bundles of fibers is increased and the dry content of the remaining fibers in the pulp is lowered.

Having now described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A process for manufacturing sulphate cellulose pulp which comprises dewatering a pulp having a dry solids content of at least 1% by weight and not more than about 4.5% by weight by a pressing operation to a pressed pulp having a dry solids content of 40-60%, subjecting the resulting pressed pulp to a fluffing operation, and drying the resulting fluffed pulp and contacting it concurrently with a heated drying gas until its average dry content is 90 to 95% by weight, the pulp slurry prior

to the dewatering step being acidified so that the pH of the water in the dewatering step is 3-7 and the pH of a baled and stored pulp is 5-7.

2. A process as claimed in claim 1 in which the pulp slurry is acidified so that the pH of a baled and stored pulp is 6.3-6.7.

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