(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 September 2009 (11.09.2009)

PCT

(10) International Publication Number
WO 2009/108996 A1

(51) International Patent Classification:
E03F 11/00 (2006.01) *E03F 1/00* (2006.01)
C02F 1/00 (2006.01)

(21) International Application Number:
PCT/AU2009/000243

(22) International Filing Date:
2 March 2009 (02.03.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2008901015 3 March 2008 (03.03.2008) AU

(71) Applicant *(for all designated States except US)*: **SAMARAN INTERNATIONAL PTY LTD** [AU/AU]; 17 Church Street, Traralgon, Victoria 3844 (AU).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **DUNBAR, Neil, James** [AU/AU]; 18 Coster Circle, Traralgon, Victoria 3844 (AU).

(74) Agent: **PERNAT, Alfred**; Morcom Pernat, Suite 10, 475 Blackburn Road, Mount Waverley, Victoria 3149 (AU).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) **Title**: FLUID WASTE PROCESSING SYSTEMS

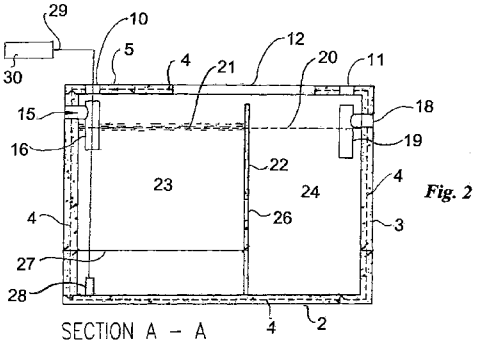


Fig. 2

(57) **Abstract**: A method of managing a plurality of fluid waste processing systems (100), each fluid waste processing system comprising a septic tank (1) for containing a water and sludge or scum mixture, at least one sensor (28) near the bottom of the tank, and an onsite electronic monitor (30), said method comprising: creating an identification code in the form of a location reference such as an address for identifying each septic tank (1), selecting pressure as a parameter for indicating when a septic tank (1) needs to be emptied, sensing the level of pressure in each septic tank (1), monitoring the sensed level in the system with the electronic monitor (30), generating an electronic signal by radio link in the form of an SMS message to characterise the level of pressure when the tank is full or requires emptying, monitoring the electronic signal in each system in a management facility, generating an action prompt in the form of an SMS message or email notification to a waste removalist when a pressure reading varies by at least 2% from a pressure reading if the tank (1) only contained water, initiating an action response on receipt of the action prompt, the action response comprising sending a remediation vehicle to remove waste fluid (20) from the tank (1).

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FLUID WASTE PROCESSING SYSTEMS

Field of the Invention

The invention relates to fluid waste processing systems, and methods for management thereof.

Background of the Invention

Septic tanks operate by allowing sewage to be digested in the tank for an appropriate residence time before fluid which has been subject to digestion in the tank is pumped or overflows from the tank into a distribution system in surrounding soil. After a period of time, there is an inevitable build-up of sludge at the bottom of the septic tank. As the level of sludge in the septic tank rises, the residence time of sewerage entering the tank for digestion begins to decrease. When the sludge level becomes high, the residence time of sewerage may be so short that there is insufficient time for adequate digestion. As a result, inadequately digested sewerage from the pump or overflow outlet of the tank which may even contain suspended matter is fed to the surrounding liquid distribution system. The dirty effluent can cause the distribution lines to clog with the result that the surrounding area may become contaminated with dangerous biological material. This biological material can even seep into nearby creeks and rivers making them unsafe for recreational or drinking purposes.

Scum, a lightweight layer typically including a substantial oil component may also build up as a surface layer with time. Excess scum may also hinder digestion and lead to premature overflow of inadequately digested material.

In order to reduce the likelihood of contamination of surrounding areas and water courses by septic tanks, there is a mandatory legal requirement in the State of Victoria, Australia that septic tanks be emptied at least once every three years to remove sludge and/or scum. However, in practice despite this mandatory legal requirement, most septic tanks are not emptied for far longer periods.

In most instances, sludge or scum build-up in a typical septic tank will not be unacceptable in the relatively short time span of three years. However, because of the variable nature of usage of different septic tanks and the fact that there is no adequate monitoring system, the relatively short mandatory three year time span for emptying septic tanks is necessary to cover the unusual situation where some septic tanks require emptying within such a short period. The risks of not following such a regime, such as threats to health and the expense of replacing or cleaning the distribution lines when they are clogged, are otherwise too great.

There is a need to distribute liquids issuing from the septic tank into soil in controlled fashion. This is a requirement for the proper management of on-site sewage processing systems. For example, as shown in Figure 4, an on-site sewage processing system 100 collects sewage effluent from sewer pipe 102 in a septic tank 104. After primary treatment in the septic tank 104, on-site sewage effluent is typically directed to junction pits 118, 120 and 122 and then on to absorption trenches 106, 108 and 110 located below the ground. An absorption line 112, 114 and 116 (egg. a perforated pipe) is located within each of the aggregate filled absorption trenches 106, 108 and 110. Space, terrain and trench length constraints usually require there to be a number of absorption lines 112, 114 and 116 that are spread out in a down slope direction. This arrangement typically allows the sewage effluent to flow to the absorption trenches 106, 108 and 110 under the force of gravity.

On-site sewage is best managed if it is spread out evenly over the absorption trenches 106, 108 and 110, in accordance with the tested soil percolation and designed long-term absorption characteristics of the soil. However, due to historical circumstances, sometimes the absorption trenches 106, 108 and 110 are flooded beyond their designed application rates in a serial fashion. A common problem with the junction pits 118, 120 and 112 that are typically used in this arrangement is that under normal operation, a small number of absorption trenches (egg. 106 and 108) are flooded beyond their assessed long-term absorption capacity and consequently fail, usually in a premature serial fashion. However, it is often difficult to control and/or adjust the flow of effluent into different absorption trenches. For example, given the small

spatial confines of the junction pits typically used in the on-site sewage processing industry, it is very difficult for plumbers and drainers to accurately assess the flow level in the pit, to construct apertures for controlling the flow proportions and outlet levels to and from the junction pit, and to monitor the absorption capacity of the absorption trenches.

Thus it would be advantageous to provide a method of managing trade waste or on site sewage processing systems whereby parameters including, but not limited to, flow rates, absorption capacities, and levels of sludge or scum may be monitored in order to limit, reduce, overcome or substantially ameliorate some of the aforesaid problems or disadvantages. For example, monitoring levels of sludge or scum to determine when a septic tank needs to be inspected or emptied may avoid the need for mandatory emptying every three years or such other time as is set by legislation.

Disclosure of the Invention

In one aspect the invention provides a method of managing a plurality of fluid waste processing systems, each fluid waste system comprising at least one sensor, said method comprising:

- creating an identification code for each system,
- selecting a parameter in each system which is indicative of the operational state of the system,
- sensing the level of the parameter in each system with the sensor,
- generating an electronic signal, to characterise that level, or when the parameter is not within a predetermined range,
- monitoring the electronic signal in each system in a management facility,
- generating an action prompt when the parameter is not within the predetermined range.

By fluid waste we mean any flowing waste material which may include a proportion of solids such as sludge.

The fluid waste processing system may comprise at least one of a trade waste processing system and a septic tank for containing a water and sludge or scum mixture.

The method may comprise initiating an action response for each system in which the parameter falls outside the predetermined range.

The action response may comprise sending a remediation vehicle equipped to remediate the system so that the parameter is returned to being within the predetermined range.

The method may comprise assessing compliance of the action response after generation of the action prompt. The compliance assessment may be conducted by local government or a body which is independent of the management facility.

The parameter may comprise the depth of fluid waste in the processing system. An action response may be prompted when the depth is indicative that the processing system is more than 50% filled.

Each system may have an on site electronic monitor for monitoring the sensed level in the system. The electronic monitor may be located in a nearby work place or dwelling.

The electronic monitor may comprise a memory for storing a plurality of parameter readings taken over a period of time. It may include an identification code for the system. Alternatively, or additionally, the system may comprise an identification device such as a machine readable bar code, microchip, or other visible identification.

The management facility may comprise any one or more of a number of information upload means for receiving data from the electronic monitor. For example, the electronic monitor may be linked directly by radio or telephone line to the management facility. Thus the management facility may comprise an electronic receiving capability for receiving data relating to a measured parameter.

In one embodiment of the invention an operator may periodically take parameter readings directly from the electronic monitor and physically transfer the readings to the management facility. An electronic reading device may be used by the operator for this purpose.

The operator may have an operator identifier code. The operator identifier code may also be associated with the electronic monitor readings when they are transferred to the management facility.

If the system has been remediated by an operator the operator may input this information to the management facility. The management facility may comprise a computer database.

Each sewage processing system may comprise a septic tank adapted to contain a water and sludge or scum mixture. Each septic tank may comprise an inlet for directing sewage into a container, and an outlet for directing digested sewage from the container.

The parameter may be detected by a sensor. The sensor may send a signal for monitoring the parameter to the electronic monitor.

The sensor may be located in the septic tank. The parameter detected by the sensor may be used to indicate or determine the depth of sludge or scum in the septic tank.

The electronic monitor may be adapted to generate a warning signal when the signal from the sensor is indicative of a depth of sludge or scum exceeding a predetermined limit.

Typically, the septic tank may be divided into a primary chamber which receives raw sewerage and a secondary chamber from which digested fluid exits into a distribution system. In such an arrangement, the primary and secondary chambers may be separated by a wall or baffle with an opening allowing fluid communication between

the two chambers. Thus, the arrangement may be such that sludge accumulates in the primary chamber below the level of the opening. The scum may accumulate as a top layer.

In such an arrangement, the density of sludge at least in the early stages of deposition of the sludge on the floor of the primary chamber, tends to be greater than water. Applicants therefore propose that one parameter which may be characteristic of the level of sludge in the primary chamber of the septic tank may be related to the density of the sludge/water mixture in the primary chamber. This may be reflected by the pressure which is found at various levels in the tank and it is particularly true of pressure at the bottom of the tank in the primary chamber. Typically, the density of sludge will range between 1.01 to 1.1, more typically 1.03 to 1.07. This compares with a normal density for water of about 1.

Thus applicants propose that a pressure sensor may be used as a means of giving an indication of the level of sludge in the septic tank. The pressure sensor may be located at or near the base of the primary chamber. However it also may be located at higher levels. There may be more than one pressure sensor. There may be a plurality of pressure sensors arranged at different levels in the primary chamber.

The pressure sensor may be associated with the electronic monitor. Thus the pressure sensor may send a signal to the electronic monitor indicating the pressure proximate the bottom of the tank. By taking into account the density of sludge, a rough calculation of the level of sludge in the septic tank may be made. The electronic monitor may be set so as to give an indication as to whether the general level and hence depth of sludge is approaching the level of the opening in the baffle between the primary and secondary chambers. Once the sludge reaches the level of the opening, it may spill into the secondary chamber. This is undesirable from the point of view of residence time and the amount of digestion achieved. Thus, the electronic monitor may be set so as to generate a warning signal which indicates the septic tank needs to be inspected and subject to the results of inspection, emptied prior to the level of the sludge being at or near the level of the opening in the baffle. The warning signal can take any form as is known in the art, eg. a warning light, a displayed

message, an alarm or even an electronic signal relayed directly to the management facility. This may comprise a sludge removal company which then initiates a waste disposal action response. Other action responses may include a servicing action response, or an effluent sampling action response.

Each septic tank system may comprise a tank identification code such as a barcode. The barcode may be adapted to be scanned in order to identify features such as council ID, type of waste, and Tank ID number. The people or companies undertaking the initiated action response may have a scanner adapted to scan the barcode. Similarly, waste disposal vehicles may also have a barcode adapted to be scanned in order to identify the vehicle or other features. The tank barcode and/or the vehicle barcode may be scanned during an action response. The data recorded by the scanner may then be monitored by the management facility. This may occur by downloading the data from the scanner into computer hardware using operational software which activates transmission of the data. The hardware may be located at a selected site such as a regional repository.

Where the parameters being monitored are based upon pressure readings taken near the bottom of the tank, it is anticipated that a pressure variation compared with water of about 1% or higher, more preferably about 2% or higher may be sufficient to trigger an indication that the septic tank needs to be emptied. In other words, the average density of mixture in the primary chamber may rise to at least 1.01 more preferably about 1.02 or more before the warning signal is activated.

The electronic monitor may include timing means to automatically ensure that regular readings are taken. Alternatively, it may monitor the pressure on a continuous basis.

In some instances, where sludge has been allowed to build up for too long, it is anticipated that after initially increasing in density, the reading for sludge density may actually decrease. Thus, as an alternative to the above scenario, the reading decrease in sludge density after the initial increase, may be taken as an indicator that the septic tank needs to be emptied ie. if pressure decreases by more than 1% at the bottom for a

given level of liquid mixture this may be taken as an indication that inspection is required.

In another scenario, pressure may decrease if the septic tank springs a leak. The resultant low pressure reading would generate a warning signal to indicate the tank needs to be checked.

Whilst it is anticipated that pressure sensing will be one preferred method, it is to be appreciated that other methods of sensing parameters characteristic of the level of the sludge may be used. For example, a transducer which vibrates within the sludge may be used to give an indication of sludge depth. The transducer may be located at a level at or below the opening in the baffle so that when the sludge reaches the level of the transducer the changing characteristics of vibration of the transducer resulting from varying damping properties or viscosity may be used as an indication of the level of the sludge.

Another alternative may involve the use of a conductimetric approach such as a pair of conductive plates arranged at an appropriate level, to determine the presence of sludge.

Yet another method may involve measurement of light transmission or other electromagnetic wave at an appropriate level to determine whether sludge has reached a predetermined level at which the tank needs to be emptied. Combinations of two or more of these possibilities may also be used as required.

Another parameter which may give an indication that the tank needs to be inspected and possibly emptied may be determined through measuring the scum layer which normally builds up on top of the liquid in the septic tank. The scum layer is an oily scummy layer which floats on top and generally has a density less than 1. As the scum layer builds up on top, so does the sludge layer at the bottom of the tank. Hence the thickness of the scum layer can be used as a guide to the sludge layer build up. Thus a measure of thickness of the scum layer may be used as the parameter to trigger emptying of the tank.

Additionally, in some instances, especially where sewerage has a high oil component, the scum layer may rapidly build up to a level which is unacceptable even when the sludge layer is still of acceptable thickness. Thus, measuring the thickness of the scum layer may be an appropriate monitoring technique even if the sludge layer has not built up unduly ie. the presence of excess scum is itself a reason for emptying the tank as this too can make its way into the distribution lines and clog them (making it difficult for the effluent to be dispersed).

At the start of the tank use, the density will be that of water as this covers the "shallow" scum sensor. As the scum layer (low density oil/fat) builds up the apparent density may fall. However, in a parallel to the lower sludge sensor, it is likely that in some instances the encapsulation of the sensor in the scum will cause the apparent density to fall to a level much lower than would be anticipated by simply calculating the pressure difference between the density of water and the density of oil/fat. This may be akin to encapsulating the sensor in a jelly which sets over time. The scum may also adhere to the sides of the tank both mechanisms acting to mask the pressure.

In practice applicants have actually measured as much as a 20% decrease in the apparent density of the sludge and scum layers in relation to the density calculated from being in plain water.

The sensing techniques already described with reference to sludge may be equally applicable when applied at the scum layer.

The scum layer thickness may be measured by a sensor placed at or below the level of the scum layer. Initially the sensor may be below the original water level but as the scum builds up it has some thickness and then the sensor may find itself in the scum layer.

It may be a pressure sensor located so that it measures pressure corresponding to an increased thickness of scum at the top of the liquid. Again a pressure variation of 1% in the scum layer region may be sufficient to trigger an inspection.

In a specific aspect of the invention the septic tank may be monitored by placing a sensor near the sludge layer at the bottom of the tank and also in the vicinity of the scum layer to monitor both. If each sensor is a pressure sensor, a variation in sensed pressure for either layer of 1% or more may be used to signal that an inspection of the tank is required.

Alternatively or additionally, a sensor may be located in the secondary chamber as this would come into play as the primary chamber becomes too full with undigested material flowing from the primary chamber to the secondary chamber.

The pressure sensor may be positioned facing upwards to read the weight of sediment "sitting" on the sensor.

The septic tank may form part of an on site sewage processing system having a junction pit arranged to receive liquid from the septic tank and at least one distribution line for receiving liquid from the junction pit. The or each distribution line may be in the form of an absorption trench.

A sensor may be located in the junction pit. The sensor may be located at a level in the junction pit such that it becomes immersed in the liquid flowing into the junction pit. The sensor may sense the rate at which the liquid flows through the junction pit after supply of the liquid to the junction pit from the septic tank.

The sensor may send a signal to the electronic monitor in order to monitor the effectiveness of liquid distribution from the septic tank.

The sensing of liquid flow may be carried out by any method known in the art. For example it may be done electrolytically, by a float, by capacitance or by pressure variation.

The sensor may sense the presence of liquid electrolytically. It may be arranged to sense the presence of liquid in the junction pit at two levels. Hence it may be

associated with timing means for timing the time taken for the level of liquid to fall from the higher of the two levels to the lower of the two levels to give a calculation of the rate of liquid flow from the junction pit into the distribution lines.

When the sensed rate of liquid flow falls below a predetermined limit, a warning signal may be generated. An action response may be generated in response to the warning signal whereby an inspection of the sewage processing system is initiated. The warning signal may even be used to initiate an action response triggering automated flow control means associated with the distribution lines to redistribute rates of flow to the distribution lines.

As the sensor readings can vary substantially, depending on variations in rates of supply of liquid to a junction pit as a result of intermittent and changeable sewer usage, the predetermined limit may be based on a calculation derived from multiple sensor readings. Multiple readings may be treated with a regression algorithm to create a graph of efficiency of dispersion of liquid corresponding to the rate of flow from the pit vs. time. When the line graph readings intersect a predetermined level of efficiency reduction, a warning signal may be generated. For example, an efficiency reduction of as little as 25% may be sufficient to trigger a warning depending on the circumstances. However in the majority of instances a reduction of efficiency of more than 40%, 50% or greater will probably be more appropriate.

The on site sewage processing systems may comprise a plurality of junction pits arranged in series with each pit feeding one or more distribution lines. A flow sensor may be placed in the uppermost pit, the lowermost pit, in all of the pits or even a selection of them to suit the circumstances of a particular installation.

One or more of the pits may be fitted with a fitting for controlling flow from the pit to a distribution line.

The fitting may include:

- a body having one or more openings formed through said body, such that, when said liquid defines a level in a conduit, at least one of said openings is at

least partially submerged in said liquid so as to define an effective flow aperture relative to said level for controlling the rate of flow of said liquid through said body;

wherein the selective rotation of said body enables adjustment of the size of said effective flow aperture.

Each fitting may be set for a particular flow rate on initial installation of the sewage processing system. The parameter detected by the sensor may be used to indicate or determine the flow rate. The electronic monitor and/or management facility may be adapted to generate a warning signal when the signal from the sensor is indicative of the flow rate dropping below a predetermined limit. An action response may be initiated following generation of the warning signal whereby the fitting setting may be altered so as to compensate for reduced efficiency of one or more distribution lines.

The body may include means for coupling said body to an open end of said conduit. Once the body has been rotated to define an effective flow aperture of a selected size, the body may be securely sealed to the conduit so as to reduce movement of the body with respect to the conduit.

The body may include means for adjusting the height of said body relative to said level. The means for height adjustment may include an elbow joint for coupling with said fitting, said elbow joint also for coupling to said conduit.

The openings may define one or more flow control regions, each said region for defining a corresponding said effective flow aperture of different size relative to said level.

The at least one of the regions may define the effective flow aperture for allowing a high rate of flow relative to the rates of flow for other said regions.

It may allow a rate of flow of around 50% of the high rate of flow.

Another of the regions may define an effective flow aperture for allowing a rate of flow of around 33% of the high rate of flow.

Another of the regions may define an effective flow aperture for allowing a rate of flow of around 25% of said high rate of flow.

The flow apertures for the regions may be defined by a single opening.

The openings may define one or more weirs, each weir corresponding to a different region.

Each of the weirs may have a notch. The notch may be generally V-shaped or U-shaped. The notch may have a rounded base.

Each of the weirs may include a knife edge.

The fitting may be made of a plastic material, such as PVC, polythene or polypropylene plastics.

The body may be rotatable along a cross-sectional axis of the body.

The conduit may alternatively or additionally include a fitting as described above.

Broadly speaking the fitting may be suitable for coupling to an end portion of a conduit for controlling the rate of flow of liquid in a conduit, the fitting including:

a disc-like body having an opening formed therethrough, said opening being shaped to form one or more respective weirs, such that, when said liquid defines a level in said conduit, at least one of said weirs is at least partially submerged in said liquid so as to define an effective flow aperture relative to said level for controlling the rate of flow of said liquid through said body;

wherein said body is selectively rotatable relative to said conduit to one or more predefined positions, each said position for defining a different said effective

flow aperture, wherein said body, in use, is coupled to said conduit in one of said predefined positions.

To control the rate of flow of liquid in a conduit such as a distribution line using a fitting as described above may involve the steps of:

(i) rotating the fitting relative to the conduit to an orientation that allows one of the one or more openings of said fitting to form an effective flow aperture relative to the level of the liquid in said conduit; and

(ii) coupling said fitting to said conduit at said orientation.

The flow of liquid through a plurality of distribution lines, using one or more fittings and sensors as described herein, may be controlled by:

(i) rotating each said fitting relative to said conduits to orientations that allow said fittings to form effective flow apertures relative to the level of the liquid in each said conduit; and

(ii) coupling each of said fitting to said conduits at orientations;

whereby the relative flows of liquid through respective conduits is within a predetermined distribution, as indicated by the sensors.

The steps above can be performed in any order, and are not limited to the order as described above.

The settings of the fittings may be altered as and when the sensors indicate that the liquid flows are approaching the limits of the predetermined distribution or have exceeded the limits ie. the flows to the different distribution lines may be altered to compensate for one or more distribution lines reducing in efficiency as indicated by sensors.

The junction pits may include fittings as herein described wherein the fittings are coupled to the conduits at predetermined respective orientations, said orientations being defined by rotating each said fitting relative to said conduits to allow said fitting to form effective flow apertures relative to the level of the liquid in each said

conduit, so that the relative flows of liquid through respective conduits is in accordance with a predetermined distribution.

The electronic monitor may monitor the distribution of the flow of liquid in multiple conduits extending from the septic tank or junction pits.

In another aspect the invention provides a method of managing a plurality of fluid waste processing systems, each fluid waste processing system comprising a septic tank for containing a water and sludge or scum mixture, at least one sensor near the bottom of the tank, and an onsite electronic monitor, said method comprising:

- creating an identification code in the form of a location reference such as an address for identifying each septic tank,
- selecting pressure as a parameter for indicating when a septic tank needs to be emptied,
- sensing the level of pressure in each septic tank,
- monitoring the sensed level in the system with the electronic monitor,
- generating an electronic signal by radio link in the form of an SMS message to characterise the level of pressure when the tank is full or requires emptying,
- monitoring the electronic signal in each system in a management facility,
- generating an action prompt in the form of an SMS message or email notification to a waste removalist when a pressure reading varies by at least 1% from a pressure reading if the tank only contained water,
- initiating an action response on receipt of the action prompt, the action response comprising sending a remediation vehicle to remove waste fluid from the tank.

Brief Description of the Drawings

A preferred embodiment of the present invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

Figure 1 shows a plan view of the base of a septic tank which may be used for carrying out the method of the invention;

Figure 2 shows the section A-A taken through the septic tank of Figure 1;

Figure 3 shows a graph of pressure readings as sludge builds up over time;

Figure 4 is a diagram of the components of an on-site sewage processing system;

Figure 5 is a front view of a flow control fitting;

Figure 6 is a cut away view of a junction pit and sensor;

Figure 7 is a graph interpreting sensor readings;

Figure 8 is a flow diagram of a preferred method of management in accordance with the invention; and

Figure 9 is a flow diagram of a preferred waste disposal action response.

Detailed Description of the Preferred Embodiments

The various elements identified by numerals in the drawings are listed in the following integer list.

Integer List

1	Septic tank
2	Circular base
3	Side wall
4	Reinforcement
5	Top
10	Inspection opening
11	Inspection opening
12	Central opening
15	Inlet
16	T-piece
18	Outlet
19	T-piece
20	Liquid level

21	Scum layer
22	Dividing wall
23	Primary chamber
24	Secondary chamber
26	Opening
27	Sludge level
28	Pressure sensor
29	Cabling
30	Electronic monitor
100	Sewage dispersal system
104	Septic tank
106	Absorption trench
108	Absorption trench
110	Absorption trench
112	Perforated pipe
114	Perforated pipe
116	Perforated pipe
118	Junction pit
120	Junction pit
122	Junction pit
124	Pipe
126	Pipe
128	Pipe
300	Fitting
302	Body
304	Opening
306	Peripheral portion
308	Peripheral portion
310	Peripheral portion
312	Peripheral portion
314	Cross-sectional axis
316	Invert
318	Invert

320 Invert
322 Invert
324 Apex angle
326 Apex radius
1201 Junction pit
1203 Pipe
1205 Baffle
1207 Open top
1209 Open bottom
1211 Perforated pipe
1213 Fitting
1215 Sensor
1217 Lower detector
1219 Upper detector
1221 Lead

Referring to Figures 1 and 2 of the drawings there is shown a septic tank generally designated by the reference numeral 1 which may typically be a reinforced concrete construction.

The septic tank includes a circular base 2, a cylindrical side wall 3, and a top 5. Reinforcement 4 is provided in the base, side wall and top of the tank. Typically this may comprise steel mesh and/or any other reinforcing material which is used for reinforcing concrete.

Inspection openings 10 and 11 are provided on opposite sides of the top 5 immediately above the T-pieces 16 and 19. A large central opening 12 for providing access to the contents of the septic tank when it needs to be emptied is also provided in the top 5. This is normally closed by a cover which neatly fits within and closes off the central opening 12.

The side wall is provided with an inlet 15 for sewerage which directs incoming sewerage into the T-piece and hence into the primary chamber 23 of the septic tank. Both the top and bottom end of the T-piece are open.

An outlet 18 connected to the T-piece 19 takes overflow liquid from the secondary chamber 24 whenever the liquid level 20 exceeds the level of the outlet 18. The outlet is at a lower level than the inlet. From the outlet, the digested liquid from the septic tank is directed to an in ground distribution system as is shown in Figure 4 and described below

It is to be noted that there will typically be a scum layer 21 build up at level 20. As the scum layer 21 builds it may extend above and/or below level 20. It may extend higher than the level of the outlet 18 in the region of the primary chamber.

The primary and secondary chambers are divided by the dividing wall 22 which has an opening 26 therein at a level below the liquid level 20. The dividing wall in effect acts as a baffle between the primary and secondary chambers.

During typical operation of the septic tank, sludge builds up in the primary chamber to a sludge level which is indicated by the line 27. Over time the sludge, which is of greater density than water builds up from the floor of the tank 4 until it begins to approach the level of the opening 26. However, it is important to ensure that the sludge level does not go so high as to allow the sludge to overflow into the secondary chamber 24 as this will mean the residence time of sewerage in the septic tank has been reduced and there is a risk that inadequately digested fluid will pass through into the secondary chamber and out of the outlet.

As the sludge initially has a higher density than the water, an indication of the level of sludge in the primary chamber can be obtained by locating a pressure sensor 28 near the base of the septic tank. The pressure sensor is connected by cabling 29 to an electronic monitor 30.

The electronic monitor 30 may include electronics to take account of the electric pressure signal provided by the pressure sensor 28 either continuously or on a periodic basis. The electronic monitor in each system is linked directly by radio or telephone line to a management facility which uploads the signals from each of the electronic monitors. When the pressure rises above a predetermined limit as may be set at the management facility, the management facility may generate an action prompt indicating that the septic tank needs to be inspected and possibly emptied. An action response is then initiated wherein a sludge removal vehicle equipped to inspect and empty the septic tank is sent. Additionally or alternatively the action prompt may be generated by the electronic monitor and then relayed on to the management facility.

For example, if the pressure of fluid including sludge in the primary chamber increases by as much as 1% or 2% above the pressure which would be expected with pure water, the electronic monitor (and/or the management facility) may generate an appropriate signal to indicate that the tank needs to be inspected. In order to do so, the electronic monitor may include a reference point setting for adjusting the pressure sensitivity for different sizes of tanks ie. a deeper tank will have a higher reference point pressure than a shallower one. Thus for each tank, an individual pressure based upon a primary chamber filled with pure water may be set as a reference point.

The graph in Figure 3 indicates a typical output from the pressure sensor registered by the electronic monitor as readings of sludge depth over time. The actual readings can vary but they are then treated with a regression algorithm to create a line of best fit. This is then used to monitor trends and predict trigger points for service.

Typically a pressure rise of about 1% may be used as a trigger point for service, as this may be indicative of a depth of sludge which has reached the limit of acceptability. However, the actual trigger point may vary depending on the configuration of the septic tank. Another way of looking at the trigger point would be to equate it to a predetermined acceptable level of sludge. For instance in a septic tank with a dividing wall 22, it may be preferable to set the trigger point at a pressure

level in the primary chamber which corresponds to a sludge depth at or below the level of the opening 26.

In another scenario, if the pressure sensor is placed in the secondary chamber, any consistent increase in pressure may be sufficient to trigger a warning.

In an alternative scenario, applicants have also found that after a period of time, following an initial rise in pressure in the primary chamber, there may also be a reduction in pressure. Whilst the reasons for this reduction in pressure are unclear, on the basis of experiments carried out so far, it would appear that the change from increase in pressure to a reduction of pressure of 1% may be taken as a trigger point or warning point whereby the electronic monitor (and/or the management facility) generates a signal to indicate that the septic tank needs to be emptied.

Similarly, an additional pressure sensor may be placed at or below the scum layer. Again this may be set so that a pressure variation of about 1% triggers an indication that an inspection is required.

Referring to Figure 4, digested liquid from the septic tank 104 is directed to a number of junction pits 118, 120 and 122 via a series of pipes 124, 126 and 128. Each junction pit 118, 120 and 122 may distribute the effluent into one or more underground absorption trenches 106, 108 and 110 via one or more perforated pipes 112, 114 and 116 located within the trenches. Alternatively, each junction pit (eg. 118) may distribute the effluent to one or more other junction pits (eg. 120).

Figure 6 shows a preferred junction pit 1201 arrangement used in an on site sewage processing system. The junction pit receives sewage for treatment via a pipe 1203 which terminates in a baffle 1205 located within the junction pit. The baffle has an open top and an open bottom. A perforated pipe 1211 directs water from the junction pit to an underground absorption trench.

A fitting 1213 is used to control the flow of water into the perforated pipe. Figure 5 is a front view of such a fitting 300 which includes a body 302 that has one or more

openings formed through the body 302. The body 302 may have only one opening 304, and preferably, the edge of the opening 304 is shaped to form multiple weirs. The one or more openings (eg. 304) define one or more flow control regions of the body 302. For example, in the configuration shown in Figure 5, the body 302 has only one opening 304, and different peripheral portions 306, 308, 310 and 312 of the opening 304 each respectively defines a different flow control region.

Referring again to Figure 6, a pit sensor 1215 is located within the junction pit at a level where it can sense the presence of different levels of liquid in the junction pit. Typically, the pit sensor may be mounted on the baffle 1205 although other alternative methods of mounting are possible.

The pit sensor has a lead 1221 which directs signals to the electronic monitor to give readings of changes of liquid levels in the junction pit. For this purpose, the pit sensor has a lower detector 1217 and an upper detector 1219. Typically, the upper and lower detectors may comprise electrolytic detectors ie. they may sense the presence of liquid at the level of the detector by the presence or absence of current flowing between electrodes in each of the detectors.

Thus, by determining the presence or absence of liquid at the levels of the two detectors and the time taken for the liquid level to fall the distance between the two detectors, it is possible to obtain an indication of the rate at which liquid flows from the junction pit into the distribution lines associated with the perforated pipe 1211 and onward to any further junction pits in the sewage dispersal system.

Referring to Figure 7, it can be seen that a typical range of readings from the pit sensor is shown by the dotted line marked "Actual Readings". The readings may typically oscillate about a trend line calculated as a regression algorithm to create a line of best fit. The variation in the actual readings will typically reflect different rates of sewage delivery over time as well as different rates of distribution of effluent in the underground absorption trenches. These rates may vary depending on a range of factors such as rainfall in the area, variation in the amount of effluent distributed and the efficiency of the absorption trench.

Once the overall efficiency over a period of time as determined by the trend line has dropped below a predetermined level eg. 50%, a trigger point is reached and the electronic monitor receiving signals from the pit sensor may give a warning indication that the system needs to be inspected. The action prompt may also be generated at the management facility which receives signals relayed from the pit sensor by the electronic monitor. As a result of inspection, it may prove necessary to extend the dispersal system to cope with the reduction in efficiency, to completely replace the system, to reconfigure the distribution of effluent through the various absorption trenches by altering the settings of the fittings 1213 (eg. adjusting weir settings by rotation of the fitting) or any combination of these alternatives.

Referring to Figure 8, there is shown a flow diagram of preferred elements involved in managing a plurality of trade waste or on site sewage processing systems. The systems are present on site near buildings being frequented by operators or occupiers. Each sewage processing system has either a tank pressure sensor as described above, or pit sensor as described above, or both. Similarly, each trade waste system has its own trade waste sensor.

The sensors send signals to their respective on site electronic monitors which display readings of the signals. A warning indicator is generated by the electronic monitors if the readings are not within predetermined limits.

The electronic monitors send data obtained from the signals by radio or phone lines to the management facility. There an action prompt will be generated if the data received is not within predetermined limits.

The management facility comprises data managers ("WDMS" in the diagram), removal managers ("Carriers" in the diagram), testing managers ("NATA" in the diagram), and servicing managers ("Contractors" in the diagram).

The data managers monitor the performance data received from the systems of the operators and occupiers. If the data does not fall within predetermined limits an

action prompt is generated. The action prompt may be in the form of an electronically generated report which lists those systems in which the data does not lie within the relevant predetermined range.

Once prompted, the data managers respond by notifying the appropriate team of managers. For example, if the data indicates that the rate of flow from a system's junction pit into a distribution line is not within the predetermined range, the data managers will notify the servicing managers that the system needs to be inspected and serviced. If the data indicates that a system's trade waste needs to be removed then the removal managers will be notified.

In another example, if the data indicates that the depth of sludge or scum in a system's septic tank exceeds the predetermined limit, the data managers will notify the removal managers by phone or internet that the septic tank needs to be emptied.

Figure 9 illustrates a waste disposal action response in this situation. Once the removal managers are notified, they send one of their carrier vehicles out to the relevant septic tank. Each carrier vehicle has a barcode which is scanned by a scanner in order to identify the vehicle sent during the action response. Each tank in each sewage processing system also has a barcode which is scanned by the driver of the carrier vehicle once they have arrived on site. The tank barcode is scanned in order to identify the council ID, the type of waste, and the tank ID number. Once the tank is emptied, the waste is carried by the carrier vehicle to a regional repository. At the regional repository the driver uploads the data recorded by the scanner into operational software and then clears the data from the scanner's memory. The operational software automatically forwards the scanner data via the internet to the data managers and to a predetermined local council database.

Auditing of waste deposited at regional repositories takes place whereby the data managers notify testing managers to verify deposition of waste and to take samples of the effluent for testing.

All systems and removal, testing, and service managers have barcodes which are scanned by the relevant manager to keep track of managers used and systems actioned. All scanned data is uploaded into operational software at designated locations and forwarded to the data managers of the management facility and to a council database.

Referring to Figure 8, all performance data from the systems which is received by the data managers is forwarded on to the relevant local council database. Similarly all scanned data uploaded at designated locations is forwarded on to the relevant local council database. The councils, who fund the operation of parts of the management facility which relate to their council jurisdiction, conduct a compliance assessment using the scanned action data and system performance data. Thus the council is able to assess the efficiency and effectiveness of the management facility as it operates in their jurisdiction, and to make changes to the management as it sees fit. The council may report any data and expenditure to its stakeholders (eg. ratepayers).

Managing trade waste and sewage processing systems according to the preferred embodiment may provide advantages such as:

- Establishing consistency and uniformity in application for local government;
- Improving efficiency and cost effectiveness;
- Collecting meaningful data for future decision making;
- Facilitating local government in meeting its legislative and common law responsibilities; and
- Easy operation.

Whilst the above description includes the preferred embodiments of the invention, it is to be understood that many variations, alterations, modifications and/or additions may be introduced into the constructions and arrangements of parts previously described without departing from the essential features or the spirit or ambit of the invention.

It will be also understood that where the word "comprise", and variations such as "comprises" and "comprising", are used in this specification, unless the context requires otherwise such use is intended to imply the inclusion of a stated feature or features but is not to be taken as excluding the presence of other feature or features.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that such prior art forms part of the common general knowledge in Australia.

Claims

1. A method of managing a plurality of fluid waste processing systems, each fluid waste processing system comprising at least one sensor, said method comprising:

- creating an identification code for each system,
- selecting a parameter in each system which is indicative of the operational state of the system,
- sensing the level of the parameter in each system with the sensor,
- generating an electronic signal to characterise that level or when the parameter is not within a predetermined range,
- monitoring the electronic signal in each system in a management facility,
- generating an action prompt when the parameter is not within the predetermined range.

2. The method according to claim 1 wherein the fluid waste processing system comprises at least one of a trade waste processing system and a septic tank for containing a water and sludge or scum mixture.

3. The method according to claim 1 or claim 2 wherein each system comprises an on site electronic monitor, and the method comprises:

- monitoring the sensed level in the system with the electronic monitor.

4. The method according to claim 3 wherein the management facility comprises information upload means for receiving data from the electronic monitor.

5. The method according to claim 3 or claim 4 comprising an operator periodically taking parameter readings directly from the electronic monitor and physically transferring the readings to the management facility.

6. The method according to any one of claims 3 to 5 wherein at least one of the fluid waste processing systems comprises a septic tank and the electronic monitor is adapted to generate a warning signal when the signal from at least one of the sensors

is indicative of a depth of sludge or scum exceeding a predetermined limit, the warning signal indicating that the septic tank needs to be inspected, sampled, serviced or emptied.

7. The method according to claim 6 wherein at least one of the sensors is located at or near the base of the septic tank.

8. The method according to claim 6 wherein at least one of the sensors is placed at or below the level of the scum layer.

9. The method according to any one of claims 6 to 8 wherein the parameter detected by at least one of the sensors is used to indicate or determine the depth of sludge or scum in the septic tank.

10. The method according to any one of the preceding claims wherein at least one of the sensors is a pressure sensor.

11. The method according to claim 10 wherein the action prompt is generated when a pressure reading varies by at least 1% from a pressure reading if the tank only contained water.

12. The method according to claim 10 wherein the action prompt is generated when a pressure reading varies by at least 2% from a pressure reading if the tank only contained water.

13. The method according to claim 11 or claim 12 wherein the pressure sensor is located near the bottom of the tank.

14. The method according to any one of the preceding claims wherein the parameter comprises the depth of fluid waste in the processing system.

15. The method according to any one of the preceding claims comprising initiating an action response for each system in which the parameter falls outside the predetermined range.

16. The method according to claim 15 wherein the action response comprises sending a remediation vehicle equipped to remove waste fluid from the system.

17. The method according to claim 15 or claim 16 comprising assessing compliance of the action response after generation of the action prompt.

18. The method according to any one of claims 6 to 17 wherein at least one of the processing systems comprises a junction pit arranged to receive liquid from the septic tank, at least one distribution line for receiving liquid from the junction pit, and at least one flow sensor located in the junction pit or distribution line for sensing the rate at which the liquid flows through the junction pit after supply of the liquid to the junction pit from the septic tank.

19. The method according to claim 18 wherein when an action prompt is generated when the sensed rate of liquid flow falls below a predetermined flow limit.

20. The method according to claim 19 wherein the predetermined flow limit is 40% below a predetermined flow rate.

21. The method according to any one of the preceding claims wherein the electronic signal is directed to the management facility by at least one of a radio link and telephone line.

22. A method of managing a plurality of fluid waste processing systems, each fluid waste processing system comprising a septic tank for containing a water and sludge or scum mixture, at least one sensor near the bottom of the tank, and an onsite electronic monitor, said method comprising:

- creating an identification code in the form of a location reference such as an address for identifying each septic tank,

- selecting pressure as a parameter for indicating when a septic tank needs to be emptied,
- sensing the level of pressure in each septic tank,
- monitoring the sensed level in the system with the electronic monitor,
- generating an electronic signal by radio link in the form of an SMS message to characterise the level of pressure when the tank is full or requires emptying,
- monitoring the electronic signal in each system in a management facility,
- generating an action prompt in the form of an SMS message or email notification to a waste removalist when a pressure reading varies by at least 1% from a pressure reading if the tank only contained water,
- initiating an action response on receipt of the action prompt, the action response comprising sending a remediation vehicle to remove waste fluid from the tank.

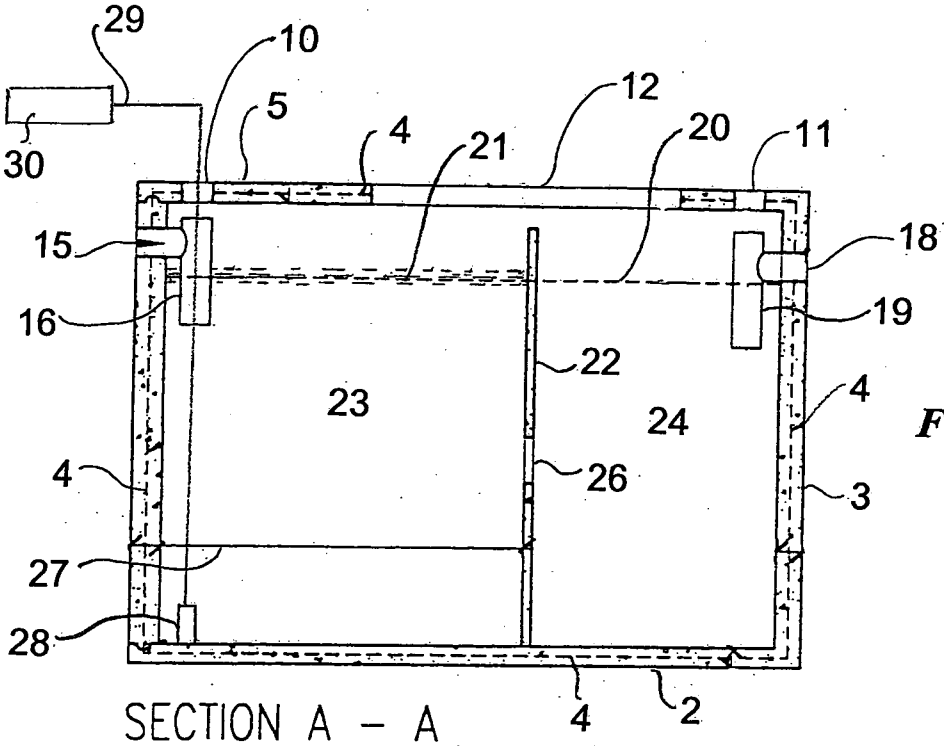

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SECTION A – A

Fig. 2

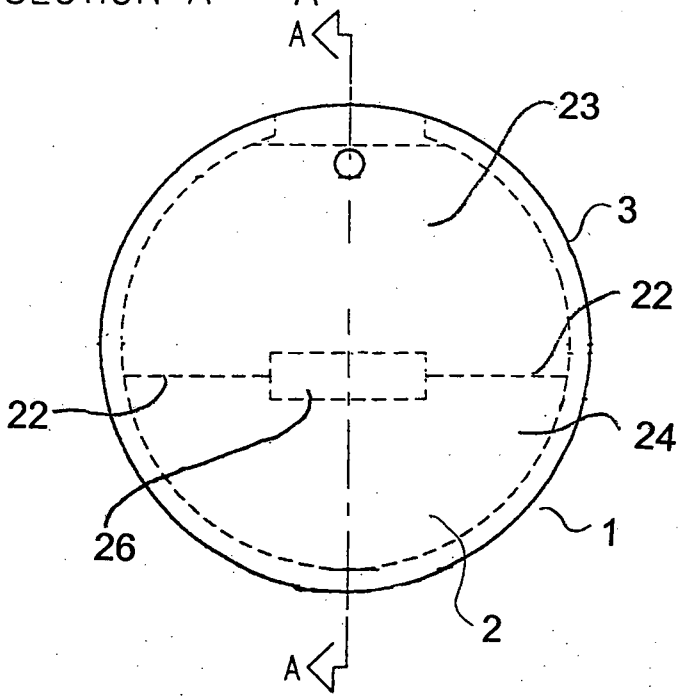

A
23
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2
A

Fig. 1

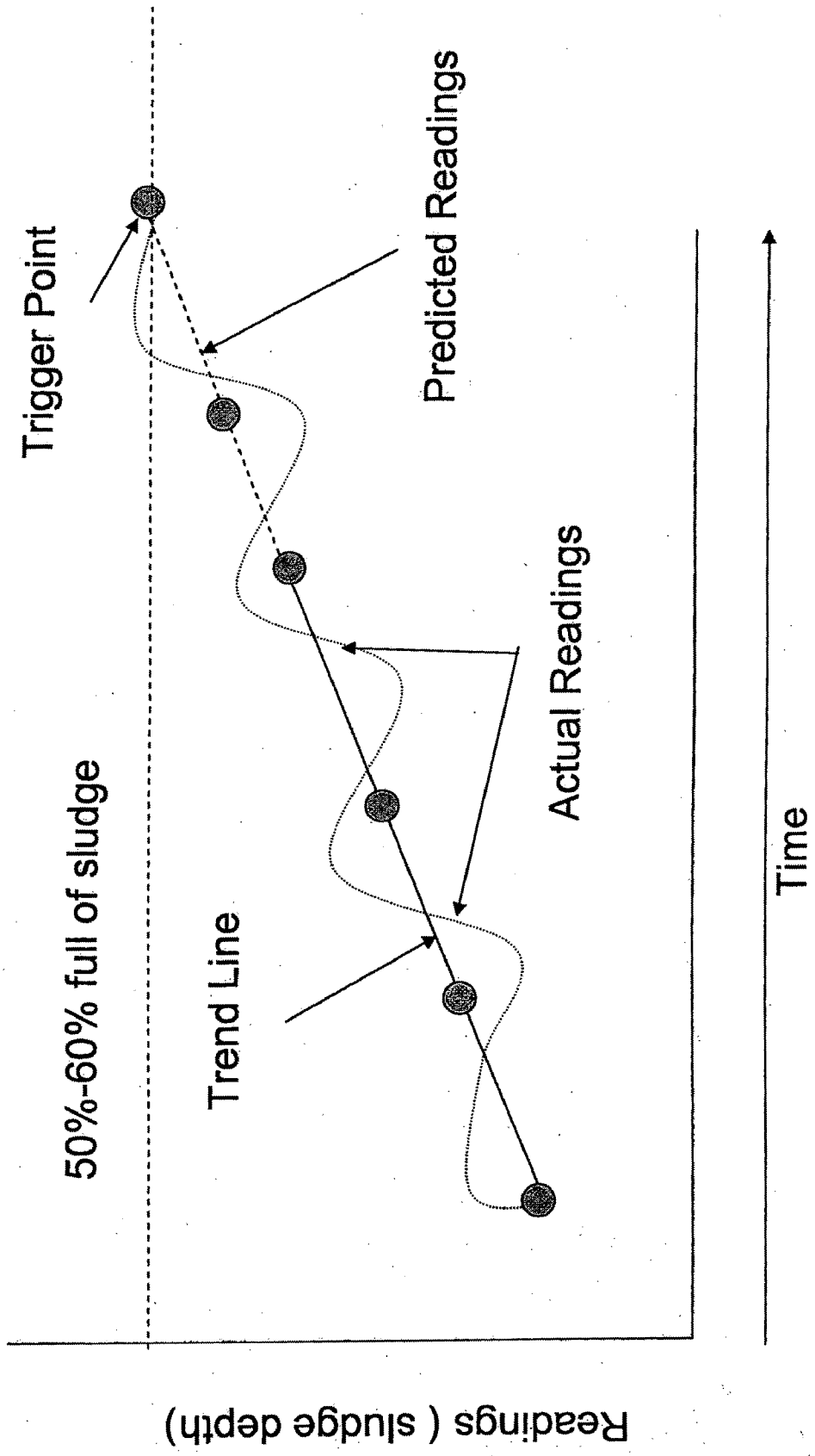

Trigger Point
Predicted Readings
50%-60% full of sludge
Trend Line
Actual Readings
Time
Readings (sludge depth)

Fig. 3

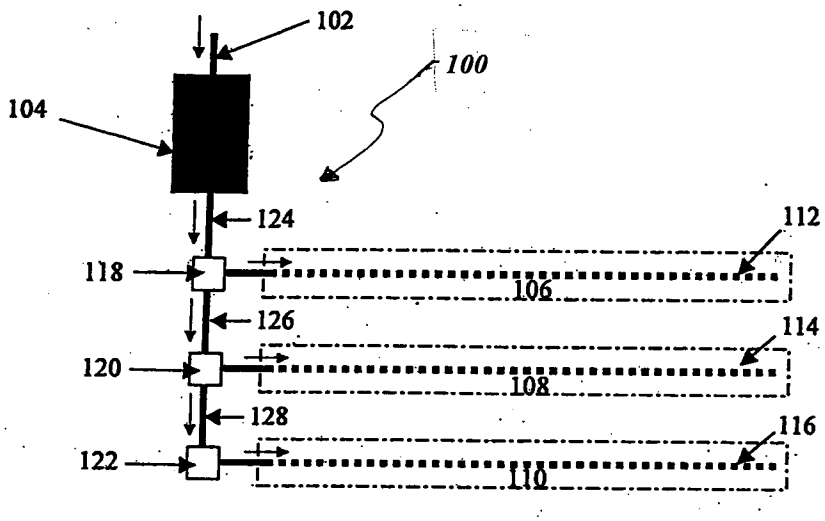

102
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104
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122
110

Fig. 4

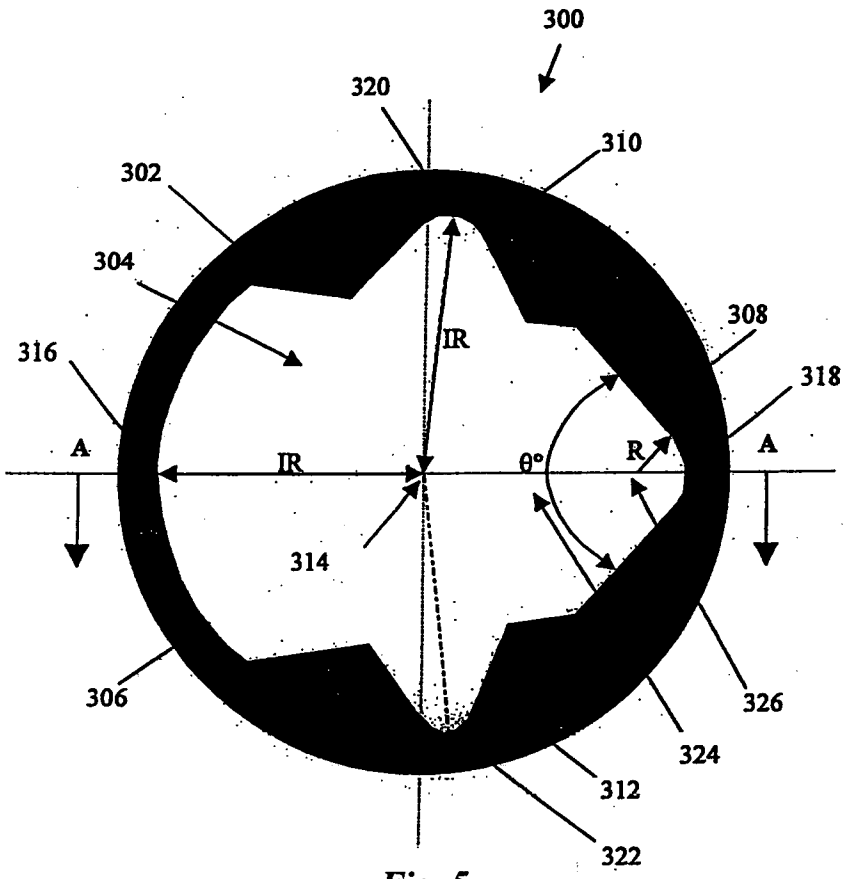

300
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Fig. 5

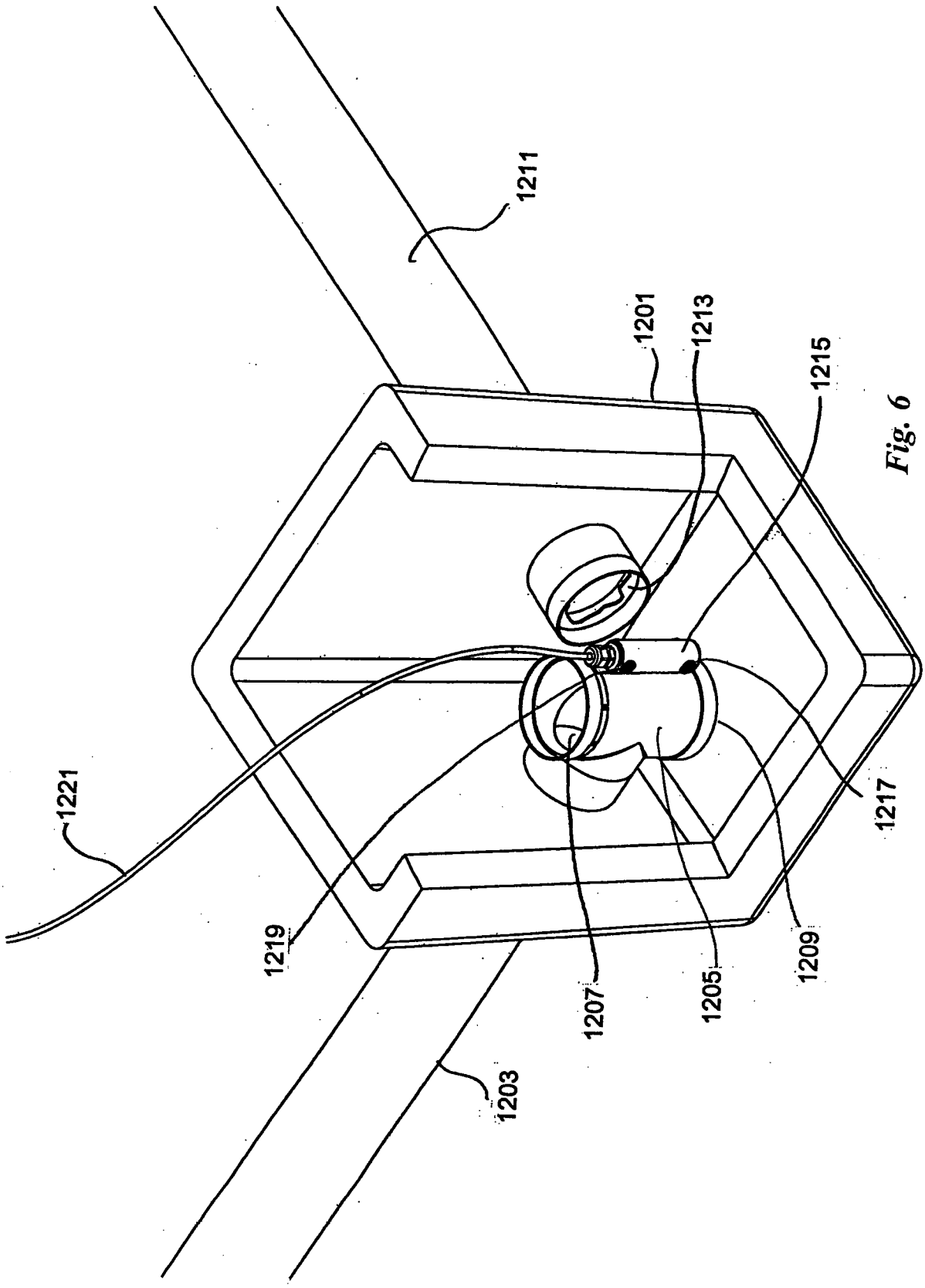


Fig. 6

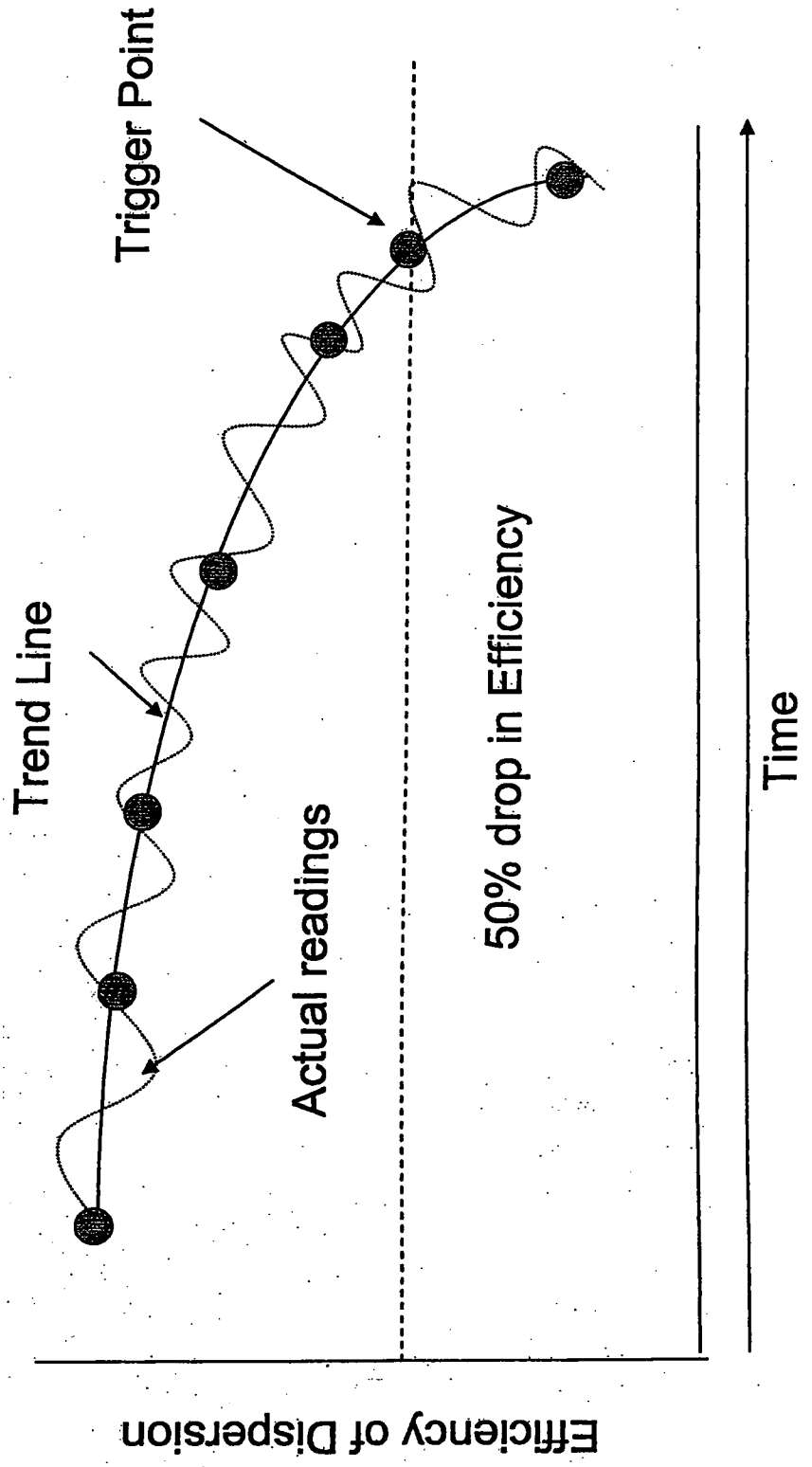

Trigger Point
Trend Line
Actual readings
50% drop in Efficiency
Time
Efficiency of Dispersion

Fig. 7

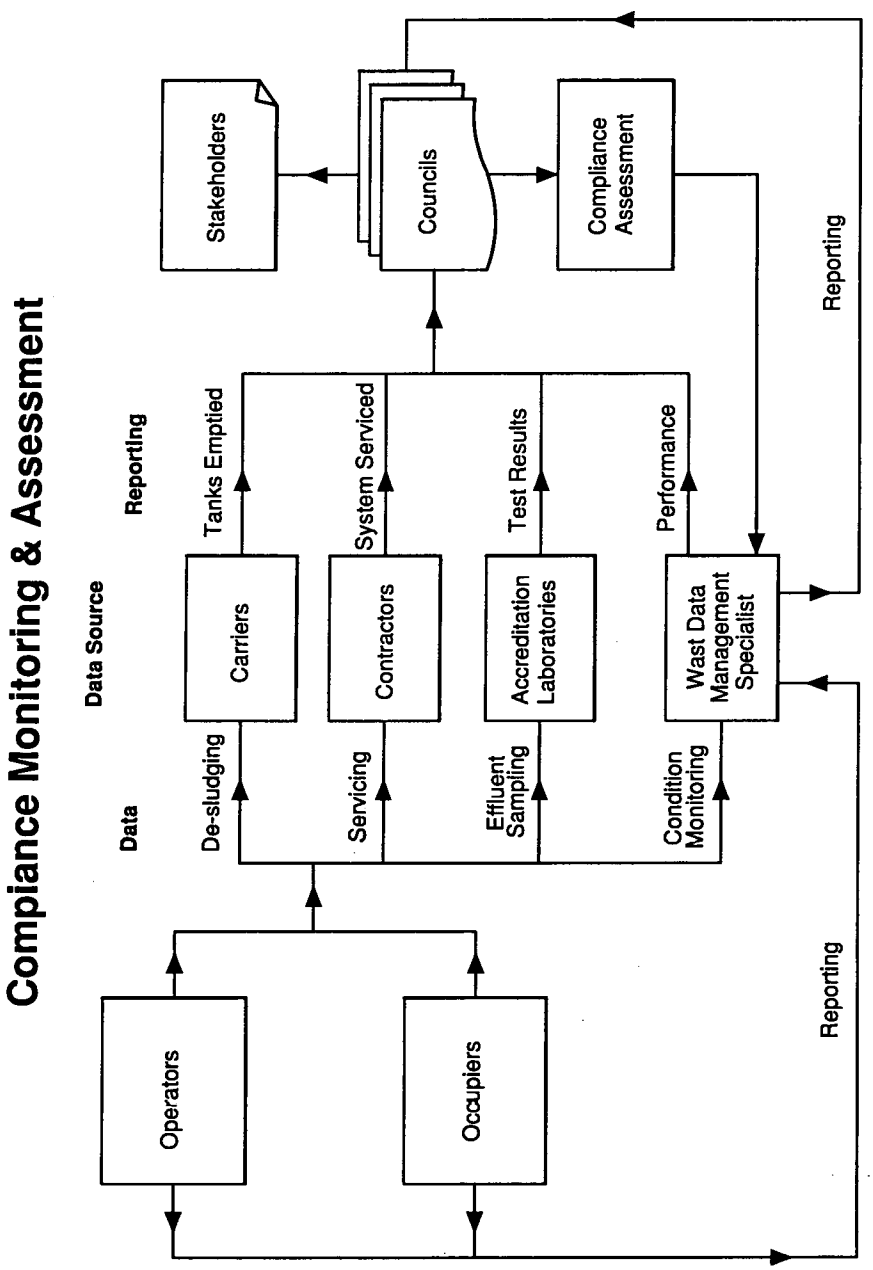

Compiance Monitoring & Assessment
Data Source
Reporting
Data
Operators
Occupiers
Carriers
Contractors
Accreditation Laboratories
Wast Data Management Specialist
De-sludging
Servicing
Effluent Sampling
Condition Monitoring
Tanks Emptied
System Serviced
Test Results
Performance
Stakeholders
Councils
Compliance Assessment
Reporting
Reporting

FIG. 8

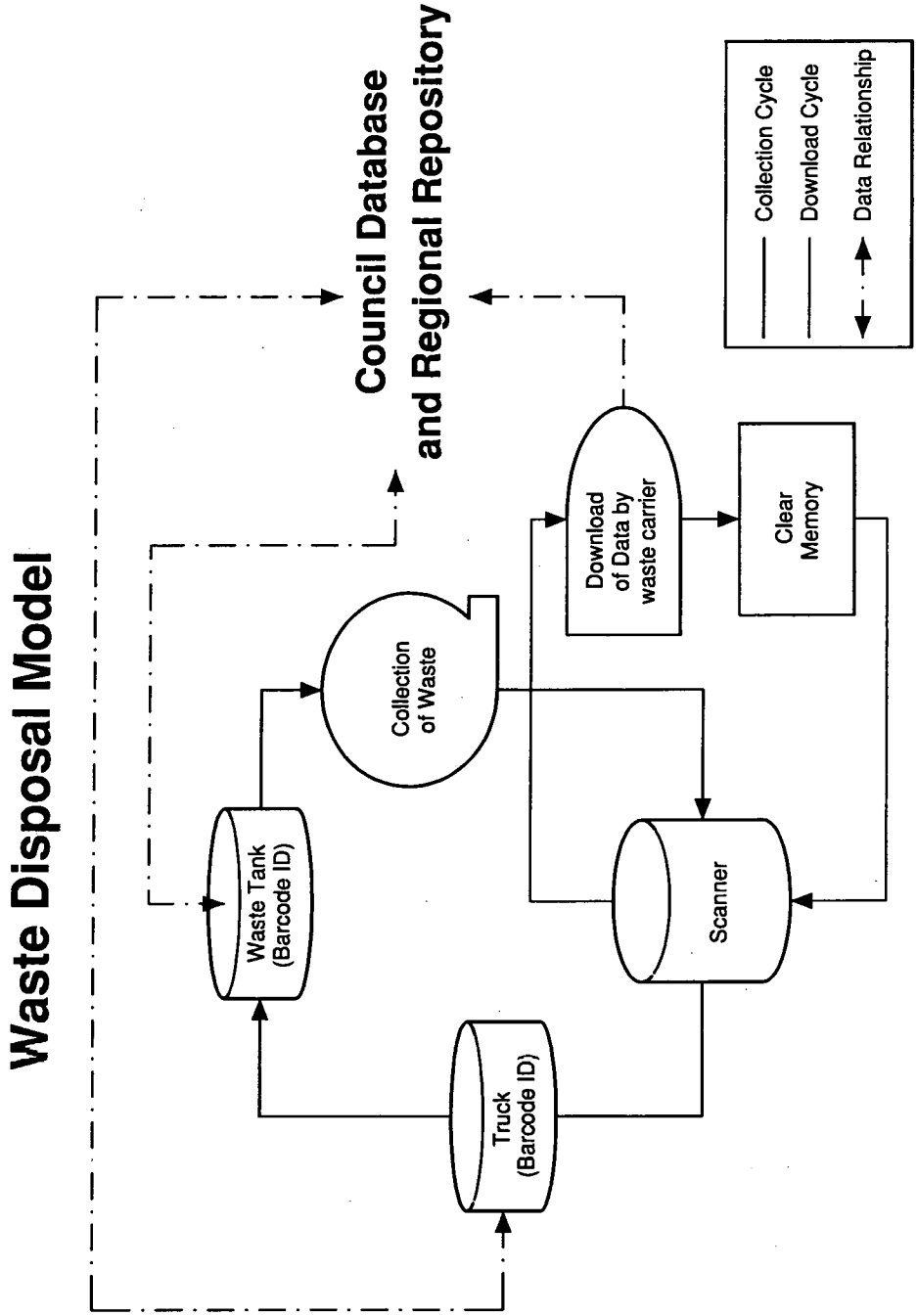

Waste Disposal Model
Council Database and Regional Repository
Collection Cycle
Download Cycle
Data Relationship
Waste Tank (Barcode ID)
Collection of Waste
Download of Data by waste carrier
Clear Memory
Scanner
Truck (Barcode ID)

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2009/000243

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

E03F 11/00 (2006.01) ***C02F 1/00*** (2006.01) ***E03F 1/00*** (2006.01)

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)

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)
WPI & EPODOC – IPC/ECLA E03F 1/00, 3/-, 5/10, 7/00, 7/02, 11/00, C02F 1/-, 3/-, 9/-, 11/- and keywords (sensor, measure, detect, monitor, signal, data, transfer, depth, pressure, level, flow, system, procedure, manage, sludge, scum, junction, branch, absorb, trench) and like terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6619118 B1 (KECK) 16 September 2003 Figs. 1-4, Abstract, Columns 4, 5, 7	1-17, 21, 22
X	US 5946967 A (RUSSELL) 7 September 1999 Figs. 1-7E, Abstract, Columns 2, 7, 21-23	1-9, 14-17, 21
A	US 4882045 A (BERGH SR. et al) 21 November 1989 Figs. 1, 2, Column 4 lines 14-25	18-20
A	WO 2007/092986 A1 (SAMARAN INTERNATIONAL PTY LTD) 23 August 2007 Whole document	1-17, 21, 22

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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
23 April 2009	29 APR 2009
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **STEPHEN MARCHANT** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 2533

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2009/000243

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	6619118	AU	2003256804	CA	2570418	EP	1651932
		US	6879935	US	2004002822	WO	2005010471
US	5946967	NONE					
US	4882045	NONE					
WO	2007092986	AU	2007215370	CA	2640516	EP	1984209
		US	2009008338				

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX