

Method and Apparatus for Reducing the water content of Waste Water Sludge

FIELD OF THE INVENTION

5 This invention relates to a method and apparatus for reducing the water content of waste water sludge and in particular to a method and apparatus for reducing the water content of sludge from settlement or thickener tanks to permit recycling of the water. The term waste water sludge is used herein to describe waste water containing a relatively high proportion of fine suspended solids, such as silt or other
10 fine contaminants.

BACKGROUND OF THE INVENTION

Waste water streams containing entrained solid impurities and contaminants in
15 suspension are produced from numerous quarrying, mining, chemical or industrial processes. It is often desirable to reuse such water, particularly in regions prone to water shortages.

Before the waste water can be reused, the solid impurities and contaminants
20 (referred to as "fines") must be removed from the water, which is typically in the form of waste sludge from various treatment processes.

A particularly difficult waste water source to deal with is the overflow from hydrocyclones, which, as well as containing a lot of water, also contains very fine
25 solid particles suspended therein. Water is recycled from such material by the use of settlement or thickener tanks, wherein solids collect in the bottom of the tank as a sludge, typically through the use of flocculants. The sludge from the bottom of the settlement or thickener tank is typically dewatered by pressing the material to squeeze out the water while retaining the fines in a filter press or belt press.
30 However, the very fine solid material contained in the sludge tends to rapidly block such filtration materials. Furthermore, such belt filters or filter presses tend to be expensive to operating, having high energy consumption.

SUMMARY OF THE INVENTION

According to the present invention there is provided an apparatus for reducing the water content of waste water sludge comprising a column for receiving waste water sludge, an outlet at a lower end of the column, a first closure for closing the outlet of the column, a controller for controlling the opening and closing of the closure, the controller being adapted to open and close the first closure to periodically discharge amounts of settled fines from the lower end of the column, and a water outlet adapted to receive water overflowing from an upper end of the column.

10 The apparatus may further comprise a second closure located above the first closure, said controller being adapted to close the second closure before or when opening the first closure to retain waste water sludge in the column above the second closure while settled fines below the second closure are discharged from the lower end of the column.

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Preferably the first and/or second closures comprise gate valves.

The apparatus may further comprise sensor means for determining the level of settled fines within the column, said controller being adapted to control opening and closing of the first closure as a function of the level of settled fines within the column. The controller may be programmed to open the first closure to discharge settled fines from the lower end of the column when the sensor means determines that the level of settled fines is at a predetermined level within the column.

25 In one embodiment the controller may be adapted to close the second closure when the sensor means determines that the level of settled fines is at said predetermined level within the column. Said predetermined level is preferably at or above the position of the second closure within the column.

30 The sensor means may comprise one or more of an optical sensors or plurality of optical sensors detecting light transmission within the column; means for determining the torque applied to paddles or similar stirring means located at a predetermined height within the column; means for determining the weight of settled fines within a lower end of the column.

The water outlet may communicate with a peripheral weir at an upper end of the column. The water outlet may be provided in a peripheral water collection chamber extending around an upper end of the column.

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In one embodiment an inlet pipe may extend downwardly into an upper end of the column for delivering waste water sludge into the column with reduced turbulence and to prevent suspended solids from passing out of the water outlet. The inlet pipe may be arranged concentrically within the column.

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Preferably the column is defined by a tubular pipe, preferably having a constant diameter and/or cross sectional area along its length.

In one embodiment the column may be mounted substantially vertically on a support frame.

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A porous barrier may be provided for selectively closing a lower end of the column, said porous barrier communicating with a pressure reduction means for drawing water out of a lower end of the column through the porous barrier while retaining settled fines within the column. The controller may be adapted to bring the porous barrier into a position against the lower end of the column, retaining settled fines within the column, when the second closure is closed and the first closure is open to reduce the water content of settled fines located in the column below the second closure and to subsequently displace the porous barrier away from the lower end of the column to permit discharge of the settled fines from the column. In one embodiment the porous barrier may be defined by a belt of an endless belt conveyor adapted to receive and carry settled fines discharged from the lower end of the column.

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According to a further aspect of the present invention there is provided a method of for reducing the water content of waste water sludge comprising the steps of delivering waste water sludge into a column having an outlet at a lower end of the column and a first closure for closing the outlet of the column, permitting fines to settle to a lower end of the column and periodically opening the first closure to

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discharge amounts of settled fines from the lower end of the column while collecting water overflowing from an upper end of the column.

5 The method may further comprise the step of closing a second closure located in the column above the first closure when or before opening the first closure to retain waste water sludge in the column above the second closure while settled fines are discharged from the column.

10 The method may comprise step of closing a lower end of the column with a porous barrier communicating with a pressure reduction means for drawing water out of said settled fines through the porous barrier to reduce the water content of the settled fines before discharging said settled fines from the lower end of the column.

15 The first closure may be opened to discharge an amount of settled fines from the lower end of the column when sensor means determines that the settled fines have reached a predetermined level within the column.

The second closure may be closed to retain waste water sludge within the column and the first closure is opened to discharge an amount of settled fines from the 20 lower end of the column when the sensor means determines that the settled fines have reached a predetermined level within the column.

Preferably said predetermined level is at or above the level of the second closure.

25 BRIEF DESCRIPTION OF THE DRAWINGS

An apparatus for reducing the water content of waste water sludge in accordance with an embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which :-

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Figure 1 is a perspective view of an apparatus for reducing the water content of waste water sludge in accordance with an embodiment of the present invention;

Figure 2 is a further perspective view of the apparatus of Figure 1;

Figure 3 is a side view of the apparatus of Figure 1;

Figure 4 is a detailed side view of an upper end of the apparatus of Figure 1;

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Figure 5 is a detailed perspective view of an upper end of the apparatus of Figure 1;

Figure 6 is a detailed side view of a lower end of the apparatus of Figure 1;

10 Figure 7 is a detailed perspective view of a lower end of the apparatus of Figure 1;
and

Figure 8 is a plan view from above of the apparatus of Figure 1.

15 DETAILED DESCRIPTION OF THE DRAWINGS

An apparatus for reducing the water content of waste water sludge in accordance with an embodiment of the present invention, as illustrated in the drawings, comprises a vertically mounted hollow pipe defining a column 2 for receiving waste
20 water sludge via a coaxially arranged inlet tube 4 extending into an open upper end of the column 2 (see Figure 4) to reduce turbulence within the column and prevent suspended fines from being discharged from an upper end of the column. A buffer tank 6 is mounted above the inlet tube 4 having an inlet 8 in an upper part of a side wall thereon and an outlet 10 at a lower end of the buffer tank 6 to minimise
25 turbulence of the waste water sludge entering the column 2 to facilitate the settling of suspended fines from the waste water in the column 2. A shield 12 may be located over the inlet of the buffer tank to further reduce turbulence. Preferably the pipe has a substantially constant diameter and/or cross sectional area along its length.

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The upper end of the column defines a weir 14 over which clean water may overflow from the column 2, such water being collected in a peripheral water collection chamber 16 located around the upper end of the column 2 and preferably having a side wall extending about the upper end of the column. A drain outlet 18 is

provided in a bottom wall of the water collection chamber 16 for removing water for disposal or more preferably reuse.

5 A pair of vertically spaced first and second gate valves 20,22 are provided at a lower end of the column 2, each gate valve 20,22 having a valve member slidable between an open position, wherein the column is substantially unobstructed by the valve member, and a closed position, wherein the valve member blocks the column. Respective solenoid actuators 24,26 are provided for opening and closing each gate valve 20,22.

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The first gate valve 20 is provided adjacent a bottom end of the column and, when in a closed position, retains waste water sludge within the column, allowing fines to settle out of suspension to collect in a lower end of the column against the first gate valve 20. The second gate valve 22 is located above the first gate valve 20, the
15 second gate valve 22 being closable to retain waste water sludge within the column 2 while the first gate valve 20 is opened to discharge settled fines collected in the column in the space between the first and second gate valves 20,22. At least a lower portion of the column may be frustoconically shaped, with an increasing diameter towards the lower end of the column, to facilitate discharge of collected
20 solids therefrom.

Sensor means (not shown in the drawings) may be provided for determining the level of settled fines within the column 2. In the embodiment shown, said sensors may comprise optical sensors adapted to measure or detect light transmission
25 through the column. A transparent viewing window 28 is preferably provided in the side wall of the column 2 to permit optical sensors to be located on the outside of the column. Alternatively the level of settled fines within the lower end of the column may be monitored by sensing the torque demand of stirring paddles located within the column or by means of load cells determining the weight of collected fines
30 in the lower end of the column.

A controller (not shown) is provided for controlling the operation of the gate valves 20,22 to periodically remove amounts of settled fines from the lower end of the column 2, as will be described below in more detail.

In one embodiment, in use, waste water sludge, or other liquid containing suspended fine solid material, is passed into the column 2, via the buffer tank 6 and inlet tube 6. At such time the second gate valve 22 is open and the first gate valve 20 is closed to allow the fines to settle out of suspension and collect in the bottom of the column 2, against the closed first gate valve 20, while relatively clean water overflows over the weir 14 at the upper end of the column 2 to be collected in and subsequently discharged from the water collection chamber 16 via the drain outlet 18 thereof.

When the sensors detect that the collected solid material within the lower end of the column has reached a predetermined level within the column 2, preferably close to but above the second gate valve 22, the controller is programmed to close the second gate valve 22, retaining the sludge above the second gate valve 22 within the column 2, and open the first gate valve 20 to permit the collected fines located within the column 2 below the closed second gate valve 22 to be discharged from the lower end of the column 2. At least the portion of the column 2 between the first and second gate valves 20,22 may be frustoconically shaped (i.e. wider at the bottom than the top) to facilitate discharge of the settled fines from said portion.

A conveyor (not shown) may be positioned below the column 2 for receiving and removing the discharged fines. Alternatively the collected fines may be received by a hopper or bin located beneath the lower end of the column.

After a predetermined period of time, sufficient for the discharge of the collected fines, the controller closes the first gate valve 20 once again and opens the second gate valve 22 to allow a further batch of fines to settle within the column against the closed first gate valve before the process repeats to remove a further amount of settled fines.

While the use of sensors is described to determine when the level of settled fines reach a predetermined level within the column 2 to enable the controller to control the removal of the settled fines from the column 2 by means of the first and second gate valves 20,22, it is envisaged that controller may be programmed to operate the

first and second gate valves 20,22 to periodically discharge amounts of settled fines from the column 2 without the use of sensors using a timer, wherein the gate valves 20,22 and opened and closed after predetermined time periods determined sufficient for the required level of settled fines to be reached within the lower end of
5 the column 2.

In order to further reduce the water content of the fines removed from the column 2, it is envisaged that a porous barrier, preferably communicating with a vacuum, for example by mean of a vacuum pump, may be selectively brought into abutment with
10 the lower end of the column 2 with the second gate valve 22 closed and the first gate valve 20 open, drawing water through the porous barrier while the barrier serves to retain the collected solids within the lower end of the column. After a suitable period of time the porous barrier may be withdrawn to allow the dewatered settled fines to be discharged from the lower end of the column.

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In one embodiment it is envisaged that the porous barrier may be defined by the belt material of an endless belt conveyor, vertically moveable into and out of abutment with the lower end of the column. When the conveyor is moved to its lower position, out of abutment with the lower end of the column, the belt may serve
20 to convey the discharged fines away from the column. The suction applied to the belt material from withdrawing water from the settled fines may also serve to facilitate removal of the collected fines from the lower end of the column.

While present invention is described in relation to the removal of fines from waste
25 water, it is envisaged that the method and apparatus according to the present invention could equally be suitable for removing suspended solids, in particular solid contaminants, from any liquid, not limited to waste water, for example to allow the liquid to be reused or recycled to simply to remove contamination from the liquid to facilitate disposal thereof.

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The invention is not limited to the embodiment described herein but can be amended or modified without departing from the scope of the present invention as defined by the appended claims.

CLAIMS

1. An apparatus for reducing the water content of waste water sludge comprising a column for receiving waste water sludge, an outlet at a lower end of the column, a
5 first closure for closing the outlet of the column, a controller for controlling the opening and closing of the closure, the controller being adapted to open and close the first closure to periodically discharge amounts of settled fines from the lower end of the column, and a water outlet adapted to receive water overflowing from an upper end of the column, wherein a porous barrier is provided for selectively closing
10 a lower end of the column, said porous barrier communicating with a pressure reduction means for drawing water out of a lower end of the column through the porous barrier while retaining settled fines within the column.
2. An apparatus as claimed in claim 1, wherein said first closure comprise a gate
15 valve.
3. An apparatus as claimed in claim 1 or claim 2, further comprising a second closure located above the first closure, said controller being adapted to close the second closure before or when opening the first closure to retain waste water
20 sludge in the column above the second closure while settled fines below the second closure are discharged from the outlet at the lower end of the column.
4. An apparatus as claimed in claim 3, wherein the second closure comprises a
25 gate valve.
5. An apparatus as claimed in any preceding claim, further comprising sensor means for determining the level of settled fines within the column, said controller being adapted to control opening and closing of the first closure as a function of the level of settled fines within the column, wherein the controller is programmed to
30 open the first closure to discharge settled fines from the outlet at the lower end of the column when the sensor means determines that the level of settled fines is at a predetermined level within the column.

6. An apparatus as claimed in claim 5, when dependent upon claim 3 or claim 4, wherein the controller is adapted to close the second closure when the sensor means determines that the level of settled fines is at said predetermined level within the column, wherein said predetermined level is at or above the position of the
5 second closure within the column.

7. An apparatus as claimed in claim 5 or claim 6, wherein said sensor means comprises one or more of an optical sensors or plurality of optical sensors detecting light transmission within the column; means for determining the torque applied to
10 paddles or similar stirring means located at a predetermined height within the column; means for determining the weight of settled fines within a lower end of the column.

8. An apparatus as claimed in any preceding claim, wherein the water outlet
15 communicates with a peripheral weir at an upper end of the column, wherein said water outlet is provided in a peripheral water collection chamber extending around an upper end of the column.

9. An apparatus as claimed in any preceding claim, wherein an inlet pipe extends
20 downwardly into an upper end of the column for delivering waste water sludge into the column.

10. An apparatus as claimed in claim 9, wherein said inlet pipe is arranged concentrically within the column.

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11. An apparatus as claimed in any preceding claim, wherein the column is defined by a tubular pipe having a constant diameter and/or cross sectional area along its length.

30 12. An apparatus as claimed in any preceding claim, wherein the column is mounted vertically or substantially vertically on a support frame.

13. An apparatus as claimed in any preceding claim, when dependent upon claim 3, wherein the controller is adapted to bring the porous barrier into a position against the lower end of the column, retaining settled fines within the column, when the second closure is closed and the first closure is open to reduce the water
5 content of settled fines located in the column below the second closure and to subsequently displace the porous barrier away from the lower end of the column to permit discharge of the settled fines from the column.

14. An apparatus as claimed in claim 13, wherein said porous barrier is defined by
10 a belt of an endless belt conveyor adapted to received and carry settled fines discharged from the lower end of the column.

15. A method of reducing the water content of waste water sludge comprising the steps of delivering waste water sludge into a column having an outlet at a lower end
15 of the column and a first closure for closing the outlet of the column, permitting fines to settle to a lower end of the column; periodically opening the first closure under the control of a controller to discharge amounts of settled fines from the outlet at the lower end of the column while collecting water overflowing from an upper end of the column, and closing a lower end of the column with a porous barrier communicating
20 with a pressure reduction means for drawing water out of said settled fines through the porous barrier to reduce the water content of the settled fines before discharging said settled fines from the lower end of the column.