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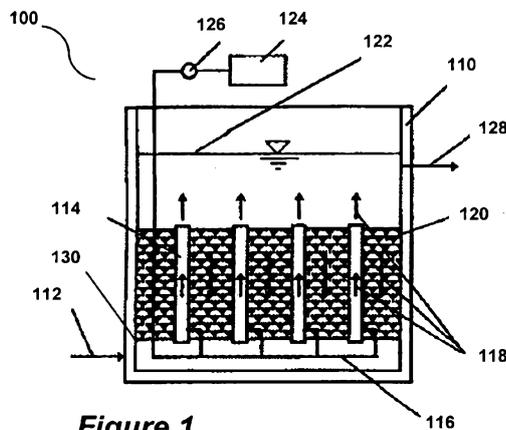


Figure 1

(57) Abstract: The present invention relates to a system for biological treatment which carries out decomposition of organic impurities by microorganisms thereof (water to be processed) in water purification or refinement processing. One of the advantages of the system for biological treatment of water purification of the present invention is that it solves the current problems in the conventional oxidation pond. Problems such as no water in the plant and the bio-carrier flow in the layer of packing layer is in laminar flow which causing the difficulties formation of the biofilm are no longer existed in the system for biological treatment of water purification of the present invention. Another advantage of the system for biological treatment of water purification of the present invention is that the contact performance of the biofilm in the layer of filler having microorganisms and the incoming water are excellent and at the end of the treated water exited from the system having a very low concentration of organic materials.

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A SYSTEM FOR BIOLOGICAL TREATMENT

FIELD OF THE INVENTION

5 The present invention relates to a system for biological treatment which carries out decomposition of organic impurities by microorganisms thereof (water to be processed) in water purification or refinement processing.

10 BACKGROUND OF THE INVENTION

The aerobic biofilm treatment plant which is an existing technology, also known as "contact oxidation pond", is widely used for municipal waste and industrial wastewater purification. Typical structures of such invention are those used for aeration and oxygenation purposes. 15 These typical structures are placed below the biological membrane with attached microbial carrier packed layer. Wastewater is being aerated when the compressed air flow through the pipe and reach the aerator. As the wastewater flows from the bottom of biological carrier up through the packing layer, a formation of air bubbles will occur and these bubbles reach to the surface of the wastewater. The oxygen in air bubbles are dissolved in the water and it creates the process of oxygenation. Oxygen that dissolves in water diffused into the biofilm interior, and provide an ambient environment for microorganisms to live in, thus it completed the degradation of organic matter in water. 20

At present, the aeration commonly used in the market are "porous aeration device" which produces tiny bubbles and "bulk-flow aerator" that produces air flow which may disperse the bubbles. However, this system has the following problems among others; the flow of bubble packing on the biological carrier causes violent disturbance which in turn causing microorganisms to have difficulties attaching to the bio-carrier packing layer. Furthermore, this system causes differences in the bio-mechanical stability of the fill vector and the biological carrier supporting the fill material is prone to fatigue strength. Thus, this will cause inefficiency in the level of biological degradation of substrates followed by damage of processing unit. 25 30

Another problem of this system is that the flow pattern of biological carrier packed layer is not at satisfactory level. Besides that, great flow resistance in horizontal direction and 35

One of the advantages of the system for biological treatment of water purification of the present invention is that it solves the current problems in the conventional oxidation pond. Problems such as no water in the plant and the bio-carrier flow in the layer of packing layer is in laminar flow which causing the difficulties formation of the biofilm are no longer existed
5 in the system for biological treatment of water purification of the present invention. Another advantage of the system for biological treatment of water purification of the present invention is that the contact performance of the biofilm in the layer of filler having microorganisms and the incoming water are excellent and at the end of the treated water exited from the system having a very low concentration of organic materials. Furthermore, the system for biological
10 treatment of water purification of the present invention requires low power consumption in used and the formation of the biofilm in the layer of filler are fast and sustainable. This system is easy to maintain and apply for variety of municipal wastewater and industrial wastewater having high organic content.

15 Various modifications of the preferred design may be made and remain within the scope of the design. The flow through the system can be controlled by the air pump and as will be appreciated by those skilled in the art, the slower the flow, the greater is the removal of toxic wastes, whereas, the greater the flow, the less removal of organic wastes per flow through. The more frequent the latter flow however results in increased flow through circulation in the
20 overall closed system. It will be appreciated therefore that the degree of removal of organic waste in the system can be simply controlled by the flow rate (pumping rate) through the system. The circulation and percolation cycles can then be used to simply provide good circulatory stirring of the layer of the filler in the desired stirred flow path.

25 The foregoing embodiment and advantages are merely exemplary and are not to be construed as limiting the present invention. The description of the embodiments of the present invention is intended to be illustrative and not to limit the scope of the claims and many alternatives, modifications and variations will be apparent to those skilled in the art.

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presence of areas of stagnant water cause desired effect for mass transfer unable to be achieved. These lead to uneven growth of many regional biofilm, thus causing inefficiency of degradation and removal of organic matter. As a result, it affects the auto renewal of biofilm, which may in turn causes further deterioration of the biological carrier packing layer, thus resulting in treatment plant malfunction. Due to the existence of above mentioned problems, this causes difficulties in improving efficiency of contact oxidation pond as well as difficulties in doing maintenance and management work.

The present invention overcomes these and other deficiencies of the above-mentioned drawbacks by providing a system for biological treatment which carries out decomposition of organic impurities by microorganisms thereof (water to be processed) in water purification or refinement processing with improvement. The invention provides an improved efficiency of treatment and at the same making the system easily maintained.

SUMMARY OF THE INVENTION

The present invention provides a system for biological treatment of water purification comprising a chamber having an inlet and an outlet, a layer of filler disposed within the chamber for allowing deposition of microorganisms and growth of a film; and a means for providing air into the chamber during the treatment to mix with the water and providing air to the microorganisms.

In yet another embodiment, the chamber is a reactor having water depth of 3 to 5 meters and the inlet of the chamber is connected to the incoming water is located at the bottom of the chamber and the outlet of the chamber is located at the top of the chamber.

In another embodiment, the layer of the filler is bio-packing layer having a depth in a range of 2 to 4 meters of the chamber and the layer of filler is being constructed to allow growth of a biofilm to decompose the organic materials in the water.

In yet another embodiment, a support layer is disposed on below the layer of filler and having a distance of 0.3 to 0.5 meters from the bottom of the chamber and the means for providing air into the chamber is an oxygen mixer.

In further embodiment, the oxygen mixer further comprising a plurality of air ducts, each air duct having a plurality of air nozzles arranged vertically in equal spacing within the layer of filler for allowing a compressed air to be distributed evenly within the chamber via anti-gravity flow direction. Each air nozzle has a diameter of approximately 30-50 mm and height of 30-50 mm.

In another embodiment, when the compressed air ejected from the air nozzles, a mixture between air and water is formed and the water is oxygenated at the same time.

In another embodiment, organic materials in the water are decomposed by the microorganisms via metabolisms into water and carbon dioxide when the mixture is contacted to the film on the layer of the filler. The layer of filler is a biological carrier formed from polyethylene materials, spinning brush having block shaped diamond hole mesh or any equivalent for allowing the water to diffuse through the layer of the filler. The oxygen mixer is connected to a air compressor. The system is used for biological treatment of municipal wastewater and industrial wastewater.

A method for assembling a system for biological treatment of water purification comprising providing a support layer into a chamber having an inlet and an outlet; providing a plurality of air ducts, each air duct having a plurality of air nozzles arranged vertically in equal spacing for allowing a compressed air to be distributed evenly within the chamber via anti-gravity flow direction; filling the chamber with a layer of filler for allowing deposition of microorganisms and growth of a film; and connecting an inlet of the chamber to a source of wastewater. The chamber is a reactor having water depth of 3 to 5 meters.

In another embodiment, the inlet of the chamber is connected to the incoming water is located at the bottom of the chamber and the outlet of the chamber is located at the top of the chamber. The layer of the filler is bio-packing layer having a depth in a range of 2 to 4 meters of the chamber.

In yet another embodiment, the support layer is disposed on below the layer of filler and having a distance of 0.3 to 0.5 meters from the bottom of the chamber. When the compressed air ejected from the air nozzles, a mixture between air and water is formed and the water is oxygenated at the same time.

In another embodiment, organic materials in the water are decomposed by the microorganisms via metabolisms into water and carbon dioxide when the mixture is contacted to the film on the layer of the filler. The layer of filler is a biological carrier formed from polyethylene materials, spinning brush having block shaped diamond hole mesh or any equivalent for allowing the water to diffuse through the layer of the filler.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

Figure 1 is a schematic diagram of a system for biological treatment in accordance of an embodiment of the present invention.

Figure 2 illustrates a top view of a system for biological treatment in accordance of an embodiment of the present invention.

Figure 3 illustrates a structure of the oxygen mixer in accordance of an embodiment of the present invention.

DETAILED DESCRIPTIONS OF THE INVENTION

The present invention will now be described in detail in connection with specific embodiments with reference to the accompanying drawings. Unless the context requires otherwise, throughout the specification and claims which follow, the word "comprise" and variations thereof, such as, "comprises" and "comprising" are to be construed in an open, inclusive sense that is as "including, but not limited to". Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, the appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring

to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

Although the present invention is particularly suited for facilitating the authorization, verification, and delivery of controlled medications, it should be understood that the present invention may be embodied in many other forms, and to deliver many types of regulated products depending upon the size, shape, configuration, and regulations associated with the regulated product being sold.

10 Referring now to **Figures 1**, a system for biological treatment (**100**) of water purification of the present invention comprising a chamber (**110**) having an inlet (**112**) and an outlet (**128**), a layer of filler (**120**) disposed within the chamber (**110**) for allowing deposition of microorganisms and growth of a film, and a means for providing air (**114**) into the chamber (**110**) during the treatment to mix with the water and providing air to the microorganisms. The chamber (**110**) of the system for biological treatment (**100**) of water purification of the present invention could be in any shape preferably cylindrical or rectangular in cross-section. This chamber (**110**) is acted as a reactor having water depth of 3 to 5 meters (**122**). The inlet (**112**) of the chamber (**110**) is connected to the incoming water is located at the bottom of the chamber and the outlet (**128**) of the chamber is located at the top of the chamber. In a preferred embodiment, the inlet (**112**) of the chamber (**110**) disposed at the opposite side to the outlet (**128**) of the chamber (**110**) such that the incoming water is treated according to a gradual flow and a flow pattern is alike a sinusoidal piston flow before exited from the chamber (**110**). The layer of the filler (**120**) of the system for biological treatment (**100**) of water purification of the present invention is bio-packing layer having a depth in a range of 2 to 4 meters of the chamber (**110**) as shown in **Figure 1**. The layer of filler (**120**) is being constructed such that to allow growth of a biofilm to decompose the organic materials in the water. A support layer (**130**) is disposed below the layer of filler (**120**) and having a distance of 0.3 to 0.5 meters from the bottom of the chamber (**110**).

30 A means for providing air (**114**) into the chamber (**110**) of a system for biological treatment (**100**) of the present invention is an oxygen mixer. The oxygen mixer is connected to an air compressor (**124**) which produces a compressed air and regulated via valve gate (**126**). The oxygen mixer comprising a plurality of air ducts (**118**), each air duct having a plurality of air nozzles arranged vertically in equal spacing within the layer of filler (**120**). These air ducts are connected to the air compressor (**124**) via a plurality of air pipes (**116**). With this

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arrangement, an incoming compressed air is able to be distributed evenly within the chamber (110) via anti-gravity flow direction. Each air nozzle has a diameter of approximately 30-50 mm and height of 30-50 mm. When the compressed air ejected from the air nozzles, a mixture between air and water is formed and the water is oxygenated at the same time. Organic materials in the water are then decomposed by the microorganisms via metabolisms into water and carbon dioxide when the mixture is contacted to the film on the layer of the filler (120). The layer of filler (120) of a system for biological treatment (100) of the present invention is selected from a biological carrier formed from polyethylene materials, spinning brush having block shaped with diamond hole mesh or any equivalent for allowing the water to diffuse through the layer of the filler (120). Various other shapes of biological carrier are possible. The surface indentations of biological carrier provide micro-shelters or niches so that there are many more areas where microorganisms can grow and protected. The system of the present invention is used for biological treatment of a municipal wastewater and industrial wastewater.

Figure 2 illustrates a top view and the arrangement of the main components of a system for biological treatment of water purification of the present invention. In a preferred embodiment, there are eight air ducts (214) arranged within the chamber (210). Each duct (214) is an elongated tube with a preferred length of 1.0 to 1.6 m and having a diameter from 20 to 40 mm. One end of these air ducts is sealed and the sealed side of the cylinder side wall of open space for the 2-4mm in diameter of the hole of 4-8, as air vents, the air exhaust tube axis direction perpendicular to improve.

The compressed air is entered into the bottom of the chamber (210) via the air pipes (216) connected to the air compressor (220) via gate valves (222). The compressed air is released into the air ducts (214) then ejected from the air nozzles equivalent to a jet aerator. Simultaneously, the incoming water is entered into the inlet (212) of the chamber at one side of the chamber opposite to the outlet (224) of the chamber. Water is then oxygenated by the oxygen mixer and flows through the layer of filler (218). The surface of the film is a biofilm in which living microorganisms are attached to. The organic materials in the water are decomposed by the microorganisms via metabolisms into water and carbon dioxide when the mixture is contacted to the film on the layer of the filler (218). With the presence of oxygen and organic materials presence in the water, the microorganisms are continued to live within the layer of the filler (218). Due to two aligned air ducts in juxtaposition, the

incoming water is treated according to a gradual flow and a flow pattern is alike a sinusoidal piston flow before exited from the chamber.

5 The air injected can be injected through any type of diffuser system. The shape or configuration of the air injection manifold is not critical; however it is desirable for efficient operation and uniform upward biological carrier/water flow that injected air be relatively uniformly distributed across the layer of the filler.

10 **Figure 3** illustrates a structure of the oxygen mixer of the system for biological treatment of the present invention. The direction of the compressed air arrival into the air ducts (310) is shown in 312. Compressed air in the air ducts (310) is used to enhance a jet mixing with water to form gas-liquid flow in the chamber via a jet mixer nozzle (314) in each air duct during the operation and releases in anti-gravity flow direction (316). In this process, oxygen
15 contained in the air is dissolved into the water and diffused into the layer of filler having biofilm surfaces. Subsequently, the microorganisms decompose and degrade the organic materials in the water into water and carbon dioxide. With the assistance of the oxygen mixer, the water flow in the chamber is filled from the bottom of chamber and gradually increased to the upper level of the chamber to form water circulation and percolation cycles. While the water is flowing in the opposite direction or in a countercurrent direction to the air,
20 it is exposed to a significant quantity of air and this provides an optimal and most energy efficient way of re-aerating the water. The system provides also an efficient way of getting the most out of the energy put in to aerate the water.

25 The system for biological treatment of water purification of the present invention is assembled via the following steps, firstly providing a support layer into a chamber having an inlet and an outlet, then, providing a plurality of air ducts, each air duct having a plurality of air nozzles arranged vertically in equal spacing for allowing a compressed air to be distributed evenly within the chamber via anti-gravity flow direction; followed by filling the chamber with a layer of filler for allowing deposition of microorganisms and growth of a film;
30 and finally connecting an inlet of the chamber to a source of water which required treatment.

CLAIMS

1. A system for biological treatment of water purification comprising:

5 a chamber having an inlet and an outlet;
a layer of filler disposed within the chamber for allowing deposition of microorganisms
and growth of a film; and
a means for providing air into the chamber during the treatment to mix with the water and
providing air to the microorganisms.

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2. The system as claimed in Claim 1 wherein the chamber is a reactor having water depth
of 3 to 5 meters.

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3. The system as claimed in Claim 1 wherein the inlet of the chamber is connected to the
incoming water is located at the bottom of the chamber and the outlet of the chamber is
located at the top of the chamber.

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4. The system as claimed in Claim 1 wherein the layer of the filler is bio-packing layer
having a depth in a range of 2 to 4 meters of the chamber.

5. The system as claimed in Claim 1 wherein the layer of filler is being constructed to allow
growth of a biofilm to decompose the organic materials in the water.

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6. The system as claimed in Claim 1 wherein a support layer is disposed on below the layer
of filler and having a distance of 0.3 to 0.5 meters from the bottom of the chamber.

7. The system as claimed in Claim 1 wherein the means for providing air into the chamber
is an oxygen mixer.

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8. The system as claimed in Claim 7 wherein the oxygen mixer further comprising

a plurality of air ducts, each air duct having a plurality of air nozzles arranged vertically in
equal spacing within the layer of filler for allowing a compressed air to be distributed
evenly within the chamber via anti-gravity flow direction.

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9. The system as claimed in Claim 8 wherein each air nozzle having a diameter of approximately 30-50 mm and height of 30-50 mm.

10. The system as claimed in Claim 8 wherein when the compressed air ejected from the air
5 nozzles, a mixture between air and water is formed and the water is oxygenated at the same time.

11. The system as claimed in Claim 10 wherein organic materials in the water are
10 decomposed by the microorganisms via metabolisms into water and carbon dioxide when the mixture is contacted to the film on the layer of the filler.

12. The system as claimed in Claim 1 wherein the layer of filler is a biological carrier formed
15 from polyethylene materials, spinning brush having block shaped diamond hole mesh or any equivalent for allowing the water to diffuse through the layer of the filler.

13. The system as claimed in Claim 7 wherein the oxygen mixer is connected to a air
compressor.

14. The system as claimed in Claim 1 wherein the system is used for biological treatment of
20 municipal wastewater and industrial wastewater.

15. A method for assembling a system for biological treatment of water purification
comprising:

25 providing a support layer into a chamber having an inlet and an outlet;

providing a plurality of air ducts, each air duct having a plurality of air nozzles arranged
vertically in equal spacing for allowing a compressed air to be distributed evenly within
the chamber via anti-gravity flow direction;

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filling the chamber with a layer of filler for allowing deposition of microorganisms and
growth of a film; and

connecting an inlet of the chamber to a source of wastewater.

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16. The method as claimed in Claim 15 wherein the chamber is a reactor having water depth of 3 to 5 meters.

5 17. The method as claimed in Claim 15 wherein the inlet of the chamber is connected to the incoming water is located at the bottom of the chamber and the outlet of the chamber is located at the top of the chamber.

10 18. The method as claimed in Claim 15 wherein the layer of the filler is bio-packing layer having a depth in a range of 2 to 4 meters of the chamber.

19. The method as claimed in Claim 15 wherein the support layer is disposed on below the layer of filler and having a distance of 0.3 to 0.5 meters from the bottom of the chamber.

15 20. The method as claimed in Claim 15 wherein when the compressed air ejected from the air nozzles, a mixture between air and water is formed and the water is oxygenated at the same time.

20 21. The method as claimed in Claim 15 wherein organic materials in the water are decomposed by the microorganisms via metabolisms into water and carbon dioxide when the mixture is contacted to the film on the layer of the filler.

25 22. The method as claimed in Claim 15 wherein the layer of filler is a biological carrier formed from polyethylene materials, spinning brush having block shaped diamond hole mesh or any equivalent for allowing the water to diffuse through the layer of the filler.

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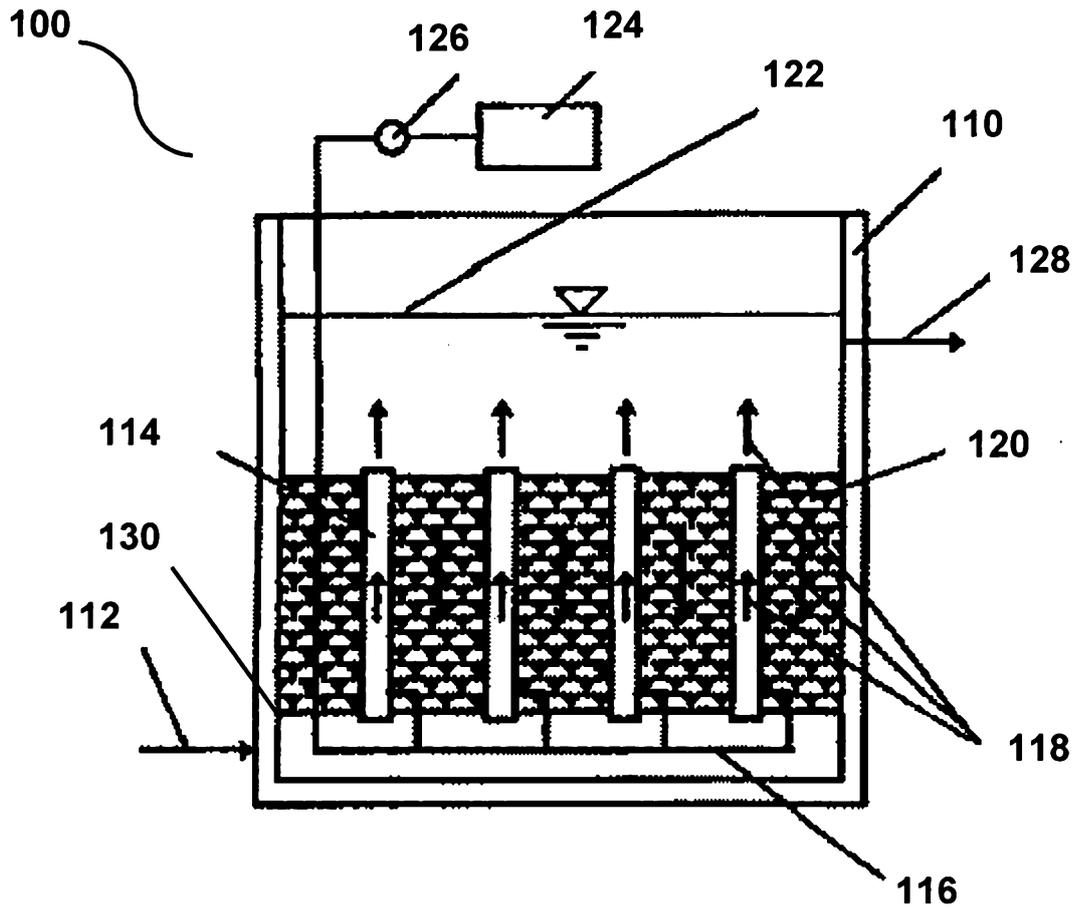


Figure 1

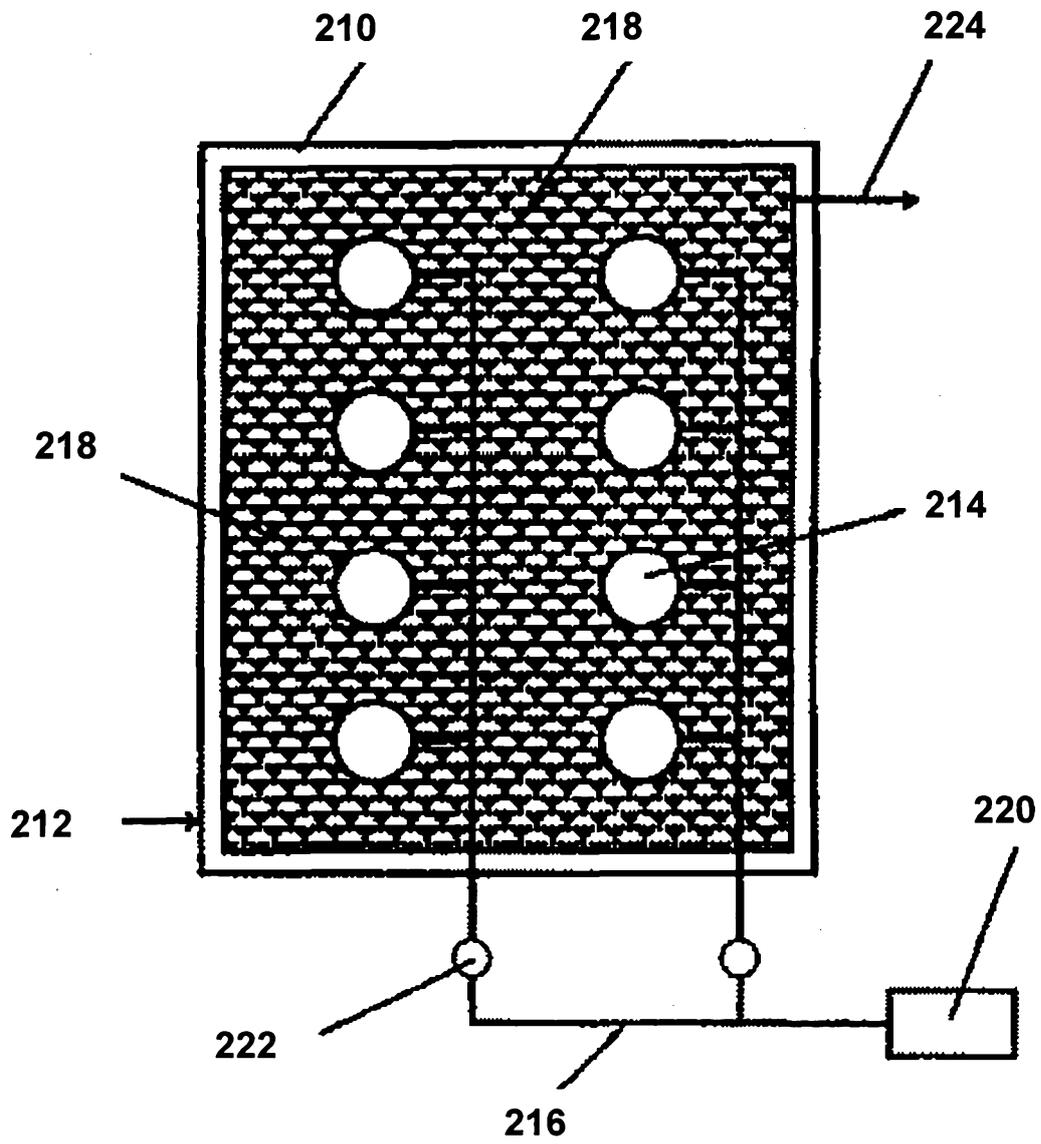


Figure 2

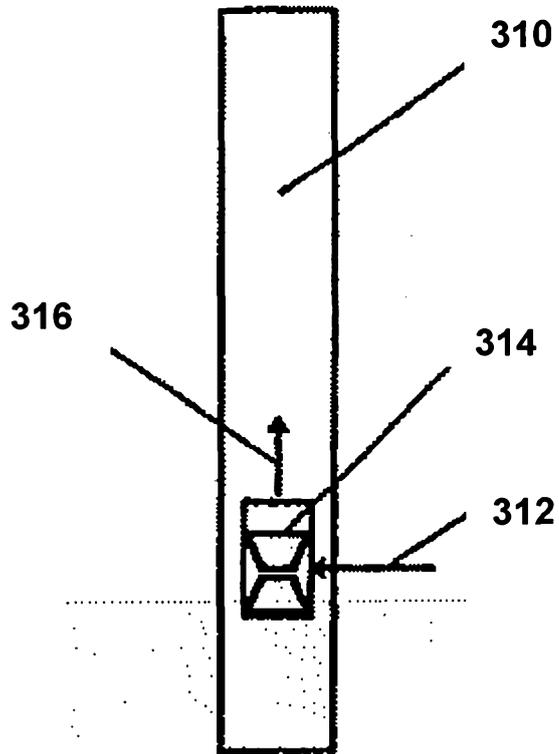


Figure 3