

PATENT SPECIFICATION

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(54) METHOD AND APPARATUS FOR DEWATERING A SUSPENSION

(71) We, REDERIAKTIEBOLAGET NORD-STJERNAN, a Swedish joint-stock company of 3, Stureplan, Stockholm, Sweden, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method and an apparatus for removing liquid from a suspension by pressing said materials under high pressure, thereby obtaining a comparatively high dry content. The invention has particular but not exclusive application to dewatering aqueous suspensions.

It is commonly known to press a slurry between a wire cloth web and a roll, about which the wire cloth web runs in order to remove some of the liquid content of the slurry. It is also known to introduce the slurry between two wire cloth webs, of which at least one web is pervious to the liquid phase, and to press these webs together by passage about one or several rolls to squeeze the slurry and thereby remove liquid therefrom.

The squeezing pressure to which the slurry is subjected when using the above-mentioned known process is partly a function of the stretch to which the wire cloth webs may be exerted. A wire cloth web, however, has a troublesomely limited strength and particularly difficulties exist in joining the ends of the web so that the joint does not form a substantially weakened part of the web. The squeezing pressure is also a function of the diameter of the roll, which the web encloses, so that a smaller diameter causes a higher squeezing pressure on the slurry. Smaller rolls, however, involve a shorter squeezing pressure length and thereby shorter time during which the slurry is subjected to the said increased pressure. As will be described more in detail below, the

time factor also has a certain significance for liquid removal.

It is also known to exert increased pressure upon the slurry by arrangement of pressure rollers or other mechanical devices at locations where the webs enclose a roll to press against the outer web relative to said roll and thus against the slurry. Such an arrangement is for instance disclosed in Swedish Patent Specification No. 109,941 and U.S. Patent Specification No. 2,711,130. The pressure thus caused, however, is momentary and only a small part of the water will be pressed out of the slurry before the additional pressure again is released.

As mentioned above, the time factor has a certain significance upon liquid removal. It has been proved that the time during which an aqueous slurry is subjected to a certain pressure initially has a substantial effect on dewatering but the longer the time is extended the less this effect means. This is illustrated in Fig. 1 of the accompanying drawings, in which Figure graphs showing obtained dry content (as ordinate) as a function of time (as abscissa) are shown. Curve A shows a representative dewatering course when slurry is subjected to a certain constant pressure. If the pressure is doubled another course, curve B is obtained. Both these curves show a dewatering more and more decreasing with time and they approach asymptotically a maximum value for the dry content at each pressure. If the pressure is further increased discontinuities arise, for instance as shown with curve C which shows that the slurry particles at a certain pressure obviously close the passage for the water to drain. It is instead possible to dewater at the beginning along for instance curve B, release the pressure and thereafter increase the pressure further, whereby a course illustrated by curve D can be obtained.

The object of the present invention is to eliminate or at least reduce the above men-

tioned difficulties and drawbacks of the prior art and to obtain a relatively higher dewatering effect.

According to the present invention, there is provided apparatus for removing liquid from a suspension, said apparatus comprising

a pair of endless webs movable together along a pressure path to convey the suspension therebetween;

an inlet for introducing between the said webs at the upstream end of the said pressure path the suspension to be treated;

an outlet for discharging from between the said webs at the downstream end of the said pressure path the treated suspension;

"first" pressure means urging the said webs together at a "first" pressure station in the said pressure path to apply a "first" pressure to the suspension carried between the said webs to remove a portion of the liquid therefrom;

"second" pressure means urging the said webs together at a "second" pressure station in the said pressure path downstream of the said "first" pressure station, said "second" pressure means comprising a press roll having a substantially continuous circumferential surface about which the said webs pass for a substantial proportion of its circumference, and

pressure belt means cooperating with the second but not the first of said two pressure means and extending along at least a substantial part of the press roll-abutting path of the webs to apply pressure greater than the said first pressure along transversely spaced paths to urge the webs together and against the press-roll at substantially constant pressure along the length of each respective path to enhance removal of further liquid from the suspension;

the outer web relative to the said press roll being pervious to the liquid whereby liquid from the suspension passes through the outer web between said transversely spaced paths. Preferably, the pressure belt means comprises a plurality of transversely spaced longitudinally extending band-shaped elements.

The invention also provides a method of removing liquid from a suspension which comprises conveying the suspension between the said webs of apparatus of the invention and subjecting the suspension to said first and second pressures at said first and second pressure stations respectively.

As mentioned above, the time factor has an essential significance upon the dewatering effect. It is accordingly appropriate to have the webs enclosing and being pressed in the direction towards the press roll about as large part of the press roll circumference as is practically possible. An enclosing angle of 180° or more is accordingly advantageous

and the present invention admits large enclosing angles.

Preferably, means are provided for adjusting the pressure applied by the pressure belt means in order to adapt said pressure to suspensions of different kinds.

Suitably, means are provided for causing the pressure belt means to exert greater pressure along outer pressure paths than along intermediate pressure paths, thereby ensuring that the suspension layer, which usually is thinned out towards the edges of the webs, is pressed with sufficient and required pressure and moreover hindering the flow of suspension towards the edges of the webs.

Advantageously, the band-shaped elements are elastic and/or the transversely spaced paths are mutually parallel.

Usually, the pressure belt means will be movable with the webs to be stationary with respect thereto along the said transversely spacing paths.

The webs and pressure belt means suitably pass about each of a pair of common guide rolls located one before and one after the press roll.

Preferably, the spacing between the transversely spaced paths is less than 20% of the width of said paths.

Desirably, the first pressure means comprises a press roll having a substantially continuous circumferential surface about which the pair of webs pass for a substantial proportion of its circumference.

The following is a description by way of example only and with reference to the accompanying drawings of preferred embodiments of the present invention. In the drawings:—

Fig. 1 is the above described graph of obtained dry content (as ordinate) as a function of time (as abscissa);

Fig. 2 is a schematic side view of a wire cloth press according to one preferred embodiment of the invention;

Figs. 3 and 4 are plan and part-sectional views respectively of part of the wire cloth press of Fig. 2 on an enlarged scale, and

Fig. 5 is a lateral schematic view corresponding to Fig. 2 of a wire cloth press according to another preferred embodiment of the invention.

In both embodiments shown in Figs. 2 and 5 two endless wire cloth webs 1 and 2 run in common along a pressure path located between an inlet (illustrated by arrow I) for the suspension to be dewatered and an outlet (arrow II) for the dewatered suspension and thereafter run over guide rolls 4 along respective separate inoperative paths. Along the pressure path a first dewatering takes place by passing the webs with the suspension therebetween in a manner known *per se* over a selected number

of rolls 3 to partly enclose these rolls. The pressure here being applied on the suspension is dependent on the stretch to which the webs are subjected and as such its magnitude is limited. This web stretch can be adjusted within certain limits, for instance by moving at least one of the guide rolls 4.

In accordance with the present invention, an essentially increased pressure is applied on the suspension between the webs 1 and 2 in the pressure path at a press roll 5 by means of a number of parallel band-shaped elements 6, preferably elastic belts. The belts run over the same rolls 3a as are guiding the webs in front of and behind the press roll 5 and also run over a stretch roll 7. In this way the belts abut under pressure the outer web relative to the press roll 5 along substantially the same length as the webs enclose the press roll. The stretch roll 7 and also the rolls 3a preferably are grooved in order to maintain the belts parallelly spaced. By moving the stretch roll 7, as shown with arrow III, for instance by means of spring or other mechanical devices, the pressure of the belts against the outer web can be adjusted. Fig. 3 shows in plan view and enlarged scale the press roll 5 and the stretch roll 7 and shows also in a schematic manner springs 8 as a device for bringing about the required pressure of the belts 6 against the outer web.

Fig. 4 shows a part section of the press roll 5 and shows on the surface of the roll the inner web 2, the suspension layer 9, the outer web 1 and the belts 6.

Fig. 5 illustrates an embodiment having two press rolls 5. This embodiment preferably is used when the press time needs to be extended without reducing the capacity of the wire cloth press.

As is evident from Fig. 3 and 4 the belts 6 are arranged with a distance between each other. This distance is chosen to be sufficiently large to allow the water pressed out of the suspension to flow out during the effective press-time. The distance is, however, also sufficiently small to keep the outer web between the belts stretched such that a substantial pressure also exists between the belts. The distance between the belts should preferably be less than 20% of the belt width. The belts may consist of many different materials, such as rubber, plastic, and the belts may also be reinforced or in some other manner strengthened. It is advantageous that the belts have a certain elasticity. As indicated in Fig. 4, the suspension layer can have varying thickness along the web width. Usually, the suspension layer is thinned out towards the web edges. With an adjusted elasticity of the belts such a thinner suspension layer will be subjected to a sufficient pressure for dewatering. It is, however, also possible to provide the

outer belts with increased stress by means of extra stress rolls or other devices and thereby also hinder the suspension from flowing out towards the web edges.

The friction between the bands and the outer web is in most cases sufficient for the driving of the bands. If desired, however, a special drive may be provided to drive the bands and in such a case the band drive should be synchronized with the drive (not shown) for the webs. If comparatively wide bands are used, such bands may furthermore be provided with holes or slots.

In order to obtain as effective dewatering as possible and also in a constructional point of view it is advisable to have the bands pressing against the outer web along substantially the same length as the webs enclose the press roll, i.e. as shown in Figs. 2 and 5. It is, however, also possible to have the bands pressing against only a part of said web enclosing length, in which case separate guide rolls for the bands are arranged.

The pressure exerted on the suspension only by means of web tension without the use of an apparatus according to the invention, is in the order of magnitude of 1-2 kp/cm². The abbreviation "kp" represents "kilopound" which is 1000 kilograms, i.e. a tonne. By means of an apparatus according to the invention, however, considerably higher pressure can be obtained. For many kinds of slurries a pressure of 5-10 kp/cm² ought to be sufficient. Considerably higher pressure, 30-35 kp/cm², can, however, be applied when necessary.

Compared with wire cloth presses according to prior art it has been proved that when using a wire cloth press including the band press according to the invention very high dry contents have been reached. For many kinds of slurries from wastewater treatment works dry contents of substantially over 30% have been obtained when using a slurry press constructed in accordance with the invention. For certain kinds of slurries it has been possible to reach dry contents between 40-55%. It is of interest to compare these dry content values obtained when using an apparatus according to the invention with the dry contents obtained for similar slurries when using slurry presses according to the prior art described in the introductory part of the description. Thus, a dry content of about 20% is obtained upon dewatering between two webs running over a number of rolls and about 25% if in addition a pressing against the webs by means of pressure roller is carried out.

A collecting vessel (not shown) for the pressed out water can be arranged in some manner shown *per se*. To be able to reach the high dry contents, which become more and most desirably, among other things

from a transportation point of view, it is advantageous to remove the pressed out water before the pressure is relieved. This can be carried out by blowing or sucking away the water by means of a strong air stream guided over the web between the belts.

As is evident from embodiments shown in Figs. 2 and 5, at predewatering of the suspension takes place before the press roll or rolls 5 by means of rolls 3. Such a predewatering can be carried out by means of other devices than rolls corresponding to the rolls 3.

The invention, of course, is not restricted to the embodiments described above and shown in the drawings, but can be varied in several ways within the scope of the following Claims in order to achieve the desired dewatering effect by subjecting the suspension between the webs enclosing the press roll to the additional pressing along spaced apart paths. For example, the bands can be connected to each other by means of elastic soft connections in order to facilitate the guidance of the bands along their paths.

WHAT WE CLAIM IS:—

1. Apparatus for removing liquid from a suspension, said apparatus comprising a pair of endless webs movable together along a pressure path to convey the suspension therebetween;

an inlet for introducing between the said webs at the upstream end of the said pressure path the suspension to be treated;

an outlet for discharging from between the said webs at the downstream end of the said pressure path the treated suspension;

"first" pressure means urging the said webs together at a "first" pressure station in the said pressure path to apply a "first" pressure to the suspension carried between the said webs to remove a portion of the liquid therefrom;

"second" pressure means urging the said webs together at a "second" pressure station in the said pressure path downstream of the said "first" pressure station, said "second" pressure means comprising a press roll having a substantially continuous circumferential surface about which the said webs pass for a substantial proportion of its circumference; and

pressure belt means cooperating with the second but not the first of said two pressure means and extending along at least a substantial part of the press roll-abutting path of the webs to apply pressure greater than the said first pressure along transversely spaced paths to urge the webs together and

against the press roll at substantially constant pressure along the length of each respective path to enhance removal of further liquid from the suspension.

the outer web relative to the said press roll being pervious to the liquid whereby liquid from the suspension passes through the outer web between said transversely spaced paths.

2. Apparatus as claimed in Claim 1 wherein the said pressure belt means comprises a plurality of transversely spaced longitudinally extending band-shaped elements.

3. Apparatus as claimed in Claim 2 wherein the said elements are elastic.

4. Apparatus as claimed in any one of the preceding Claims wherein the said transversely spaced paths are mutually parallel.

5. Apparatus as claimed in any one of the preceding Claims including means for adjusting the pressure applied to the said webs by the said pressure belt means.

6. Apparatus as claimed in any one of the preceding Claims wherein the said pressure belt means is movable with the said webs to be stationary with respect thereto along the said transversely spaced paths.

7. Apparatus as claimed in Claim 6 wherein the said webs and pressure belt means pass about each of a pair of common guide rolls located one before and one after the said press roll.

8. Apparatus as claimed in any one of the preceding Claims including means for causing the pressure belt means to exert greater pressure along the outer paths of the said transversely spaced paths than along the intermediate paths of the said transversely spaced paths.

9. Apparatus as claimed in any one of the preceding Claims wherein the said webs enclose the press roll with an enclosing angle of at least 180°.

10. Apparatus as claimed in any one of the preceding Claims wherein the spacing between the said transversely spaced paths is less than 20% of the width of the said transversely spaced paths.

11. Apparatus as claimed in any one of the preceding Claims wherein the said first pressure means comprises a press roll having a substantially continuous circumferential surface about which the said pair of webs pass for a substantial proportion of its circumference.

12. Apparatus as claimed in Claim 1 and substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.



from a transportation point of view, it is advantageous to remove the pressed out water before the pressure is relieved. This can be carried out by blowing or sucking away the water by means of a strong air stream guided over the web between the belts.

As is evident from embodiments shown in Figs. 2 and 5, at predewatering of the suspension takes place before the press roll or rolls 5 by means of rolls 3. Such a predewatering can be carried out by means of other devices than rolls corresponding to the rolls 3.

The invention, of course, is not restricted to the embodiments described above and shown in the drawings, but can be varied in several ways within the scope of the following Claims in order to achieve the desired dewatering effect by subjecting the suspension between the webs enclosing the press roll to the additional pressing along spaced apart paths. For example, the bands can be connected to each other by means of elastic soft connections in order to facilitate the guidance of the bands along their paths.

WHAT WE CLAIM IS:—

1. Apparatus for removing liquid from a suspension, said apparatus comprising a pair of endless webs movable together along a pressure path to convey the suspension therebetween;

an inlet for introducing between the said webs at the upstream end of the said pressure path the suspension to be treated;

an outlet for discharging from between the said webs at the downstream end of the said pressure path the treated suspension;

"first" pressure means urging the said webs together at a "first" pressure station in the said pressure path to apply a "first" pressure to the suspension carried between the said webs to remove a portion of the liquid therefrom;

"second" pressure means urging the said webs together at a "second" pressure station in the said pressure path downstream of the said "first" pressure station, said "second" pressure means comprising a press roll having a substantially continuous circumferential surface about which the said webs pass for a substantial proportion of its circumference; and

pressure belt means cooperating with the second but not the first of said two pressure means and extending along at least a substantial part of the press roll-abutting path of the webs to apply pressure greater than the said first pressure along transversely spaced paths to urge the webs together and

against the press roll at substantially constant pressure along the length of each respective path to enhance removal of further liquid from the suspension,

the outer web relative to the said press roll being pervious to the liquid whereby liquid from the suspension passes through the outer web between said transversely spaced paths.

2. Apparatus as claimed in Claim 1 wherein the said pressure belt means comprises a plurality of transversely spaced longitudinally extending band-shaped elements.

3. Apparatus as claimed in Claim 2 wherein the said elements are elastic.

4. Apparatus as claimed in any one of the preceding Claims wherein the said transversely spaced paths are mutually parallel.

5. Apparatus as claimed in any one of the preceding Claims including means for adjusting the pressure applied to the said webs by the said pressure belt means.

6. Apparatus as claimed in any one of the preceding Claims wherein the said pressure belt means is movable with the said webs to be stationary with respect thereto along the said transversely spaced paths.

7. Apparatus as claimed in Claim 6 wherein the said webs and pressure belt means pass about each of a pair of common guide rolls located one before and one after the said press roll.

8. Apparatus as claimed in any one of the preceding Claims including means for causing the pressure belt means to exert greater pressure along the outer paths of the said transversely spaced paths than along the intermediate paths of the said transversely spaced paths.

9. Apparatus as claimed in any one of the preceding Claims wherein the said webs enclose the press roll with an enclosing angle of at least 180°.

10. Apparatus as claimed in any one of the preceding Claims wherein the spacing between the said transversely spaced paths is less than 20% of the width of the said transversely spaced paths.

11. Apparatus as claimed in any one of the preceding Claims wherein the said first pressure means comprises a press roll having a substantially continuous circumferential surface about which the said pair of webs pass for a substantial proportion of its circumference.

12. Apparatus as claimed in Claim 1 and substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

13. A method of removing liquid from a suspension which comprises conveying the suspension between the said webs of an apparatus as claimed in any one of the preceding Claims and subjecting the suspension to said first and second pressure at said first and second pressure stations respectively.
14. A method as claimed in Claim 13 and substantially as hereinbefore described with 10 reference to the accompanying drawings.

W. H. BECK, GREENER & CO.,
Chartered Patent Agents,
7, Stone Buildings,
Lincoln's Inn,
London, WC2A 3SZ.
Agents for the Applicants.

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