angle of an intermediate straight line with respect to the axis 229 of the curved-funnel-shaped inner separator surface 223, and the angle of the intermediate straight line with respect to the axis 229 of the curved-funnel-shaped inner separator surface 223 may be smaller than an angle of the outermost straight line with respect to the axis 229 of the curved-funnel-shaped inner separator surface 223.

[00020] As shown in FIG. 2B, the curvature of the curved-funnel-shaped inner separator surface 223 of the solid-liquid separator 120 may be defined by a smooth curve fitted to three straight lines 292, 294, 296 arranged in sequence one after another. Accordingly, the at least three straight lines may include the three successive straight lines 292, 294, 296 in a sequence of a first straight line 292 (or the innermost straight line) followed by a second straight line 294 (or the intermediate straight line) and followed by a third straight line 296 (or the outermost straight line). The first straight line 292 may form an angle between 20° to 35°, or between 25° to 30° with respect to the axis 229 of the curved-funnel-shaped inner separator surface 223. The second straight line 294 may form an angle between 50° to 65°, or between 55° to 60° with respect to the axis 229 of the curved-funnel-shaped inner separator surface 223. The third straight line 296 may form an angle between 65° to 75°, or between 67° to 72°with respect to the axis 229 of the curved-funnel-shaped inner separator surface 223. According to various embodiments, a lateral distance of the first straight line 292 may be approximately 15% of the entire lateral distance between the spout and the mouth of the curved-funnel-shaped inner separator surface 223. According to various embodiments, a lateral distance of the second straight line 294 may be approximately 40% of the entire lateral distance between the spout and the mouth of the curved-funnel-shaped inner separator surface 223. According to various embodiments, a lateral distance of the third straight line 296 may be approximately 45% of the entire lateral distance between the spout and the mouth of the curved-funnel-shaped inner separator surface 223. According to various embodiments, the curvature of the curved-funnel-shaped inner separator surface 223 as defined above may effectively separate the solids and the liquid as the solid-liquid mixture move along the curved-funnel-shaped inner separator surface 223 from the mouth of the curved-funnel-shaped inner separator surface 223 to the spout of the curved-funnel-shaped inner separator surface 223.

[00021] According to various embodiments, the solid-liquid separator 120 may include a frustoconically-shaped inner liquid guide surface 225. Referring back to FIG. 2A, the frustoconically-shaped inner liquid guide surface 225 may be an inner surface of the hollow structure 221 having a shape resembling a frustum of a cone, a truncated cone, or a tapering

circular sidewall. According to various embodiments, the spout of the curved-funnel-shaped inner separator surface 223 and a narrower end of the frustoconically-shaped inner liquid guide surface 225 may be directed towards each other. According to various embodiments, the frustoconically-shaped inner liquid guide surface 225 may receive the liquid flowing or travelling from the spout of the curved-funnel-shaped inner separator surface 223 and further guide the liquid to flow or travel along the frustoconically-shaped inner liquid guide surface 225 from the narrower end to a broader end of the frustoconically-shaped inner liquid guide surface 225. Accordingly, liquid may continue to flow onto the frustoconically-shaped inner liquid guide surface 225 upon exiting the spout of the curved-funnel-shaped separator surface. On the other hand, solids falling though the centre of the spout of the curved-funnel-shaped separator surface may continue to fall along a centre axis of the frustoconically-shaped inner liquid guide surface 225. Thus, liquid may be collected at a periphery of the frustoconically-shaped inner liquid guide surface 225, while the solids may be collected along the centre axis of the frustoconically-shaped inner liquid guide surface 225.

[00022] According to various embodiments, a ratio of a difference in radius between the broader end and the narrower end of the frustoconically-shaped inner liquid guide surface 225 to a height of the frustoconically-shaped inner liquid guide surface 225 may be between 1.2 to 2.75, or between 1.43 to 2.14. Accordingly, the frustoconically-shaped inner liquid guide surface 225 may form an angle of between 50° to 70°, or between 55° to 65° with respect to the axis of the frustoconically-shaped inner liquid guide surface 225. According to various embodiments, the slant of the frustoconically-shaped inner liquid guide surface 225 as defined above may effectively guide most of the liquid along the frustoconically-shaped inner liquid guide surface 225 from the narrower end of the frustoconically-shaped inner liquid guide surface 225 to the broader end of the frustoconically-shaped inner liquid guide surface 225.

[00023] According to various embodiments, the solid-liquid separator 120 further comprises a conduit portion 227. The spout of the curved-funnel-shaped inner separator surface 223 may be directly connected to a first end of the conduit portion 227 and the narrower end of the frustoconically-shaped inner liquid guide surface 225 may be directly connected to a second end of the conduit portion 227. Accordingly, the conduit portion 227 may be disposed between the curved-funnel-shaped inner separator surface 223 and the frustoconically-shaped inner liquid guide surface 225 such that the conduit portion 130 forms a connection or linkage between the curved-funnel-shaped inner separator surface 223 and the frustoconically-shaped inner liquid guide surface 225 for fluid communication. Hence, the solids and the liquid may

Claims

1. A waste treatment device, comprising:

a solid-liquid separator which is configured to receive and separate waste into solids and liquid;

a solids treatment arrangement configured to receive the solids from the solid-liquid separator, wherein the solids treatment arrangement comprises a disinfection unit having a heating mechanism configured to heat, without burning, the solids so as to disinfect the solids to convert the solids into pathogen-free-treated-solids; and

a liquid treatment arrangement which is configured to receive the liquid from the solid-liquid separator and to treat the liquid so as to convert the liquid into pathogen-free-effluent,

wherein the solid-liquid separator comprises a curved-funnel-shaped inner separator surface configured to set the waste into spiral motion as the waste moves towards a spout of the curved-funnel-shaped inner separator surface,

wherein the solid-liquid separator comprises a frustoconically-shaped inner liquid guide surface, and wherein the spout of the curved-funnel-shaped inner separator surface and a narrower end of the frustoconically-shaped inner liquid guide surface are directed towards each other.

2. The waste treatment device as claimed in claim 1, further comprising a single casing structure wherein the solid-liquid separator, the solids treatment arrangement and the liquid treatment arrangement are integrated into the single casing structure.

3. The waste treatment device as claimed in claim 2, wherein the single casing structure comprises an upper level and a lower level, wherein the upper level is configured to house the solid-liquid separator and the lower level is configured to co-locate the solids treatment arrangement and the liquid treatment arrangement.

4. The waste treatment device as claimed in claim 3, wherein the lower level comprises at least one partitioning wall to divide the lower level into two or more chambers for demarcating separate areas for the solids treatment arrangement and the liquid treatment arrangement within the lower level.

5. The waste treatment device as claimed in any one of claims 2 to 4, wherein the single casing structure is partitioned into three or more internal spaces for separately locating the solid-liquid separator, the solids treatment arrangement and the liquid treatment arrangement within the single casing structure.

6. The waste treatment device as claimed in any one of claims 3 to 5, wherein the single casing structure comprises a suspended support frame which separates the lower level and the upper level, and which is configured to support the solid-liquid separator.

7. The waste treatment device as claimed in any one of claims 2 to 6, wherein the single casing structure comprises a removable cover to enclose the solid-liquid separator.

8. The waste treatment device as claimed in claim 7, wherein the single casing structure comprises at least one other removable cover to cover over a portion of the lower level of the single casing structure.

9. The waste treatment device as claimed in any one of claims 1 to 8, wherein the solid-liquid separator is configured to separate the waste into solids and liquid based on centrifugal force and gravity.

10. The waste treatment device as claimed in any one of claims 1 to 9, wherein the solid-liquid separator further comprises a conduit portion, wherein the spout of the curved-funnel-shaped inner separator surface is directly connected to a first end of the conduit portion and the narrower end of the frustoconically-shaped inner liquid guide surface is directly connected to a second end of the conduit portion.

11. The waste treatment device as claimed in claim 10, wherein a ratio of a length of the conduit portion to a height of the curved-funnel-shaped inner separator surface is equal or less than 0.2.

12. The waste treatment device as claimed in any one of claims 1 to 11, wherein the heating mechanism of the disinfection unit of the solids treatment arrangement is

further configured to heat, without burning, the solids to remove moisture content from the solids so as to dry the solids.

13. The waste treatment device as claimed in any one of claims 1 to 12, wherein the heating mechanism of the disinfection unit of the solids treatment arrangement is configured to heat an elongate housing of the disinfection unit so as to heat an internal space of the elongate housing to create a heated environment to apply thermal disinfection to the solids received inside the elongate housing from the solid-liquid separator.

14. The waste treatment device as claimed in any one of claims 1 to 13, wherein the heating mechanism comprises one or more heating elements directly coupled to the elongate housing, and wherein the one or more heating elements comprises a band heater, or a heater pad, or a heater plate, or a heating net, or a heater coil, or a heater wire, or a heater rod, or a heater fin, or any combination thereof, preferably the one or more heating elements comprises the band heater.

15. The waste treatment device as claimed in any one of claims 1 to 14, wherein the disinfection unit comprises a conveying mechanism configured to move the solids along and within the elongate housing, and wherein the conveying mechanism comprises a screw conveyor mechanism, or a bucket conveyor mechanism, or a drag chain conveyor mechanism, or a belt conveyor mechanism, or a wire mesh conveyor mechanism, or a roller conveyor mechanism, or a spiral conveyor mechanism, preferably, the conveying mechanism comprises the screw conveyor mechanism.

16. The waste treatment device as claimed in any one of claims 1 to 15, wherein the solids treatment arrangement further comprises a collector unit which is configured to receive the pathogen-free-treated-solids from the disinfection unit.

17. The waste treatment device as claimed in any one of claims 1 to 16, wherein the liquid treatment arrangement comprises a biological treatment unit which is configured to remove organic substances in the liquid.

18. The waste treatment device as claimed in claim 17, wherein the biological treatment unit comprises a filtration chamber, or an anaerobic treatment chamber, or an aerobic treatment chamber, or an anoxic treatment chamber, or any combination thereof.

19. The waste treatment device as claimed in claim 18, wherein the biological treatment unit comprises the filtration chamber, the anaerobic treatment chamber, the aerobic treatment chamber, and the anoxic treatment chamber, wherein the biological treatment unit is configured to flow the liquid through the respective chambers in a sequence of the filtration chamber followed by the anaerobic treatment chamber followed by the aerobic treatment chamber and followed by the anoxic treatment chamber.

20. The waste treatment device as claimed in claim 18 or 19, wherein the biological treatment unit further comprises a recirculation pump configured to recirculate the liquid through the anaerobic treatment chamber, the aerobic treatment chamber, and the anoxic treatment chamber.

21. The waste treatment device as claimed in any one of claims 1 to 20, wherein the liquid treatment arrangement comprises a sedimentation unit which is configured to remove suspension particle in the liquid.

22. The waste treatment device as claimed in any one of claims 1 to 21, wherein the liquid treatment arrangement comprises an electrochemical unit which is configured to oxidize chloride-ion in the liquid to chlorine.

23. The waste treatment device as claimed in any one of claims 17 to 22, wherein the liquid treatment arrangement further comprises a sedimentation unit and an electrochemical unit, and wherein the liquid treatment arrangement is configured to flow the liquid through the respective units in a sequence of the biological treatment unit followed by the sedimentation unit and followed by the electrochemical unit.

24. The waste treatment device as claimed in any one of claims 1 to 23, wherein the liquid treatment arrangement comprises an outlet configured to discharge the pathogen-free-effluent.

25. The waste treatment device as claimed in any one of claims 22 to 24, further comprising a fluid sensing sensor disposed at any point from the liquid discharge outlet of the solid-liquid separator to the liquid treatment arrangement.

26. The waste treatment device as claimed in claim 25, wherein the disinfection unit of the solids treatment arrangement further comprises one or more temperature sensors configured to measure a temperature of the internal space of the housing of the disinfection unit of the solids treatment arrangement.

27. The waste treatment device as claimed in claim 26, further comprising a controller electrically coupled to the one or more temperature sensors of the disinfection unit of the solid treatment arrangement, the heating mechanism of the disinfection unit of the solid treatment arrangement, the conveying mechanism of the disinfection unit of the solid treatment arrangement, the electrochemical unit of the liquid treatment arrangement, the fluid sensing sensor, or any combination thereof.

28. The waste treatment device as claimed in claim 26, further comprising a controller electrically coupled to the one or more temperature sensors of the disinfection unit of the solid treatment arrangement, the heating mechanism of the disinfection unit of the solid treatment arrangement, the conveying mechanism of the disinfection unit of the solid treatment arrangement, the electrochemical unit of the liquid treatment arrangement, and the fluid sensing sensor.

29. The waste treatment device as claimed in claim 28, wherein the controller is configured to activate the electrochemical unit upon detection of liquid flow from the solid-liquid separator to the liquid treatment arrangement by the fluid sensing sensor.

30. The waste treatment device as claimed in claim 29, wherein the controller is configured to count the number of times the fluid sensing sensor detects liquid flow from the solid-liquid separator to the liquid treatment arrangement.

31. The waste treatment device as claimed in claim 30, wherein the controller is configured to activate the conveying mechanism of the disinfection unit of the solids treatment arrangement based on a predetermined number of times the fluid sensing

sensor detects liquid flow from the solid-liquid separator to the liquid treatment arrangement.

32. The waste treatment device as claimed in any one of claims 28 to 31, wherein the controller is configured to activate the heating mechanism of the disinfection unit of the solids treatment arrangement based on a pre-set timing.

33. The waste treatment device as claimed in claim 32, wherein the controller is configured to control the heating mechanism of the disinfection unit of the solids treatment arrangement to maintain the temperature of the internal space of the elongate housing of the disinfection unit of the solids treatment arrangement at a predetermined disinfection temperature so as to maintain the heated environment within the elongate housing of the disinfection unit of the solids treatment arrangement.

34. The waste treatment device as claimed in claim 33, wherein the controller is configured to control the conveying mechanism of the disinfection unit of the solids treatment arrangement to repeatedly move the solids in a first longitudinal direction and in a second longitudinal direction along the elongate housing of the disinfection unit of the solids treatment arrangement based on a predetermined sequence.

35. The waste treatment device as claimed in claim 33 or 34 wherein the controller is configured to activate the conveying mechanism of the disinfection unit of the solids treatment arrangement after the internal space of the elongate housing of the disinfection unit of the solids treatment arrangement is maintained at the predetermined temperature for a predetermined period of time.

36. The waste treatment device as claimed in claim 34 or 35, wherein the controller is configured to maintain the internal space of the housing of the disinfection unit of the solids treatment arrangement at the predetermined temperature while the conveying mechanism of the disinfection unit of the solids treatment arrangement is in operation.