

(19) AUSTRALIAN PATENT OFFICE

(54) Title
Circular installation for the biological treatment of wastewater

(51)⁶ International Patent Classification(s)
C02F 3/30 (2006.01) ^{8BMEP} **C02F**
C02F 3/12 (2006.01) 3/12
C02F 3/30 20060101ALI2005100
20060101AFI2005100 ^{8BMEP}
PCT/FR03/00963

(21) Application No: 2003239657

(22) Application Date: 2003 .03 .26

(87) WIPO No: W003/082752

(30) Priority Data

(31) Number	(32) Date	(33) Country
02/04050	2002 .03 .29	FR

(43) Publication Date : 2003 .10 .13

(43) Publication Journal Date : 2003 .11 .20

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(56) Related Art
US 3809242
EP 0749942
FR 2748742

-2-



(81) États désignés (*national*) : AE, AG, AI, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SI, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

européen (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IL, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), brevet OAPI (BF, BJ, CI, CG, CL, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Publiée :

— avec rapport de recherche internationale

(84) États désignés (*régional*) : brevet ARIPO (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), brevet eurasien (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), brevet

En ce qui concerne les codes à deux lettres et autres abréviations, se référer aux "Notes explicatives relatives aux codes et abréviations" figurant au début de chaque numéro ordinaire de la Gazette du PCT.

amont (3) est prévu en position centrale et lesdits bassins à chenaux (2a, 2b, 2c, 2d) ont une forme incurvée et sont prévus en position périphérique autour dudit bassin amont central.

CIRCULAR INSTALLATION FOR THE BIOLOGICAL TREATMENT OF
WASTEWATER

The invention relates to the field of biological treatment of water for its purification.

More precisely, the invention relates to the biological treatment of water by activated sludge.

- 5 Industrial and / or urban activated sludge wastewater treatment processes conventionally involve different treatment phases that conventionally require the use of several treatment ponds.

- 10 One particular type of pond used for wastewater treatment is composed of channel ponds.

This type of pond is described particularly in the document according to prior art "design of municipal wastewater treatment plants", WEF manual of practice No. 8, 4th Edition, pages 11-28 to 11-36 (volume 2-1998).

- 15 Channel ponds of this type have an elongated shape, a longitudinal median wall and one or two correcting partitions to delimit two or three channels, and which are also provided with means of circulating water passing along

a circuit preventing short circuits and providing optimal contact between the water to be purified and the biomass present in the pond.

5 This invention is particularly related to wastewater treatment installations using this type of pond.

As mentioned above, many wastewater installations require the use of several ponds.

10 The use of several ponds may be necessary to implement several steps of a treatment process or may be made necessary by the quantity and / or flow of water to be treated. Ponds may be set up in series or in parallel depending on the case.

15 One known way of constructing such installations with several ponds is to do the civil work for each pond independently and to set up hydraulic links by pipes between the ponds thus constructed.

This type of configuration has several disadvantages.

20 Firstly, separate installation of ponds requires a large ground occupancy. In many cases, it is desirable to make the most compact possible installations, for example for land cost reasons.

25 Secondly, the use of possibly large pipes to form hydraulic connections between ponds considerably increases the construction and maintenance costs of the installations. In practice, construction of these hydraulic links may account for up to 25% of the total cost of an installation.

The use of this type of pipes also increases the probability of a risk of malfunction of the assembly.

According to prior art, it is also known how to associate several ponds in the same wastewater treatment installation in a single essentially square or rectangular civil works.

5 In this case, water passes from one pond to the next through weir(s) or trough(s), which eliminates the above mentioned pipes so that more compact installations are possible.

10 However, the construction cost of square or rectangular civil works for ponds containing water more than approximately 5 metres deep are high, particularly when these installations include channel ponds.

One purpose of this invention is to propose a new type of installation without the above-mentioned disadvantages
15 according to the state of the art.

Thus, one purpose of this invention is to present an installation type with minimum ground occupancy with an identical treatment capacity as installations known according to prior art.

20 Another purpose of this invention is to present a new type of installation, in which the construction cost of the civil works is less than the cost according to the state of the art.

These different objectives, and others that will
25 become clear later, are achieved with the invention for a biological water treatment installation comprising means of conveying the water to be treated, means of conveying sludge from at least one downstream clarifier, the said sludge bringing in a purifying biomass, at least one
30 upstream pond, at least two channel ponds provided with

aeration means and evacuation means to the said downstream clarifier of the mixed liquor including treated water and purifying biomass, this installation being characterised in that it has an essentially circular configuration according to which the said upstream pond is provided in the central position and the said channel ponds are curved in shape and are located in a peripheral position around the said central upstream pond.

Therefore, the principle of the invention consists of using an essentially circular configuration of the civil work associated with at least two channel ponds and an upstream pond and locating the said upstream pond at the centre of the installation.

It will be noted that in the context of this description, the terms "upstream" and "downstream" according to standard practice by an expert in the subject, are defined with reference to the path followed by the water to be treated. According to this definition, the water to be treated then passes firstly in the upstream pond before entering the channel ponds.

This type of circular configuration enables construction of the civil works containing these different ponds at lower cost than would be possible for the civil works for ponds with the same volume according to the state of the art.

The civil works for the circular configuration proposed by the invention are easier to make. It is known in architecture that circular structures or structures in the form of an arc of a circle have better resistance than

rectangular or square structures, for the same wall thickness.

According to a first variant of the invention, this type of installation has two channel ponds and a central essentially circular upstream pond.

This type of circular configuration of the central upstream pond further optimises the construction cost of the installation since the external wall of this central pond can be the same as the internal wall of the channels.

According to a second variant of the invention, this type of installation includes two channel ponds and two central essentially semi-circular upstream ponds.

The use of two central semi-circular upstream ponds has the advantage that it enables the use of each of these upstream ponds in parallel as described below.

This invention is explicitly not limited to the case in which the installation includes two channel ponds. Thus, it would be possible to have more than two channel ponds and particularly three channel ponds, or according to one interesting variant, four channel ponds all of which are curved and are inscribed in a circle.

Thus, according to a third variant of the invention, such an installation has four channel ponds and a central essentially circular upstream pond.

According to a fourth variant of the invention, this type of installation has four channel ponds and two central essentially semi-circular upstream ponds.

With reference to the first and second variants mentioned above, the installation may include means of making the said two channel ponds operate in parallel, or

according to another possibility, means of making the said two channel ponds operate in series. If two central upstream semi-circular channel ponds are provided, they could be used in parallel.

5 With reference to the third and fourth variants mentioned above, the installation may include means of making the said four channel ponds operate in parallel, or according to another possibility, means could be provided of making the said four channel ponds operate in series in
10 pairs.

According to one preferred aspect of the invention, the central upstream pond or each central upstream pond includes means of defining two zones.

15 These two zones could be used, as specified below in more detail to delimit phases of the water treatment process in the installation.

It would be possible to envisage different methods of constructing delimitation means preferably provided in the central upstream pond or in each central upstream pond, to
20 define the zones concerned.

According to one variant, the said delimitation means define a peripheral circular zone in the central upstream pond or in each central upstream pond.

25 According to another variant, these means define a central circular zone at the centre of the installation, in the central upstream pond or each central upstream pond.

Preferably, the said water conveyance means and the said recycled sludge conveyance means in the downstream clarifier are provided in the said central upstream pond.

According to one variant, the auxiliary water conveyance means to bring only part of the water to be treated directly into the said channel ponds are provided in the installation. In this case, the said part of the
5 water brought into the said channel ponds through the said auxiliary water conveyance means is preferably equal to 0 to approximately 75% of the total water volume to be treated, and the remaining 100% to 25% of the total volume being conveyed by the said water conveyance means.

10 In some cases, these auxiliary water conveyance means may be used according to the requirements of a given water treatment process.

According to one interesting variant of the invention, the installation could include water transit zones between
15 channel ponds. This type of zones may advantageously be used to carry water from one pond to the other, to evacuate treated water or as selection zones.

According to one preferred variant, these zones may have an essentially triangular cross-section, each located
20 between two channel ponds.

Note also that one or several lamellar settlement zones could be included in the said channels either to increase the concentration of mixed liquor in the said channels and thus optimise the size of these channels, or
25 to reduce the concentration of the mixed liquor sent to clarification and thus to reduce the size of the downstream clarifier.

The installation according to this invention may be used for implementation of different biological water
30 treatment processes known in prior art, such as the

BIODENITRO or BIODENIPHO processes described particularly in patent DK131297 or the AZENIT process and its variants described in patents FR2725193 and FR2760232.

5 The invention will be better understood after reading the following description of a non-limitative embodiment of the invention with reference to the drawings in which:

- Figure 1 shows a top view of a circular biological wastewater treatment installation according to this invention;
- 10 - Figure 2 shows a longitudinal sectional view AA' of the installation shown in Figure 1;
- Figure 3 shows a longitudinal sectional view OB (where O is the centre of this same installation).

15 With reference to Figures 1 to 3, the installation comprises conveyance means 1 carrying the water to be treated and delivering it in the centre of the installation. The water to be treated arrives at these conveyance means 1 through a pipe 11 installed under the installation.

20 According to this invention, the installation includes a central upstream pond 3, which in the context of this embodiment has a circular shape and is provided with delimitation means consisting of a wall 6 that defines a first zone 3a and a second zone 3b within this central
25 upstream pond 3. This pond 3 also contains the recycled sludge conveyance means 40 through a pipe 40a from a downstream clarifier (not shown).

Still, according to this invention, the installation comprises channel ponds, in this case four ponds 2a, 2b, 2c
30 and 2d. Each channel pond has a central wall 12 and four

corrective partitions 13, 14, 15, 16 for making the channels.

The central upstream pond 3 and the channel ponds 2a, 2b, 2c, 2d are all inscribed within the circular outline of the civil works.

As can be seen in Figure 3, these channel ponds are provided with aeration means 17.

The central upstream pond 3 is provided with mixing means 18 that circulate the water to be treated and the sludge passing through it.

As can be seen clearly in Figure 1, the channel ponds are curved in shape and are arranged in a ring around the central upstream pond 3.

It will be noted that the zones 20, 21 and 5 with essentially triangular cross-sections are provided between the channel ponds.

The zones 21 communicate with the central upstream pond 3 through weirs, and with the zones 20 to which they are connected through pipes 22 located under the installation.

These zones 20 communicate with channel ponds over weirs 23, 24, 25 and 26.

The channel ponds communicate with zones 5 that form part of the means of evacuating the mixed liquor, over weirs 30, 31, 32 and 33.

Note also that the water conveyance means 1 cooperate with auxiliary water conveyance means 1a consisting of a trough that conveys part of the water to channel ponds without this part passing through the central upstream pond 3.

As already mentioned, the installation according to this invention may be used according to variable usage configurations.

Thus, according to this embodiment, it would be possible to place the zone 3a of the central upstream pond 3 in an anoxia condition and zone 3b of the central upstream pond 3 in the anaerobiosis condition. In parallel, the aeration means 17 of the channel ponds can be activated in a sequenced manner so as to set up aerobiosis phases and anoxia phases in them.

The central zone 3a of the central upstream pond 3 is an anoxia zone that eliminates nitrates circulated by the sludge from the downstream clarifier and possibly nitrates carried in the water to be treated. This zone 3a provides protection for the anaerobe zone 3b that must remain in an anaerobiosis condition.

The presence of anaerobiosis conditions in the central zone 3b of the central upstream pond 3 will provide a means of eliminating phosphorus pollution contained in the effluent to be treated, and also eliminating filamentary bacteria noxious to the biological depollution process and thus selecting the biomass required for this purpose.

The use of a sequenced aeration in the channels provides a means of degrading carbonaceous and nitrogen pollution in the water to be treated.

In the context of this configuration, the operating mode of the installation shown in Figures 1 to 3 is as follows.

The effluent to be treated arrives through pipe 11 as far as the water conveyance means 1 into the installation

provided in the central position of the installation. 70% of this water is then distributed in the central upstream pond 3 to pass firstly in the zone 3a of the installation kept in anoxia, and then in zone 3b of the installation kept in anaerobiosis condition.

All recycled sludge from the downstream clarifier is introduced into zone 3a through pipe 40a.

Circulation and mixing of water and sludge in these ponds are improved due to the presence of the mixers 18. When the effluent passes through zone 3b in the anaerobiosis condition, the phosphorus degradation process starts and filamentary bacteria are eliminated.

After passing through the central upstream pond 3, the mixed liquor passes above the weirs connecting this central upstream pond 3 to the zones 21. The water then passes through the pipes 22 to reach the zones 20 in which it is distributed passing over weirs 23, 24, 25, 26 in channel ponds 2c, 2d, 2a, 2b respectively.

Therefore, it will be understood that with this configuration, the channel ponds 2a, 2b, 2c, 2d operate in parallel.

Due to sequencing of the aeration, the effluent is cleaned of most of its nitrogen and carbonaceous pollution as it passes through these ponds.

The water thus purified and the purifying sludge forming the mixed liquor then pass over the weirs 30, 31, 32 and 33 to be evacuated through the evacuation means 5 carrying mixed liquor to the downstream clarifier (not shown) that separates this mixed liquor into purified water

and sludge recycled through pipe 40a to zone 3a of the upstream pond 3.

5 It will be noted that 30% of the water arriving through evacuation means 1 passes through the trough 1a and reaches zones 21 and is distributed in channels 2a, 2b, 2c, 2d without passing through the upstream pond 3. This optimises operation of the anaerobiosis zone.

10 The embodiment of the installation described here and the example configuration in which it is used are absolutely not limitative.

15 As already mentioned, in particular, it would be possible to provide two central semi-circular upstream ponds, rather than a single central upstream pond. It would also be possible to provide less than or more than four channel ponds, for example two channel ponds.

As already mentioned, the installation could also be provided with means of making the channel ponds operate in series.

20 According to the BIODENIPHO process known to persons skilled in the art, the effluent (mixed liquor) will transit through the two channels placed in series and alternately under anoxic and aerobic conditions.

CLAIMS

1. Installation for the biological treatment of water comprising means (1) of conveying water to be treated, means (40) of conveying sludge from at least one downstream clarifier, the said sludge bringing in the purifying biomass, at least one upstream pond (3), at least two channel ponds (2a, 2b, 2c, 2d) provided with aeration means, and evacuation means (5) to the said downstream clarifier of the mixed liquor including treated water and the purifying biomass, characterised in that it has an essentially circular configuration according to which the said upstream pond (3) is provided in the central position and the said channel ponds (2a, 2b, 2c, 2d) are curved in shape and are located in a peripheral position around the said central upstream pond.
2. Installation according to claim 1, characterised in that it has two channel ponds and a central essentially circular upstream pond.
3. Installation according to claim 1, characterised in that it has two channel ponds and two central essentially semi-circular upstream ponds.
4. Installation according to claim 1, characterised in that it has four channel ponds (2a, 2b, 2c, 2d), and a central essentially circular upstream pond (3).
5. Installation according to claim 1, characterised in that it has four channel ponds and two central essentially semi-circular upstream ponds.

6. Installation according to claim 2 or 3, characterised in that it includes means of making the said two channel ponds operate in parallel.

5 7. Installation according to claim 2 or 3, characterised in that it includes means of making the said two channel ponds operate in series.

8. Installation according to claim 4 or 5, characterised in that it includes means of making the said four channel ponds operate in parallel.

10 9. Installation according to claim 4 or 5, characterised in that it includes means of making the said four channel ponds operate in series in pairs.

10. Installation according to any one of claims 1 to 9, characterised in that the central upstream pond or each
15 central upstream pond includes means (6) of defining two zones.

11. Installation according to claim 10, characterised in that the said delimitation means define a peripheral zone around the arc of a circle in the central upstream
20 pond or in each central upstream pond.

12. Installation according to claim 10, characterised in that the said delimitation means (6) define a central circular zone (3a) at the centre of the installation, in the central upstream pond or in each central upstream pond.

25 13. Installation according to any one of claims 1 to 12, characterised in that the said water conveyance means (1) and the said recycled sludge conveyance means (40) are provided in the said central upstream pond.

14. Installation according to any one of claims 1 to
30 13, characterised in that it has auxiliary water conveyance

means (1a) to bring only part of the water to be treated directly into the said channel ponds.

5 15. Installation according to claim 14, characterized in that the said proportion of the water brought into the said channel ponds through the said auxiliary water conveyance means (1a) is preferably equal to 0 to approximately 75% of the total water volume to be treated, the remaining 100% to 25% of the total volume being conveyed by the said water conveyance means (1).

10 16. Installation according to any one of claims 1 to 15, characterised in that it includes water transit zones (20, 21, 5) between channel ponds.

15 17. Installation according to claim 16, characterized in that the said transit zones (20, 21, 5) have essentially triangular cross-sections, and each is located between two channel ponds.

18. Installation according to any one of claims 1 to 17, characterised in that one or several lamellar settlement zones could be included in the said channels.

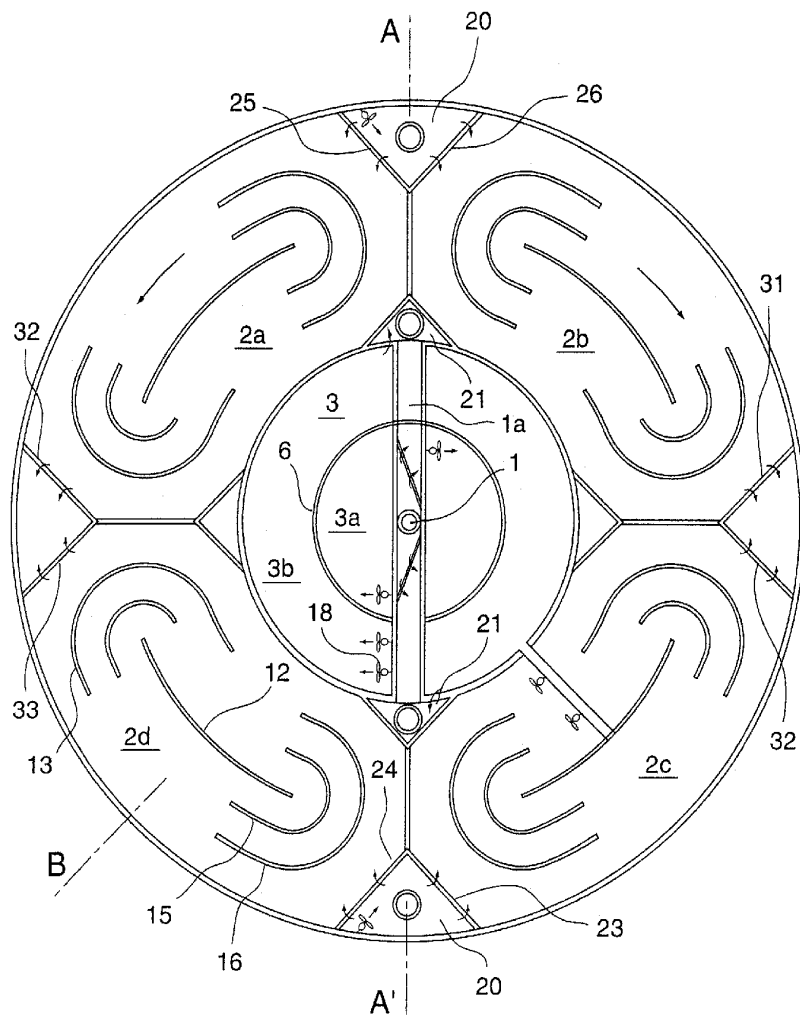


Fig. 1

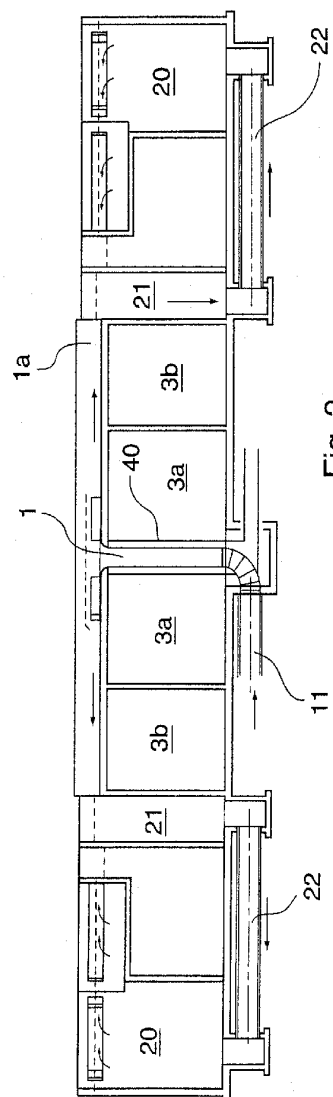


Fig. 2

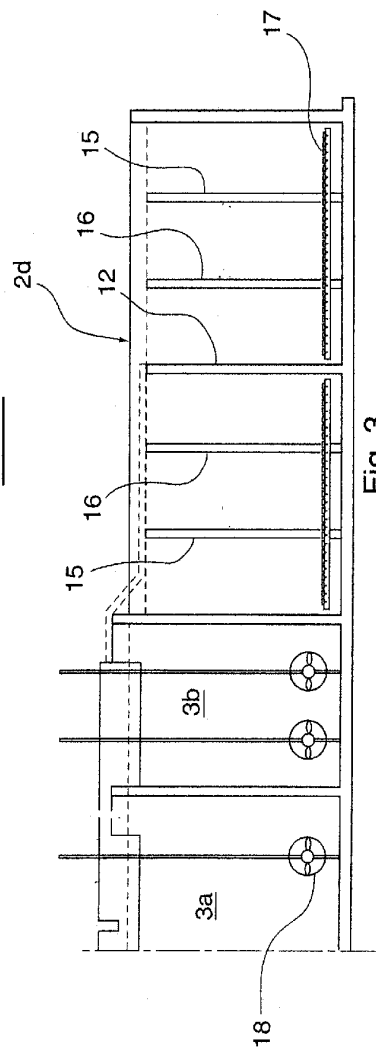


Fig. 3