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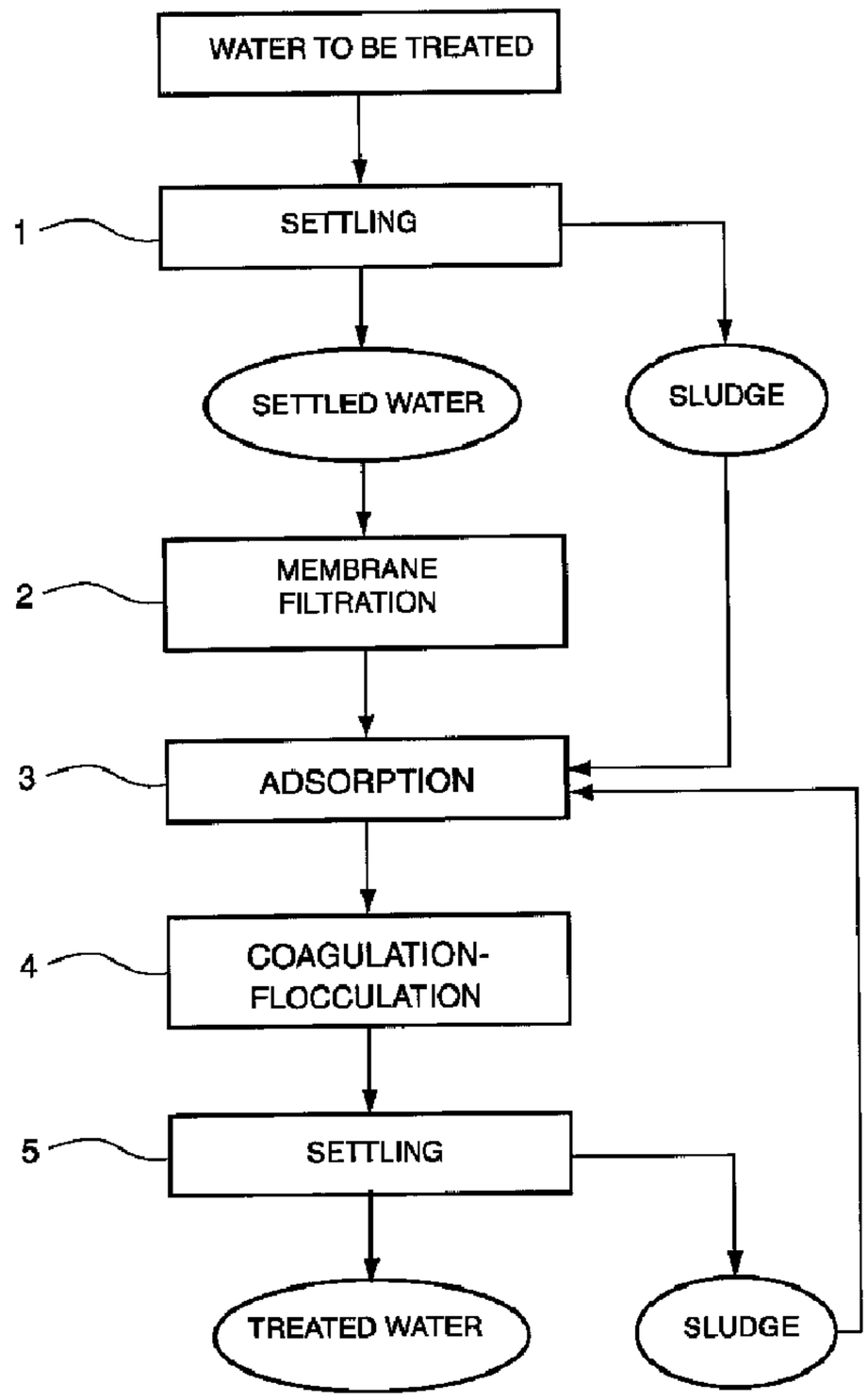
(54) Titre : PROCEDE DE TRAITEMENT DE REJET DE STATION MEMBRANAIRE
(54) Title: MEMBRANE STATION WASTE TREATMENT PROCESS



(57) Abrégé/Abstract:
The invention relates to a water treatment process comprising a first pre-treatment step which produces pretreated water and sludge, wherein said pretreated water undergoes at least one filtration step, at least one of which is a membrane filtration step, and

CA 2667701 C 2015/05/12

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(57) Abrégé(suite)/Abstract(continued):
wherein said filtration step produces waste, characterized in that said waste derived from said membrane filtration step undergoes a treatment phase which includes at least one coagulation-flocculation step followed by a second decanting step which produces sludge, wherein said coagulation-flocculation step is preceded by at least one step of adsorption onto said sludge derived from the pretreatment or the decanting step, wherein said adsorption step is aimed at removing the phosphonates contained in said water derived from said membrane filtration step.

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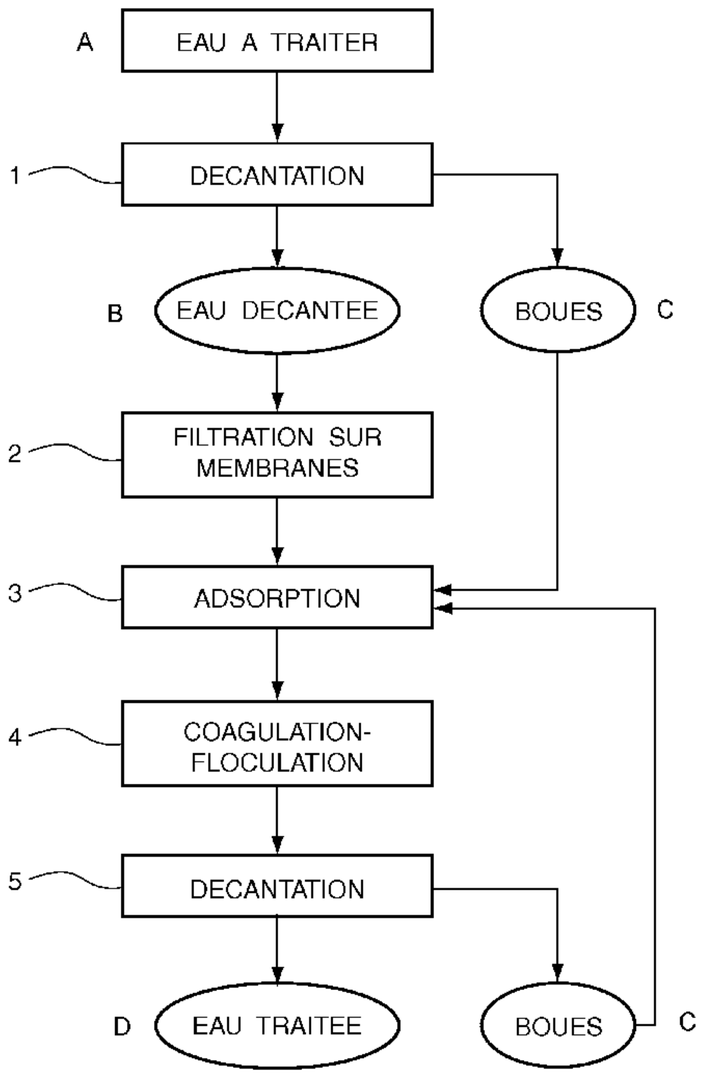
[Suite sur la page suivante]

(54) **Title:** MEMBRANE STATION WASTE TREATMENT PROCESS

(54) **Titre :** PROCEDE DE TRAITEMENT DE REJET DE STATION MEMBRANAIRE



A WATER TO BE TREATED
1 DECANTING
B DECANTED WATER
C SLUDGE
2 FILTRATION THROUGH MEMBRANES
4 COAGULATION-FLOCCULATION
5 DECANTING
D TREATED WATER

(57) Abstract: The invention relates to a water treatment process comprising a first pre-treatment step which produces pretreated water and sludge, wherein said pretreated water undergoes at least one filtration step, at least one of which is a membrane filtration step, and wherein said filtration step produces waste, characterized in that said waste derived from said membrane filtration step undergoes a treatment phase which includes at least one coagulation-flocculation step followed by a second decanting step which produces sludge, wherein said coagulation-flocculation step is preceded by at least one step of adsorption onto said sludge derived from the pretreatment or the decanting step, wherein said adsorption step is aimed at removing the phosphonates contained in said water derived from said membrane filtration step.

(57) Abrégé : L'invention a pour objet un procédé de traitement d'eaux, comprenant une première étape de prétraitement produisant une eau prétraitée et des boues, ladite eau prétraitée subissant au moins une étape de filtration dont au moins une sur membrane, ladite étape de filtration produisant des rejets, caractérisé en ce que lesdits rejets issus de ladite étape de filtration membranaire subissent une phase de traitement incluant au moins une étape de coagulation-floculation suivie d'une deuxième étape de décantation produisant des boues, ladite étape de coagulation-floculation étant précédée d'au moins une étape d'adsorption sur lesdites boues issues du prétraitement ou de l'étape de décantation, ladite étape d'adsorption visant un abattement des phosphonates contenus dans lesdites eaux issues de ladite étape de filtration membranaire.

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MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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MEMBRANE STATION WASTE TREATMENT PROCESS

The field of the invention is that of water treatment. More specifically, the invention relates to water treatment processes comprising at least one membrane filtration step.

The invention particularly, but not exclusively, applies to treatments of water intended to undergo a reverse osmosis or nanofiltration membrane treatment.

The invention preferentially applies to water potabilisation processes.

Water for human consumption is conventionally subjected to a nanofiltration or reverse osmosis membrane filtration treatment to reduce the content thereof of pesticides and other micro-pollutants which may be removed by means of membrane processes.

Nanofiltration also makes it possible to remove bivalent anions, such as sulphates, and also reduce the content of other salts, such as nitrates for example.

Reverse osmosis uses membranes similar to those for nanofiltration but with a higher separation power. It makes it possible to remove practically all the organic and mineral pollutants from water. Reverse osmosis is particularly used for the production of water for human consumption.

In addition, it is conventional to have the water undergo a pre-treatment upstream from the reverse osmosis and nanofiltration membrane treatments, said pre-treatment consisting of a low-speed liquid-solid

separation (for example, simple or lamellar settling and/or two-layer direct filtration, and/or floatation).

A coagulation-flocculation treatment is also frequently performed.

One drawback of membrane filtration techniques is the production of waste referred to as concentrates representing 10 to 60% of the initial flow rate, and which are in the majority of cases, charged with phosphonates.

These phosphonates are obtained from sequestering agents injected upstream from the membranes. They are intended to prevent the precipitation of salts on the membranes. They are completely stopped by same, thus being concentrated approximately 2 to 7 times in the membrane waste.

However, authorities tend to prohibit phosphonate waste in rivers. This problem particularly occurs for waste from drinking water production plants, which is liable to partly reach river waters.

Therefore, it is necessary to propose a technique to prevent such waste.

This is an aim of the invention.

More specifically, the aim of the invention is to propose a technique for the elimination of undesirable species in waste such as phosphonates, applied to a water treatment comprising a pre-treatment and membrane filtration step.

The aim of the invention is also to propose such a technique which makes it possible to reduce the operating costs compared to processes according to the prior art.

The aim of the invention is also to provide such a technique which offers optimised recycling processes for pre-treatment sludge, particularly that produced by the settling steps.

A further aim of the invention is to provide such a technique which is simple in design and easy to implement.

The invention also makes it possible to treat the waste in order to recycle same using it for cleaning industrial constructions such as for example the sand filter.

These aims, along with others which will emerge hereinafter, are achieved by means of the invention which relates to a water treatment process, comprising a first pre-treatment step producing pre-treated water and sludge, said pre-treated water undergoing at least one filtration step including at least one on a membrane, said filtration step producing waste, characterised in that said waste from said membrane filtration step undergoes a treatment phase including at least one coagulation-flocculation step followed by a second settling step producing sludge, said coagulation-flocculation step being preceded by at least one adsorption step on said sludge from the pre-treatment or the settling step, said adsorption step being intended to lower the phosphonates contained in said water from said membrane filtration step.

As mentioned above, the phosphonates are obtained from sequestering agents injected upstream from the membranes, concentrated approximately 2 to 7 times thereon.

However, the sequestering agents being chelating agents, they are easily adsorbed on clays, calcites or metal hydroxides, the latter compounds being conventionally found in settling sludge. Said hydroxides are obtained from iron or aluminium-based coagulants used during the coagulation step.

Therefore, the adsorption capacity of the sludge is used to eliminate phosphonates from the membrane filtration concentrates.

In addition, the process according to the invention enables a reduction in the coagulant dosages, and therefore a reduction in the corresponding operating costs.

Indeed, in the case of conventional concentrate coagulation-flocculation, the coagulant dosages are two to three times higher than in the case of the process according to the invention. This is explained by the fact that part of the phosphonates is pre-adsorbed on drinking water plant waste treatment station sludge. Therefore, the residue to be eliminated involves a lower coagulant consumption.

It is noted that the use of sludge for the adsorption step does not generate high additional costs, said sludge being a by-product of the process according

to the invention. Therefore, recycling this sludge is relatively inexpensive.

It is also noted that enriching the sludge with phosphorus is beneficial for the agricultural recycling thereof, the concentration of the sludge with phosphorus enabling superior fertilisation of soils in manure. In addition, phosphorus in phosphonate form is less accessible than phosphorus in phosphate form. The breakdown thereof to phosphorus will therefore be slower, and thus more beneficial for the soil.

Preferentially, said sludge consists of iron and/or aluminium hydroxide sludge.

According to a preferred embodiment, said adsorption step is performed under stirring for approximately 10 minutes.

According to another feature, said coagulation-flocculation step is performed at least in two successive phases, the first under fast stirring and the second under slow stirring.

Advantageously, said settling step(s) is/are performed for approximately 15 minutes.

According to another feature, the process comprises a recycling step of said sludge in agricultural manure.

In this case, the process comprises at least one concentration step of said sludge when said sludge is saturated with phosphorus.

In this way, the phosphorus concentration of the sludge is increased further, which improves the capacity to fertilise soils in manure.

Other features and advantages of the invention will emerge more clearly on reading the following description of a preferential embodiment of the invention, given as an illustrative and non-limitative example, and the appended figures wherein:

- figure 1 is a synoptic representation of a water treatment process according to the invention;

- figure 2 is a phosphorus reduction graph at different sludge doses.

As specified above, the principle of the invention lies in the provision, in a water treatment including a pre-treatment step and at least one membrane filtration step, an elimination step of the phosphonates found in the concentrates by means of physicochemical adsorption on sludge from a drinking water waste treatment.

An example of a process according to the invention is illustrated by figure 1.

As illustrated, the water to be treated undergoes a primary settling step 1, following which settled water and settling sludge are obtained.

The settled water undergoes a membrane filtration step 2, by means of nanofiltration or reverse osmosis.

The membrane treatment concentrates then undergo a treatment phase including a coagulation/flocculation step 4 and a secondary settling step 5, following which treated water and settling sludge are obtained.

According to the principle of the invention, a phosphonate adsorption step 3 is inserted between the

membrane filtration step 2 and the coagulation/flocculation step 4.

Said adsorption step is performed for 10 minutes, under stirring, with a stirring speed of 60 rpm, on sludge from the primary settling step 1 and/or on the secondary settling step 5.

The adsorbent material is preferentially iron or aluminium hydroxide sludge. The sludge concentration will vary between 125 and 400 mg/l (expressed as SS) according to site availabilities.

The coagulation/flocculation step 4 is broken down into two phases: a first phase under fast stirring at 250 rpm followed by a second phase under slow stirring at 60 rpm.

The coagulant is of the mineral type, preferentially $FeCL_3$, wherein the concentration will vary between 50 and 100 mg/l.

The flocculent is of the 4190 SH Floerger type (registered trademark), having a concentration between 0.5 and 1 ppm.

The duration of the settling steps 1, 5 is 15 minutes.

Tests were conducted to demonstrate the contribution of a process according to the invention to the quantity of coagulant with respect to a process with an adsorption step.

To perform said tests, concentrates from a membrane installation were mixed with sludge from a drinking water

plant water treatment. This sludge is rich in FeCl3 used as a coagulant on the treatment station.

The tests were conducted according to the protocol detailed above.

For superior reliability of the analyses, the elimination of the phosphonates is determined according to the reduction of Ptotal.

The membrane concentrates were mixed during the adsorption step at different sludge doses expressed in mg/l of suspended solids (SS).

In a second phase, a coagulation step is performed at different FeCl3 doses.

The results of these tests are listed in the graph in figure 2.

It is observed that, for the same Ptotal reduction percentage, the FeCl3 doses used are much lower when an adsorption step is performed with sludge at 125 mg/l.

In this way, to eliminate 75% of the Ptotal, it is necessary to use 60 ppm of $FeCl_3$ (commercial product) with 126 ppm (SS) sludge for 150 ppm of $FeCl_3$ without an adsorption step.

CLAIMS

1. Water treatment process, comprising a step of adding sequestering agents comprising phosphonates to the water, a first pre-treatment step producing pre-treated water and sludge, said pre-treated water undergoing at least one filtration step including at least one on a membrane, said filtration step producing waste, characterised in that said waste from said membrane filtration step undergoes a treatment phase including at least one coagulation-flocculation step followed by a second settling step producing sludge, said coagulation-flocculation step being preceded by at least one adsorption step on said sludge originating from the pre-treatment or the settling step, said adsorption step being intended to lower the phosphonates contained in said water from said membrane filtration step.

2. Water treatment process according to claim 1, characterised in that said sludge is iron or aluminium hydroxide sludge.

3. Water treatment process according to any one of claims 1 and 2, characterised in that said adsorption step is performed under stirring for 10 minutes.

4. Water treatment process according to any one of claims 1 to 3, characterised in that the coagulation-flocculation step is performed at least in two successive phases, the first under fast stirring and the second under slow stirring.

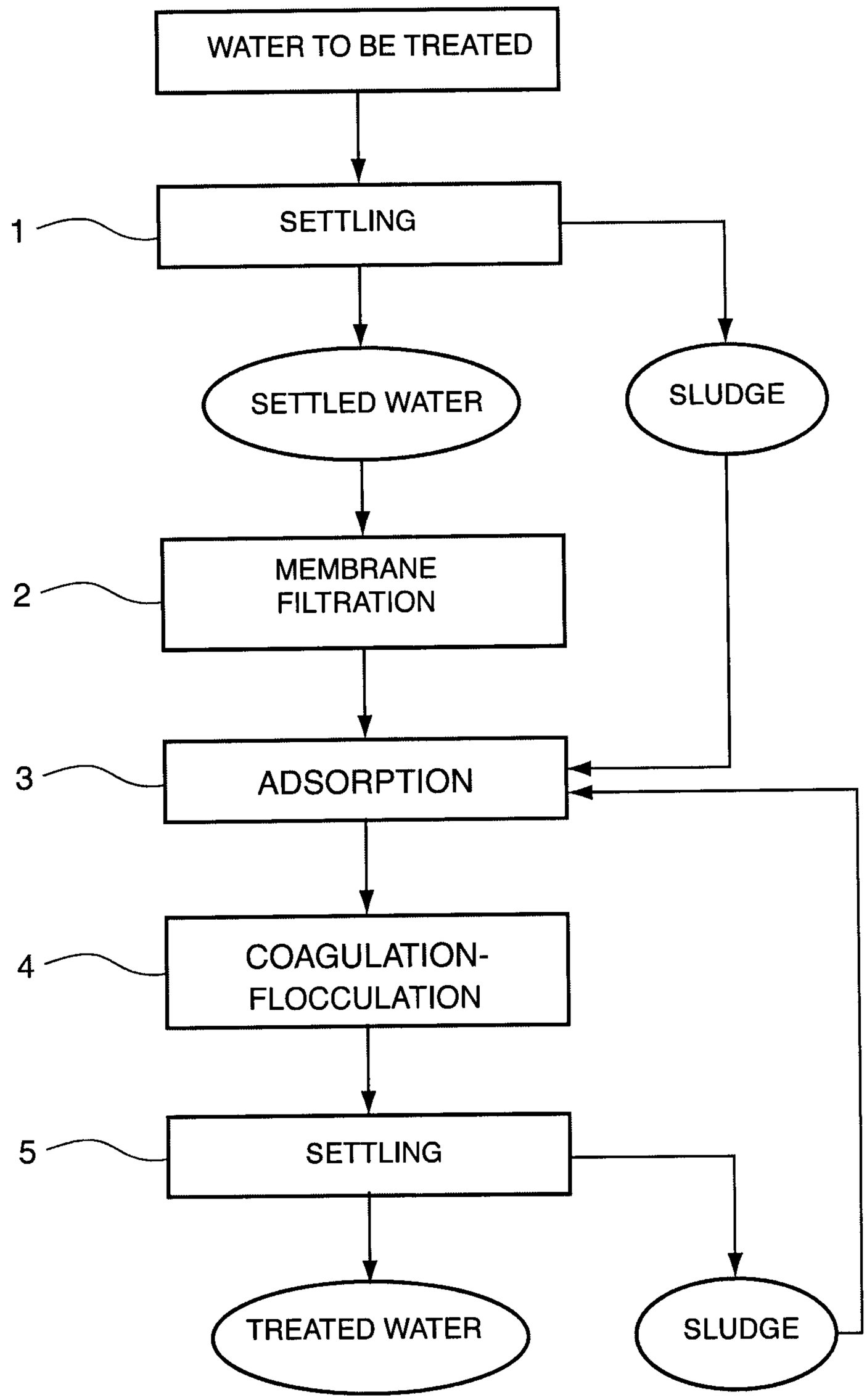
5. Water treatment process according to any one of claims 1 to 4, characterised in that said filtration step belongs to the following group:

- reverse osmosis filtration; or

- nanofiltration.

6. Water treatment process according to any one of claims 1 to 5, characterised in that it comprises a recycling step of said sludge for agricultural manure.

7. Water treatment process according to claim 6, characterised in that it comprises at least one concentration step of said sludge when said sludge is saturated with phosphorus.


WATER TO BE TREATED
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SETTLED WATER
SLUDGE
2
MEMBRANE FILTRATION
3
ADSORPTION
4
COAGULATION-FLOCCULATION
5
SETTLING
TREATED WATER
SLUDGE

Fig. 1

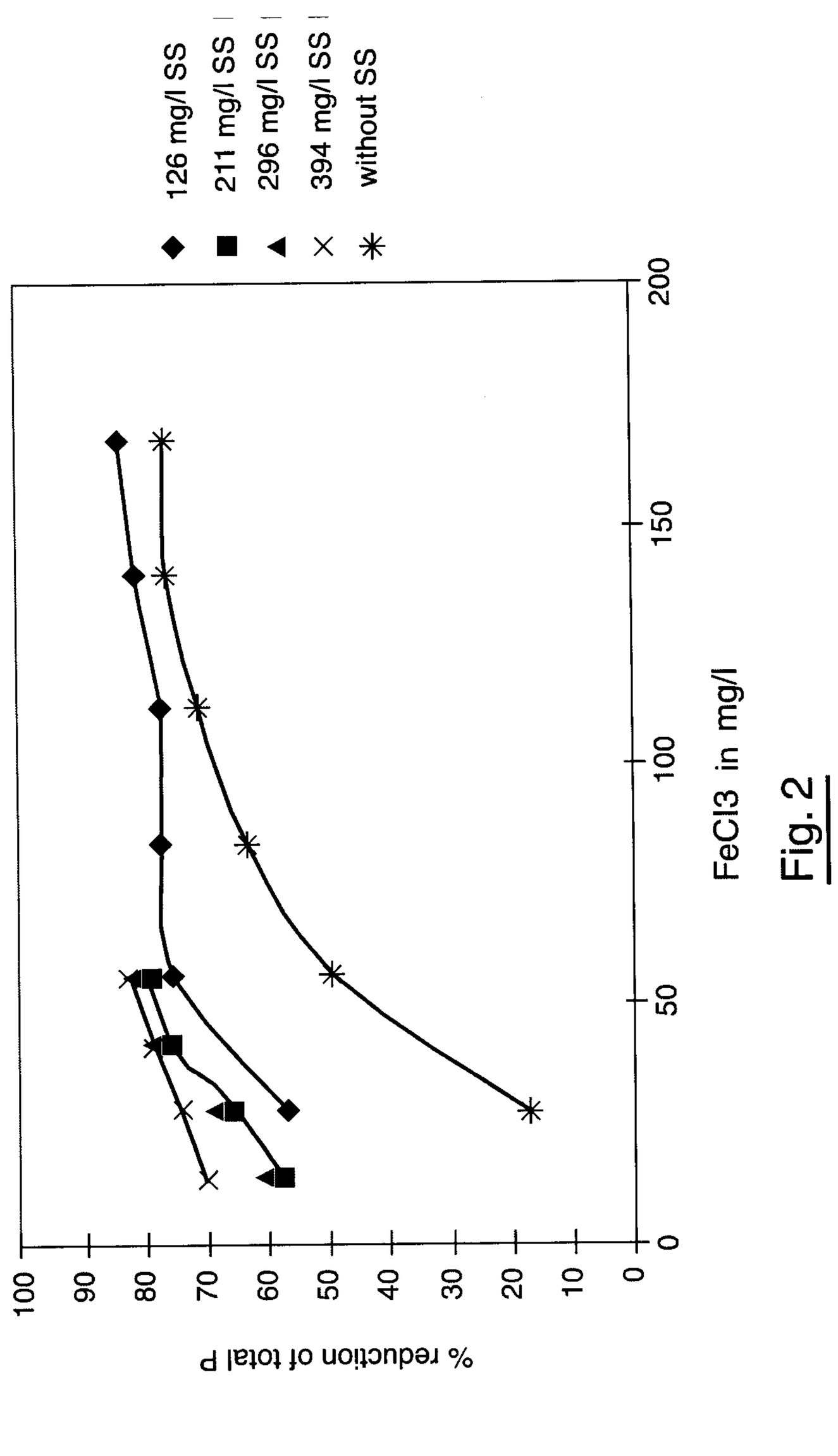
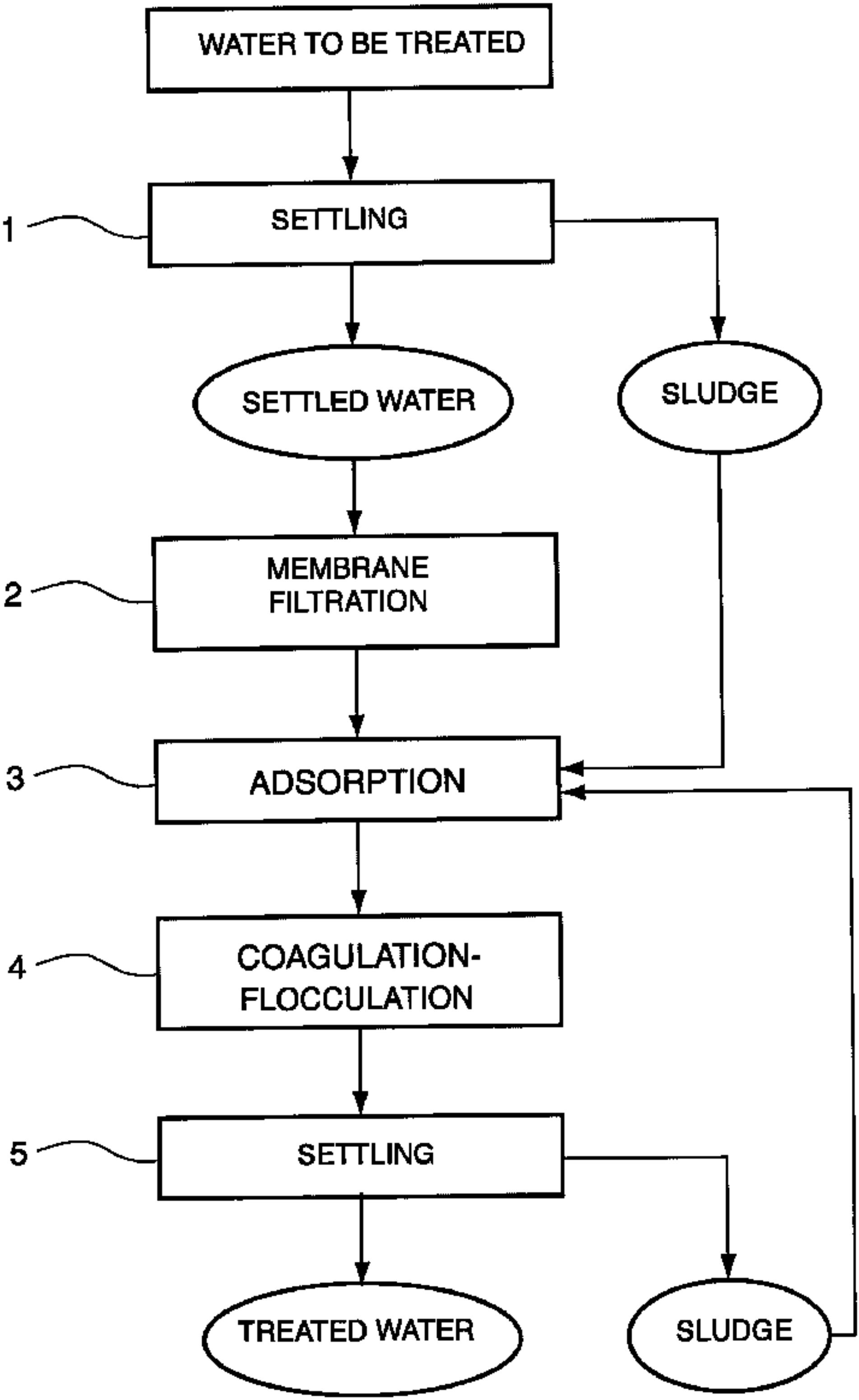

126 mg/l SS
211 mg/l SS
296 mg/l SS
394 mg/l SS
without SS
% reduction of total P
0
10
20
30
40
50
60
70
80
90
100
FeCl3 in mg/l
0
50
100
150
200

Fig. 2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