

DESCRIPTION

Title of the Invention: Method for desalting treatment of chlorine-containing powder

5 Technical Field

[0001] The present invention relates to a desalting treatment method for reducing the chlorine content of chlorine-containing powder such as incineration ash.

Background Art

10 [0002] Incineration ash generated when municipal waste such as general waste and industrial waste are incinerated, clinker dust generated from a cement plant, and the like are being reused effectively as a cement raw material from the standpoint of resources and environmental protection. They are however in the form of chlorine-rich powder and this chlorine interferes with the quality of the resulting cement or the normal operation of a
15 cement manufacturing apparatus. Desalting treatment is therefore necessary for the use of them as a cement raw material and for this treatment, a large amount of wash water becomes necessary. In the reuse, reducing the using amount of wash water has been a problem.

[0003] In connection with such a problem, there is disclosed, for example, in Patent
20 Literature 1 (Japanese Patent Application Laid-Open No. 2003-211129), an ash washing method, including providing a multistage washing step having a mixer for mixing ash with water and a solid-liquid separator for separating the resulting mixture into ash and water; washing the ash in a plurality of stages; making the ash flow and the water flow countercurrent; and dehydrating the ash, which has been obtained by solid-liquid separation
25 by means of the first-stage solid-liquid separator, into wet ash having a water content of less than 60%. According to this literature, ash can be desalted efficiently with a smaller amount of wash water (Column 0021 of Patent Literature 1).

[0004] In addition, there is disclosed, for example, in Patent Literature 2 (Japanese
30 Patent Application Laid-Open No. 2005-246295), an incineration ash treatment apparatus which has a multistage drum filter for washing incineration ash and washes the incineration

ash transported from the first stage to the final stage by supplying new wash water to the final stage and successively making use of collected wash water, which has been suctioned and collected in the individual stages, as wash water for a stage prior thereto, wherein the drum filter in the individual stages has a collected-wash water supply means for supplying a portion of the collected wash water suctioned and collected in the drum filter to the mixture retained at the periphery of the filter at a drum-rotation-direction position upstream of the washing water supply position of this stage. According to this literature, when the same level of a washing effect as before is intended, this apparatus can reduce the number of the stages of the drum filter and decrease the water using amount (Column 0014 of Patent Literature 2).

Citation List

Patent Literatures

[0005] Patent Literature 1: Japanese Patent Application Laid-Open No. 2003-211129

Patent Literature 2: Japanese Patent Application Laid-Open No. 2005-246295

Summary of Invention

Technical Problem

[0006] According to the aforesaid Patent Literatures 1 and 2, in desalting treatment of chlorine-containing powder such as incineration ash, it is possible to reduce the water using amount by providing a multistage washing device for efficiently removing a chlorine content which remains as a residue in the water content of a desalted cake obtained by adding wash water to the powder to elute chlorine in a liquid phase, followed by dehydration.

[0007] According to the finding of the present inventors, however, washing of the desalted cake by providing a multistage washing device as described above in Patent Literatures 1 and 2 rather increases the water using amount due to the washing of a residual dust which has attached to a filter cloth or the device itself, making it impossible to suppress the water using amount of the entire system.

[0008] An object of the present invention is therefore to provide a desalting treatment

method of chlorine-containing powder capable of effectively reducing the water using amount of the entire system.

Solution to Problem

5 [0009] With a view to achieving the aforesaid object, the present invention firstly provides a desalting treatment method of chlorine-containing powder including:

a slurring step for mixing the chlorine-containing powder with a first desalting wash liquid to obtain a slurry;

10 a chlorine elution step for eluting chlorine contained in the chlorine-containing powder in a liquid phase in the slurry,

a desalted-cake formation step for dehydrating the slurry in which the chlorine has been eluted to obtain a first desalted cake and a first filtrate,

15 a first-desalted-cake washing step for washing the first desalted cake with a second desalting wash liquid different from the first desalting wash liquid to obtain a second desalted cake and a second filtrate, and

a second-desalted-cake washing step for washing the second desalted cake with a third desalting wash liquid different from the first desalting wash liquid and the second desalting wash liquid to obtain a third desalted cake and a third filtrate; wherein:

20 the slurring step, the chlorine elution step, the desalted-cake formation step, the first-desalted-cake washing step, and the second-desalted-cake washing step are repeated for each chlorine-containing powder to be supplied; and

25 at least a portion of the third filtrate obtained in the second-desalted-cake washing step is collected and stored, and is reused as either or both of the second desalting wash liquid for the first-desalted-cake washing step and the third desalting wash liquid for the second-desalted-cake washing step for chlorine-containing powder to be supplied to a latter stage and is recycled as the first desalting wash liquid after the reuse once or multiple times.

[0010] According to the aforesaid desalting treatment method of chlorine-containing powder, chlorine-containing powder is mixed with a first desalting wash liquid to obtain a slurry; chlorine contained in the chlorine-containing powder is eluted in the liquid phase of the resulting slurry; the slurry is dehydrated to obtain a first desalted cake and a first filtrate;

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the resulting first desalted cake is washed with a second desalting wash liquid different from the first desalting wash liquid to obtain a second desalted cake and a second filtrate; the resulting second desalted cake is washed with a third desalting wash liquid different from the first desalting wash liquid and the second desalting wash liquid to obtain a third
5 desalted cake and a third filtrate. Thus, the third desalted cake from which chlorine has been removed sufficiently can be obtained. This method is therefore useful for converting chlorine-containing incineration ash and the like into a cement raw material. In addition, since at least a portion of the third filtrate obtained in the second-desalted-cake wash step is collected and stored, it can be reused as a desalting wash liquid for chlorine-containing
10 powder to be supplied to a latter stage without providing a multistage desalted-cake washing device. After reuse of it once or multiple times, it is recycled as the first desalting wash liquid and therefore, the water using amount of the entire system can be reduced while maintaining a desalting effect brought by the desalting treatment of chlorine-containing powder. In addition, by the reduction in the water using amount, an elution amount of a
15 heavy metal can be suppressed.

[0011] With a view to achieving the aforesaid object, the present invention secondly provides the desalting treatment method of chlorine-containing powder, wherein the desalted-cake formation step, the first-desalted-cake washing step, and the second-desalted-cake washing step are performed using a solid-liquid separator making use of a filter cloth
20 and at least a portion of the filter-cloth washing wastewater obtained by washing the filter cloth is recycled as either or both of the second desalting wash liquid and the third desalting wash liquid.

[0012] According to the aforesaid constitution, use of the solid-liquid separator making use of a filter cloth makes it possible to efficiently perform desalted-cake formation from a slurry and washing thereafter over a large amount of chlorine-containing powder supplied.
25 In order to prevent clogging of the filter cloth of the solid-liquid separator used, constant washing is required during the operation term of the separator, but by the recycling use of the washing wastewater generated by filter-cloth washing as either or both of the second desalting wash liquid and the third desalting wash liquid, the water using amount of the
30 entire system can be reduced further.

[0013] With a view to achieving the aforesaid object, the present invention thirdly provides the desalting treatment method of chlorine-containing powder having the second constitution, wherein the solid-liquid separator is a filter press or a belt filter.

5 [0014] According to the aforesaid constitution, an existing device system can be used as the solid-liquid separator.

[0015] With a view to achieving the aforesaid object, the present invention fourthly provides the aforesaid desalting treatment method of chlorine-containing powder having the second constitution, wherein the solid-liquid separator is a filter press and at least a portion of the filter-cloth washing wastewater is subjected to solid-liquid separation and a liquid portion thus obtained is recycled as either or both of the second desalting wash liquid and the third desalting wash liquid.

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[0016] According to the aforesaid constitution, an existing device system can be used as the solid-liquid separator making use of a filter cloth. The filter press is a device capable of washing a cake and an ordinary cake washing mechanism washes it by feeding water from the side of a filter cloth opposite to a filtering surface. Direct use of the filter-cloth washing wastewater containing a solid content as cake wash water (use as the second and third desalting wash liquid) becomes a cause for clogging of the filter cloth. The filter-cloth washing wastewater is therefore subjected to solid-liquid separation and then is preferably used as the second and third desalting wash liquids.

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[0017] With a view to achieving the aforesaid object, the present invention fifthly provides the aforesaid desalting treatment method of chlorine-containing powder, wherein the desalted-cake formation step, the first-desalted-cake washing step, and the second-desalted-cake washing step are performed using a solid-liquid separator making use of a filter cloth and at least a portion of the filter-cloth washing wastewater obtained by washing the filter cloth is recycled as the first desalting wash liquid.

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[0018] According to the aforesaid constitution, use of the solid-liquid separator making use of a filter cloth makes it possible to efficiently perform desalted-cake formation from the slurry and washing thereafter over a large amount of chlorine-containing powder supplied. In order to prevent clogging of the filter cloth of the solid-liquid separator used, constant washing is required during the operation term of the device, but since the resulting

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washing wastewater is recycled as the first desalting wash liquid, the water using amount of the entire system can be reduced further.

[0019] With a view to achieving the aforesaid object, the present invention sixthly provides the desalting treatment method of chlorine-containing powder, wherein upon reusing the third filtrate obtained in the second-desalted-cake washing step, whether or not to use the third filtrate is determined by observing at least one of the following (1) to (5) in a reservoir tank in which at least a portion of the third filtrate is collected and stored:

- (1) a total time for the reuse treatment with the third filtrate,
- (2) a total water amount for the reuse treatment with the third filtrate,
- (3) pH of the third filtrate,
- (4) a chlorine ion concentration of the third filtrate, and
- (5) electric conductivity of the third filtrate.

[0020] According to the aforesaid constitution, upon reusing the third filtrate, it is possible to avoid use of a wash liquid not suited for washing of a desalted case.

[0021] With a view to achieving the aforesaid object, the present invention seventhly provides the aforesaid desalting treatment method of chlorine-containing powder, wherein at least a portion of the second filtrate obtained in the first-desalted-cake washing step is collected and stored so as to reuse it, for chlorine-containing powder to be supplied to a latter stage, as the second desalting wash liquid for the first-desalted-cake washing step and recycle it as the first desalting wash liquid after reuse once or multiple times.

[0022] According to the aforesaid constitution, the second filtrate obtained in the first-desalted-cake washing step is also reused, making it possible to ensure a reduction in the water using amount of the entire system. In addition, at least a portion of the second filtrate is collected and stored so that it can be reused as a desalting wash liquid for chlorine-containing powder to be supplied to a latter stage without providing a multistage desalted-cake washing device.

[0023] With a view to achieving the aforesaid object, the present invention eighthly provides the desalting treatment method of chlorine-containing powder, wherein upon reusing the second filtrate obtained in the first-desalted-cake washing step, whether or not to use the second filtrate is determined by observing at least one of the following (1) to (5)

in a reservoir tank in which at least a portion of the second filtrate is collected and stored:

- (1) a total time for the reuse treatment with the second filtrate,
- (2) a total water amount for the reuse treatment with the second filtrate,
- (3) pH of the second filtrate,
- 5 (4) a chlorine ion concentration of the second filtrate, and
- (5) electric conductivity of the second filtrate.

[0024] According to the aforesaid constitution, upon reusing the second filtrate, it is possible to avoid use of a wash liquid not suited for washing of a desalted cake.

10 [0025] With a view to achieving the aforesaid object of the present invention, the present invention ninthly provides the desalting treatment method of chlorine-containing powder, wherein:

washing of the first desalted cake with the second desalting wash liquid in the first-desalted-cake washing step is performed multiple times with the second desalting wash liquid, and/or

15 washing of the second desalted cake with the third desalting wash liquid in the second-desalted-cake washing step is performed multiple times with the third desalting wash liquid.

[0026] According to the aforesaid constitution, washing the cake multiple times ensures the desalting treatment.

20 [0027] With a view to achieving the aforesaid object, the present invention tenthly provides the desalting treatment method of chlorine-containing powder, wherein:

a water using amount is 1.5 parts by mass to 4 parts by mass based on 1 part by mass of a dry weight of the chlorine-containing powder to be subjected to desalting treatment.

25 [0028] According to the aforesaid constitution, the water using amount in the desalting treatment of chlorine-containing powder such as incineration ash can be reduced largely. In addition, by the reduction in the water using amount, an elution amount of a heavy metal can be suppressed.

30 [0029] With a view to achieving the aforesaid object, the present invention eleventhly provides the aforesaid desalting treatment method of chlorine-containing powder, wherein:

the desalted-cake formation step, the first-desalted-cake washing step, and the second-desalted-cake washing step are performed in a single solid-liquid separator.

[0030] According to the aforesaid constitution, a device constitution can be simplified, making it possible to reduce an initial cost or running cost. In addition, water consumption for washing a residual dust attached to the filter cloth or the device itself can be minimized.

Brief Description of Drawings

[0031] FIG. 1 is a flow chart showing one embodiment of the desalting treatment method of chlorine-containing powder according to the present invention.

FIG. 2 is a flow chart for describing, in one example of the desalting treatment method of chlorine-containing powder according to the present invention, an aspect in which washing in a desalted-cake washing step is performed multiple times with a desalting wash liquid. FIG. 2A shows an aspect in which washing of a second desalted cake with a third desalting wash liquid is performed multiple times with the third desalting wash liquid. FIG. 2B shows an aspect in which washing of a first desalted cake with a second desalting wash liquid is performed multiple times with the second desalting wash liquid. FIG. 2C shows an aspect in which both washing with the second desalting wash liquid multiple times and washing with the third desalting wash liquid multiple times are performed.

FIG. 3 is a flow chart for describing, in another example of the desalting treatment method of chlorine-containing powder according to the present invention, an aspect in which a desalted-cake formation step, a first-desalted-cake washing step, and a second-desalted-cake washing step are performed in in a single solid-liquid separator.

FIG. 4 is a flow chart for describing, in a further example of the desalting treatment method of chlorine-containing powder according to the present invention, an aspect in which a desalted-cake formation step, a first-desalted-cake washing step, and a second-desalted-cake washing step are performed in in a single solid-liquid separator and as the solid-liquid separator, a solid-liquid separator making use of a filter cloth is used.

FIG. 5 is a flow chart for describing an aspect of Comparative Examples 1 to 7 performed in Test Example 1.

FIG. 6 is a flow chart for describing an aspect of Examples 1 to 5 performed in Test Example 1.

FIG. 7 is a flow chart for describing an aspect of Example 6 performed in Test Example 1.

5 FIG. 8 is a graph showing the relationship between a new water ratio and a desalted-cake chlorine concentration after washing, obtained as the results of Test Example 1.

 FIG. 9 shows a graph (FIG. 9A) showing the relationship between a chlorine concentration and a Pb concentration in a wastewater component and a graph (FIG. 9B) showing the relationship between a chlorine concentration and a Zn concentration in a wastewater component, each obtained as the results of Test Example 1.

 FIG. 10 shows a graph (FIG. 10A) showing the relationship between a desalted-cake chlorine concentration and a Pb concentration in a wastewater component and a graph (FIG. 10B) showing the relationship between a desalted-cake chlorine concentration and a Zn concentration in a wastewater component, each obtained as the results of Test Example 1.

 FIG. 11 is a graph showing the relationship between a difference obtained by subtracting a quotient obtained by dividing a desalted-cake chlorine concentration by a new water ratio in Example from that in Comparative Example at the same new water ratio and the corresponding new water ratio, each obtained as the results of Test Example 1.

Description of Embodiments

[0032] A material to be subjected to the desalting treatment method of chlorine-containing powder according to the present invention is not particularly limited insofar as it is chlorine-containing powder. Examples include incineration fly ash, molten fly ash, and chlorine bypass dust. They are wastes conventionally used effectively as a cement raw material after desalting treatment and typical municipal-waste incineration fly ash, that is, fly ash (incineration fly ash) generated when household garbage waste is incinerated generally contains chlorine (Cl) at a concentration of about 10 mass% to 30 mass% and fly ash (molten fly ash) generated from a gasification melting furnace generally contains

chlorine at a concentration of about 10 mass% to 40 mass%. On the other hand, chlorine bypass dust, that is, dust contained in a cement kiln extraction gas generally contains chlorine at a concentration of about 10 mass% to 40 mass%.

[0033] The desalting treatment method of chlorine-containing powder according to the present invention reduces the chlorine concentration of the chlorine-containing powder as described above to about 3 mass% or less, more typically, about 2 mass% or less, which enables effective use of it, for example, as a cement raw material. The chlorine concentration of the chlorine-containing powder can be measured by a known method and preferred examples of it include a potentiometric titration method based on JIS A 1154 “Methods of test for chloride ion content in hardened concrete”, an ion chromatography method, and a fundamental parameter method for fluorescent X-ray analysis.

[0034] The present invention will hereinafter be described more specifically referring to drawings.

[0035] FIG. 1 is a flow chart showing one embodiment of the desalting treatment method of chlorine-containing powder according to the present invention.

[0036] As shown in this embodiment, the desalting treatment method of chlorine-containing powder according to the present invention includes a slurring step for mixing the chlorine-containing powder with a first desalting wash liquid to form a slurry, a chlorine elution step for eluting chlorine contained in the chlorine-containing powder in a liquid phase of the slurry, a desalted-cake formation step for dehydrating the slurry from which the chlorine has been eluted to obtain a first desalted cake and a first filtrate, a first-desalted-cake washing step for washing the resulting first desalted case with a second desalting wash liquid different from the first desalting wash liquid to obtain a second desalted cake and a second filtrate, and a second-desalted-cake washing step for washing the resulting second desalted cake with a third desalting wash liquid different from the first desalting wash liquid and the second desalting wash liquid to obtain a third desalted cake and a third filtrate.

[0037] Mixing the chlorine-containing powder with the first desalting wash liquid to form a slurry or eluting chlorine contained in the chlorine-containing powder in a liquid phase of the resulting slurry may be carried out using a predetermined dissolution tank known to those skilled in the art. Dehydrating the slurry or adding a desalting wash liquid

to the desalted cake formed by dehydration may be carried out using a predetermined mixing tank or dehydrator known to those skilled in the art. Transferring the slurry or liquid may be carried out using a fluid supplier-supply tank, fluid supply tube, or predetermined reservoir tank known to those skilled in the art.

5 [0038] The aforesaid slurring step, the chlorine elution step, the desalted-cake formation step, the first-desalted-cake washing step, and the second-desalted-cake washing step are repeated for each chlorine-containing powder supplied (they are repeated in the first stage, the second stage, and the third stage in FIG. 1) and at this time, at least a portion of the third filtrate obtained by the second-desalted-cake washing step is collected and
10 stored and is reused as a desalting wash liquid suited for chlorine-containing powder to be supplied to a latter stage. More specifically, it is reused as either or both the second desalting wash liquid for the first-desalted-cake washing step and the third desalting wash liquid for the second-desalted-cake washing step. After the third filtrate is reused once or more times, it is recycled as a first desalting wash liquid.

15 [0039] The term “chlorine-containing powder to be supplied to a latter stage” means a chlorine-containing powder different from the chlorine-containing powder which was present previously in the same step. Therefore, in the embodiment shown in FIG. 1, the desalting treatment is repeated in the first stage, the second stage, and the third stage in order of time and the third filtrate from the first stage is reused in the second stage and it
20 may be reused as either or both of a second desalting wash liquid and a third desalting wash liquid for chlorine-containing powder to be supplied in the third stage or thereafter.

[0040] The desalted-cake washing step for further washing the desalted cake formed is divided into first and second steps in the order of steps in which it is treated and it may be divided into more steps and for these steps, desalted-cake washing steps such as a third-
25 desalted-cake washing step, a fourth-desalted-cake washing step, a fifth-desalted-cake washing step, and another desalted-cake step thereafter may be provided. In this case, it is preferred to reuse a filtrate, which is from a desalted-cake washing step to which an arbitrary number is assigned, for a desalted-cake washing step, in chlorine-containing powder which is to be supplied to a latter stage, to which the same number or a number
30 therefore is assigned as the number assigned in the order of step time.

[0041] In the embodiment shown in FIG. 1, at least a portion of the second filtrate obtained in the first-desalted-cake washing step is collected and stored and is reused for chlorine-containing powder to be supplied to a latter stage as a second desalting wash liquid for a first-desalted-cake washing step. After the second filtrate is reused once or multiple
5 times, it may be recycled as a first desalting wash liquid.

[0042] The term “chlorine-containing powder to be supplied to a latter stage” means, as described above, is chlorine-containing powder different from that was present earlier in the same step. For example, in the embodiment shown in FIG. 1, therefore, the second filtrate from the first stage is reused in the second stage, but alternatively, it may be reused
10 as a second desalting wash liquid for chlorine-containing powder supplied in the third stage or a stage thereafter. The desalted-cake washing step may be provided as a multistage one by adding a third-desalted-cake washing step and the like, but even in this case, the first-desalted-cake washing step is a step of washing first a desalted cake formed by dehydration of the slurry and a desalting wash liquid used therefor is a second desalting wash liquid.

[0043] In the desalting treatment method of chlorine-containing powder according to the present invention, the aforesaid reusing of the second filtrate is not always essential. In addition, in the embodiment shown in FIG. 1, the first filtrate obtained in the desalted-cake formation step is treated as wastewater, but it may be reused as the first desalting wash liquid for chlorine-containing powder to be supplied to a latter stage if necessary.
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[0044] In the embodiment shown in FIG. 1, new water is used for each of the desalting wash liquids used in the desalting treatment of first-stage chlorine-containing powder and it means water to be supplied newly to the system. As this new water, water other than sea water, such as industrial water (fresh water) or chlorine-containing water whose chlorine ion concentration has been adjusted by arbitrarily adding a chlorine concentration
25 adjusting agent such as NaCl or KCl if necessary may be used. In a region where a large amount of industrial water (fresh water) cannot be used or use of industrial water (fresh water) is limited by cost or the like, it is convenient to use seawater after diluting it with industrial water (fresh water).

[0045] The desalting wash liquid introduced into the system sometimes has an increased
30 chlorine ion concentration when reused. For example, the chlorine ion concentration of

the first desalting wash liquid is preferably suppressed to fall within a range of 3 mass% to 15 mass%. That of the second desalting wash liquid is preferably suppressed to fall within a range of 0.5 mass% to 6 mass%. That of the third desalting wash liquid is preferably suppressed to fall within a range of 0 mass% to 2 mass%.

5 [0046] FIG. 2 shows, in one example of the desalting treatment method of chlorine-containing powder according to the present invention, an aspect in which a desalted cake is washed multiple times with a desalting wash liquid. Described specifically, in the desalting treatment method of the present invention, for example, as shown in FIG. 2A, washing of a second desalted cake with a third desalting wash liquid may be performed
10 multiple times with the third desalting wash liquid. As shown in FIG. 2B, washing of a first desalted cake with a second desalting wash liquid may be performed multiple times with the second desalting wash liquid. As shown in FIG. 2C, washing with a second desalting wash liquid may be performed multiple times and at the same time, washing with a third desalting wash liquid may be performed multiple times. After the wash liquid is
15 used at an arbitrary number of times, it may be treated as wastewater or may be reused for chlorine-containing powder to be supplied to a latter stage.

[0047] FIG. 3 shows, in the desalting treatment method of chlorine-containing powder according to the present invention, an aspect in which a desalted-cake formation step, a first-desalted-cake washing step, and a second-desalted-cake washing step are performed
20 in a single solid-liquid separator. More specifically, the solid-liquid separator may be, for example, a filter press or a belt filter. This means that in the example shown in FIG. 3, slurry which has passed the chlorine elution step is introduced into the solid-liquid separator 1 and is then dehydrated according to the ordinary specification of the separator to obtain a first filtrate. A second desalting wash liquid is introduced into a dehydrated cake
25 retained in the separator and is then washed according to the ordinary washing specification of the separator to obtain a second filtrate. Further, a third desalting wash liquid is introduced into a cake washed with the second desalting wash liquid and retained in the separator and is washed according to the ordinary washing specification of the separator to obtain a third filtrate. The second and third filtrates are stored in reservoir tanks 2 and 3,
30 respectively and they can be supplied at desired timing as a wash liquid for chlorine-

containing powder to be supplied in a latter stage.

[0048] In the example shown in FIG. 3, the reservoir tank 2 and the reservoir tank 3 are equipped with a measuring device 4 and a measuring device 5, respectively to enable observation of the properties of the liquids in the tanks. The observation is not limited and it may be, for example, as described in the following (1) to (5).

(1) A total time spent for reuse treatment with the second or third filtrate: an operation time of a pump used for the reuse treatment is measured with a timer.

(2) A total water amount used for reuse treatment with the second or third filtrate: a water amount is measured with a flowmeter.

(3) PH of the second or third filtrate: the pH of the liquid in the tank is measured with a pH meter.

(4) A chlorine ion concentration of the second or third filtrate: the chlorine ion concentration of the liquid in the tank is measured by ion chromatography or a potentiometric titration method.

(5) Electric conductivity of the second or third filtrate: the electric conductivity of the liquid in the tank is measured with an electric conductivity meter.

[0049] For example, with respect to the chlorine ion concentration described above in (4), as described above for the second desalting wash liquid and the third desalting wash liquid, the standard chlorine ion concentration for the second filtrate is preferably suppressed to a range of 0.5 mass% to 6 mass% and that for the third filtrate is preferably suppressed to a range of 0 mass% to 2 mass%.

[0050] For example, with respect to the total time described above in (1), the standard total time for the second filtrate is preferably suppressed to a range of 0 minute to 10 minutes and that for the third filtrate is preferably suppressed to a range of 0 minute to 20 minutes.

[0051] For example, with respect to the total water amount described above in (2), the standard water using amount for the second filtrate is preferably suppressed to 0 part by mass to 3.5 parts by mass and that for the third filtrate is preferably suppressed to 0 part by mass to 3.5 parts by mass, each based on 1 part by mass of the dry weight of chlorine-containing powder to be subjected to desalting treatment.

[0052] For example, with respect to the pH described above in (3), the standard pH for the second filtrate is preferably suppressed to a range of pH 7 to pH 13 and that for the third filtrate is preferably suppressed to a range of pH 7 to pH 12.5.

5 [0053] For example, with respect to the electric conductivity described above in (5), the standard electric conductivity for the second filtrate is preferably suppressed to a range of 3 S/m to 30 S/m and that for the third filtrate is preferably suppressed to a range of 0 S/m to 10 S/m.

[0054] FIG. 4 shows another example of the desalting treatment method of chlorine-containing powder according to the present invention. Described specifically, in the
10 desalting treatment method of the present invention, for example, as described in FIG. 3, the desalted-cake formation step, the first-desalted-cake washing step, and the second-desalted-cake washing step may be performed using the single solid-liquid separator and this separator may make use of a filter cloth. More specifically, the solid-liquid separator
15 1 may be, for example, a filter press or a belt filter. Usually in a solid-liquid separator making use of a filter cloth, washing is regularly required over the operation time of the separator in order to prevent clogging of the filter cloth. Since a large amount of filter-cloth washing wastewater is therefore generated, it is stored in the reservoir tank 6 to supply it as a wash liquid of chlorine-containing powder at a desired timing. In this case, the filter-cloth washing wastewater contains an insoluble matter which has been washed away
20 from the filter cloth used so that it may be treated with a solid-liquid separator 7 and the liquid portion may be used as a wash liquid of chlorine-containing powder. Particularly in a filter press, direct use of the solid-containing filter-cloth washing wastewater as cake wash water (use for the second or third desalting wash liquid) may cause clogging of the filter cloth so that the wastewater after solid-liquid separation may be used preferably as
25 the second or third desalting wash liquid or filter cloth wash liquid. The solid-liquid separator 7 may be, for example, a filter press, a belt filter, a belt press, a vacuum drum filter, a precipitation tank, or the like.

[0055] In the desalting treatment method of chlorine-containing powder according to the present invention, the water using amount is not limited and it is 1.5 parts by mass to 4 parts
30 by mass based on 1 part by mass of the dry weight of chlorine-containing powder to be

subjected to desalting treatment. As the “water using amount” used herein, a preferable range of the water amount can be calculated by dividing the amount of water supplied newly to the entire system by the dry weight of chlorine-containing powder supplied per hour to the system. The amounts of water used in the individual steps including recycled water are as follows: about 1.5 parts by mass to 7.0 parts by mass for the slurring step, about 0.5 part by mass to 5.0 parts by mass for the first-desalted-cake washing step, and about 0.5 part by mass to 5.0 parts by mass for the second-desalted-cake washing step. The amount of water used for the filter-cloth washing step if necessary is about 0.1 part by mass to 2 parts by mass.

[0056] The present invention is not limited to the aforesaid embodiments and it may include various combinations of the ranges disclosed herein and embodiments obtained by modification. Such embodiments may be embraced in the technical scope of the present invention.

Examples

[0057] The present invention will hereinafter be described more specifically by Test Examples. It is to be noted that the scope of the present invention is however not limited by these Test Examples.

[0058] <Test Example 1>

Chlorine bypass dust (chlorine concentration determined by a fundamental parameter method for fluorescent X-ray analysis: 20.94%) discharged from a cement plant was subjected to the following treatments: slurring, chlorine elution, desalted-cake formation, and washing of the desalted cake at predetermined water amounts shown in Table 1. During the treatments, the effect of recycling use of the wastewater generated by desalted-cake washing was studied. For the test, a beaker, a propeller stirrer, and a Buchner funnel were used. Described specifically, a predetermined amount of water and a predetermined amount of the dust were mixed in the beaker to obtain slurry. Dehydration was performed according to the following constitution in which filter paper (quantitative filter paper No. 5c) and a Buchner funnel equipped with a filtrate receiving bottle were used and the resulting slurry placed on the filter paper was dehydrated by

reducing the pressure in the bottle and suctioning with a vacuum pump. With respect to the washing of a desalted cake, the desalted cake was washed by spraying a desalted-cake wash liquid onto the desalted cake while placing the desalted cake on the filter paper of the Buchner funnel. Then, the desalted cake was separated from the filter paper to obtain the desalted cake and the filter paper was attached to the Buchner funnel again. While reducing the pressure in the bottle with the vacuum pump, a wash liquid was sprayed to the filter paper and washing of the filter paper and solid-liquid separation were conducted simultaneously.

[0059] [Table 1]

	Drawing used for description	Amount of water used (equivalent */stage)						
		Slurrying	First-desalted-cake washing		Second-desalted-cake washing		Filter-cloth wash water	Total amount of new water
		Recycled water	New water	Recycled water	New water	Recycled water	New water	
Comp. Ex. 1	Fig. 5	5.0	3.5	0.0	-	-	1.5	5.0
Comp. Ex. 2	Fig. 5	4.5	3.0	0.0	-	-	1.5	4.5
Comp. Ex. 3	Fig. 5	4.0	2.5	0.0	-	-	1.5	4.0
Comp. Ex. 4	Fig. 5	3.5	2.0	0.0	-	-	1.5	3.5
Comp. Ex. 5	Fig. 5	2.75	1.25	0.0	-	-	1.5	2.75
Comp. Ex. 6	Fig. 5	2.5	1.0	0.0	-	-	1.5	2.5
Comp. Ex. 7	Fig. 5	1.5	0.0	0.0	-	-	1.5	1.5
Ex. 1	Fig. 6	5.0	0.0	3.5	3.5	0.0	1.5	5.0
Ex. 2	Fig. 6	4.0	0.0	2.5	2.5	0.0	1.5	4.0
Ex. 3	Fig. 6	3.0	0.0	1.5	1.5	0.0	1.5	3.0
Ex. 4	Fig. 6	2.75	0.0	1.25	1.25	0.0	1.5	2.75
Ex. 5	Fig. 6	2.5	0.0	1.0	1.0	0.0	1.5	2.5
Ex. 6	Fig. 7	1.5	0.0	1.5	0.0	1.5	1.5	1.5

Equivalent *: part by mass of water based on 1 part by mass of dry weight of chlorine bypass dust

[0060] More specifically, as shown in Fig. 5, in Comparative Examples 1 to 7, 1.5 to 5.0 parts by mass of new water was added based on 1 part by mass of the dry weight of chlorine bypass dust (the aforesaid water amount ratio will hereinafter be described simply as “1.5 equivalents” or so based on the dry weight of chlorine bypass dust) provided for the first-stage treatment and 3.5 equivalents, 3 equivalents, 2.5 equivalents, 2 equivalents, 1.25

equivalents, or 1 equivalent of new water was added to the desalted cake after dehydration to wash it therewith. In addition, for washing of the filter paper, 1.5 equivalents of new water were used, while for slurring of chlorine bypass dust to be provided for second-stage treatment, 3.5 equivalents, 3 equivalents, 2 equivalents, 1.25 equivalents, or 1 equivalent of a second filtrate discharged from the first stage and 1.5 equivalents of solid-free filter-paper washing wastewater discharged from the first stage were used together. In Comparative Example 7, however, washing of the desalted cake was not performed.

[0061] As shown in FIG. 6, in Examples 1 to 5, 1.5 to 5.0 equivalents of new water were added to chlorine bypass dust provided for the first-stage treatment and the resulting mixture was slurried. To the desalted cake after dehydration, 3.5 equivalents, 2.5 equivalents, 1.5 equivalents, 1.25 equivalents, or 1 equivalent of new water was added to wash the desalted cake (first-desalted-cake washing) and further, washing of the desalted cake with the same equivalent of new water was repeated (second-desalted-cake washing). Similar to Comparative Examples 1 to 7, 1.5 equivalents of new water were used for washing of filter paper and for slurring of chlorine bypass dust provided for the second stage treatment, 3.5 equivalents, 2.5 equivalents, 1.5 equivalents, 1.25 equivalents, or 1 equivalent of the second filtrate discharged from the first stage was used together with 1.5 equivalents of filter-paper washing wastewater discharged from the first stage. In Examples 1 to 5, however, 3.5 equivalents, 2.5 equivalents, 1.5 equivalents, 1.25 equivalents, or 1 equivalent of the third filtrate discharged upon the first-stage second-desalted-cake washing was used for washing of the first desalted cake at the second-stage desalting treatment.

[0062] In Example 6, as shown in FIG. 7, the slurring, the first-desalted-cake washing, the second-desalted-cake washing, and filter-paper washing were each performed with 1.5 equivalents of water. However, the second filtrate discharged from the first-desalted-cake washing of the first stage was used for the slurring of chlorine bypass dust to be provided for the second stage treatment; the third filtrate discharged from the second-desalted-cake washing of the first stage was used for first-desalted-cake washing; and the filter-paper washing wastewater discharged from the first stage was used for second-desalted-cake washing.

[0063] The chlorine concentration of the product washed with water after treatment was measured by a fundamental parameter method for fluorescent X-ray analysis. In addition, with respect to wastewater, the first filtrate discharged upon the desalted-cake formation was subjected to ICP analysis (Pb, Zn) and ion chromatographic analysis (CI).

5 [0064] Table 2 collectively shows the total amount per stage of new water used for the treatment of chlorine bypass dust, a chlorine concentration of the product washed with water and analysis results of wastewater components.

[0065] [Table 2]

	Drawing used for description	Amount of water used	Product washed with water		Wastewater components			Chlorine concentration (%-dry)/total of new water (equivalent*/stage)	
		Total of new water (equivalent*/stage)	Chlorine concentration %-dry	Desalting ratio %	Cl %	Pb mg/L	Zn mg/L	-	Δ(Comparative Example/Example)
Raw powder	-	-	20.94	-	-	-	-	-	-
Comp. Ex. 1	Fig. 5	5.0	0.41	98.3	4.6	500	13	0.08	
Comp. Ex. 2	Fig. 5	4.5	0.67	98.2	-	-	-	0.15	
Comp. Ex. 3	Fig. 5	4.0	0.59	98.5	4.8	450	5.0	0.15	
Comp. Ex. 4	Fig. 5	3.5	0.74	98.0	5.4	360	4.9	0.21	
Comp. Ex. 5	Fig. 5	2.75	0.86	97.5	6.8	260	3.8	0.31	
Comp. Ex. 6	Fig. 5	2.5	0.93	97.2	7.4	230	3.2	0.37	
Comp. Ex. 7	Fig. 5	1.5	6.10	73.5	11	110	2.3	4.06	
Ex. 1	Fig. 6	5.0	0.27	98.8	4.6	500	13	0.05	0.028
Ex. 2	Fig. 6	4.0	0.43	98.2	4.8	450	5.0	0.11	0.041
Ex. 3	Fig. 6	3.0	0.57	98.4	6.3	290	4.3	0.19	-
Ex. 4	Fig. 6	2.75	0.54	98.4	6.8	260	3.8	0.20	0.115
Ex. 5	Fig. 6	2.5	0.62	98.2	7.4	230	3.2	0.25	0.126
Ex. 6	Fig. 7	1.5	0.84	97.6	11	110	2.3	0.56	3.506

Equivalent*: part by mass of water based on 1 part by mass of the dry weight of chlorine bypass dust

[0066] The results have revealed the following.

[0067] As shown in FIG. 8, both in Comparative Examples and Examples, as a new water ratio decreased, the dehydrated-cake chlorine concentration after washing increased. When wash water was recycled as in Examples, the new water ratio was reduced (wastewater treatment amount) at a dehydrated-cake chlorine concentration similar to that

in Comparative Examples. For example, in Comparative Example 3, the total amount per stage of new water used for the treatment of chlorine bypass dust was 4 equivalents and the chlorine concentration at that time was 0.59%-dry, while in Example 1, 3 equivalents were adequate as the total amount of new water in order to achieve a chlorine concentration of 0.57%-dry similar to that of Comparative Example 3.

[0068] On the other hand, the Pb and Zn components in the wastewater decreased due to an increase in Cl concentration in the wastewater caused by a decrease in new water ratio both in Comparative Examples and Examples (FIG. 9). Further, recycling use of wash water as in Examples makes it possible to decrease the dehydrated-cake chlorine concentration (while maintaining the desalting performance) and decrease the Pb and Zn concentrations in the wastewater (FIG. 10). This has revealed that the cost of a wastewater treatment chemical necessary for the treatment of Pb and Zn can be reduced.

[0069] FIG. 11 is a graph showing the relation between a difference obtained by subtracting a value of Example from a value of Comparative Example at the same new water ratio and a new water ratio corresponding thereto, the value meaning a quotient obtained by dividing a dehydrated-cake chlorine concentration by a new water ratio, that is, a residual chlorine concentration per water amount

[0070] As the result, as shown in FIG. 11, compared with the effect in Comparative Examples at the same new water ratio, the effect of desalting treatment caused by recycling use of wash water in Examples is more marked when a new water ratio is smaller.

[0071] Thus, it has been found that the water using amount of the entire system necessary for achieving the object of desalting treatment can be reduced by recycling use of wash water.

Description of Reference Numerals

[0072] 1: solid-liquid separator (for slurring or dehydration of a cake), 2,3,6: reservoir tank, 4,5: measurement device, 7: solid-liquid separator (for removing the washing residue of a filter cloth).

CLAIMS

1. A desalting treatment method of chlorine-containing powder comprising:
 - a slurring step for mixing the chlorine-containing powder with a first desalting wash liquid to obtain a slurry;
 - a chlorine elution step for eluting chlorine contained in the chlorine-containing powder in a liquid phase in the slurry,
 - a desalted-cake formation step for dehydrating the slurry in which the chlorine has been eluted to obtain a first desalted cake and a first filtrate,
 - a first-desalted-cake washing step for washing the first desalted cake with a second desalting wash liquid different from the first desalting wash liquid to obtain a second desalted cake and a second filtrate, and
 - a second-desalted-cake washing step for washing the second desalted cake with a third desalting wash liquid different from the first desalting wash liquid and the second desalting wash liquid to obtain a third desalted cake and a third filtrate; wherein:
 - the slurring step, the chlorine elution step, the desalted-cake formation step, the first-desalted-cake washing step, and the second-desalted-cake washing step are repeated for each chlorine-containing powder to be supplied; and
 - at least a portion of the third filtrate obtained in the second-desalted-cake washing step is collected and stored, is reused for chlorine-containing powder to be supplied to a latter stage as either or both of the second desalting wash liquid for the first-desalted-cake washing step and the third desalting wash liquid for the second-desalted-cake washing step, and is recycled as the first desalting wash liquid after being reused once or multiple times.
2. The desalting treatment method of chlorine-containing powder according to claim 1, wherein the desalted-cake formation step, the first-desalted-cake washing step, and the second-desalted-cake washing step are performed using a solid-liquid separator making use of a filter cloth and at least a portion of the filter-cloth washing wastewater obtained by washing the filter cloth is recycled as either or both of the second desalting wash liquid and the third desalting wash liquid.

3. The desalting treatment method of chlorine-containing powder according to claim 2, wherein the solid-liquid separator is a filter press or a belt filter.

5 4. The desalting treatment method of chlorine-containing powder according to claim 2, wherein the solid-liquid separator is a filter press and at least a portion of the filter-cloth washing wastewater is subjected to solid-liquid separation and a liquid portion thus obtained is recycled as either or both of the second desalting wash liquid and the third desalting wash liquid.

10 5. The desalting treatment method of chlorine-containing powder according to any one of claims 1 to 4, wherein the desalted-cake formation step, the first-desalted-cake washing step, and the second-desalted-cake washing step are performed using a solid-liquid separator making use of a filter cloth and at least a portion of filter-cloth washing
15 wastewater obtained by washing the filter cloth is recycled as the first desalting wash liquid.

6. The desalting treatment method of chlorine-containing powder according to any one of claims 1 to 5, wherein upon reusing the third filtrate obtained in the second-desalted-cake washing step, whether or not to use the third filtrate is determined by observing at
20 least one of the following (1) to (5) in a reservoir tank in which at least a portion of the third filtrate is collected and stored:

- (1) a total time for the reuse treatment with the third filtrate,
- (2) a total water amount for the reuse treatment with the third filtrate,
- (3) pH of the third filtrate,
- 25 (4) a chlorine ion concentration of the third filtrate, and
- (5) electric conductivity of the third filtrate.

7. The desalting treatment method of chlorine-containing powder according to any one of claims 1 to 6, wherein at least a portion of the second filtrate obtained in the first-
30 desalted-cake washing step is collected and stored, is reused for chlorine-containing powder

to be supplied to a latter stage as the second desalting wash liquid for the first-desalted-cake washing step, and is recycled as the first desalting wash liquid after being reused once or multiple times.

5 8. The desalting treatment method of chlorine-containing powder according to claim 7, wherein upon reusing the second filtrate obtained in the first-desalted-cake washing step, whether or not to use the second filtrate is determined by observing at least one of the following (1) to (5) in a reservoir tank in which at least a portion of the second filtrate is collected and stored:

- 10 (1) a total time for the reuse treatment with the second filtrate,
 (2) a total water amount for the reuse treatment with the second filtrate,
 (3) pH of the second filtrate,
 (4) a chlorine ion concentration of the second filtrate, and
 (5) electric conductivity of the second filtrate.

15 9. The desalting treatment method of chlorine-containing powder according to any one of claims 1 to 8, wherein:

 washing of the first desalted cake with the second desalting wash liquid in the first-desalted-cake washing step is performed multiple times with the second desalting wash liquid, and/or

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 washing of the second desalted cake with the third desalting wash liquid in the second-desalted-cake washing step is performed multiple times with the third desalting wash liquid.

25 10. The desalting treatment method of chlorine-containing powder according to any one of claims 1 to 9, wherein:

 the water using amount is 1.5 parts by mass to 4 parts by mass based on 1 part by mass of a dry weight of the chlorine-containing powder to be subjected to desalting treatment.

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11. The desalting treatment method of chlorine-containing powder according to any one of claims 1 to 10, wherein:

the desalted-cake formation step, the first-desalted-cake washing step, and the second-desalted-cake washing step are performed in a single solid-liquid separator.