

WASTEWATER TREATMENT METHOD COMPRISING DECANTATION AND
FINE SCREENING STAGES, AND DEVICE FOR CARRYING OUT SAID
METHOD

5 The field of the invention is that of water
treatment. More precisely, the invention relates to a
physical or physical and chemical method for the
reduction of the content of matters in suspension or
parasites in such water, as well as the device
10 corresponding to this method.

The invention can be used for treating any water
containing matter in suspension when reduction of this
matter content is such as in particular:

15 - wastewater already treated biologically, in
order to refine the purification thereof;

 - wastewater intended to be reused after
treatment, for example in industry or agriculture, in
particular for irrigation;

20 - water intended to be discharged into the sea;
 - wastewater already treated, biologically or
otherwise, in order to control the residual phosphorus
content of the discharge.

As indicated below, the method and device according to the invention are particularly advantageous for treating matters in suspension contained in waters intended to be reused for
5 irrigation.

This is because wastewater is being re-used more and more frequently in irrigation, both for the irrigation of cultivation and for that of municipal parks or golf courses for example.

10 Usually wastewater is treated in order to remove therefrom the pollution that may represent a danger for the quality of the environment receiving the treated wastewater. Thus, apart from the parameters representing carbonaceous, nitrogenous and phosphorous
15 pollutions, microbiology is more and more often taken into account in the treatment requirements, with the frequent use of finishing treatments, such as exposure of treated water to ultraviolet or final filtration on membranes for example.

20 There exist in the prior art several techniques for treating matters in suspension. Among these techniques the following can be cited:

- physical or preferably physical and chemical settling consisting in subjecting the water to
25 clarification possibly coupled with an addition of coagulating reagent in order to the ability of the matters in suspension to settle;

- filtration on a sand bed which thickness generally ranges between 1.5 and 2 m.

30 With regard to the treatment speeds applied to settling tanks of a conventional type, these rarely

exceed 2 to 2.5 m/hour. These treatment speeds can be increased up to 10 to 15 m/hour when the settling tank used is of the lamellar type and up to 20 m/hour when the lamellar settling is coupled with a
5 coagulation/flocculation step.

To obtain a good water quality, the prior art recommends the use of sand beds with a maximum filtration speed of 10 m/hour.

Both types of treatment therefore present the
10 drawback of not being able to be implemented at high speed, which makes it necessary to use large installations involving high civil engineering costs.

Moreover, in the case of the reuse of wastewater for irrigation, it is generally required to provide
15 treatment to limit the concentration of helminth eggs in irrigation water at a low level, usually 1 egg per litre of water.

These eggs are resistant to treatments of the UV or chlorine type and are for now removed either by
20 final filtration on sand or by membrane micro- or ultrafiltration.

Thus it has been proposed, according to the French patent document having the publication number FR-2 767 521, to complete the removal of helminth eggs by
25 successive passage of the biologically treated wastewater through a rapid settling step (>20 m/hour) and then in a multilayer ascending filtration step at high speed (>10 m/hour).

In a more elaborate combination, it is proposed to
30 interpose a screening step, with a mesh ranging between 0.5 and 5 mm, between the settling tank and the filter,

in order to minimise the arrival on the filtering material of sludge, fibres and other clogging elements possibly contained in the settled water.

5 This technique has shown to be efficient in reducing helminth eggs to levels always below the maximum limit usually sought of 1 egg per litre of water.

10 Although more compact than the slower finishing techniques by mono-layer and/or descending sand filtration, this rapid filtration technique however still remain relatively costly because of the size of the filtration equipment necessary.

15 The objective of the invention is in particular to propose a water treatment method that is less expensive than the methods of the prior art.

Another object of the invention is to propose a water treatment device that involves equipment of reduced size compared to those of the prior art.

20 Another objective of the invention is to provide such a method and/or such a device which is adapted to the treatment of water intended both for irrigation and for industry, or for use as drinking water.

25 These objectives, as well as others that will emerge subsequently, are achieved by virtue of the invention, the object of which is a water treatment method which aims to reduce the water content of matters in suspension, and in particular the content of parasites, comprising a settling step consisting in circulating said water through a settling tank at a
30 treatment speed greater than 10 m/hour, characterised in that said settling step is followed by a fine

screening step using a screen with mesh dimensions ranging between approximately 5 micrometres and approximately 25 micrometres.

It should be noted that the results obtained with the method according to the invention are as good as those obtained with the methods of the prior art which recommend a three steps treatment (settling, coarse screening and multi-layer filter filtration) and which in no way suggest that a method combining only two steps, including a fast settling and a fine screening, can lead to the required reduction in parasites.

According to a preferred embodiment, said fine screening step is carried out using a screen with mesh dimensions ranging between approximately 8 micrometres and approximately 12 micrometres.

It appears indeed that the wastewater leaves the settling tank with a statistically low helminth egg content (around less than one to a few helminth eggs per litre, depending on whether the wastewater is untreated or biologically treated) with such fine screening.

Thus, although helminth eggs are capable of ovalising in order to pass through the screen meshes, it became clear, unexpectedly, during the tests carried out by the Applicant, that the eggs remaining after the settling steps are reduced to a sufficient extent by a screening between 8 and 12 micrometres so that all the waters tested have a helminth egg concentration under the limit of 1 egg per litre after screening.

According to an advantageous solution, said settling step is preceded by a coagulation/flocculation step.

5 It appears indeed that the eggs tend to integrate the floc and are better stopped both at the settling and at the screening of the remaining flocs.

According to a first advantageous variant, said coagulation/flocculation step is obtained by recirculating the sludge coming from said settling
10 step, with addition in said water of at least one coagulation agent and at least one flocculation agent.

In this case, the said flocculation step is preferentially carried out at a speed of at least 20 m/hour.

15 According to a second advantageous variant, said coagulation/flocculation step is obtained by adding to said water at least one coagulation agent, at least one flocculation agent and at least one water insoluble granular ballasting material.

20 In this case, said flocculation/coagulation step is preferentially carried out at a speed of at least 30 m/hour.

Advantageously, it comprises a step, downstream of said settling step, for injecting an oxidising agent.

25 In this case, said oxidising agent injection step is preferentially carried out upstream of said screening step.

Preferentially, said oxidising agent comprises at least one of the agents belonging to the following
30 group:

- chlorine;

- sodium hypochlorite;
- chlorine dioxide;
- ozone.

In this way a disinfection of the water is carried
5 out, in order to improve further the quality of the
treated water.

Advantageously, the method comprises a step,
upstream of said screening step, for injecting a
powdery agent comprising at least one of the agents
10 belonging to the following group:

- activated carbon in granular form;
- activated carbon in powder form;
- ion exchange resin.

In this way the treatment of dissolved pollutants
15 is carried out.

According to a first variant embodiment, it
comprises, downstream of said screening step, a step
for disinfecting said water by UV radiation.

According to a second variant embodiment, the
20 method comprises, downstream of said settling step and
upstream of said screening step, a step for
disinfecting said water by UV radiation.

The invention also concerns a device for treating
water in order to reduce the content of matters in
25 suspension, and in particular the parasites content,
comprising at least one settling tank, characterised in
that it comprises, downstream of said settling tank, at
least one screen, which screen mesh dimensions range
between approximately 5 micrometres and approximately
30 25 micrometres, and preferentially between

approximately 8 micrometres and approximately 12 micrometres.

According to a preferred solution, said settling tank is of the coagulation/flocculation/settling with
5 ballasted floc type.

In this case, said settling tank is advantageously associated with a ballast comprising a granular material with a specific weight greater than that of water and with a mean diameter ranging between
10 approximately 50 micrometres and approximately 250 micrometres.

According to a preferred embodiment, said screen or screens are of the disc or drum type.

Advantageously, it comprises means for unclogging
15 said screen or screens.

In this case, the unclogging means preferentially comprise means for spraying washing water under pressure.

In this case, the device advantageously comprises
20 means for disinfecting said washing water before its recirculation upstream of said settling tank.

Preferentially, said disinfecting means of said washing water are chosen from the following techniques:

- chlorination;
- 25 - ozonisation;
- UV radiation.

Advantageously, said spraying means spray the washing water at counter-flow of said water to be treated.

According to an advantageous solution, the device comprises means for recirculating the washing water upstream of said settling tank.

Other characteristics and advantages of the invention will appear more clearly after reading the following description of a preferential embodiment of the invention, given as an illustrative and non-limitative example, and the accompanying drawings, amongst which:

10 - figure 1 is a schematic representation of the principle of the invention;

 - figure 2 is a schematic view of a water treatment device according to a preferential embodiment of the invention.

15 As illustrated by figure 1, the principle of the invention lies in successively causing the wastewater, untreated or biologically treated, to pass through a settling tank 1, then through a screening system 2, external to the settling tank and with a mesh ranging
20 between 5 and 25 micrometres, preferentially between 8 and 12 micrometres.

 A ballast of this type can for example consist of sand.

 With reference to figure 2 the settling technique
25 used will be preceded by a coagulation step 3, in line or in a coagulation basin, with injection 31 of a mineral salt or a cationic polyelectrolyte, and a flocculation phase 4 before injection 41 of an anionic or cationic polyelectrolyte (polymer).

30 According to another variant that can be envisaged, the settling tank 1 is a sludge

recirculation settling tank, with the addition of at least one coagulating agent and one flocculating agent, functioning at a speed of at least 20 m/hour.

According to yet another variant that can be envisaged, the settling tank 1 is a ballasted floc settling tank, with addition of at least one coagulating agent, one flocculating agent and one water insoluble granular ballasting material, functioning at a speed of at least 30 m/hour, the ballast used in the settling tank 1 being a granular material with a specific gravity greater than that of water and with a mean diameter ranging between 50 and 250 micrometres.

The screening step is carried out on screens external to the settling tank and downstream thereof, to allow the control of the screen clogging and the cleaning thereof.

The screen preferentially has a 10 micrometre mesh and is of the disc or drum type, the disc type being preferred.

The preferred screening direction is from the inside of the disc or drum towards the outside, while the screen will be preferentially equipped with water spray washing systems 21, with injection nozzles or manifolds preferentially disposed outside the screen, injecting the water in the opposite direction to the screening.

During tests, disc screens of the "Hydrotech" type (registered trademark) were used, these affording easy washing by means of nozzles disposed outside and easy of access, when the screen begins to clog.

With screens with a nominal mesh of 10 micrometres the Applicant found, on biologically treated wastewater intended for irrigation, helminth egg levels always below to one egg per litre after passing through
5 coagulation/flocculation/ballasted settling and then screening, and this with settling speeds greater than 100 metres per hour, and approach speeds ranging between 10 and 30 m³ of settled water per hour and per square metre of developed screening surface, with
10 coagulant doses (aluminium sulphate used in this case, iron salts also being an excellent coagulant) around 12 mg/l expressed as aluminium, and doses of polymer of 0.7 mg/l.

The concentrations of matter in suspension were
15 divided by a factor of more than 20 in the same time, by passing through flocculation/ballasted settling/screening.

The settling/screening treatment therefore considerably reduces the level of matter in suspension
20 in the treated water and promotes the polishing of this water by the use of supplementary treatments, such as:

- the treatment of dissolved pollutants by the injection of powdery reagents, such as activated carbon in powder or granular form, or with ion exchange
25 resins;

- the disinfection of the water by oxidising reagent, such as ozone, hydrogen peroxide, chlorine, sodium hypochlorite, chlorine dioxide or chloramines, or by UV radiation.

30 It should be noted that UV may be applied after screening so as to benefit from the reduction in the

content of matter in suspension (MS) due to the screening.

UV can also be applied upstream of the screening, regarding the good quality of the settled water.

5 In the latter case, application by UV emitters installed directly in the vicinity of the screening grille is preferred, illuminating the latter with a flow of UV, the germicidal action of which is reinforced by the fact that the microorganisms retained
10 on the screen are subjected to high UV dosages by their periodic passage, at each turn through to the screen, in front of the UV emitters.

 The screen washing water is preferentially recycled 22 upstream of the settling tank so as to be
15 reflocculated and settled. In a manner that is preferred among all others, the washing water is disinfected by the action of an oxidant 23 before returning to the settling tank.

 More generally, this washing water can be
20 disinfected by chlorination, ionisation or UV radiation.

 The same process chain can be applied with profit to the treatment of surface water of the river or lake water type, in particular in order to remove from it
25 matter in suspension and microorganisms with a size greater than approximately 5 micrometres, but also dissolved heavy metals and colour. The treatment can also be supplemented by a disinfection treatment by oxidants or UV.

30 By way of indication tests carried out on lake water with an assembly comprising a floc settling tank

ballasted with sand functioning at a settling speed of 58 m/hour followed by a screen with a 10 micrometres mesh gave, under the operating conditions indicated in table 1 below, the results of the following table 2:

5

Table 1:

	Throughput	1,800-2,200 m ³ /h
	Total retention time:	15-20 minutes
	Speed at settling tank mirror:	50-58 m/hour
10	Dosing of coagulant:	8 mg Al/l
	Dosing of polymer:	0.30 mg/l
	pH:	5.8-5.9
	Recirculation:	4% of input rate

15

Table 2:

	Parameter	Input	Output	Objective	Efficiency
	Colour	up to 109 mg Pt/l	5 mg Pt/l	≤15 mg/Pt/l	95%
20	Matter in suspension	3.3 mg/l	<2 mg/l	≤5.0 mg/l	>38%
	Turbidity	4.5 NTU	0.19 NTU	≤1.00 NTU	-
	KMnO ₄	60.6 mg/l	9.6 mg/l	-	84%
	COD _{Cr}	34.8 mg/l	9.3 mg/l	≤20 mg/l	74%
	Total Aluminium	-	0.12 mg Al/l	≤0.50 mg Al/l	-
25	Dissolved Aluminium	-	<0.05 Al/l	≤0.10 mg Al/l	-

CLAIMS

1. Water treatment method aimed at reducing its content of matter in suspension, and in particular its
5 parasites content, comprising a settling step consisting in making said water pass through a settling tank, at a treatment speed greater than 10 m/hour,

characterised in that said settling step is followed by a fine screening step using a screen whose
10 screen mesh has dimensions ranging between approximately 5 micrometres and approximately 25 micrometres.

2. Water treatment method according to Claim 1, characterised in that said fine screening step is
15 carried out by means of a screen whose screen mesh has dimensions ranging between approximately 8 micrometres and approximately 12 micrometres.

3. Water treatment method according to one of Claims 1 and 2, characterised in that said settling
20 step is preceded by a coagulation/flocculation step.

4. Water treatment method according to Claim 3, characterised in that said coagulation/flocculation step is obtained by the recirculation of sludge coming from said settling step, with addition to said water of
25 at least one coagulation agent and at least one flocculation agent.

5. Water treatment method according to Claim 4, characterised in that said coagulation/flocculation step is carried out at a speed of at least 20 m/hour.

30 6. Water treatment method according to Claim 3, characterised in that said coagulation/flocculation

step is obtained by adding to said water at least one coagulation agent, at least one flocculation agent and at least one granular ballasting material insoluble in water.

5 7. Water treatment method according to Claim 6, characterised in that said coagulation/flocculation step is carried out at a speed of at least 30 m/hour.

 8. Water treatment method according to Claims 1 to 7, characterised in that it comprises a step,
10 downstream of said settling step, of injecting an oxidising reagent.

 9. Water treatment method according to Claim 8, characterised in that said step of injecting an oxidising reagent is carried out upstream of said
15 screening step.

 10. Water treatment method according to one of Claims 8 and 9, characterised in that said oxidising reagent comprises at least one of the reagents belonging to the following group:

- 20 - chlorine;
 - sodium hypochlorite;
 - chlorine dioxide;
 - ozone.

 11. Water treatment method according to any one of
25 Claims 1 to 10, characterised in that it comprises a step, upstream of said screening step, of injecting a powdery reagent comprising at least one of the reagents belonging to the following group:

- activated carbon in granular form;
30 - activated carbon in powder form;
 - ion exchange resin.

12. Water treatment method according to any one of Claims 1 to 11, characterised in that it comprises, downstream of said screening step, a step of disinfecting said water by UV radiation.

5 13. Water treatment method according to any one of Claims 1 to 11, characterised in that it comprises, downstream of said settling step and upstream of said screening step, a step of disinfecting said water by UV radiation.

10 14. Water treatment device aimed at reducing the content of matter in suspension, and in particular the parasites content, comprising at least one settling tank, characterised in that it comprises, downstream of said settling tank, at least one screen whose screen
15 mesh has dimensions ranging between approximately 5 micrometres and approximately 25 micrometres.

 15. Water treatment device according to Claim 14, characterised in that said screen mesh of said screen has dimensions ranging between approximately 8
20 micrometres and approximately 12 micrometres.

 16. Water treatment device according to one of Claims 14 and 15, characterised in that said settling tank is of the coagulation/flocculation/ballasted floc settling type.

25 17. Water treatment device according to Claim 16, characterised in that said settling tank is associated with a ballast comprising a granular material with a specific gravity greater than that of water and with a mean diameter ranging between approximately 50
30 micrometres and approximately 250 micrometres.

18. Water treatment device according to Claims 14 to 17, characterised in that said screen or screens are of the disc or drum type.

5 19. Water treatment device according to any one of Claims 14 to 18, characterised in that it comprises means of de-clogging said screen or screens.

20. Water treatment device according to Claim 19, characterised in that said de-clogging means comprise means for spraying washing water under pressure.

10 21. Water treatment device according to Claim 20, characterised in that said spraying means spray at counter-flow to said water to be treated.

22. Water treatment device according to one of Claims 20 and 21, characterised in that it comprises
15 means for recirculating the washing water upstream of said settling tank.

23. Water treatment device according to Claim 22, characterised in that it comprises means for disinfecting said washing water before its
20 recirculation upstream of said settling tank.

24. Water maintenance device according to Claim 23, characterised in that said means for disinfecting said washing waters are chosen from the following techniques:

- 25 - chlorination;
 - ozonation;
 - UV radiation.