

SLUDGE DEWATERING METHOD

FIELD OF THE INVENTION

The present disclosure relates to a sludge dewatering process that makes it possible to achieve a high degree of dryness for a limited
5 electricity consumption.

Such a process may in particular be used to dewater sludge, the sludge derived from wastewater treatment plants for example, in preparation for the incineration thereof or the landfilling thereof.

10 PRIOR ART

Sludge, such as the sludge derived from wastewater treatment plants for example, is generally subjected to dewatering followed by recovery, as organic soil conditioner (land application of sludge) or by combustion (incineration), or burying at a landfill site. In the case of
15 combustion, the dryness of the sludge achieved at the end of the dewatering step, that is to say the ratio of dry matter relative to the total mass of sludge, should be sufficient to enable the combustion to be self-sustaining: a dryness of 30% to 45% is thus preferred. Similarly, in the case of landfilling, certain national legislations require a minimum degree
20 of dryness before landfilling of the sludge, of the order of 40% for example. The importance of developing effective dewatering processes is thus understood, in particular when the sludge is of a type that is difficult to dewater as is the case in particular for biological sludge from a wastewater treatment plant.

25 Among the known processes, some aim to mechanically dewater the sludge: these may be centrifugation or filtration processes under pressure, with in particular the use of a filter press or a belt filter. However, such processes are limited. For example, for wastewater treatment plant sludge, they make it possible to achieve dryness values of
30 only 15% to 40%; this maximum value of 40% only being achieved in rare cases with particularly effective devices and sludge that is particularly easy to treat (predominantly mineral sludge for example). Thus, for some sludge, such as biological sludge from a wastewater treatment plant, it is difficult to achieve a dryness of 30%, which may be insufficient depending
35 on the future of this sludge.

Other processes aim to thermally dewater the sludge: they then heat the sludge with the aim of drying it. These processes are very effective: depending on the heating temperature and the duration of the treatment, it is possible to achieve dryness values of the order of 90%.

5 However, these processes are highly energy-consuming and consume at least 700 kWh per tonne of water removed (kWh/tWR), or even more, whereas a mechanical process in general consumes less than 20 kWh/tWR depending on the type of technology (filter press, belt filter or centrifuge).

10 Finally, electrically-assisted mechanical dewatering processes, referred to as electro-dewatering processes, aim to filter a volume of sludge under pressure, for example in a filter press, by additionally applying an electric field. This electric field, added to the hydrolysis phenomenon that it creates, makes it possible to break the water-sludge bonds, facilitating the migration of the water molecules in the opposite
15 direction to the solid particles. Such electrical assistance therefore makes it possible to improve the dewatering of the sludge and thus to gain a few additional dryness points. However, such a process is confronted with certain difficulties in the case of certain sludge.

Specifically, during electro-dewatering, the sludge behaves as an
20 electrical resistance. And yet, in the case of certain sludge for which the electromobility and/or the amount of ions is low, a rapid rise in the electrical resistance of the sludge is observed. Consequently, via Joule effect and at constant intensity, the rapid rise in the electrical resistance of the sludge results in an increase in the temperature. The drier the sludge,
25 the lower the electromobility and therefore the higher the electrical resistance. This simultaneously leads to an increase in the temperature, in particular on the anode side which is the driest zone during the electro-dewatering. For this reason, the duration of such electro-dewatering operations is necessarily limited in time so as not to damage the electro-
30 dewatering device. Moreover, this increase in the electrical resistance at constant intensity, and consequently in the voltage, gives rise to significant energy losses.

Consequently, for such types of sludge, the increase in dryness is relatively small and not very advantageous considering the additional
35 electricity consumption invested.

There is therefore a real need for a sludge dewatering process that is free, at least partly, of the drawbacks inherent to the abovementioned known processes.

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BACKGROUND OF THE INVENTION

The present disclosure relates to a sludge dewatering process, comprising a step of chemical conditioning of the sludge to be dewatered during which a flocculation aid and a coagulant aid are added to the sludge, and an electro-dewatering step.

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Individually, the coagulant aids and the flocculation aids do not have a substantial effect on the operation and the effectiveness of an electro-dewatering process. On the other hand, the inventors have observed that their combined use in the conditioning of the sludge offers a synergistic effect that makes possible a significant increase in the effectiveness of the electro-dewatering step and therefore in the final dryness of the sludge.

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Specifically, when none or only one of these components is used, a rapid increase in the voltage at the terminals of the electrodes of the electro-dewatering device is customarily observed, which may then stabilize and drop back down or else achieve and peak at a maximum voltage value set by the operator to protect the electrodes. Consequently, this voltage peak, appearing practically immediately after the start of the electro-dewatering, leads to a rapid rise in the temperature of the sludge on the side where it is driest, that is to say on the anode side, which results in the premature shutdown of the electro-dewatering in order to prevent the deterioration of the device.

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Conversely, when a coagulant aid and a flocculation aid are combined, it is unexpectedly observed that the voltage peak customarily seen does not occur. On the contrary, the experiments carried out by the inventors have shown that the voltage began by dropping during the first minutes of electro-dewatering before rising again then stabilizing or dropping again. Consequently, the increase in temperature in the vicinity of the anode is delayed, which makes it possible to prolong the duration of the electro-dewatering step before reaching a temperature level that risks damaging the device: a large amount of water can thus be extracted, leading to a greater dryness.

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One theory put forward by the inventors for explaining this surprising phenomenon would be, that beyond the improvement in the filterability of the sludge, the combination of a coagulant aid and a flocculation aid increases the amount and electromobility of the ions contained in the sludge. Such a phenomenon would help to reduce the electrical resistance of the sludge, in particular at the start of the application of the electric field, and therefore to reduce the increase in the voltage and therefore the heating of the electrodes by the Joule effect.

Thus, owing to this process and to this particular conditioning, the tests have shown that from 10 to 60 dryness points are gained relative to a conventional dehydration for a reduced electricity consumption, the overall energy consumption of such a process thus remaining less than 300 kWh/tWR.

In certain embodiments, the flocculation aid used is a polymer. In certain embodiments, the polymer used is of cationic flocculant type. This type of polymer specifically enables a better agglomeration of the sludge particles and gives good filtration results within the context of the present disclosure.

In certain embodiments, the polymer used is a cationic flocculant of high density and low molecular weight.

However, other anionic, cationic or nonionic flocculation aids would also be possible with various molecular weights depending on the type of sludge to be dewatered.

In certain embodiments, during the chemical conditioning step, the mass of flocculation aid added to the sludge is between 1 and 25 kg of pure product, that is to say of active matter (AM), per tonne of dry matter within the sludge (kgAM/tDM), preferably between 4 and 15 kgAM/tDM. The inventors have indeed observed during their tests that this concentration range gave results that were very satisfactory in terms of control of the electro-dewatering kinetics and therefore in terms of attainable dryness values.

In certain embodiments, the coagulant aid is a coagulant of mineral type, for example FeCl_3 . However, other mineral or organic aids would also be possible.

In certain embodiments, during the chemical conditioning step, the mass of pure product of coagulant aid added to the sludge is between

0.5% and 20% of the mass of dry sludge. The inventors have indeed observed during their tests that this concentration range gave results that were very satisfactory in terms of control of the electro-dewatering kinetics and therefore in terms of attainable dryness values.

5 In certain embodiments, the electro-dewatering step is carried out within a filter press comprising at least one chamber consisting of two plates, each plate being equipped with at least one electrode and at least one plate being equipped with a filter, preferably a filter cloth. Each chamber consists of a plate equipped with an anode and a plate equipped with a cathode in order to apply the electric field. Such a filter press makes it possible firstly to filter then compress a volume of sludge between two plates in order to extract the water therefrom through the filter cloths covering the plates. Secondly, while the sludge is still compressed, the electrodes make it possible to create an electric field between the plates in order to facilitate the migration and therefore the evacuation of water through the filter cloths.

 In certain embodiments, at least one plate of the filter press is equipped with a membrane configured to be deformed by a compression fluid in order to compress the sludge present in the filter press.

20 In certain embodiments, the pressure exerted during the compression is between 5 and 20 bar, preferably between 10 and 13 bar.

 In certain embodiments, the electro-dewatering step is carried out, at least initially, at constant intensity. This control mode makes it possible specifically to favor a rapid dewatering of the sludge.

25 In certain embodiments, the intensity used is between 5 and 200 A/m².

 In certain embodiments, during the electro-dewatering step, the constant intensity control is abandoned in favor of a constant voltage control when a predetermined condition is met. Such a control mode makes it possible specifically to limit the rise of the temperature at the electrodes. The constant voltage value used then is preferably that which was reached at the moment when the predetermined condition is met.

30 In certain embodiments, during the electro-dewatering step, the constant intensity control is abandoned in favor of a constant voltage control when the voltage reaches a threshold voltage. This threshold

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voltage is set by the operator so as to use the electrodes below their breakdown voltage.

In other embodiments, the constant intensity control is abandoned in favor of a constant voltage control when the temperature in the vicinity of an electrode reaches a threshold temperature. This enables operation at constant intensity, therefore at high dewatering efficiency, while the temperature remains quite low and makes it possible to switch to constant voltage once the threshold temperature is reached in order to slow down the rise in temperature and therefore to prolong the dewatering before the temperature becomes too high and dangerous for the electro-dewatering device.

In certain embodiments, the constant intensity control is abandoned in favor of a constant voltage control when the temperature of the anode reaches a threshold temperature between 50°C and 65°C. This is indeed a good compromise between the advantage of benefiting for as long as possible from highly efficient dewatering at constant intensity and the advantage of being able to prolong the dewatering at constant voltage for as long as possible once this threshold temperature is reached.

In certain embodiments, during the electro-dewatering step, the temperature of the sludge in the vicinity of the electrodes does not exceed a ceiling temperature below or equal to 150°C, preferably below or equal to 80°C, more preferably below or equal to 70°C. This makes it possible to reduce the risk of damaging the device. The electro-dewatering is thus preferably stopped as soon as such a ceiling temperature is reached.

In certain embodiments, the electro-dewatering step lasts at least 45 minutes, preferably at least 60 minutes, more preferably at least 100 minutes. Such durations, permitted by the present process, make it possible to achieve higher degrees of dryness of the sludge than the conventional electro-dewatering processes.

In certain embodiments, at the end of the electro-dewatering step, the dryness of the sludge is greater than 30%, preferably greater than 40%, more preferably greater than 50%.

In certain embodiments, the process additionally comprises a filtration step carried out before the electro-dewatering step. This filtration step makes it possible to carry out a first filtration before the application of the electric field in order to eliminate most of the free water contained

in the sludge. This filtration step is preferably carried out after the conditioning step.

5 In certain embodiments, the process additionally comprises a compression step carried out before the electro-dewatering step. This step of compression alone makes it possible to mechanically extract the remaining free water without electrical assistance. This may make it possible to already extract the free water of a sludge without consuming the electricity necessary for the electro-dewatering and without initiating the rise in temperature of the electrodes. Preferably, this step is carried
10 out after the filtration step and with the aid of the filter press. The compression pressure may be between 5 and 20 bar, preferably between 10 and 13 bar.

In other embodiments, the process lacks a compression step before the electro-dewatering step. The inventors have indeed observed during
15 their tests that an application of the electric treatment just after the filtration step was not too energy-consuming and even that such a prior step of compression alone could be unfavorable in the case of sludge that is difficult to dewater, having a high electrical resistance in particular.

In certain embodiments, the sludge to be dewatered is a biological
20 sludge derived from a wastewater treatment plant, and in particular from an aerobic biological treatment process. This type of sludge specifically contains a high proportion of bound water. However, naturally, the present disclosure could be applied to other types of sludge.

The abovementioned features and advantages, and others too, will
25 become apparent on reading the detailed description that follows, of examples of implementation of the proposed process. This detailed description refers to the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

30 The appended drawings are schematic and aim, above all else, to illustrate the principles of the invention.

In these drawings, from one figure (FIG) to the next, identical elements (or element parts) are identified by the same reference signs.

FIG 1 is a block diagram of an example of a process according to
35 the invention.

FIG 2 is a schematic diagram of the filter press used for the requirements of the process.

FIG 3 is a graph comparing the change in voltage during a conventional electro-dewatering and an electro-dewatering according to the invention.

FIG 4 is a graph comparing the change in temperature during a conventional electro-dewatering and an electro-dewatering according to the invention.

FIG 5 is a graph of the temporal tracking of the parameters of a conventional electro-dewatering at high intensity.

FIG 6 is a graph of the temporal tracking of the parameters of a conventional electro-dewatering at lower intensity.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENT(S)

In order to render the invention more concrete, examples of dewatering processes are described in detail below, with reference to the appended drawings. It is recalled that the invention is not limited to these examples.

FIG 5 illustrates the temporal tracking of the various parameters of an electro-dewatering carried out by the inventors without the conditioning according to the present invention. This first test is carried out at high intensity. In this case, the electro-dewatering is carried out on a sludge that is difficult to dewater, having a high electrical resistance, with a constant intensity of 16 A, i.e. around 70 A/m², and a voltage limited to 110 V in order not to reach the breakdown voltage of the system.

As can be seen in FIG 5, due to the high electrical resistance of the sludge, the voltage 82 (broken bold line) increases very rapidly to reach its maximum value of 110 V in less than a minute. The constant intensity control can then no longer be maintained and the intensity 81 (continuous bold line) begins to decrease before stabilizing whereas the voltage 82 is maintained at 110 V. A rapid increase in the temperature on the anode side 83 (continuous fine line) is then observed which reaches 70°C in less than 15 minutes, then requiring the test to be stopped. It is observed on the other hand that the increase in temperature on the cathode side 84 (broken fine line) is much slower so that it is determined that the

temperature on the anode side is the limiting parameter for such electro-dewatering.

Thus, in this first test that does not implement the process according to the invention, it is observed that the total duration of the treatment does not exceed 15 minutes. It is therefore understood that the degree of dryness achieved is not satisfactory.

In a second test carried out without conditioning in accordance with the present invention, the inventors sought to reduce the intensity of the current applied during the electro-dewatering. In this case, the latter is carried out with a constant intensity of 9 A, i.e. around 40 A/m².

As can be seen in FIG 6, the voltage 92 (broken bold line) again increases very rapidly in the first seconds of the test then slows down its increase before nevertheless reaching its safety value at 110 V after three minutes approximately. The constant intensity control can then no longer be maintained and the intensity 91 (continuous bold line) begins to decrease whereas the voltage 92 is maintained at 110 V. However, a rapid increase in the temperature on the anode side 93 (continuous fine line) is also observed that reaches 70°C in around 10 minutes, then requiring the test to be stopped. Here too, the increase in temperature on the cathode side 94 (broken fine line) is negligible considering that of the anode 93.

Thus, in this second test that does not implement the process according to the invention, it is observed that the duration of the treatment at constant intensity is slightly longer but does not however exceed four minutes. Furthermore, the total duration of the treatment does not exceed ten minutes. It is therefore understood that the degree of dryness achieved is once again insufficient.

In order to improve these dewatering conditions, the process according to the present invention will now be described. Its overall sequence is represented in FIG. 1.

Within the context of the present process, the sludge to be treated is a biological sludge derived from a wastewater treatment plant. This type of sludge is derived from a membrane bioreactor operating directly on the screened raw water.

The sludge 10, the initial dryness of which is around 0.9% in this example, that is to say 9 g of dry matter per liter of liquid sludge, is first subjected to a chemical conditioning step S1 during which certain

chemical components are added to the sludge 10 in order to facilitate the treatment thereof and the dewatering thereof. Among these components, a coagulant aid (11a) and a flocculation aid (11b) are added.

In this example, the coagulant aid (11a) used is FeCl_3 . It is added
 5 to the sludge tank in an amount of 15% by mass of dry sludge matter. The flocculation aid (11b) used is itself the polymer Flopam EM 640 TBD. It is injected in-line with a target concentration of 4.6 kg of pure product per tonne of dry matter (4.6 kgAM/tDM).

The sludge 10 thus treated is injected into the filter press 20 with
 10 the aid of a booster pump.

This filter press 20 is depicted in FIG 2. It comprises three plates 21a, 21b defining two chambers 22 into which the sludge 10 is introduced. Each wall of the plates 21a, 21b defining an edge of a chamber 22 is equipped with an electrode 23a, 23b: the lateral plates 21a are thus
 15 equipped with an electrode that forms the anode 23a and the central plate 21b is equipped on each of its faces with an electrode that forms the cathode 23b.

The internal wall of each lateral plate 21a is additionally equipped with a filter cloth 24 positioned in front of the electrode 23a considered.
 20 Each wall of the central plate 21b is itself equipped with a membrane 25 positioned behind the electrode 23b considered and with a filter cloth 24 positioned in front of the electrode 23b considered.

The three plates 21a, 21b of the filter press 20 are clamped against one another via a hydraulic jack 26 which ensures the leaktightness of the
 25 filtration chambers 22. Under the high-pressure of the jack 26, the plates are moved closer to one another in order to maintain the sludge volumes present in the chambers 22. It is naturally understood that it is possible to provide several modules of plates 21a, 21b before the jack 26.

Each plate 21a and 21b is equipped with a first outlet that makes it
 30 possible to discharge the filtrates 12 and a second outlet 13a and 13b that makes it possible to discharge the possible gases produced.

During a filtration step S2, the booster pump generates a mechanical pressure of 8 bar within the sludge 10 which is then filtered with the aid of the filter cloths 24. This step S2 is stopped when the flow
 35 rate of filtrate 12 discharged by the plates 21 reaches a predetermined

low threshold. This step S2 makes it possible to remove the free water present at the surface of the sludge flocs at a lower energy expenditure.

Once the sludge 10 is filtered through the chambers 22 of the filter press 20, a step of compression alone S3 is carried out within the filter press 20. A compressed air booster makes it possible to inflate the membranes 25 of the filter press 20 so as to compress the sludge present in the chambers 22 until a pressure in the chambers 22 of around 11 to 12 bar is reached. The compression is thus maintained for 10 minutes. No electrical assistance is performed during this step S3.

10 This step of compression alone S3 makes it possible to extract the remaining free water present in the sludge 10 in the form of filtrates 12 discharged through the outlets of the plates 21.

At the end of this step of compression alone S3, the compression is maintained and the electrical assistance is started in order to initiate an electro-dewatering step S4.

15 An electrical generator then imposes a current between the pairs of electrodes 23a, 23b of each chamber 22. Initially, the control is carried out at constant current. In this example, an intensity of around 9 A is chosen, i.e. around 40 A/m².

20 During this step, the water extracted from the sludge 10 is discharged in the form of filtrates 12 through the outlets of the plates 21a and 21b. Moreover, the gases generated during this step S4, oxygen and hydrogen resulting from the hydrolysis of the water for example, are discharged through the second outlets of the plates 13a and 13b.

25 The constant current control is maintained until the temperature in the vicinity of an anode 23a, measured using a thermocouple for example, reaches 60°C: when this condition is met, the current control is abandoned in favour of a constant voltage control. The voltage value chosen for this constant voltage control is the maximum safety voltage value, 110 V in this example.

30 The electrical assistance at constant voltage is then maintained until the temperature in the vicinity of an anode 23a reaches 70°C: when this condition is met, electrical treatment is stopped and the compression is released.

The sludge cakes 14 thus dewatered are then removed from the chambers 22 of the filter press 20 during a cake removal step S5. The dryness values obtained for these cakes 14 are on average around 38.3%.

These cakes 14 may then be landfilled, or recovered as organic soil conditioner or as energy.

Several series of tests will now be presented to illustrate the contribution of the invention relative to conventional processes.

In all these tests, the same type of sludge 10 was used: it is a biological sludge of the type that is derived from wastewater treatment plants. More particularly, it is a sludge of the type which is derived from a membrane bioreactor operating on screened raw water. This sludge has an initial dryness of less than 1%, i.e. 10 g/L.

The operating conditions of the test T0 are the following:

- FLOPAM EM 640TBD polymer in an amount of 8.95 kg/tDM, i.e. 3.8 kg AM/tDM;
- no coagulant;
- filtration by itself at 8 bar;
- compression by itself at 11-12 bar for 10 minutes;
- compression at 11-12 bar + electro-dewatering at 9 A (i.e. around 40 A/m²) with switching to constant voltage beyond a temperature on the anode side of 60°C.

The operating conditions of the test T1 are the following:

- FLOPAM EM 640TBD polymer in an amount of 12.8 kg/tDM, i.e. 5.4 kg AM/tDM;
- coagulant FeCl₃ in an amount of 15% of the mass of dry sludge;
- filtration by itself at 8 bar;
- no compression step by itself;
- compression at 11-12 bar + electro-dewatering at 9 A (i.e. around 40 A/m²) without switching to constant voltage beyond a temperature on the anode side of 60°C.

FIGS 3 and 4 aim to compare the change in the voltage and in the temperature of a conventional electro-dewatering and of an electro-dewatering according to the invention.

Thus, the voltage 31, 36 and the anode temperature 32, 37 were monitored during the electro-dewatering step of these tests: the curves

relating to test T0 are broken lines whereas the curves relating to test T1 are continuous lines.

Within the context of test T0 in which the conditioning did not use coagulant, it is seen in FIG 3 that the voltage 31 firstly increases rapidly and forms a voltage peak 31a at around 80 V in the first minutes of the test; the voltage then drops back down in order to stabilize starting from the tenth minute approximately in the vicinity of 50 V.

It is then observed that the voltage measured within the context of test T1, the conditioning of which simultaneously used a coagulant and a polymer, follows a change that is completely opposite to the voltage 31 of test T0 since, after establishing the electric field, the voltage 36 of test T1 decreases from its initial value instead of increasing as was the case in test T0. The voltage 36 then reaches a minimum voltage value at around 40 V and only begins to increase significantly later, after 30 minutes of the test approximately, until a plateau 36a is reached at around 50 V after approximately 40 minutes, before stabilizing at a value between 30 and 40 V.

Consequently, it is observed in FIG 4 that the anode temperature 32 of test T0 increases much more rapidly than the anode temperature 37 of test T1 since it reaches a value of 40°C from the start of test T0 whereas this same threshold is reached by the anode temperature 37 of test T1 after 15 minutes.

Hence, at the end of this transient regime, the behavior of which differs between tests T0 and T1, a time lag of the temperature curves is observed: the ceiling temperature of 70°C is thus reached after 45 minutes for the test T0 and after 120 minutes for the test T1. Thus, in total, the electro-dewatering in the test according to the invention T1 will have lasted around 75 minutes longer than the comparative test T0 which finishes after around 45 minutes.

Furthermore, a measurement of the dryness at several points of the cakes thus obtained revealed:

- for test T0, a mean dryness value of $26 \pm 5\%$;
- for test T1, a mean dryness value of $38 \pm 7\%$.

Therefore, on average, a gain of 12 dryness points is observed when the conditioning combines a polymer and a coagulant relative to the conditioning with a polymer alone.

Moreover, the energy consumption generated by each of these electro-dewatering operations was measured during the test according to the invention T1 and the reference test T0.

5 These energy consumptions are 260 kWh/tWR for the conventional electro-dewatering of test T0 and 140 KWh/tWR for the electro-dewatering according to the invention of test T1 i.e. an energy consumption that is reduced by almost half.

10 The embodiments or examples of implementation described in the present disclosure are given by way of illustration and nonlimitingly, a person skilled in the art could easily, in view of this disclosure, modify these embodiments or examples of implementation, or envisage other ones thereof, while remaining within the scope of the invention.

15 Furthermore, the various features of these embodiments or examples of implementation may be used alone or may be combined with one another. When they are combined, these features may be as described above or otherwise, the invention not being limited to the specific combinations described in the present disclosure. In particular, unless otherwise specified, a feature described in connection with an embodiment or example of implementation may be applied in a similar
20 manner to another embodiment or example of implementation.

CLAIMS

- 5 1. A sludge dewatering process, comprising
 a step of chemical conditioning (S1) of the sludge to be dewatered
 (10) during which a flocculation aid (11b) and a coagulant aid (11a) are
 added to the sludge (10), and
 an electro-dewatering step (S4).
- 10 2. The process as claimed in claim 1, wherein the flocculation aid
 (11b) used is a polymer of anionic, cationic or nonionic flocculant type.
3. The process as claimed in claim 1 or 2, wherein, during the
15 chemical conditioning step (S1), the mass of flocculation aid (11b) added
 to the sludge is between 1 and 25 kg of pure product per tonne of dry
 matter.
4. The process as claimed in any one of claims 1 to 3, wherein the
20 coagulant aid (11a) used is of mineral type.
5. The process as claimed in any one of claims 1 to 3, wherein the
 coagulant aid (11a) used is of organic type.
- 25 6. The process as claimed in any one of claims 1 to 5, wherein,
 during the chemical conditioning step (S1), the mass of pure product of
 the coagulant aid (11a) added to the sludge is between 0.5% and 20% of
 the mass of dry sludge.
- 30 7. The process as claimed in any one of claims 1 to 6, wherein
 the electro-dewatering step (S4) is carried out within a filter press (20)
 comprising at least two plates (21a, 21b), each plate (21a, 21b) being
 equipped with at least one electrode (23a, 23b) and at least one plate
 (21a) being equipped with a filter (24), wherein the filter press (20)
35 compresses the sludge (10) during the electro-dewatering step (S4).

8. The process as claimed in any one of claims 1 to 7, wherein the electro-dewatering step (S4) is carried out, at least initially, at constant intensity then the constant intensity control is abandoned in favor of a constant voltage control when the temperature in the vicinity of an electrode (23a) reaches a threshold temperature.

9. The process as claimed in any one of claims 1 to 7, wherein the electro-dewatering step (S4) is carried out, at least initially, at constant intensity then the constant intensity control is abandoned in favor of a constant voltage control when the voltage reaches a threshold value.

10. The process as claimed in any one of claims 1 to 9, wherein, during the electro-dewatering step (S4), the temperature of the sludge in the vicinity of the electrodes (23a, 23b) does not exceed a ceiling temperature below or equal to 150°C, preferably below or equal to 70°C.

11. The process as claimed in any one of claims 1 to 9, additionally comprising a filtration step (S2) carried out before the electro-dewatering step (S4).

12. The process as claimed in any one of claims 1 to 10, additionally comprising a compression step (S3) carried out before the electro-dewatering step (S4).

13. The process as claimed in any one of claims 1 to 11, wherein the sludge to be dewatered (10) is a biological sludge derived from a wastewater treatment plant.