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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Trickling Filter Waste Treatment Plant

We, THE MEAD CORPORATION, a corporation duly organized and existing under the laws of the State of Ohio, United States of America, of 118 West First Street, Dayton, State of Ohio, United States of America, 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 relates to a high efficiency trickling filter waste treatment plant.

Generally, there is provided a trickling filter of conventional or known construction which is positioned directly over a sump of relatively large volume but not so large that the liquid therein will become anaerobic. The sump levels out load surges, since the flow to the trickling filter will normally remain constant. A circulating pump constantly recirculates waste from the bottom of the sump and through the trickling filter.

Lint screens, sludge tanks or comminutors, may be installed in the system ahead of the sump, and settling and/or chlorination chambers, after the sump, as desired.

The present disclosure is designed primarily for, but is not limited to, meeting the demands of smaller systems, such as, for example, which would be used by laundries or schools.

Normally, trickling filters are considered to reduce biological oxygen demand of an effluent by about 25%. Recycling through the filter will increase the efficiency to about 50%. If higher BOD removals are required, it is the normal practice to treat by activated sludge. Compared to trickling filters, an activated sludge system is more expensive to operate, cannot withstand shock loads and requires much closer supervision.

One of the main reasons for higher efficiency of activated sludge systems is longer retention time, which is hours compared to minutes for a normal trickling filter. The present system

incorporates features of a trickling filter with the retention time feature of activated sludge. With a properly sized sump and trickling filter, efficiencies as high as that obtainable by activated sludge systems can be obtained.

An aerobic lagoon or a specially designed sump can be used. For most efficient operation, the sump can be based upon a conventional down-flow clarifier principle with raw wastes and trickling filter effluent discharging, for example, into a draft tube. Maximum recycle to raw feed is maintained and will depend upon organic loading and reduction desired. The sump is sized to total raw feed volume and total retention time required for desired stabilization.

This system will treat small volume wastes as well as large volumes. The only variables are trickling filter sump and recirculating pump sizes. The sump feature will level-out variations in flow and BOD loading. The system can be automated to require a minimum of supervision. Under certain conditions, clarification of suspended solids either before or after the unit may be necessary.

It is, accordingly, an object of the present invention to provide a high efficiency trickling filter plant utilizing a relatively large sump beneath a trickling filter and continuously operating means for recycling the waste in the sump through the trickling filter.

It is another object of the invention to provide a plant of the character described having treatment efficiencies comparable to activated sludge systems but with lower plant and operating costs and smaller space requirements.

It is a further object of this invention to provide a plant of the type disclosed having a trickling filter and a large sump therebeneath coupled for continuous recirculation, the sump receiving the raw wastes to level out load surges.

Other and further objects of the invention

will become apparent from a reading of the following specification, taken in conjunction with the accompanying drawings, in which:

Figure 1 is an elevational view of a preferred embodiment of the invention in vertical medial section.

Figure 2 is a schematic diagram of the system embodied in the structure of Figure 1;

Figure 3 is a schematic diagram of a modified form of the basic system of Figure 2;

Figure 4 is a schematic system diagram of a further modification; and,

With reference to Figures 1 and 2, the numeral 11 generally designates a tower type trickling filter. Filter 11 comprises a vertically elongated rectangular or cylindrical casing 12 of sheet metal or other suitable material, which is desirably lined with a chemical resisting material of any suitable kind. Casing 12 is filled almost to its upper end with filter units 13 each formed of a plurality of horizontally undulated sheets 14 of plastic material, impregnated paper or metal, separated by flat sheets 15 of similar material to define a multiplicity of vertical flow passages having collectively a very large surface area. Sheets 14 are shown vertically undulated in Figure 1 for the purpose of schematic illustration only.

Recirculated liquid enters filter 11 by flowing from pipe 16 into an input chamber 17 of flow box 18. The flow box 18 is divided by a baffle 19 defining input chamber 17 and output chamber 20. Chamber 20 has a discharge tube 21 directing the recirculated liquid to a distribution pan having a ventilated bottom plate 22. A splash guard strip 24 desirably surrounds casing 12 adjacent its upper end, as shown.

Trickling filter 11 is supported on a welded bar grating 25 resting on I-beams 26. I-beams 26 bridge a reinforced concrete sump tank 27 which is herein shown as being almost completely buried in the ground 28.

Sewage or raw waste enters sump tank 27 through a feed pipe 29. The pipe bends downwardly at 30 and has a jet forming reducing ell 31 at its lower end oriented to produce an agitating peripherally directed discharge stream. A pipe 32 conducts the sewage from the bottom of sump tank 27 to one or more pumps 33, Figure 2, for recirculation thereby through pipe 16 to the trickling filter 11. The lower end of pipe 32 is spaced from the bottom of sump tank 27 by a spider type pedestal 34.

Partially clarified and treated sewage overflows from sump tank 27 through a connecting pipe 35 which has a downward extension 36 terminating at another jet forming reducing ell 37 oriented to produce an agitating peripheral horizontal discharge into the bottom of settling chamber 38 of reinforced concrete construction. Pipe 39 spaced from the bottom

of the settling chamber 38 by spider type pedestal 40, pump 41 and pipe 42 recirculates the sludge or concentrated waste from settling chamber 38 to sump tank 27.

Overflow from settling chamber 38 flows through pipe 43 into a smaller chlorination chamber 44. Pipe 43 terminates in a jet forming reducing ell 45 oriented to produce an agitating horizontal discharge peripherally of the chlorination chamber 44. Chlorinating fluid is injected by convention apparatus, not shown, into input pipe 43 through conduit 43.

Chlorinated effluent is discharged upwardly through pipe 47 and laterally through its horizontal extension 48. A tee 49 connects pipes 47 and 48 to each other and to an upwardly extending ventilation pipe 50. A spider type pedestal 51 spaces the lower end of pipe 47 from the bottom of chamber 44.

A recirculation line 52 controlled by valve 53 may be employed to bypass any desirable amount of recirculated sewage or waste from the sump tank around the trickling filter and back into the sump tank.

Another bypass line 54 controlled by a valve 55 may be used to recirculate any desired part of the sewage from the bottom of the settling chamber 38 back to trickling filter 11. Other valves, collectively designated 56, are employed to selectively isolate pumps 33 and 41 or a shut-down bypass line 57.

In the species of Figure 3, raw waste enters a sump tank 58 through pipe 59 and is recirculated from the bottom of the sump by pump 60 through conduits 61 and 62 to and through a trickling filter 63 including a distribution box 64.

A filter-bypassing line 65 connects conduit 62 below the conduit valve 68 to the top of sump tank 58. Bypass flow through line 65 is controlled by valve 67 therein and by valve 68 in the upper part of conduit 62.

Overflow from sump tank 58 enters a combined clarifier and chlorination chamber 69 through pipe 70. Partially treated waste from the bottom of chamber 69 is pumped through a conduit 71 by pump 60 for recirculation back through the trickling filter 63 and/or sump tank 58, depending on the settings of valves 67 and 68 and of valves 72 and 73 which proportion the amounts of recirculation from tank 58 and chamber 69. Chlorinating fluid is forced through, at desired rate, a conduit 74 into the pipe 70 by conventional chlorinating apparatus, not shown.

Parts 58, 59, 61, 63, 64, 69 and 70 correspond closely in construction and function, respectively, to parts 27, 30, 32, 12, 22, 44 and 43 in the species of Figures 1 and 2.

In the species of Figure 4, raw waste first enters a lint screen box 75 from which filtered waste flows through pipe 76 into the first of two interconnected sludge tanks 77 and 78, the latter of which is also a sump tank above

which trickling filter 79 is positioned. Trickling filter 79 includes a distribution box 80.

Sludge from the bottom of sump tank 78 is recirculated by pump 81 through conduits 82 and 83 back through the trickling filter 79 and/or through a horizontally discharging agitation branch conduit 84 and thence into the bottom of first sludge tank 77.

The recirculated sludge is proportioned between conduits 83 and 84 by valves 86 and 85 therein, respectively.

Overflow from sludge or sump tank 78 passes through a pipe 87 down into a settling chamber 88. Dam-type partition 89 separates chamber 88 from an adjacent chlorination chamber 90 having baffles 91 providing a horizontally tortuous flow path therethrough. A depending chemically resistant baffle membrane 92, as for example a suitable plastic membrane, prevents foam and sludge from spilling over into chlorination chamber 90. Tube 93 injects chlorinating fluid into chamber 90 well below the surface of the liquid therein.

Overflow from chamber 90 flows through a valved conduit 94 to a discharge box 95 which, in turn, discharges through outlet conduit 96.

WHAT WE CLAIM IS:—

1. A trickling filter treatment plant for sewage and the like, in which the liquid from the trickling filter is discharged into the top portion of a sump disposed directly below the trickling filter and provided with inlet means and overflow means and including means for recirculating liquids from the lower portion of the sump to the input portion of the trickling filter, characterized in that the overflow means is connected to a treatment chamber provided with means for selectively recirculating liquids from the lower portion thereof to the trickling filter and the sump.
2. A structure as set forth in claim 1,

characterized in that the treatment chamber is a chlorination chamber provided with means for injecting chlorinating fluid into the same.

3. A structure as set forth in claim 1, characterized in that the treatment chamber is a settling chamber provided with overflow means which is connected with a chlorination chamber having means for injecting chlorinating fluid into the same.

4. A structure as set forth in any one of claims 1 to 3, characterized in that at least one of said overflow means is provided with a jet discharge portion oriented for producing a horizontally and peripherally directed agitating jet stream.

5. A structure as set forth in claim 2 or 3, characterized in that the chlorinating fluid injecting means is connected directly to the overflow means for more efficient mixing.

6. A structure as set forth in claim 3, characterized in that the chlorination chamber is separated from the treatment chamber by a dam-type partition, a depending plastic membrane baffle being positioned to prevent foam and sludge from spilling over the partition into the chlorination chamber.

7. A structure as set forth in any one of the preceding claims, characterized in that at least one sludge tank is interposed between the sump and the source of sewage or the like, a branch conduit being connected to the recirculating means and discharging horizontally in the sludge tank adjacent the bottom thereof for agitating the sludge.

8. A trickling filter waste treatment plant substantially as herein described with reference to Figures 1 and 2, 3 or 4 of the accompanying drawings.

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which trickling filter 79 is positioned. Trickling filter 79 includes a distribution box 80.

5 Sludge from the bottom of sump tank 78 is recirculated by pump 81 through conduits 82 and 83 back through the trickling filter 79 and/or through a horizontally discharging agitation branch conduit 84 and thence into the bottom of first sludge tank 77.

10 The recirculated sludge is proportioned between conduits 83 and 84 by valves 86 and 85 therein, respectively.

15 Overflow from sludge or sump tank 78 passes through a pipe 87 down into a settling chamber 88. Dam-type partition 89 separates chamber 88 from an adjacent chlorination chamber 90 having baffles 91 providing a horizontally tortuous flow path therethrough. A depending chemically resistant baffle membrane 92, as for example a suitable plastic membrane, prevents foam and sludge from 20 spilling over into chlorination chamber 90. Tube 93 injects chlorinating fluid into chamber 90 well below the surface of the liquid therein.

25 Overflow from chamber 90 flows through a valved conduit 94 to a discharge box 95 which, in turn, discharges through outlet conduit 96.

WHAT WE CLAIM IS:—

- 30 1. A trickling filter treatment plant for sewage and the like, in which the liquid from the trickling filter is discharged into the top portion of a sump disposed directly below the trickling filter and provided with inlet means and overflow means and including 35 means for recirculating liquids from the lower portion of the sump to the input portion of the trickling filter, characterized in that the overflow means is connected to a treatment chamber provided with means for selectively recirculating liquids from the lower portion 40 thereof to the trickling filter and the sump.
2. A structure as set forth in claim 1,

characterized in that the treatment chamber is a chlorination chamber provided with means 45 for injecting chlorinating fluid into the same.

3. A structure as set forth in claim 1, characterized in that the treatment chamber is a settling chamber provided with overflow means which is connected with a chlorination 50 chamber having means for injecting chlorinating fluid into the same.

4. A structure as set forth in any one of claims 1 to 3, characterized in that at least one of said overflow means is provided with a jet discharge portion oriented for producing a horizontally and peripherally directed agitating jet stream. 55

5. A structure as set forth in claim 2 or 3, characterized in that the chlorinating fluid injecting means is connected directly to the overflow means for more efficient mixing. 60

6. A structure as set forth in claim 3, characterized in that the chlorination chamber is separated from the treatment chamber by a dam-type partition, a depending plastic membrane baffle being positioned to prevent foam and sludge from spilling over the partition into the chlorination chamber. 65

7. A structure as set forth in any one of the preceding claims, characterized in that at least one sludge tank is interposed between the sump and the source of sewage or the like, a branch conduit being connected to the recirculating means and discharging horizontally 75 in the sludge tank adjacent the bottom thereof for agitating the sludge.

8. A trickling filter waste treatment plant substantially as herein described with reference to Figures 1 and 2, 3 or 4 of the accompanying drawings. 80

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