

PATENT SPECIFICATION

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(19)



(54) IMPROVEMENTS IN OR RELATING TO ELECTROLYTIC FLOTATION APPARATUS

(71) We, SIMON-HARTLEY LIMITED, a British Company, of Etruria Works, Stoke-on-Trent, Staffordshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

THIS INVENTION concerns flotation apparatus of the kind comprising a tank through which a liquid to be treated, such as activated sludge for example, is caused to flow, electrodes in the base of the tank for the generation of gas bubbles by electrolytic action, whereby suspended material, usually but not necessarily solids, in the liquid are carried to the surface of the liquid within the tank by said bubbles to form a layer of thickened material, and means for removing said thickened material.

According to the present invention, there is provided flotation apparatus comprising a tank through which liquid to be treated is caused to flow, at least one electrode assembly located in the base of the tank and formed by a system of current carrying components defining a generally planar cathode and a superimposed generally planar and parallel anode structure of open form and of substantially the same shape and area overall as the cathode, the assembly having boundary edges defining an area therebetween over which gas bubbles are liberated when the apparatus is in use by electrolytic action, and means for introducing liquid to be treated substantially evenly either along or adjacent to one of said boundary edges of the electrode assembly or flow across the assembly to the other boundary edge, characterised in that the dimension across the electrode assembly in the direction of liquid flow be-

tween said opposed boundary edges lies in the range of from 0.5 to 1.5 metres.

The invention will be further apparent from the following description with reference to the several figures of the accompanying drawings, which show by way of example only, a number of forms of apparatus embodying the invention.

Of the drawings:—

Fig. 1 shows a partially sectioned side elevation of one form of the apparatus;

Fig. 2 shows a partially sectioned, end elevation of the apparatus of Fig. 1;

and Figs. 3-8 inclusive show schematic plan views of six alternative forms of apparatus.

Referring now to the drawings, and more especially Figs. 1 and 2 thereof, it will be seen that the first form of apparatus essentially comprises a tank generally indicated at 10 and comprising by oppositely disposed parallel side walls 11 and 12, end walls 13 and 14 and base plates 15 and 16. The base plates 15 and 16 slope inwardly and downwardly from the lower edges of the side walls 11 and 12, respectively, whereby the depth of the tank 10 increases gradually across its width from both of its sides to a maximum at the centre of the tank. The inner lower edges of the base plates 15 and 16 define the upper ends of a channel 17, running longitudinally of the tank 10 and connecting with the interior thereof and whose depth increases gradually from one end of the tank to the other.

Within the tank 10 are two plate-like cathodes 18 and 19 disposed over the base plates 15 and 16 respectively in parallel relationship therewith.

Spaced above each of the cathodes 18 and 19 is an anode in the form of a grid comprised by a plurality of longitudinally

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extending spaced parallel bars 20 arranged in a common plane. Each anode grid is supported so that the plane containing the bars 20 is parallel with the surface of the cathode therebeneath, by means of insulating support members 21 mounted on the upper surface of such cathode.

Each cathode and superimposed anode grid forms an electrode assembly whose width between opposed longitudinally extending boundary edges which are parallel with the side walls of the tank lies in the range of from 0.5 to 1.5 metres.

The liquid to be treated is supplied via feed pipes 22 into open topped channels 23 and 24 running along the length of the tank 10 at the upper ends of the side walls 11 and 12 respectively.

The liquid flows into the body of the tank from the channels 23 and 24 over the upper edges of the side walls 11 and 12 which define weirs for this purpose. The upper edges of the side walls 11 and 12 are, as best seen in Fig. 1, provided with a serrated profile to ensure that the liquid is substantially evenly distributed over the length of the tank 10 on either side thereof.

Inwardly spaced from the side walls 11 and 12 are parallel depending baffle plates 25 extending longitudinally over the length of the tank, whose lower ends are disposed adjacent the upper ends of the grids defined by the anodes 20, whereby the inflowing liquid is introduced into the body of the tank 10 for downward flow through the spaces in the electrode assemblies between the cathodes and anode grids thereof.

A plurality of nozzles 26 of fishtail form are provided and disposed in side-by-side relationship with their orifices directed downwardly along the length of the tank 10 above the channel 17 and located at a position between the inner lower edges of the two cathodes 18 and 19 and lowermost anode bars 20 of the two anode grids, at a level coinciding with the spaces in the electrode assemblies between the cathodes and anode grids thereof.

Each nozzle 26 connects with a pipe 27 which extends out of the body of the tank 10 to terminate in an upright portion 28 disposed within an overflow box 29. The upper ends of the portions 28 are positioned at a level slightly below the desired level of liquid in the tank 10.

Means to remove thickened material from the surface of the liquid contained within the tank 10 is provided and comprises endless chains 40 supported on sprocket wheels 41 at opposite sides of the tank 10, there being a plurality of spaced transversely extending scraper blades 42 between the two chains 40 on the opposite

sides of the tank.

The chains are adapted to be driven in the direction of the arrows so that the scraper blades 42, whose lower edges dip into the surface of the contents of the tank, are drawn longitudinally of the tank to gather thickened material and move it towards an inclined upper terminal portion 13a of the end wall 13. The sprocket wheels 41 are so disposed that adjacent the end of the tank 10, defined by the wall 13, the blades 42 travel in an inclined direction to draw the collected thickened material over the portion 13a to drop from the end thereof into suitable collecting means (not shown).

In use, liquid to be treated, such as activated sludge for example, is continuously fed to the tank 10 and introduced substantially evenly along the length of each of the two electrode assemblies for downward flow through the spaces between the cathodes and anode grids thereof. An electrical potential difference is established between the cathodes and anodes whereby gas bubbles are generated by electrolytic action. Suspended materials within the liquid to be treated tend to flocculate under the influence of the electric field and gas bubbles attach to the flocs to carry them to the surface to form the thickened sludge material which is harvested in the manner described above.

It should be understood that the gas bubbles are liberated over the area lying between the opposed longitudinally extending boundary edges of each of the electrode assemblies, and that the liquid is subjected to the action of such bubbles throughout its passage over an electrode assembly between said boundary edges.

The treated liquid is collected by the nozzles 26 as it flows from the electrode assemblies and passes into the box 29 under the action of hydrostatic pressure and is conveyed away from the apparatus through a pipe 30 connecting with the box 29.

Any sediment which tends to collect in the base of the tank is displaced by the washing action of the incoming liquid and gravity into the channel 17 which can be cleared continuously or at periodic intervals by means of the outlet 31.

It will be appreciated that it is not intended to limit the invention to the above example only.

Thus, for example, two electrode assemblies need not be provided in a common tank, and a single electrode assembly may be provided in the tank which may be one of a variety of shapes. A number of possible shapes are shown in Figs. 3 to 8 inclusive in which the flow of liquids to be treated through the tanks is indicated by

arrows. The arrangements of Figs. 5 and 6 deserve special mention where the tanks are of circular shape having a central zone serving for the collection of treated liquid on the one hand and supply of liquid to be treated on the other hand. In all these arrangements it is preferred that the bases of the tanks slope downwardly in the direction of liquid flow and it follows that the bases of the tanks in the arrangements of Fig. 5 and 6 are in the form of inverted and right conical form respectively. In each of these arrangements the dimension D measured in the direction of liquid flow between opposed boundary edges of the electrode assemblies lies in the range of from 0.5 to 1.5 metres.

Whilst it is preferred to arrange for the liquid to be treated to flow downwardly over the or each electrode assembly, it would be possible for such to flow upwardly over the or each electrode assembly which would then be inclined upwardly from the position at which the liquid to be treated was fed thereto.

Having regard to the provisions of Section 9 of the Patents Act attention is directed to the claims of British Patent No. 1 215 804.

WHAT WE CLAIM IS:—

1. Flotation apparatus comprising a tank through which liquid to be treated is caused to flow, at least one electrode assembly located in the base of the tank and formed by a system of current carrying components defining a generally planar cathode and a superimposed generally planar and parallel anode structure of open form and of substantially the same shape and area overall as the cathode, the assembly having boundary edges defining an area therebetween over which gas bubbles are liberated when the apparatus is in use by electrolytic action, and means for introducing liquid to be treated substantially evenly either along or adjacent to one of said boundary edges of the electrode assembly for flow across the assembly to the other boundary edge, characterised in that the dimension across the electrode assembly in the direction of liquid flow between said opposed boundary edges lies in the range of from 0.5 to 1.5 metres.

2. Apparatus according to claim 1 wherein the electrode assembly is comprised by a first electrode in the form of a plate and a second electrode in the form of a grid made up from a plurality of spaced parallel bars arranged in a common plane, said grid being positioned above the plate in spaced relationship therefrom, said plate forming a cathode and said grid forming an anode.

3. Apparatus according to claim 2 wherein the liquid to be treated is supplied to the or each electrode assembly for flow into the space between said plate and said grid.

4. Apparatus according to any preceding claim wherein the liquid supplied to each electrode assembly is caused to flow over a weir which extends along the entire boundary edge of the electrode assembly which is to receive the liquid and at a position above said boundary edge.

5. Apparatus according to claim 4 wherein the or each said weir has a serrated profile.

6. Apparatus according to either claim 4 or claim 5 wherein a baffle plate is provided to guide the liquid downwardly into the tank from the or each said weir to the level of its associated electrode assembly.

7. Apparatus according to any one of claims 2 to 6 inclusive wherein means is provided for collecting the treated liquid as it emerges from the space between the plate and grid at the downstream boundary edge of the or each electrode assembly.

8. Apparatus according to claim 7 wherein the treated liquid is collected into slot means which communicate with conduit means terminating at a level slightly below the required level of liquid in the tank, whereby liquid entering said slot means overflows the upper end of the conduit means into a collecting reservoir through the action of hydrostatic pressure.

9. Apparatus according to any one of claims 2 to 8 inclusive wherein the plane or the or each electrode assembly is inclined to the horizontal.

10. Apparatus according to claim 9 wherein the or each electrode assembly slopes downwardly in the direction of flow of liquid to be treated.

11. Apparatus according to either claim 9 or claim 10 wherein the base of the tank beneath each electrode assembly is parallel therewith.

12. Apparatus according to any preceding claim wherein the tank is provided with a well portion beneath the level of the or each electrode assembly for the collection of any sediment from the contents of the tank.

13. Apparatus according to any one of claims 2 to 12 inclusive wherein the tank is rectangular, having two electrode assemblies each sloping downwardly from the opposed longitudinal side walls of the tank towards a central portion of the tank of maximum depth, liquid to be treated being introduced into the tank for flow across the opposed electrode assemblies from both of the opposed longitudinal sides of the tank towards the centre thereof.

arrows. The arrangements of Figs. 5 and 6 deserve special mention where the tanks are of circular shape having a central zone serving for the collection of treated liquid on the one hand and supply of liquid to be treated on the other hand. In all these arrangements it is preferred that the bases of the tanks slope downwardly in the direction of liquid flow and it follows that the bases of the tanks in the arrangements of Fig. 5 and 6 are in the form of inverted and right conical form respectively. In each of these arrangements the dimension D measured in the direction of liquid flow between opposed boundary edges of the electrode assemblies lies in the range of from 0.5 to 1.5 metres.

Whilst it is preferred to arrange for the liquid to be treated to flow downwardly over the or each electrode assembly, it would be possible for such to flow upwardly over the or each electrode assembly which would then be inclined upwardly from the position at which the liquid to be treated was fed thereto.

Having regard to the provisions of Section 9 of the Patents Act attention is directed to the claims of British Patent No. 1 215 804.

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1. Flotation apparatus comprising a tank through which liquid to be treated is caused to flow, at least one electrode assembly located in the base of the tank and formed by a system of current carrying components defining a generally planar cathode and a superimposed generally planar and parallel anode structure of open form and of substantially the same shape and area overall as the cathode, the assembly having boundary edges defining an area therebetween over which gas bubbles are liberated when the apparatus is in use by electrolytic action, and means for introducing liquid to be treated substantially evenly either along or adjacent to one of said boundary edges of the electrode assembly for flow across the assembly to the other boundary edge, characterised in that the dimension across the electrode assembly in the direction of liquid flow between said opposed boundary edges lies in the range of from 0.5 to 1.5 metres.

2. Apparatus according to claim 1 wherein the electrode assembly is comprised by a first electrode in the form of a plate and a second electrode in the form of a grid made up from a plurality of spaced parallel bars arranged in a common plane, said grid being positioned above the plate in spaced relationship therefrom, said plate forming a cathode and said grid forming an anode.

3. Apparatus according to claim 2 wherein the liquid to be treated is supplied to the or each electrode assembly for flow into the space between said plate and said grid.

4. Apparatus according to any preceding claim wherein the liquid supplied to each electrode assembly is caused to flow over a weir which extends along the entire boundary edge of the electrode assembly which is to receive the liquid and at a position above said boundary edge.

5. Apparatus according to claim 4 wherein the or each said weir has a serrated profile.

6. Apparatus according to either claim 4 or claim 5 wherein a baffle plate is provided to guide the liquid downwardly into the tank from the or each said weir to the level of its associated electrode assembly.

7. Apparatus according to any one of claims 2 to 6 inclusive wherein means is provided for collecting the treated liquid as it emerges from the space between the plate and grid at the downstream boundary edge of the or each electrode assembly.

8. Apparatus according to claim 7 wherein the treated liquid is collected into slot means which communicate with conduit means terminating at a level slightly below the required level of liquid in the tank, whereby liquid entering said slot means overflows the upper end of the conduit means into a collecting reservoir through the action of hydrostatic pressure.

9. Apparatus according to any one of claims 2 to 8 inclusive wherein the plane or the or each electrode assembly is inclined to the horizontal.

10. Apparatus according to claim 9 wherein the or each electrode assembly slopes downwardly in the direction of flow of liquid to be treated.

11. Apparatus according to either claim 9 or claim 10 wherein the base of the tank beneath each electrode assembly is parallel therewith.

12. Apparatus according to any preceding claim wherein the tank is provided with a well portion beneath the level of the or each electrode assembly for the collection of any sediment from the contents of the tank.

13. Apparatus according to any one of claims 2 to 12 inclusive wherein the tank is rectangular, having two electrode assemblies each sloping downwardly from the opposed longitudinal side walls of the tank towards a central portion of the tank of maximum depth, liquid to be treated being introduced into the tank for flow across the opposed electrode assemblies from both of the opposed longitudinal sides of the tank towards the centre thereof.



14. Apparatus as claimed in claim 1 and substantially as described herein with reference to and as illustrated by the figures of the accompanying drawings.

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