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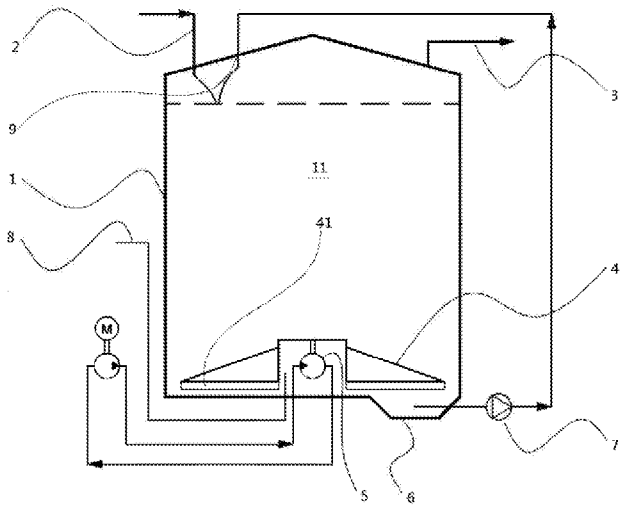

Fig. 3

(57) Abstract: An anaerobic reactor and an anaerobic wastewater treatment process are described herein. The anaerobic reactor includes a tank body (1) and a sludge scraper (4). The tank body (1) has a reaction chamber (11) therein. The reaction chamber (11) has a wastewater inlet (2) and a biogas outlet (3). A sludge collecting groove (6) is defined on the bottom surface of the reaction chamber (11). A sludge outlet pipe (12) in communication with the sludge collecting groove (6) is defined in an inner wall of the tank body (1). The sludge scraper (4) includes a sludge scraping plate (41) and a driving device (5). The sludge scraping plate (41) is located on the bottom of the reaction chamber (11), and is configured to scrape sludge on the bottom surface of the reaction chamber (11) into the sludge collecting groove (6). The driving device (5) is arranged on the bottom of the tank body (1) and connected to the sludge scraping plate (41) to drive it to rotate.

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DESCRIPTION

ANAEROBIC REACTOR AND ANAEROBIC WASTEWATER TREATMENT PROCESS

FIELD

The present disclosure relates to a field of environmental technologies, more particularly to an anaerobic reactor and an anaerobic wastewater treatment process used for wastewater treatment.

BACKGROUND

An anaerobic reactor is a common apparatus used for wastewater treatment, and the anaerobic reactor treats and converts oxygen consumption substances in the wastewater into biogas by means of anaerobic sludge in the anaerobic reactor. The wastewater contains impurities, such as fiber (cow manure), straw, or the like. In order to convert COD (chemical oxygen demand) in the fiber or the like into biogas as much as possible, produce a certain upflow velocity in the anaerobic reactor, and improve anaerobic treatment efficiency, the wastewater does not undergo a fiber pretreatment before entering the anaerobic reactor. Mixing homogeneity of the wastewater and the anaerobic sludge is an important factor influencing the treatment efficiency. In order to mix the wastewater and the anaerobic sludge uniformly and improve the treatment efficiency, stirring is usually needed in the anaerobic reactor. However, methods for improving mixing efficiency by stirring have their own problems, which need to be improved.

SUMMARY

The present application is made by the inventor based on discoveries and understandings of the following facts and problems.

There are several modes of stirring for the anaerobic reactor. (1) Stirring by compressed gas: the compressed gas is introduced into the anaerobic reactor for stirring. This mode of stirring has problems of high energy consumption and high safety requirements for the anaerobic reactor. (2) Stirring by circulating pump: wastewater in an upper portion of the anaerobic reactor is pumped to a lower portion of the anaerobic reactor by a circulating pump to produce an upward flow velocity, such that the wastewater and sludge can be flushed upwardly. This mode of stirring has stirring dead zones. (3) Mechanical stirring: a stirring paddle is provided in the anaerobic reactor, the

stirring paddle is driven to rotate by an electric motor arranged at a top of the anaerobic reactor through a driving shaft. Since the electric motor arranged at the top of the anaerobic reactor needs to drive the stirring paddle through a long transmission shaft and the anaerobic reactor typically has a relatively large height, hence, there are problems of large vibration and unstable stirring paddle. A distance between the stirring paddle and an inner bottom surface of the anaerobic reactor is usually one third of the height of the anaerobic reactor. If the stirring paddle is too close to the inner bottom surface, stirring energy will be lost and energy consumption and costs will increase. If the stirring paddle is too far away from the inner bottom surface, a stirring dead zone (i.e. a zone which cannot be stirred) often occurs on the bottom of the anaerobic reactor, affecting the mixing effect.

In addition, since the sludge is easily deposited on the inner bottom surface of the anaerobic reactor, the sludge on the inner bottom surface cannot be well stirred by all of the conventional stirring ways, thereby affecting the mixing effect of the sludge and the wastewater.

The present disclosure realizes the problems existing in the conventional stirring ways, and is intended to solve at least one of the technical problems in the related art at least to a certain extent. Thus, the present disclosure proposes an anaerobic reactor and an anaerobic wastewater treatment process that does not need stirring and have low energy consumption. Furthermore, the mixing effect of the sludge and the wastewater is good, and the stirring dead zone on the bottom of the anaerobic reactor is reduced, thereby greatly improving the wastewater treatment efficiency.

The anaerobic reactor according to embodiments of the present disclosure includes a tank body having a reaction chamber therein, the reaction chamber having a wastewater inlet and a biogas outlet, a sludge collecting groove being defined on a bottom surface of the reaction chamber, and a sludge outlet in communication with the sludge collecting groove being defined in an inner wall of the tank body; and a sludge scraper including a sludge scraping plate and a driving device, the sludge scraping plate being located on a bottom of the reaction chamber and configured to scrape sludge on the bottom surface of the reaction chamber into the sludge collecting groove, the driving device being arranged on a bottom of the tank body, connected to the sludge scraping plate, and configured to drive the sludge scraping plate to rotate.

The anaerobic wastewater treatment process according to embodiments of the present disclosure includes supplying wastewater into a reaction chamber of an anaerobic reactor, and performing anaerobic wastewater treatment by utilizing sludge in the reaction chamber; scraping

the sludge on a bottom surface of the reaction chamber into a sludge collecting groove on the bottom surface by means of a sludge scraper, and the sludge scraper including a sludge scraping plate and a driving device arranged on a bottom of the anaerobic reactor and configured to drive the sludge scraping plate; and discharging the sludge in the sludge collecting groove from the reaction chamber.

In the anaerobic reactor and the anaerobic wastewater treatment process according to embodiments of the present disclosure, the sludge on the bottom of the reaction chamber is scraped into the sludge collecting groove by the sludge scraper, such that the sludge can be avoided from depositing on the bottom of the reaction chamber, and the mixing effect of the sludge and the wastewater can be improved. Furthermore, no stirring device is needed, so as to overcome problems brought by the conventional stirring ways. Since the driving device for driving the sludge scraper is arranged on the bottom of the tank body, the driving device can be connected to the sludge scraper without the long transmission shaft, such that the sludge scraper operates steadily and has little vibration and noise.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a schematic view of an anaerobic reactor according to a first embodiment of the present disclosure.

Fig. 2 illustrates a schematic view of an anaerobic reactor according to a second embodiment of the present disclosure.

Fig. 3 illustrates a schematic view of an anaerobic reactor according to a third embodiment of the present disclosure.

Fig. 4 illustrates a top view of an anaerobic reactor according to an embodiment of the present disclosure.

Fig. 5 illustrates a schematic view of an anaerobic reactor according to a fourth embodiment of the present disclosure.

DETAILED DESCRIPTION

Embodiments of the present disclosure will be described in detail, and examples of the embodiments are illustrated in the accompanying drawings. The embodiments described below with reference to the drawings are exemplary, and are intended to explain the present disclosure,

but cannot be construed as limitations to the present disclosure.

As illustrated in Figs. 1 to 4, an anaerobic reactor according to embodiments of the present disclosure includes a tank body 1 and a sludge scraper 4.

An inner cavity of the tank body 1 forms a reaction chamber 11. The reaction chamber 11 defines a wastewater inlet 2 and a biogas outlet 3, wastewater is transmitted into the reaction chamber 11 through the wastewater inlet 2, and biogas produced in the reaction chamber 11 is discharged through the biogas outlet 3. A sludge collecting groove 6 is defined on a bottom surface of the reaction chamber 11, and the sludge collecting groove 6 is configured to collect sludge on the bottom surface of the reaction chamber 11. Herein, the term "collect" means that the sludge scraper 4 scrapes the sludge on the bottom surface of the reaction chamber 11 and concentrates the sludge into the sludge collecting groove 6.

The sludge scraper 4 includes a sludge scraping plate 41 and a driving device 5. The sludge scraping plate 41 is located on a bottom of the reaction chamber 11, spaced apart from the bottom surface and a circumferential wall of the reaction chamber 11 at a preset distance, and configured to scrape the sludge on the bottom surface of the reaction chamber 11 into the sludge collecting groove 6. The driving device 5 is arranged to a bottom of the tank body 1, connected to the sludge scraping plate 41, and configured to drive the sludge scraping plate 41 to rotate. When the sludge scraping plate 41 rotates, the sludge on the bottom of the reaction chamber 11 is scraped into the sludge collecting groove 6 to prevent the sludge in the reaction chamber 11 from depositing on the bottom of the reaction chamber 11. At least a part of the sludge collected in the sludge collecting groove 6 can be returned to an upper portion of the reaction chamber 11. In other words, all of the sludge in the sludge collecting groove 6 can be circulated and returned to the upper portion of the reaction chamber 11, or a part of the sludge can be returned to the upper portion of the reaction chamber 11 and the other part of the sludge can be discharged.

In the anaerobic reactor according to embodiments of the present disclosure, by providing the sludge scraper 4 on the bottom of the reaction chamber 11, the sludge on the bottom surface of the reaction chamber 11 can be scraped into the sludge collecting groove 6 to prevent the sludge from depositing on the bottom of the reaction chamber 11. Moreover, the driving device 5 for driving the sludge scraping plate 41 is also arranged to a lower portion of the tank body 1 instead of a top of the tank body 1, accordingly, the driving device 5 is not necessary to be connected to the sludge scraping plate 41 through a long transmission shaft and has little vibration, such that the sludge

scraper operates steadily. The sludge collected in the sludge collecting groove 6 can be returned into the reaction chamber 11 to be mixed with the wastewater. Thus, in the anaerobic reactor according to embodiments of the present disclosure, the sludge on the bottom of the reaction chamber is not necessary to be stirred by a conventional stirring device, thereby solving problems brought by conventional stirring ways.

The anaerobic reactor according to specific embodiments of the present disclosure will be described below with reference to the drawings.

As illustrated in Fig. 1, in some embodiments, the tank body 1 defines the reaction chamber 11 therein, and the reaction chamber 11 has the wastewater inlet 2 and the biogas outlet 3. The sludge collecting groove 6 is defined on the bottom surface of the reaction chamber 11 and configured to collect the sludge on the bottom surface of the reaction chamber 11. The sludge scraper 4 includes the sludge scraping plate 41 and the driving device 5, and the sludge scraping plate 41 is configured to scrape the sludge on the bottom surface of the reaction chamber 11 into the sludge collecting groove 6. The sludge scraping plate 41 is arranged adjacent to the bottom surface of the reaction chamber 11. For example, a distance between a lower edge of the sludge scraping plate 41 and the bottom surface of the reaction chamber 11 is smaller than 100 mm. The driving device 5 is arranged to the bottom of the tank body 1, connected to the sludge scraping plate 41, and configured to drive the sludge scraping plate 41 to rotate.

A rotating speed of the sludge scraping plate 41, for example, is smaller than 5 revolutions per hour, but it is not limited to this. In embodiments of the present disclosure, as long as the rotating speed of the sludge scraping plate 41 satisfies that the sludge scraping plate 41 can scrape the sludge on the bottom surface of the reaction chamber 11 without a substantial stirring function. It should be understood by those skilled in the art that, if the stirring is needed, the rotating speed of a stirring component configured to stir, such as a stirring paddle, is typically greater than a preset value. However, in embodiments of the present disclosure the sludge scraping plate 41 is configured to scrape the sludge on the bottom surface of the reaction chamber instead of stirring. Accordingly, the anaerobic reactor according to embodiments of the present disclosure does not have problems existing in conventional anaerobic reactors that require stirring.

In an example illustrated in Fig. 1, the driving device 5 is a hydraulic motor, such that the driving device 5 can be immersed in the wastewater without being sealed, thereby simplifying the structure. The driving device 5 can be driven by a power device located outside the tank body 1.

In other embodiments, as illustrated in Fig. 2, the anaerobic reactor further includes a circulating pump 7 having an inlet in communication with the sludge outlet (the sludge outlet is in communication with the sludge collecting groove 6 and defined in an inner wall of the tank body) of the sludge collecting groove 6 and an outlet in communication with the upper portion of the reaction chamber 11, and the circulating pump 7 is configured to pump at least a part of the sludge in the sludge collecting groove 6 to the upper portion of the reaction chamber 11, thereby improving a mixing effect of the sludge and the wastewater and improving a treatment effect of the wastewater.

The circulating pump 7 can be arranged outside the tank body 1. The inlet of the circulating pump 7 is in communication with the sludge outlet of the sludge collecting groove 6, and the outlet of the circulating pump 7 is in communication with the upper portion of the reaction chamber 11. At least a part of the sludge collected in the sludge collecting groove 6 enters the circulating pump 7 through the inlet of the circulating pump 7, under the pumping of the circulating pump 7, the sludge enters the reaction chamber 11 through the outlet of the circulating pump 7 to be mixed with the wastewater, such that the wastewater and the sludge can be mixed uniformly, and the treatment effect can be improved.

In some examples, the circulating pump 7 pumps the sludge to the upper portion of the reaction chamber 11 in a tangent direction of the reaction chamber 11. That is to say, an opening (either a pipe hole or a nozzle) of the reaction chamber 11 connected to the circulating pump 7 is orientated in the tangent direction of the reaction chamber 11, the sludge is sprayed into the reaction chamber 11 in the tangent direction to make the wastewater in the reaction chamber 11 rotate in along the circumferential direction, thereby avoiding accumulation of floating stuff on the surface of wastewater. Furthermore, the wastewater and the sludge are mixed uniformly, such that the wastewater treatment efficiency is better. In some examples, the sludge is supplied to a position, below a liquid surface, in the upper portion of the reaction chamber 11 by the circulating pump 7, such that the mixing of the sludge and the wastewater can be achieved better.

In other specific examples, as illustrated in Fig. 5, the tank body 1 includes a cement bottom wall and an upper metal tank body arranged on the cement bottom wall and having an open lower end. An outer periphery of the cement bottom wall extends outwardly beyond an outer periphery of the upper metal tank body. The cement bottom wall is provided with a sludge outlet pipe 12 therein, one end of the sludge outlet pipe 12 is connected to the sludge outlet of the sludge

collecting groove 6 and the other end of the sludge outlet pipe is connected to the inlet of the circulating pump 7.

A ratio of length to diameter of the sludge outlet pipe 12 is smaller than 40: 1. Through a lot of researches and engineering practices, the inventor found that, the sludge may contain fiber, or the like therein. In the case where a pipe diameter of the sludge outlet pipe 12 is constant, the sludge outlet pipe 12 can be blocked very easily when the sludge outlet pipe 12 exceeds a certain length. Moreover, the sludge outlet pipe 12 is very hard to clean in case of blocking, which not only affects the wastewater treatment, but also increases the maintenance cost. Thus, the ratio of length to diameter of the sludge outlet pipe 12 is limited to be smaller than a preset value, such that the problem of blocking can be solved better.

As described above, the distance between the lower edge of the sludge scraping plate 41 and the bottom surface of the reaction chamber 11 is smaller than 100 mm. In order to scrape the sludge on a bottom wall of the reaction chamber 11 into the sludge collecting groove 6, the lower edge of the sludge scraping plate 41 is as close as possible to the bottom wall of the reaction chamber 11. In some optional examples, the distance is smaller than 100 mm.

As described above, since the sludge scraping plate 41 does not serve the function of stirring, the rotating speed of the sludge scraping plate 41 is smaller than 5 revolutions per hour. Thus, the sludge can be scraped and the energy consumption is reduced.

In other optional examples, as illustrated in Fig. 5, the sludge scraper 4 further includes a truss 42. The sludge scraping plate 41 is connected to the truss 42, the truss 42 may be provided with a roller configured to roll on the bottom surface of the reaction chamber 11 so as to auxiliarily support the truss 42 and the sludge scraping plate 41.

In order to prolong service life of the sludge scraping plate 41 and improve a sludge scraping effect, the lower edge of the sludge scraping plate 41 may be provided with an elastic rubber sheet 411 in elastic contact with the bottom surface of the reaction chamber 11. When the sludge scraping plate 41 rotates and scrapes the sludge, the elastic rubber sheet 411 is in contact with the bottom wall of the reaction chamber 11, thereby improving the sludge scraping effect and achieving a buffering function to prevent damages to the bottom surface of the reaction chamber 11 and the sludge scraper 4.

In other optional examples, as illustrated in Fig. 5, in order that the sludge scraping plate 41 can conveniently scrape a large area of the sludge on the bottom wall of the reaction chamber 11

into the sludge collecting groove 6 as far as possible, an outer edge of the sludge scraping plate 41 extends outwardly beyond an outer edge of the sludge collecting groove 6.

An inner side wall surface of the sludge collecting groove 6 is a bevel inclined outwardly and downwardly. Thus, the sludge on the bottom wall of the reaction chamber 11 can flow into the sludge collecting groove 6 more easily.

In other optional examples, the driving device 5 includes the hydraulic motor, and the sludge scraper 4 further includes a central shaft sleeve 43. The sludge scraping plate 41 is mounted to the central shaft sleeve 43 and rotates with the rotation of the central shaft sleeve 43. The hydraulic motor 5 is arranged in the central shaft sleeve 43, and an output shaft of the hydraulic motor 5 is connected to the central shaft sleeve 43 to drive the central shaft sleeve 43 to rotate.

In other optional example, as illustrated in Fig. 3, the anaerobic reactor further includes a gas supply pipe 8, the gas supply pipe 8 is configured to transmit gas into the central shaft sleeve 43 to maintain a preset pressure in the central shaft sleeve 43, such that the wastewater in the reaction chamber 11 can be prevented from entering the central shaft sleeve 43, greatly prolonging the service life of the driving device 5. In this case, the driving device 5 may employ an electric motor.

In other optional examples, as illustrated in Fig. 5, the driving device 5 includes the hydraulic motor or the electric motor, and the sludge scraper 4 further includes the central shaft sleeve 43. The sludge scraping plate 41 is mounted to the central shaft sleeve 43, the central shaft sleeve 43 is further provided with a sealing sleeve 44 therein, and a top end and an outer circumferential wall of the sealing sleeve 44 are spaced apart from the central shaft sleeve 43. For example, a lower end of the sealing sleeve 44 is arranged to the bottom wall of the reaction chamber 11, and the hydraulic motor or the electric motor is arranged in the sealing sleeve 44. The output shaft of the hydraulic motor or the electric motor passes through an upper end of the sealing sleeve 44 and is connected to the central shaft sleeve 43.

The sealing sleeve 44 has a gas supply opening configured to supply the gas into the sealing sleeve 44 to maintain the preset pressure in the sealing sleeve 44 so as to prevent the wastewater in the reaction chamber 11 from entering the sealing sleeve 44.

The lower end of the sealing sleeve 44 is arranged in the bottom wall of the reaction chamber 11, and the gas supply opening is connected to a gas supply channel or the gas supply pipe 8 arranged in the bottom wall of the reaction chamber 11 and connected to an external gas source.

In other optional examples, the sludge collecting groove 6 may be a single annular groove

extending in a circumferential direction of the tank body 1 or a plurality of grooves spaced apart in the circumferential direction of the tank body 1. In other optional examples, one or more circulating pumps 7 may be provided.

In other optional examples, the bottom surface of the reaction chamber 11 may be divided into a plurality of sludge scraping zones, a plurality of sludge scrapers is provided and corresponding to the plurality of sludge scraping zones, and each sludge scraping zone defines at least one sludge collecting groove 6 therein.

In other optional example, the upper portion of the reaction chamber 11 is provided with a circulating spray head 9, and the outlet of the circulating pump 7 is connected to the circulating spray head 9.

A wastewater spray head configured to spray the wastewater into the reaction chamber 11 is provided at the wastewater inlet 2.

The wastewater spray head supplies the wastewater to a position above the liquid surface in the reaction chamber in a tangent direction. The wastewater spray head sprays the wastewater into the reaction chamber 11 in the tangent direction of the reaction chamber 11, the wastewater sprayed into the reaction chamber 11 causes the circumferential rotation motion of the wastewater in the reaction chamber 11, thereby avoiding the accumulation of the surface flotage of the wastewater. Furthermore, the wastewater and the sludge are mixed uniformly, such that the wastewater treatment effect is better.

The anaerobic wastewater treatment process according to embodiments of the present disclosure will be described briefly.

In the anaerobic wastewater treatment process according to embodiments of the present disclosure, wastewater is supplied into a reaction chamber of an anaerobic reactor, such that an anaerobic wastewater treatment can be performed by utilizing sludge in the reaction chamber.

A sludge scraper scraps the sludge on a bottom surface of the reaction chamber into a sludge collecting groove on the bottom surface, and the sludge scraper includes a sludge scraping plate and a driving device arranged on the bottom of the anaerobic reactor and configured to drive the sludge scraping plate.

The sludge in the sludge collecting groove id discharged from the reaction chamber.

In some embodiments, at least a part of the sludge discharged from the sludge collecting groove is pumped to an upper portion of the reaction chamber in a tangent direction of the reaction

chamber.

In some embodiments, the at least a part of the sludge is pumped to a position above a liquid surface in the reaction chamber, and the wastewater is supplied into the reaction chamber in the tangent direction of the reaction chamber.

In the anaerobic wastewater treatment process according to embodiments of the present disclosure, the sludge on the bottom of the reaction chamber is scraped into the sludge collecting groove by the sludge scraper, a part of the sludge can be circulated to the upper portion of the reaction chamber, such that the mixing effect of the sludge and the wastewater can be improved. Furthermore, no stirring device is needed, so as to overcome problems brought by the conventional stirring ways. Since the driving device for driving the sludge scraper is arranged on the bottom of the tank body, driving device can be connected to the sludge scraper without a long transmission shaft, such that the sludge scraper operates steadily and has little vibration and noise.

The anaerobic wastewater treatment process of the present disclosure does not need stirring and has low energy consumption. Furthermore, the mixing effect of the sludge and the wastewater is good, and stirring dead zone (i.e. a zone which cannot be stirred) on the bottom of the anaerobic reactor is reduced, thereby greatly improving the wastewater treatment effect.

In the specification, it is to be understood that terms such as “central,” “longitudinal,” “lateral,” “length,” “width,” “thickness,” “upper,” “lower,” “front,” “rear,” “left,” “right,” “vertical,” “horizontal,” “top,” “bottom,” “inner,” “outer,” “clockwise,” “counterclockwise,” “axial,” “radial” and “circumferential” should be construed to refer to the orientation as then described or as shown in the drawings under discussion. These relative terms are for convenience of description and do not require that the present disclosure be constructed or operated in a particular orientation.

In addition, terms such as “first” and “second” are used herein for purposes of description and are not intended to indicate or imply relative importance or significance. Thus, the feature defined with “first” and “second” may comprise one or more of this feature. In the description of the present disclosure, the term “a plurality of” means two or more than two, unless specified otherwise.

In the present disclosure, unless specified or limited otherwise, the terms “mounted,” “connected,” “coupled,” “fixed” and the like are used broadly, and may be, for example, fixed connections, detachable connections, or integral connections; may also be mechanical or electrical

connections; may also be direct connections or indirect connections via intervening structures; may also be inner communications of two elements, unless limited otherwise. The above terms can be understood by those skilled in the art according to specific situations.

In the present disclosure, unless specified or limited otherwise, a structure in which a first feature is "on" or "below" a second feature may include an embodiment in which the first feature is in direct contact with the second feature, and may also include an embodiment in which the first feature and the second feature are not in direct contact with each other, but are contacted via an additional feature formed therebetween. Furthermore, a first feature "on," "above," or "on top of" a second feature may include an embodiment in which the first feature is right or obliquely "on," "above," or "on top of" the second feature, or just means that the first feature is at a height higher than that of the second feature. While a first feature "below," "under," or "on bottom of" a second feature may include an embodiment in which the first feature is right or obliquely "below," "under," or "on bottom of" the second feature, or just means that the first feature is at a height lower than that of the second feature.

Reference throughout this specification to "an embodiment," "some embodiments," "an example," "a specific example," or "some examples," means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present disclosure. Thus, the appearances of the phrases in various places throughout this specification are not necessarily referring to the same embodiment or example of the present disclosure. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples. In addition, without conflicting, various embodiments or examples or features of various embodiments or examples described in the present specification may be combined by those skilled in the art.

Although explanatory embodiments have been shown and described, it would be appreciated by those skilled in the art that the above embodiments cannot be construed to limit the present disclosure, and changes, alternatives, and modifications can be made in the embodiments without departing from spirit, principles and scope of the present disclosure.

CLAIMS

1. An anaerobic reactor, comprising:

a tank body having a reaction chamber therein, the reaction chamber having a wastewater inlet and a biogas outlet, a sludge collecting groove being defined on a bottom surface of the reaction chamber, and a sludge outlet in communication with the sludge collecting groove being defined in an inner wall of the tank body; and

a sludge scraper comprising a sludge scraping plate and a driving device, the sludge scraping plate being located on a bottom of the reaction chamber and configured to scrape sludge on the bottom surface of the reaction chamber into the sludge collecting groove, the driving device being arranged to a bottom of the tank body, connected to the sludge scraping plate, and configured to drive the sludge scraping plate to rotate.

2. The anaerobic reactor according to claim 1, further comprising:

a circulating pump having an inlet in communication with the sludge outlet, and an outlet in communication with an upper portion of the reaction chamber to pump at least a part of the sludge in the sludge collecting groove to the upper portion of the reaction chamber.

3. The anaerobic reactor according to claim 2, wherein the circulating pump pumps the sludge to the upper portion of the reaction chamber in a tangent direction of the reaction chamber.

4. The anaerobic reactor according to claim 2, wherein the tank body comprises a cement bottom wall and an upper metal tank body arranged on the cement bottom wall and having an open lower end, an outer periphery of the cement bottom wall extends outwardly beyond an outer periphery of the upper metal tank body, the cement bottom wall is provided with a sludge outlet pipe therein, the sludge outlet pipe has one end connected to the sludge outlet and the other end connected to the inlet of the circulating pump.

5. The anaerobic reactor according to claim 4, wherein a ratio of length to diameter of the sludge outlet pipe is smaller than 40:1.

6. The anaerobic reactor according to any one of claims 1 to 5, wherein a distance between a lower edge of the sludge scraping plate and the bottom surface of the reaction chamber is smaller than 100 mm.

7. The anaerobic reactor according to any one of claims 1 to 6, wherein a rotating speed of the sludge scraping plate is smaller than 5 revolutions per hour.

8. The anaerobic reactor according to any one of claims 1 to 7, wherein the sludge scraper

further comprises a truss, the sludge scraping plate is connected to the truss, the truss is provided with a roller configured to roll on the bottom surface of the reaction chamber so as to auxiliarily support the truss and the sludge scraping plate, and the lower edge of the sludge scraping plate is provided with an elastic rubber sheet in elastic contact with the bottom surface of the reaction chamber.

9. The anaerobic reactor according to any one of claims 1 to 8, wherein an outer edge of the sludge scraping plate extends outwardly beyond an outer edge of the sludge collecting groove, and an inner side wall surface of the sludge collecting groove is a bevel inclined outwardly and downwardly.

10. The anaerobic reactor according to any one of claims 1 to 9, wherein the driving device comprises a hydraulic motor, the sludge scraper further comprises a central shaft sleeve, the sludge scraping plate is mounted on the central shaft sleeve, the hydraulic motor is arranged in the central shaft sleeve, and an output shaft of the hydraulic motor is connected to the central shaft sleeve to drive the central shaft sleeve to rotate.

11. The anaerobic reactor according to claim 10, further comprising: a gas supply pipe configured to transmit a gas into the central shaft sleeve to maintain a preset pressure in the central shaft sleeve, such that wastewater in the reaction chamber can be prevented from entering the central shaft sleeve.

12. The anaerobic reactor according to any one of claims 1 to 9, wherein the driving device comprises a hydraulic motor or an electric motor, the sludge scraper further comprises a central shaft sleeve, the sludge scraping plate is mounted on the central shaft sleeve, the central shaft sleeve is provided with a sealing sleeve therein, a top end and an outer circumferential wall of the sealing sleeve are spaced apart from the central shaft sleeve, a lower end of the sealing sleeve is arranged to a bottom wall of the reaction chamber, the hydraulic motor or the electric motor is arranged in the sealing sleeve, and an output shaft of the hydraulic motor or the electric motor passes through an upper end of the central shaft sleeve and is connected to the central shaft sleeve, and the sealing sleeve has a gas supply opening configured to supply a gas into the sealing sleeve to maintain a preset pressure in the sealing sleeve so as to prevent wastewater in the reaction chamber from entering the sealing sleeve.

13. The anaerobic reactor according to claim 12, wherein the lower end of the sealing sleeve is arranged in the bottom wall of the reaction chamber, and the gas supply opening is connected to

a gas supply channel or a gas supply pipe arranged in the bottom wall of the reaction chamber and connected to an external gas source.

14. The anaerobic reactor according to any one of claims 1 to 13, wherein the sludge collecting groove is a single annular groove extending in a circumferential direction of the tank body or a plurality of grooves spaced apart in the circumferential direction of the tank body, and one or more circulating pumps are provided.

15. The anaerobic reactor according to any one of claims 1 to 14, wherein the bottom surface of the reaction chamber is divided into a plurality of sludge scraping zones, a plurality of sludge scrapers are provided and corresponding to the plurality of sludge scraping zones, and each sludge scraping zone defines at least one sludge collecting groove therein.

16. The anaerobic reactor according to claim 2, wherein the upper portion of the reaction chamber is provided with a circulating spray head, and the outlet of the circulating pump is connected to the circulating spray head, and a wastewater spray head configured to spray the wastewater into the reaction chamber is provided at the wastewater inlet.

17. The anaerobic reactor according to claim 16, wherein the wastewater spray head supplies the wastewater to a position, above a liquid surface, in the reaction chamber in a tangent direction.

18. A anaerobic wastewater treatment process, comprising:

supplying wastewater into a reaction chamber of an anaerobic reactor, and performing an anaerobic wastewater treatment by utilizing sludge in the reaction chamber;

scraping the sludge on a bottom surface of the reaction chamber into a sludge collecting groove on the bottom surface by means of a sludge scraper, and the sludge scraper comprising a sludge scraping plate and a driving device arranged on a bottom of the anaerobic reactor and configured to drive the sludge scraping plate; and

discharging the sludge in the sludge collecting groove from the reaction chamber.

19. The anaerobic wastewater treatment process according to claim 18, further comprising:

pumping at least a part of the sludge discharged from the sludge collecting groove to an upper portion of the reaction chamber in a tangent direction of the reaction chamber.

20. The anaerobic wastewater treatment process according to claim 19, wherein the at least the part of the sludge is pumped to a position, above a liquid surface, in the reaction chamber, and the wastewater is supplied into the reaction chamber in the tangent direction of the reaction chamber.

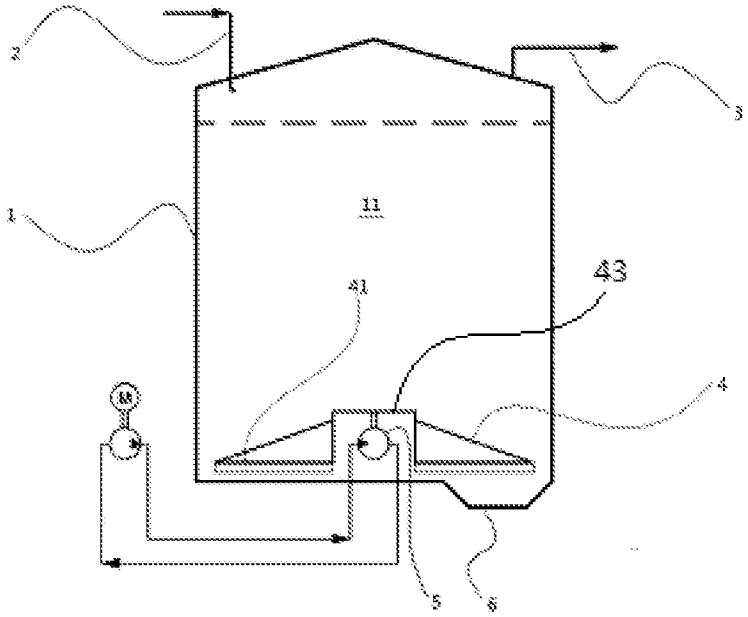

Fig. 1

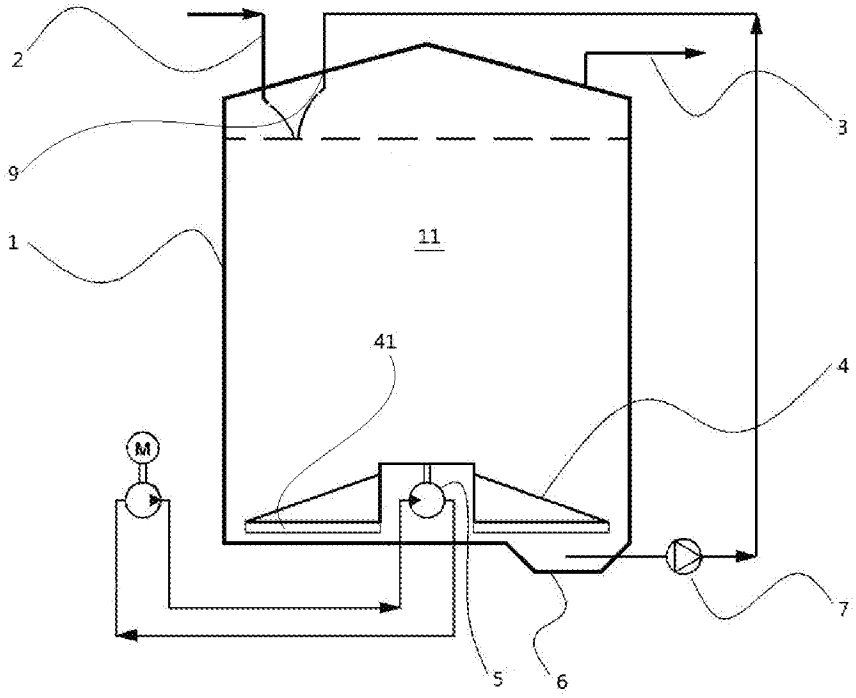

Fig. 2

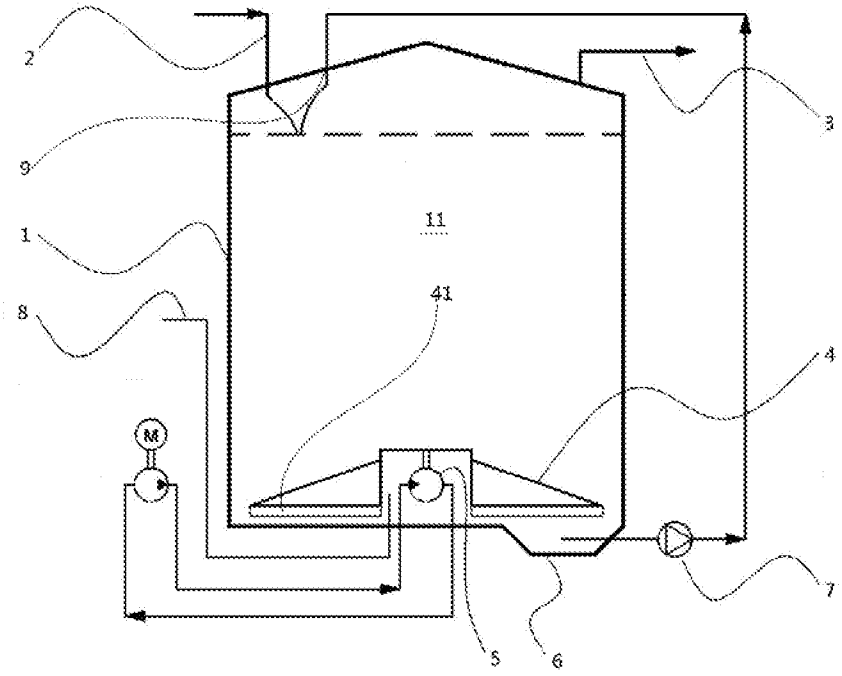

Fig. 3

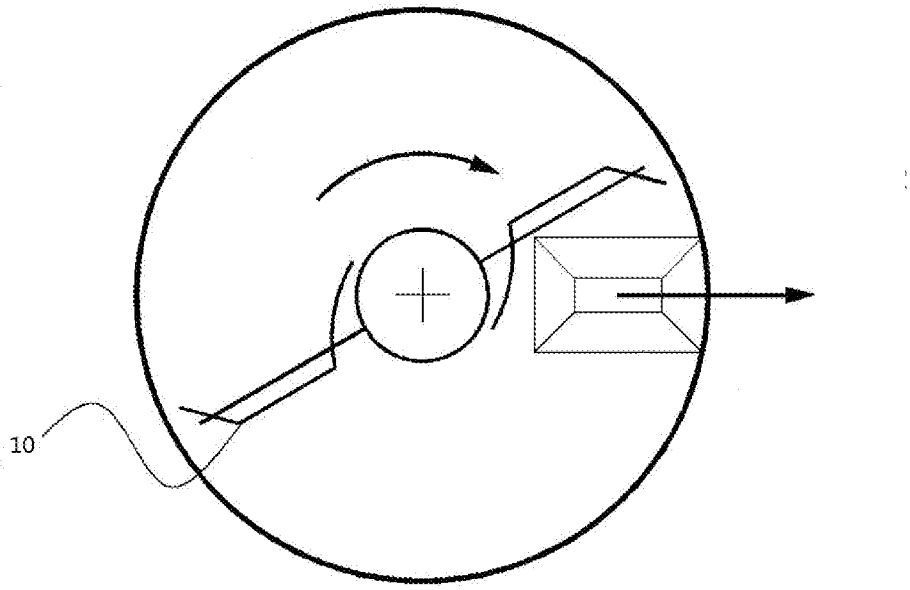

Fig. 4

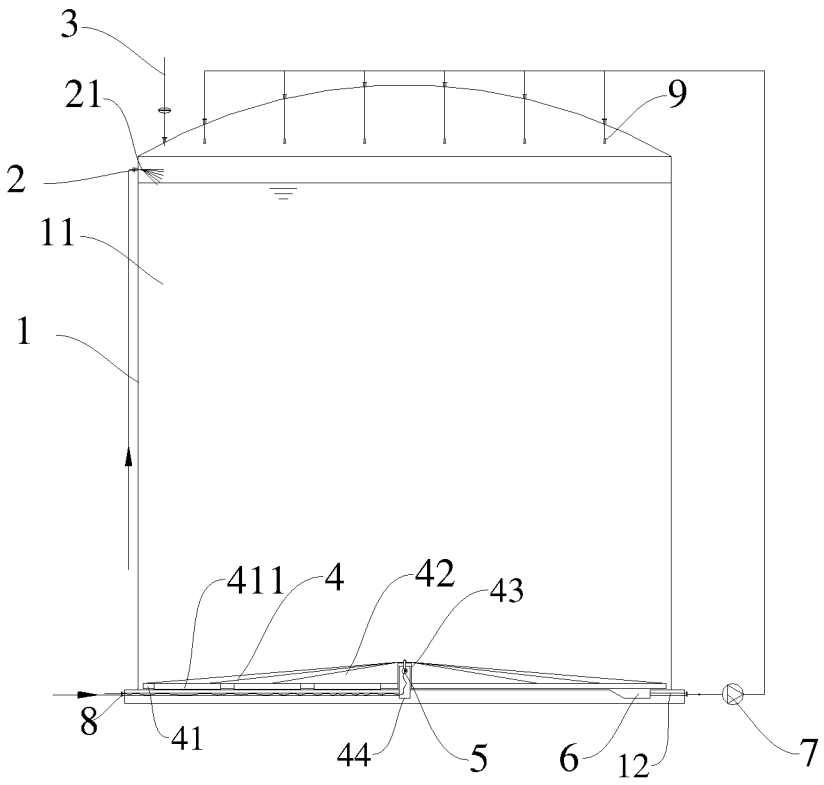

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2017/107904

A. CLASSIFICATION OF SUBJECT MATTER

C02F 3/28(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT,CNKI,WPI,EPODOC:anaerobic, digest+, sludg+, mud, scraper, discharg+, recycl+, circl+, back, bottom, down, lower, motor, driving, groove, collect+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 205275300 U (WISDRI ENG & RES INC LTD.) 01 June 2016 (2016-06-01) description, paragraph [0023], and figure 1	1-20
A	CN 205856107 U (ANHUI PAN-ASIAN ENVIRONMENTAL PROTECTION) 04 January 2017 (2017-01-04) the whole document	1-20
A	CN 102757126 A (SHANDONG INST TUMOUR PREVENTION ET AL.) 31 October 2012 (2012-10-31) the whole document	1-20
A	CN 204111412 U (GUANGXI LVCHEN ENVIRONMENTAL ENG CO., LTD.) 21 January 2015 (2015-01-21) the whole document	1-20
A	US 2004031734 A1 (CHEN G H ET AL.) 19 February 2004 (2004-02-19) the whole document	1-20
A	NL 1032379 C2 (HASKONING NEDERLAND B V) 06 July 2007 (2007-07-06) the whole document	1-20

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 January 2018	**31 January 2018**

Name and mailing address of the ISA/CN	Authorized officer
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2017/107904

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 205275300 U	01 June 2016	None	
CN 205856107 U	04 January 2017	None	
CN 102757126 A	31 October 2012	CN 102757126 B	07 August 2013
CN 204111412 U	21 January 2015	None	
US 2004031734 A1	19 February 2004	US 6758965 B2	06 July 2004
NL 1032379 C2	06 July 2007	None	