

Method and device for removing solids downstream of a siphon of a toilet, and operation of a device of this type

[0001] The public wastewater infrastructure is demanding and is constantly being expanded in many countries, and it also has to be constantly maintained and repaired. In civilized countries, the water closet, or toilet for short, has become established. This involves defecating in a collection bowl and then flushing it and any toilet paper used into a sewer system with a batch of flushing water. The sewer pipes must all be laid with a minimum gradient to ensure sufficient slope for the flow and they flow into ever larger pipes until they finally flow into large underground sewers that feed the wastewater to the treatment plants. There, the contaminated water has to be purified at great expense before it can be released into the natural waters.

[0002] The history of the disposal of domestic waste from human settlements is very old. A forerunner of today's sewer system was built in Rome over 2000 years ago. This system drained wastewater and rainwater from the city. During the Middle Ages, the earlier technology was neglected and the disposal of faeces was mainly carried out by washing it away, sometimes via the streets. This resulted in the uncontrollable spread of pathogens. Many people fell victim to this neglected hygiene.

[0003] As a result of the 19th century industrial revolution in Europe and North America, personal hygiene became more and more of a central concern because people were often unable to attend work due to illness. Underground sewers were built again to discharge feces into rivers or lakes. Due to the heavy pollution of the water and the growth of settlements, the absorption capacity and self-purification power of the waters

was exceeded over time. As a result of the pollutants entering the waters, people in turn experienced considerable problems in obtaining drinking water.

[0004] Gradually, due to economic development, the treatment of faeces in newly constructed sewage treatment plants also came into play. Today, the system of central water supply, alluvial sewers and central wastewater treatment plants "at the end of the pipe" is an important part of an integrated supply and disposal system for residential areas.

[0005] Decentralized wastewater disposal has long been practiced in rural areas as an alternative to centralized wastewater treatment. Decentralized wastewater treatment refers to the treatment of domestic wastewater in small and very small wastewater treatment plants as a communal facility for districts or as an individual solution. Rainwater is stored separately, infiltrated or discharged.

[0006] The facts outlined above make it clear that it is necessary to develop an alternative wastewater and water strategy in line with modern knowledge and technical possibilities. Approaches for a sustainable on-site wastewater policy range from rainwater harvesting and the use of treated wastewater to the recovery and recycling of nutrients in agriculture.

[0007] In 2011, the Melanie & Bill Gates Foundation launched a global competition to develop an ecological, environmentally friendly and economical simple toilet facility. The results were rather poor. Moreover, the proposed solutions were not very suitable for a broad population of apparently 2.5 billion people who do not have direct access to a toilet.

[0008] A new approach assumes that the problems should be tackled at source wherever possible. However, this would mean that a user or operator of a corresponding toilet facility would have to pay extra to dispose of the waste. This cannot and should not be the case, which is why these ideas were dropped from the proposed options for ecological disposal.

[0009] In the combined system, domestic wastewater is discharged together with rainwater via a combined sewer system and treated in a wastewater treatment plant. The wastewater mixture is purified at great technical expense. Reuse of the substances contained in the wastewater is virtually impossible or only practicable with a high level of technical effort. The treated wastewater is discharged into a receiving

watercourse and is thus lost to the inner-city groundwater balance. There are no real "patent solutions" for (waste) water management. The trick is to select technologies that are adapted to the local climatic, hydrological, social, cultural and economic conditions.

[0010] Modern toilets offer the advantage of being able to relieve oneself comfortably and hygienically in buildings, with minimal odor nuisance. However, the price for this is a considerable water requirement. In many countries, around 9 liters of drinking water are used for each flush, and 6 liters with improved flushing. The water is only used for transportation purposes and then has to be purified again, which is time-consuming and expensive.

[0011] Using Switzerland as an example, the costs involved are illustrated below using a few figures. According to a study conducted by EAWAG, the water research institute of the ETH Domain, in November 2006, there were already 759 wastewater treatment plants with more than 500 connected inhabitants each and 47,400 km of sewer pipes in Switzerland. In addition, there were more than 3,383 small wastewater treatment plants, around 42,000 km of property drainage pipes and around 1,700,000 house connections. The total replacement value of these public structures at that time was already estimated at around CHF 65.3 billion and that of the property drainage systems at around CHF 16.8 billion. Together with the estimated value of the sanitary installations of CHF 17.4 billion, this resulted in a total value for the entire Swiss urban drainage system of just under CHF 100 billion. Of this, 34% is privately managed and 66% is in public hands.

[0012] According to the information provided by the municipalities and the higher-level cantons, which in Switzerland comprise several municipalities, the projected annual costs for wastewater disposal amounted to CHF 1.69 billion even back then. Of this, 48% was caused by wastewater treatment plants and 52% by the sewerage system. The annual operating costs of the entire public infrastructure amounted to around CHF 727 million, of which CHF 440 million (61%) was for the operation of the wastewater treatment plants. The total interest costs were stated at CHF 92 million and thus amounted to 0.145% of the replacement value.

[0013] For more than 500 municipalities, representing around 25% of the Swiss population, the costs of sewerage systems were examined in detail. The extrapolated value of public sewer systems in Switzerland amounted to CHF 55.2 billion or around

CHF 7,600 per inhabitant. Although the specific replacement value of the sewer system per meter of sewer increases significantly with increasing settlement density, the replacement value per inhabitant varied only slightly between the different types of municipality. According to the available data, the annual investment requirement for the renovation of the sewer systems already amounted to around 0.8% of the replacement value of the systems in 2006. The condition of the systems and the expected life expectancy are the reasons why the need to renovate the sewer systems has increased significantly in recent years.

[0014] In addition to all the advantages of modern urban drainage, the concept of sewerage and centralized wastewater treatment also has disadvantages, and these give rise to doubts as to whether this established solution is the last word in wisdom in the long term. The following aspects can be cited in this regard:

[0015] The alluvial sewer system is not sufficient for a high level of water protection. Despite the large volumes of water treated and the high dilutions, even the expensively treated wastewater often still represents a heavy burden on natural waters.

[0016] Operation and maintenance of the existing sewer system and wastewater treatment plants are cost-intensive and construction requires high investments.

[0017] Approaches to ecological material flow management through material separation and recycling of recyclable materials are only possible to a very limited extent in the existing system.

[0018] Against this background, this invention aims to bring about an improvement by separating the solid excrements and other solid materials such as toilet paper from the wastewater flow and treating them separately in order to relieve the entire sewer system and only dispose of the flushing water via the sewer system or, if necessary, also the urine.

[0019] The challenge here is to create a procedure and a facility with which the following requirements can be met:

1. The process and the equipment should reliably separate solid excrement and toilet paper from the wastewater flow and treat them separately in order to relieve the wastewater of the direct entrainment of these substances.
2. The device should be compact enough to be installed in the cistern bay behind a modern WC.

3. The device should be designed as simply as possible and function reliably over the long term, be quiet (max. 47dBA) and, above all, odor-free.
4. The device should be as easy as possible to maintain and operate.

[0020] The solution to these tasks consists in a process for separating the solids from a water closet after its siphon, which is characterized by the fact that the solids are packed together with an air portion into individual bags of an endlessly fed hose and the buoyant bags are hermetically sealed and released into the sewer system.

[0021] Furthermore, the problem is solved by a device for separating solids from a water closet downstream of its siphon, which is characterized in that it includes at least the following technical components downstream of the siphon for treating the siphon outlet within a closed system:

- A solids separation tank for collecting the solids,
- A solids pump for conveying the separated solids upwards in a riser pipe into a high-level solids tank,
- A portioning device with a valve for dropping portions of solid material into a tubular bag packaging unit arranged underneath,
- A tubular bag packaging unit for the production of hermetically sealed and subsequently separated bags with solids and an air content from a continuously fed tube, for discharge into the sewage system.

[0022] This device or toilet system can also be combined, for example, with the TOTO toilet separation system from Toijs Toki Co. Ltd. in Japan, or with the "Urine Trap" toilet from Keramik Laufen AG, Wahlenstrasse 46, CH-4242 Laufen, whereby the urine can be collected and disposed of separately. In principle, however, the liquid and solid parts of the flushed urine are separated using this system. The solids are processed and packaged in such a way that they can be transported in the form of a pillow-shaped bag, and these bags are either transported via the sewage system and collected and disposed of intact in the sewage treatment plant without contaminating the sewage system water with faeces, or they are concentrated outside the building in a collection container and periodically disposed of from there.

[0023] The device is presented on the basis of the drawings and its construction is described in more detail and its function for the process for separating the solids is

explained. Due to its function, the device could be aptly described as a LEFT device, where LEFT = (in German: Lokale Entsorgung von Esten Toilettenabfällen), in English: Local Disposal of Solid Toilet waste.

It shows:

- Figure 1: A longitudinal section of a toilet for the separation of urine and solid excrement;
- Figure 2: A standard installation frame with cistern and connections for the installation of a wall-hung WC of conventional design;
- Figure 3: A diagram of a house with its drainage system with separation of the urine and encapsulation of the solid excrement;
- Figure 4: A built-in unit with frame for a wall installation of the entire device, to be installed behind a wall-mounted WC, with all components for the operation of the WC with solids separation and bag packaging of the solids shown from an oblique front view;
- Figure 5: The lower area of the installation unit seen from behind, shown separately;
- Figure 6: A schematic representation of all components of the device according to the invention for separating and bagging the solid excrements;
- Figure 7: An alternative lifting device for lifting the solids from the solids separation tank in the position for receiving the solids from the solids separation tank in its collecting basket;
- Figure 8: The lifting device shown in Figure 7 when lifting the collecting basket;
- Figure 9: The lifting device shown in Figure 7 with the bottom of the collecting basket opened and emptied into the portioning device;
- Figure 10: The lifting device shown in Figure 7 after the basket has been raised and tilted into an emptying position;
- Figure 11: The portioning device for the portioned dropping of solid portions into the bag packaging unit in an exploded view along the central axis of rotation as seen from diagonally above;

- Figure 12: The portioning device shown in Figure 11, viewed diagonally from below;
- Figure 13: The assembled portioning device seen from above;
- Figure 14: The assembled portioning device seen from below;
- Figure 15: The tubular bag packaging unit in its original state;
- Figure 16: The tubular bag packaging unit after pulling up a tubular section to form a single tubular bag;
- Figure 17: The tubular bag packaging unit before cross-sealing of the raised tubular section at its lower end to form a single tubular bag open at the top;
- Figure 18: The tubular bag packaging unit after opening the upper mouth of the bag closed at the bottom with a transverse seal;
- Figure 19: The tubular bag packaging unit when separating the bag held open at the top from the following endless tube;
- Figure 20: The tubular bag packaging unit with the bag held open and the cut-off device pulled away and a support plate pushed under the bag when filling with solids;
- Figure 21: The tubular bag packaging unit with the filled bag still held open and resting on the support plate after insertion of an air tube;
- Figure 22: The tubular bag packaging unit when the upper bag mouth of the bag is retracted;
- Figure 23: The tubular bag packaging unit during sealing of the closed upper bag mouth;
- Figure 24: The design of the vacuum strips with their welding bars for welding around the mouth of the air tube;
- Figure 25: The welded tubular bag packaging unit, hanging from the upper vacuum bars with welding bars, after the support plate has been moved away and ready for discharge into the sewer system;
- Figure 26: A sliding chute pushed under the bag to discharge the hermetically sealed bag into the discharge pipe with a siphon as an odor trap for the sewer system, with the vacuum bars moved apart;

- Figure 27: An alternative tubular bag packaging unit for the production of approximately round bags, with the lower, arc-shaped welding bars used for the arc-shaped welding of the raised tubular section after their retraction, after formation of a single tubular bag open at the top and arc-shaped at the bottom for its filling;
- Figure 28: The tubular bag packaging unit shown in Figure 27, after the lower curved sealing bars have been moved apart, with the bag now tightly sealed at the bottom and hanging from the vacuum bars at the top;
- Figure 29: The tubular bag packaging unit as shown in Figures 23 and 24, after filling and now when the upper vacuum bars are moving together and enclosing the air tube, as well as when the upper curved sealing bars are moving together;
- Figure 30: The tubular bag packaging unit according to Figures 23 to 25 after air has been blown in through the air tube, the sealing around the lower air tube mouth by the sealing bars in the vacuum bars and after the arc-shaped sealing at the top and before the upper arc-shaped sealing bars are subsequently moved apart;
- Figure 31: The situation after the support plate has been moved away, the air tube has been pulled back upwards, and after a sliding channel or sliding plate has been inserted under the tubular bag and after the vacuum bars have been moved apart, after which the tubular bag falls onto the sliding channel or sliding plate;
- Figure 32: An arc-shaped welding bar with an arc-shaped spring-loaded knife with a sharp blade outside the welding bar for cutting off the film residues remaining on the outside;
- Figure 33: A finished, approximately round tubular bag bulging at the top and bottom with hermetically sealed solids and an air portion;
- Figure 34: A finished round tubular bag of this type, bulging at the top and bottom, in a photographic reproduction as it was produced with a prototype system, for the proof of concept.

[0024] First of all, Figure 1 shows a special, already existing toilet bowl 100 in a longitudinal section, which is suitable for separating urine and the solid components of the excrement, including the toilet paper used and the flushing water, at the source. For this purpose, this toilet bowl 100 has an additional platform-shaped base 101 at the front, which extends from the front towards approximately the middle of the bowl 100 and ends there in a sloping draining nose 102. The urine is collected on this base 101 and then runs over this draining nose 102 into a collecting chamber 103 at the bottom and is drained off via a small siphon 104 through a separate, small-dimensioned pipe 105. It can thus be led into a separate container and collected there for separate further use. The solid excrement falls downwards behind the drainage nose 102 into the siphon water 106 of the large siphon 108 and then enters the discharge pipe 107, which leads out of the back of the siphon 108 from the toilet bowl 100. Furthermore, the invention deals with the treatment of these solid parts of the excrements as well as the toilet paper used, which is also discharged through this large siphon 108 together with the excrements and the flushing water.

[0025] Figure 2 shows a conventional installation unit for wall installation, for subsequent installation of a wall-mounted WC, in a plan view. It includes an installation frame 200, which rests on associated feet 202 in a height-adjustable manner and fits as a whole into a bay cut out of a wall. Such a bay in the rear wall generally measures 500 mm in width and 280 mm in depth, as well as up to approx. 1500 mm in height. In order to create more space in new systems for the installation module for the tubular bag packaging of solids, which is still to be introduced, the bays could also be extended upwards to room height. Within this installation frame 200, the cistern 201 can be seen at the very top in this example. Below this, a cover 206 can be seen, in which the buttons 209 for operating the cistern 201 are located. The connection pipe 205 for the flush is located above the connection support 204 for the discharge pipe 107 from the siphon in Figure 1, and next to it, slightly below, the threaded bushes 203 for screwing on the wall-mounted toilet can be seen, as well as any electrical connections 207 for connecting an under-shower toilet and signal lines for controlling the entire system via a keypad 209 with display 210 above the toilet. This can be used to trigger a flush and, if an under-shower toilet is installed, to check its maintenance status.

[0026] As Figure 3 shows on the basis of a sectional view of a house with sewer connections, there is a discharge pipe 110 from the water closet toilet 100 for urine, and a larger 111 for the solid excrement still to be treated, as will be shown. Next to it

is a drainage pipe 112 from a bathtub 113 , from a washbasin 114 and from a washing machine 115 , which leads in the conventional manner into the sewer 119, then into a sewer 109 and from there finally into a sewage treatment plant. The solid excrements as well as the toilet paper, on the other hand, are specially treated according to the present concept and hermetically packed in buoyant bags, and these bags are then transported away floating in the flushing water. They can be retained in a collection container 117 as shown here and are disposed of from there from time to time, or they float with the flushing water in the sewer 119 and into the sewer 109 to the sewage treatment plant, where they are separated from the waste water and disposed of separately.

[0027] The bags are therefore either collected in decentralized collection containers in collection stations for a single house or several houses, for example, or collected somewhere on the way to the sewage treatment plant and removed from the sewage system, or this only happens in the sewage treatment plant. In any case, it is important that human waste does not get into the sewer system water in the first place. Both urine and faeces increasingly contain pharmaceutical residues, which are difficult or impossible to remove from sewer water. Water enriched in this way can have a negative impact on the fauna and flora of bodies of water despite being treated. For example, it has already been established that hormones in wastewater, such as excreted active ingredients from contraceptive pills, have a negative impact on the fertility of fish and other aquatic organisms. It is therefore advisable to tackle this problem at the very beginning and not to contaminate the rinsing water with urine and excrement, but rather to use it solely as a transport medium. This is precisely the thrust of the present concept, namely that the faeces should pollute as little water as possible, but that the flushing water should be used solely for transporting hermetically packed bags and its pollution should be avoided as far as possible. Firstly, this relieves the burden on wastewater treatment plants and, as mentioned above, also helps to prevent pharmaceutical residues from entering rivers and lakes and ultimately groundwater.

[0028] In the following, it is shown how such hermetic packaging of the solid excrements according to this concept and the device required for this can be implemented in a compact manner. The device, if realized as a built-in unit, then has a width dimension like all other common standard elements of 500 mm or, more advantageously, 750 mm. The connection points for the flush water inlet and outlet must have the usual dimensions so that commercially available WC systems can be

connected to this module. Toilet models as shown in Figure 1, which are able to separate the solid and liquid outlets in the toilet, such as those already available from TOTO of Toihs Toki Co. Ltd. in Japan, or the "Urine Trap" toilet from Keramik Laufen AG, Wahlenstrasse 46, CH-4242 Laufen, are advantageous. The actual treatment of the solids to produce hermetically sealed, pillow-shaped bags is carried out exclusively by the device according to the invention. In various stations, the solids are portioned and hermetically packed to such an extent that a bag can float independently through the pipe system in an existing or new drainage pipe system. The advantage of this disposal method is, among other things, that there is no additional burden on the user or operator for the operation of the facility in the household, except that a packaging material cassette has to be replaced periodically or disinfectants have to be refilled. However, this only corresponds to a maintenance cost similar to that of a shower toilet.

[0029] Figure 4 shows a built-in unit 1 for implementing the concept of packing the solids in a built-in bay installed as a complete built-in module, similar to the way a module is conventionally used for installing a cistern in a bay in the wall behind the toilet.

[0030] The built-in unit 1 is enclosed by a steel frame 49, which stands on the bottom of the bay in the wall. The connection pipe 2 for the discharge pipe 107 of the toilet bowl 100 from Figure 1 can be seen at the bottom of the installation module. This leads into a solids separation tank 3. A riser pipe 4 leads up from the solids separation tank 3 to a solids tank 5, at the bottom of which is a portioning device 6 in the form of a drum with a valve 7 underneath. From this, a downpipe 8 leads into a tubular bag packaging unit 9. In its lower area, a change cassette 10 can be seen, which contains tubular bag material on a roll. The waste water pipe 11 leads from this tubular bag packaging unit 9 into the sewage system. The rinsing tank 12 with fresh water is located centrally at the top and to the right of it is a gray water tank 13. A brown water tank 14 is installed at the bottom right, the water from which is used for the first rinsing cycle. The connection 16 for the rinsing water can be seen in the middle of the cross strut 15 of the steel frame 1. On the right above the waste water pipe 11 is the power supply 17 and above it an electronic computer unit 18 for controlling the entire system. In the uppermost area on the right-hand side of the built-in unit is an ultraviolet disinfection unit 19 for disinfecting the rinsing liquid in the grey water tank 13. To the left of this is a control panel 20 with displays and buttons for controlling and operating all the system components. It is clear that the entire post-treatment of the solid

components of the outlets must be carried out absolutely odor-tight in a hermetically sealed system, but the components of the system must still be accessible for technical maintenance or repair if necessary. Appropriate odor-tight doors are provided for this purpose, which can be opened if necessary.

[0031] Figure 5 shows the lower area of the installation unit as seen from behind, shown separately. In particular, the tubular bag packaging unit 9 can be seen here on the right and the solids separation tank 3 below it. To the left of this, a distributor in the form of a rotary valve 21 can be seen. The discharge pipe 107 (Figure 1) from the toilet is connected to this distributor or this rotary valve 21 and the solids arriving from above as well as the flush water and the urine then enter the solids separation tank 3 via pipe 23 in normal operation or, in fault operation, directly into the downpipe 24 via pipe 22, which leads into the sewer system. It is clear that the arrangement of the individual components within an installation module can be designed differently, depending on the design of the individual components. However, the solids tank 5 as well as the rinse water tank 12 and the gray water tank 13 must be arranged as high up as possible.

[0032] Figure 6 now shows a schematic representation of all components of the built-in unit according to the invention for separating and bagging the solid excrements. The toilet waste, i.e. the solid excrement, the toilet paper and the urine, if it is not drained off separately beforehand, passes from the gray water tank 13 arranged at the top, which contains approx. 4 liters of gray water, from the toilet bowl 100 via the siphon and rotary valve 21, when the latter is in position 1, into the solids separation tank 3 after a flush triggering by the gray water valve 93. The solids sink downwards therein and solids sensors 89 are activated. These switch on the solids pump 28 with integrated chopper 26 and the solids pump 28 pumps the solids, mixed with grey water, upwards via the open valve 30 via the riser pipe 4 into the solids tank 5 placed as high up as possible in the installation module. As soon as the solids sensors 89 detect the absence of solids in the lower solids separation tank 3, the solids pump 28 switches off and the valve 30 closes to prevent the aqueous solids slurry from flowing back. The riser pipe 4 also serves as a reservoir for the solids slurry. The riser pipe 4 is always filled.

[0033] At the same time, the excess gray water flows passively via the retention strainer 29 and the open brown water valve 97 from the lower solids separation tank 3 through the overflow pipe 78 into the brown water tank 14 with its approximately 4 liters

of usable volume, measured up to the mouth of the feed opening of the overflow pipe 78. A vent line 96 branching off from the top of the brown water tank 14 discharges the excess pressure generated by the filling into the sewer system. After reaching the 4 liter limit in the brown water tank 14, the overflow valve 91 is opened to lower the content of the brown water tank to 2 liters.

[0034] Once this is achieved, a post-rinse from the fresh water tank 12, which is supplied with fresh water via valve 97, is triggered with approximately 2 liters through valve 95. This flushes the toilet siphon. This relatively clean water now also flows passively into the brown water tank 14. At the end of this second flushing and filling process, 4 liters of the brown water, the quality of which has thus been improved, is conveyed by the feed pump 32 into the UV disinfection system 19 arranged above. The feed pump 32 is switched on intermittently in order to convey only as much brown water as the UV disinfection system 19 can process. If the grey water tank 13, which is supplied with fresh water via the valve 98 and fed by the disinfection system 19 via the line 99, is not filled to 4 liters by the feed pump 32 after delivery is complete, it is automatically refilled with fresh water. This two-stage rinsing process, first with gray water and then with fresh water, proves to be particularly economical. Only 2 liters of fresh water are required and supplied for a 6-liter flush. This saves precious fresh water.

[0035] As usual, the toilet control panel has a small and a large flush button. The large button is used for the toilet flush with fixed outlets, the small button for urine flush only. The following situations can be distinguished:

- A) Pure urine output: With pure urine output, the small button triggers flushing through the fresh water tank 12. The rotary valve 21 is switched to position 2 immediately before flushing and the urine flows conventionally into the outlet pipe 31 and thus into the sewage system.
- B) Incorrect manipulation with large button: If the large button is accidentally pressed after no solids have been dispensed and the solids sensors 89 have not detected any solids in the solids separation tank 3, a 4-litre grey water rinse is triggered. Therefore, no 2-liter fresh water flush is triggered. The unused gray water flows into the brown water tank 14 in which the overflow valve 91 is closed. The feed pump 32 intermittently pumps the unused grey water back into the UV disinfection system until the grey water tank 13 is filled again.

- C) Overloading the system: If the toilet is used frequently, for example at parties or when there is a large number of guests in the home, the system may be overloaded: It may be that the processing of the previously discharged solids has not yet been completed. In this case, the system switches to emergency operation. The rotary valve 21 switches to position 2 and valve 94 on the fresh water cistern 12 in the module opens and flushes 4 to 5 liters of solids into pipe 31 for the sewage system. As soon as the processing of the solids in the background is complete, the system switches back to normal operation.

[0036] A separate drain 25 for the separately collected urine leads out of the toilet 100 into a separate collection container, not shown here. The rotary valve 21 below the siphon of the toilet 100 is motor-controlled and can assume three positions: A first position 1 for normal operation, in which the incoming flush material consisting of water, possibly also urine if this is not collected separately, and solids such as excrement and toilet paper is passed into the subsequent solids separation tank 3. A second position 2 is used for malfunction operation, in which the rotary valve 21 discharges the flushed material directly into the drain pipe 31 in the conventional manner and then into the sewage system, and a third position 3 is intended for cleaning operation, for backwashing the subsequent solids separator tank 3; both the rotary valve 21 and the solids separator tank 3 can be cleaned and flushed through by cleaning nozzles arranged inside them. It is planned to connect the computer 18 of a PLC controller (Figure 4) to a web server so that the status of the system can also be queried and displayed decentrally. Webcams installed in the interior can also be used for this purpose, which in turn can be cleaned by cleaning nozzles as required.

[0037] During the rinsing process, the excess gray water flows passively via the retention strainer 29 and the open brown water valve 89 into the brown water tank 14 with approx. 4 liters of usable volume from its feed opening. A vent line 96 discharges the excess pressure generated by the filling into the sewer system. The overflow valve 91 is open and a filling volume of approx. 2 liters is reached after a defined time. Once this is reached, flushing from the fresh water tank 12, also with 2 liters, is triggered by valve 95 and the overflow valve 91 is closed. This relatively clean water now also flows passively into the brown water tank. At the end of the second filling process, the 4 liters of brown water improved by fresh water is intermittently conveyed into the UV disinfection system by the feed pump 32. The solids separator tank 3 is always filled

up to the $L_{\max}$ mark. When the level $L_{\min}$ is reached, the solids feed pump 28 switches off in any case, as no more material can be sucked in below this level.

[0038] From the solids tank 5 placed at the very top of the built-in unit, the viscous slurry of excrement, toilet paper and a small amount of water is dispensed into the tubular bag packaging unit 9 arranged below via a portioning device 6 and a valve 7. The filling level of the solids tank 5 is monitored by a sensor so that the solids pump 28 can only run if the level in the solids tank 5 is not too high. The valve 7 is opened and closed under the control of the portioning unit 6.

[0039] A vent line 33 leads from the solids tank 5 into the drain pipe 31 to the sewer system so that excess pressure can never build up in the solids tank 5. Down from the portioning device 6, an emergency line 34 leads via a solenoid valve 35 into the drain pipe 31 and into the sewer system. If, for any reason, the tubular bag packaging unit 9 should be defective, the solids tank 5 can be emptied directly into the sewage system.

[0040] The concept presented so far relies on a fecal matter pump arranged at the bottom of the solids separation tank 3 for the upward transport of the solids, which crushes the solids and transports them together with rinsing water into the upper solids tank. An alternative realization for this upward transport of the solids is presented below, in order to subsequently ensure the further processing of the solids or the slurry of solids in the dosing device for dispensing into the packaging unit. As an alternative to the system described above, the 120 degree rotary valve could/should not be omitted here and the upper gray water tank could also no longer be necessary, and thus also not a WC flush in two phases. This would simplify the system considerably and would result in conventional water consumption during flushing.

[0041] A lift system is used for this purpose, with a lift basket that can be moved up and down, as this lift system is shown in Figures 7 to 10. When the toilet flush is triggered, the solids and the flush water enter the lift basket 121 via the inlet pipe 120 of the lift system. The solids are deposited in the lift basket 121 and the flush water is discharged directly into the sewer system via the side slots 122 in the lift basket 121. The bottom of the lift basket 121 is formed by a lift basket bottom flap 123, which is held in the closed position by means of a tension spring or torsion spring. Once filled, the lift basket 121 is raised. For this purpose, a drive is provided by two threaded rods 124 arranged symmetrically to the lift basket 121 with the two threaded guide nuts 125 on the lift basket 121. A drive motor 126 is connected to the two threaded rods 124 via

a toothed belt 127. Magnetic switches signal the positions of the lift basket 121 to the control unit. The lift basket 121 is kept on track by guide profiles 128 arranged on both sides. For this purpose, complementary guide ribs 129 are fitted on both sides of the lift basket 121. Both profiles 128, the fixed lateral ones and the guide ribs 129 on the lift basket 121 are V-shaped at their ends, so that correct guidance is always restored when the lift basket 121 is lowered.

[0042] Figure 8 shows the situation when the lift basket 121 is moved upwards. 2/3 of its lateral guide ribs 129 have already moved upwards out of the profiles 128. Once the lift basket 121 has reached the upper position, the guide ribs 129 on the sides of the lift basket 121, which previously slid upwards in the guide profiles 128, have moved out of these and the lift basket 121 thus hangs freely on the two opposing guide thread nuts 125. These nuts 125 are pivotably mounted on the lift basket 121, so that the lift basket 121 can now be tilted about the pivot axis 130 in this freely suspended position.

[0043] In Figure 9, the lift basket 121 is shown in the position swung out laterally about the axis 130. In this swung-out position, it protrudes into a discharge chute 131. For the swing-out, for example, a catch hook not shown here grips the lift basket 121 at a lower lateral connection point and swivels or tilts it until the lift basket 121 is aligned with the discharge chute 131. A further catch hook grips the lift bottom flap 132 and opens it against the acting spring force until the solids stored in the lift basket 121 slide out of the lift basket 121 for further processing and enter the portioning device. It is also possible to combine the two movements of swinging out the lift basket 121 and folding out the bottom flap 123 by means of a kinematic drive.

[0044] If the lift basket 121 is emptied, its movements run in the reverse direction and sequence analogous to that described above. The spring on the lift bottom flap 123 closes the lift basket 121 again and during the subsequent downward movement of the lift basket 121, it is centered by the V-shaped guide profiles 128 and held in place. In the event of a malfunction of the system, the lift basket 121 can be positioned at half height and the solids are transported directly into the sewer system as usual or conventionally.

[0045] These can be pressed into cylindrical solids by screw compression (meat grinder principle) or a similar principle. The solids are dosed by the number of turns of the screw compression. They are then dispensed in the packaging unit described below. Alternatively, the solids could be dosed with the addition of water and then

mixed to form a slurry with a defined viscosity in order to then pass through the dosing device into the packaging unit.

[0046] Figure 11 shows the solids tank 5 and the portioning device 6 for the portioned dropping of solid portions from the solids tank 5 into the tubular bag packaging unit 9 in an exploded view along a central axis of rotation. At the top, the solids tank 5 is shown open at the top. Below this, the portioning device 6 can be seen with a rotor housing 36 and an inlet opening 37 and a swivel lever 38 to be inserted therein. The rotor 43 is shown below the rotor housing 36 and has a through channel 39. At the bottom you can see a stationary rotor housing base 40 with its outlet opening 41 and below it an electric double drive 42 with two coaxial axles. One axis 47 rotates the rotor 43, another axis 48 rotates the swivel lever 38 into the two intended rotational positions.

[0047] Figure 12, which shows this portioning device according to Figure 11 viewed from below at an angle, is used to explain it further. The through-channel of the rotor 43 is located under the inlet opening 46 of the rigid rotor housing 36. The swivel lever 38 rotates slowly over the inlet opening and fills the through-channel of the rotor 43. The swivel lever 38 can be operated in a 360° rotation or also in a reversed direction. The rotor 43 then continues to rotate until its passage channel 39 is located above the outlet opening 41 in the rotor base 40. The mixture now flows downwards via the valve 7 into the tubular bag packaging unit 9. Two lateral openings at the top of the through-channel 39 of the rotor 43 and in the opposite rotor housing 36 prevent the formation of a vacuum, which would hinder the discharge of the mixture portion, by means of an air supply.

[0048] Figure 13 shows the assembled portioning device 6 seen from diagonally above and Figure 14 shows it seen from diagonally below. This portioning device 6 thus dispenses measured, equally sized portions into the tubular bag packaging unit 9 via the dispensing valve 7 arranged below it. This tubular bag packaging unit 9 is described in more detail below, based on its mode of operation on the time axis.

[0049] Figure 15 shows the interior of the tubular bag packaging unit 9, initially in an initial state. It includes an "endless roll" 50 of a tube 51, from which tubular bags can be produced by transverse welding. The unrolled section passes through two spring-loaded press rollers 52, 53 which roll against each other. At the upper end of the unrolled section, a vacuum strip 54, 55 can be seen on both sides, each with an electrically heatable sealing strip 56 integrated into it.

[0050] From this initial state, the two vacuum bars 54, 55, which suck tightly on both sides of the tubular material 51 and are then moved upwards by a motor, are pressed on while the tubular material 51 is unrolled from the roll 50 and pulled through the two pressing rollers 52, 53, so that the state as shown in Figure 16 is finally achieved. The pressing rollers 52, 53 can be motor-driven if necessary, torque-controlled if necessary, so that under no circumstances can the mouth of the tubular bag be torn off the vacuum strips 54, 55. In the illustration according to Figure 12, a tubular section has been pulled up to form a single tubular bag and it is still held in this position by the vacuum bars 54, 55.

[0051] The next step is shown in Figure 17: Two electrically heatable welding bars 58, 59 with heating strips 57 for welding are moved above the press rollers 52, 53 from both sides to the tubular material 51 and pressed together. The tubular material 51 is then transversely welded at this point, forming a bag from the tubular section that is tightly sealed at the bottom and open at the top.

[0052] What happens next is shown in Figure 18, where the vacuum pumps 76, 77 for the vacuum bars 54, 55 are shown. The two lower welding bars 58, 59 have already moved apart into the state shown here, and the two upper vacuum bars 54, 55 also move apart a little. As a result, the end areas 60, 61 of the hose material 51 detach from the vacuum bars 54, 55 and their heating or welding bars 56, as indicated by the curved arrows, while one half of the hose width in the middle area remains held in place by the vacuum bars 54, 55. As a result, a square opening 62 of the tubular bag 63 is formed. At the bottom of the tubular bag 63, a welded, band-shaped area 64 extending across the tube 51 can be seen.

[0053] In the next step, as shown in Figure 19, the tubular bag 63 is cut along the center of this band-shaped area 64 by a cutting device 65 with a cutting blade 66. The cutting blade 66 moves along a beam of the cutting device 65 and its cutting edges 67, which run at an angle to the plane of the tubular material, cut through the tubular bag 51. Meanwhile, the welding beams 58, 59 with their electrically heatable welding bars 57 are moved away from the hose 51 in a translatory manner by their drive.

[0054] Now the bag 63 is held freely suspended by the upper vacuum bars 54, 55. As shown in Figure 20, the cutting device 65 is also moved away from the tube 51 in a translatory manner and a motorized displaceable support plate 75 is moved underneath the hanging bag 63. The vacuum bars 54, 55 are then moved downwards

until the bag 63 stands up loosely on the support plate 75, i.e. is no longer hanging. In this state, a feed tube 68 is lowered from the valve 7 (Figure 6) arranged above the tubular bag packaging unit 9 a little way into the bag 63, which is held open at the top, and a portion of solid material 69 is dropped into the bag 63.

[0055] The next figure 21 shows the tubular bag packaging unit 9 with the filled bag 63 still held open at the top and resting on the support plate 75 after retraction of the feed tube 68 and after insertion of an air tube 70 into the bag 63 from above. The contents of the bag 63 are now removed. Figure 22 shows the tubular bag packaging unit 9 during the subsequent closing of the upper bag mouth 62 of the bag 63. The vacuum bars 54, 55 move towards each other as indicated by the dotted arrows and clamp the bag mouth 62 between them. Figure 23 shows the state reached at the end. Now, as required, some air is pumped into the bag 63 via the air tube 70 so that it bulges out to contain an air portion so that it can be reliably floated in the sewer system later. The extent of these bulges in the resulting bag 63 can be controlled via the internal pressure. As soon as a set pressure is reached, the air pump switches off. Or the bag bulge is limited by the extent of the bulges, for example with light barriers 83 on both sides. As soon as the light barriers 83 are interrupted, the air pump stops.

[0056] Finally, the bag is welded at the entry point of the air tube 70, as explained with reference to Figure 24, and then the air tube 70 is withdrawn upwards from the bag 63. The bag 63 is thus hermetically sealed with its contents and an air portion. In this state, the bag 63 is again firmly clamped at the top and held securely, while it still rests on the support plate 75 at the bottom. The vacuum strips 54, 55 closing around the air tube 70 weld the mouth of the bag with their integrated welding strips 56.

[0057] Figure 24 shows a solution for how the vacuum strips 54, 55 with their welding bars 56 are designed so that the bag 63 is first welded along the straight welding bar sections 56, while air is then blown into the bag 63 via the air tube 70. The vacuum bars 54, 55 each have a recess 79 in the middle so that they close tightly around the inserted air tube 70. At this recess point, they each extend downwards into a hollow extension 82 towards the air tube 70, into which the mouth 80 of the air tube 70 extends. Curved welding bars 81 extend along the edge of this extension. When the vacuum bars 54, 55 are still retracted and tightly enclose the air tube 70 in their center, the straight sections of the welding bar 56 on both sides of the air tube 70 are first activated to weld the bag 63 and the bag is welded along these welding bar sections.

Air can then still be pumped into the bag 63 via the air tube 70 and its mouth 80 until it bulges sufficiently. Only then are the curved welding bars 81 also activated and weld the area of the bag 63 around the opening 80 of the air tube 70. The bag is thus hermetically welded and closed and is still held by the vacuum bars 54, 55.

[0058] The situation as shown in Figure 25 arises, in which the filled, hermetically sealed bag 63 hangs freely on the two vacuum bars 54, 55 after the support plate 75 has been moved away laterally. In the next step, as shown in Figure 26, a sliding plate 71 is moved at an oblique angle under the hanging bag 63 and then the vacuum bars 54, 55 are moved apart after ventilation into the position in which they are shown in Figure 26, and thus they allow the bag 63 to fall, which then slides on this sliding plate 71 into the drain pipe 31 and then into the sewer system, as indicated by the arrows. The drain pipe 31 is equipped here with a spring-loaded odor flap 87 to prevent odors from the sewer system from entering the entire device.

[0059] A particularly advantageous implementation of the bag packaging for producing bags that are rounded at the top and bottom is shown in the following figures. Figure 27 shows the special arcuate design of the lower sealing bars 83, 84. When a piece of tubular bag material is pulled up from the vacuum bars 55, 54, these two arcuate sealing bars 83, 84 move together as shown by the arrows and clamp the tubular material 51 between them. Next, a weld is made by these two welding bars 83, 84, whereby the tubular bag material 51 is welded at the bottom in an arc-shaped seal. At the same time, the material outside or below the welding beams 83, 84 is cut away by special arc-shaped knife blades on the welding beams 83, 84 and falls downwards into a collecting container, not shown, from which these shreds can be emptied from time to time.

[0060] Figure 28 shows the situation after the two arcuate welding bars 83, 84 with their electrically heatable welding strips 56 have been moved apart. Here, the lower sealed weld can be recognized with a thick dashed line, so that a bag 63 open at the top has now already been created, as is held open in a square shape by the upper vacuum strips 55, 54, as already described. This figure also shows one of the two curved upper sealing bars 85. After the solids are dropped from the portioning device in this state of the tubular bag 63 and fall into the tubular bag 63, which is held open at the top, it must also be sealed at the top.

[0061] This is shown in Figure 29. For this purpose, the upper vacuum bars 55, 54 move together and close the upper opening or mouth of the tubular bag 63 around the air tube 70 still projecting into the bag. Now a controlled amount of air is blown into the bag through the air tube 70, so that the bag assumes a desired curved shape bulging to the front and rear. The purpose of the air is to ensure that the finished tubular bag generates sufficient buoyancy in the sewer system so that it floats or at least approximately floats with sufficient buoyancy in the sewer pipes. After this filling with air, the two upper curved welding bars 85, 86 move together as shown by the arrows and clamp the tubular bag 63 between them. The tubular material is then tightly welded and at the same time the excess pieces of film above the welding bars 85, 86 are cut or punched away by the curved blades of knives which extend along the length of the actual electrically heatable welding bars 56 above them. The foil snippets fall into the aforementioned collecting container.

[0062] After the sealing bars 85, 86 have been moved away from the finished tubular bag 63, the situation is as shown in Figure 30. A tubular bag 63, curved at the top and bottom, with straight edges on both sides and bulging towards the front and rear, contains a defined portion of solids together with a defined amount of air. It is still suspended here between the vacuum strips 55, 54, which were responsible for the welding at the bottom around the lower opening of the air tube 70.

[0063] Figure 31 shows what now follows. The air tube 70 is pulled upwards a little. After a sliding channel 71 or a sliding plate has been moved under the support plate 75 from below, the support plate 75 is pulled away. The tubular bag 63 is released downwards via this sliding channel 71 or this sliding plate by venting the vacuum bars 55, 54 and then moving them apart into the position shown here. The tubular bag 63 then slides into a collecting pipe 31 and through a spring-loaded odor flap 87, which is pivotably arranged in a housing 88, it falls downwards and finally into the sewage system.

[0064] Figure 32 shows the design of an arcuate welding bar 83-86. It has an arcuate, electrically heatable welding bar 56, and an arcuate knife 73 with a sharp blade extends parallel to this electric welding bar 56 in the radial direction outside the same. These arcuate blades 73 are advantageously arranged with their rear side in the arcuate welding bar 83-86 so as to be slightly elastically flexible, for example by means of a spring plate arranged underneath or by means of a rubber-elastic profile as shown.

[0065] Finally, Figure 33 shows the finished welded and punched bag 63 in its final state. Apart from two straight sections, the bag 63 is curved, i.e. almost circular and bulging at the top and bottom. Such bags 63 slide or float along with the wastewater in the sewer system without any problems and finally arrive intact either in a separate collection station for sporadic emptying, or to a sewage treatment plant, where they float in the clarifier and can be removed for further processing.

[0066] Figure 34 shows a photographically captured tubular bag 63 from a prototype system, with which technical proof was successfully provided that such tubular bags 63 with a proportion of solids in them can actually and easily be produced and can easily be washed along in the sewer system without being damaged.

[0067] Overall, this concept uses much less fresh water and significantly reduces the load on wastewater treatment plants, as the solids are specifically separated from the rinsing water and do not mix with it and then have to be laboriously separated from it again in the wastewater treatment plant.

[0068] The method of disposal of the bags 63 with the solids contained therein can in principle be left open here. It is probably best to recycle them thermally, whereby the heat generated can then be used as process heat, or to treat hot water in decentralized systems.

[0069] This should also be mentioned as an afterthought:

- The entire device and all its components are automatically monitored and controlled by a PLC controller with computer 18, which controls all the functions described.
- The device preferably includes remote monitoring so that any faults are immediately detected and indicated by a visual and audible alarm, or such a message can be transmitted via an electronic network or via the Internet to the smartphones of the occupants of the building and/or a service company. For example, it can be used to indicate when the roll 50 of tubular film material 51 is running low and will soon need to be replaced by a new roll. When the roll is used up, the tubular bag packaging unit 9 is stopped so that no more solid encapsulation is possible until the new roll 50 in the form of a replacement cassette 10 (Figure 4) is installed ready for operation. Until this is completed, the rotary valve 21 switches to direct discharge into the sewage system and the toilet 100 is used conventionally.

- In the case of domestic or residential depots 117 (Figure 3), their fill level is monitored and also reported to the residents or directly to a disposal service provider, who assumes responsibility for ensuring that these depots 117 are always emptied in good time and always have sufficient free capacity. If the fill level reaches an adjustable maximum, the tubular bag packaging unit 9 is blocked so that no further bag disposal is possible, but instead the rotary valve 21 is switched to direct discharge into the sewer system and the toilet can be used conventionally.
- Because the device can be housed as a complete unit in an installation module 1, it can ideally be designed so compactly that it can also be connected to existing toilets as an optional replacement solution. In contrast to the conventional toilets already installed, the discharge of the hermetically packed bags⁶³ must be ensured by a separate supply line and inlet into the existing drain pipe. Otherwise, the entire installation module fits into the standardized installation bays for the installation of cisterns in wall-mounted WCs.
- The facility significantly reduces the burden on public sewage treatment plants, which is very much welcomed by the wastewater industry.
- Depending on the post-treatment or further treatment of the excrement encapsulated in pillow-shaped bags⁶³, there is the possibility of a sensible further use of the excrement.
- The system or concept with this facility offers the option of using standard toilet bowls from well-known manufacturers.
- Installation in frame elements (Duo Fix) with the specified connection dimensions can be used for the built-in modules and also for standard WC bowls.
- The serviceable part of the system, i.e. installation module 1, can be replaced as a unit (slide-in module).
- The operation of this facility does not result in any additional costs compared to the conventional disposal system - on the contrary, it can ultimately be more cost-effective overall compared to the current disposal system.
- The device is odorless, as it is completely hermetically sealed.
- The device can be operated by an operator with minimal effort and comfort. A replacement cassette with a new roll 50 of hose material 51 simply needs to be inserted from time to time.

- Optionally, LEDs and webcams can be installed inside the solids separation tank 3 and the solids tank 5 arranged at the top, as well as inside the tubular bag packaging unit 9, so that the processes in the individual components can be tracked from the outside on a screen or control panel 20 as required, and any faults can thus be inspected and analyzed without having to open anything.
- If necessary, film clips can be sent to a service center so that they know immediately what needs to be done.
- The bags 63 and, optionally, the accumulated urine are drained into a specially installed pipe system in the building and removed.
- This installation can be realized as a modular box with commercially available dimensions, such as the current lightweight systems from Geberit (Duofix & GIS) or Nussbaum (Optivis-Tec) or Grohe Germany. The standard width for wall installation is 500 mm or 750 mm, the height is variable and can be 1120 mm, for example, and the depth approx. 280 mm. These standard dimensions are the same for all other suppliers. This means that it is possible to connect and operate any type of WC with a corresponding module for this installation.

List of digits

- | | |
|----|---|
| 1 | Installation module for solids separation and tubular bag packaging |
| 2 | Connecting pipe for discharge pipe 107 from WC bowl 100 |
| 3 | Solids separator tank |
| 4 | Rising pipe |
| 5 | Solids tank at the top of the module |
| 6 | Portioning device |
| 7 | Valve |
| 8 | Downpipe |
| 9 | Tube bag packaging unit |
| 10 | Removable cassette in 9 |
| 11 | Waste water pipe in the module |
| 12 | Cistern in the module |
| 13 | Grey water tank in the Module |
| 14 | Brown water tank in module |
| 15 | cross braces on steel frame from 1 |
| 16 | Connection for rinsing water in 1 |

- 17 Power supply from 1
- 18 electronic computer unit/PLC control unit in 1
- 19 Ultraviolet disinfection system in 1
- 20 Control panel in 1
- 21 Rotary valve
- 22 Pipe directly into the downpipe 24
- 23 Pipe into the solids separation tank 3
- 24 Drop pipe into the sewer system (Figure 5)
- 25 Separate drain for urine (Figure 6)
- 26 Stirrer with paddle wheel as shaker
- 27 Tank bottom
- 28 Solids pump
- 29 Retention strainer
- 30 Valve in riser pipe 4
- 31 Outlet pipe into the sewer system
- 32 Feed pump for brown water into the UV disinfection unit 19
- 33 Ventilation line for the solids tank 5
- 34 Emergency line from portioning device 6
- 35 motorized valve in the emergency line 34 to pipe 31
- 36 Rotor housing
- 37 Entrance opening in 36
- 38 Swivel lever in the rotor housing
- 39 Continuous channel
- 40 Rotor housing base
- 41 Outlet opening
- 42 Electric double drive for two coaxial axes
- 43 Rotor
- 44 Axle for the rotor 43
- 45 Axle for the swivel lever 38
- 46 Fresh water pipe into the gray water tank
- 47 Axis to rotor 43
- 48 Axis to swivel lever 38
- 49 Steel frame of module 1
- 50 Continuous roll of hose

- 51 Hose
- 52, 53 Press rolls
- 54, 55 Vacuum bars
- 56 Heating/welding strip on 54, 55
- 57 Heating/welding strip on 58, 59
- 58, 59 Lower welding bar
- 60 End area of the hose material on one side
- 61 End area of the hose material on the other side
- 62 Square opening, tube mouth
- 63 Tube bag
- 64 Band-shaped welded area in the hose
- 65 Cutting device
- 66 Cutting knife
- 67 Cutting edges of the cutting blade 66
- 68 Feeding tube for solids into the tubular bag 63
- 69 Solids portion
- 70 Air tube
- 71 Slide plate, slide channel, slide channel
- 72 Interface around circular cushion-shaped bag
- 73 Knife on semicircular welding bar
- 74 Corner areas of the bag before cutting away
- 75 Support plate
- 76 Vacuum pump for vacuum strip 54
- 77 Vacuum pump for vacuum strip 55
- 78 Overflow pipe from solids separation tank 3 into the brown water tank 14
- 79 Recess in squeegee 55 for air pipe 70
- 80 Mouth of the air pipe 70
- 81 arc-shaped weld around the orifice 80 of the air tube 70
- 82 Continuation set on the welding bars 55, 54 for enclosing the orifice 80 Air tube 70
- 83 Lower front arched welding beam
- 84 Lower rear arched welding beam
- 85 upper front arched welding beam
- 86 Upper rear arched welding beam

87	Smell damper, spring-loaded
88	Housing for odor trap
89	Solids sensors
90	Cleaning valve
91	Overflow valve
92	Rubber-elastic profile under the knife 73
93	Valve for gray water tank
94	Valve to fresh water tank
95	Rinse valve fresh water tank
96	Vent line
97	Fresh water tank supply valve
98	Valve supply gray water tank 13
99	Pipe from the disinfection device to the gray water tank
100	WC Bowl
101	Platform floor in WC 100
102	Dropping nose of the floor 101
103	Collection chamber in WC 100
104	Small siphon for urine
105	Small pipe for urine
106	Siphon water
107	Drain pipe into the sewer system
108	Large siphon for outlet with solids
109	Sewer to the sewage treatment plant
110	Drain pipe for urine
111	Larger drain pipe for outlet with solids
112	Drain pipe bathtub
113	Bathtub
114	Lavabo
115	Washing machine
117	Collection container
119	Sewerage system
120	Inlet pipe for lift
121	Lift basket
122	Slots on the lift cage

123	Swivel-out base plate
124	Threaded rods
125	Guide thread nuts
126	Drive motor
127	Thooted belt
128	Guidance profiles
129	Guide ribs on the lift cage 121
130	Swivel axis of the lift basket
131	Distributing gutter
200	Installation frame
201	Cistern
202	Feet of the installation frame
203	Threaded bushes
204	Connection piece for WC drain
205	Connection pipe for WC flush
207	electrical connections
209	Keypad
210	Display above the WC

Patent claims

1. Method for separating the solids from a water closet (100) downstream of its siphon (108), characterized in that the solids are packed together with an air portion into individual bags (63) of an endlessly supplied hose (51) and the buoyant bags (63) are discharged hermetically sealed into the sewer (119).
2. Method for operating a device for separating the solids from a water closet (100) downstream of its siphon (108) according to claim 1, characterized in that
 - a) The solids are fed into a solids separation tank (3), from which they fall in portions from above into a catch basket (121) of a lift system,
 - b) The solids are conveyed upwards in the catch basket (121) of the lift system and simultaneously drip off through the catch basket (121),
 - c) The solids pass from the catch basket (121) into a portioning device (6), from which the solids are discharged in portions (69) through a valve (7) and dropped into the mouth (62) of a tubular bag (63), which is held open at the top, wherein the tubular bag (63) is produced at the bottom by a transverse weld (64) of a tube (51) of a roll (50) fed endlessly from below and is held by vacuum bars (54, 55) in the mouth region and is cut away from the endless tube (51) below the transverse weld (64) and then a support plate (75) is moved under the bag (63) and the bag (63) is placed on the same (75),
 - d) the bag (63) is closed by welding the mouth (62) after filling and blowing in air,
 - e) the bag (63) is dropped onto a sliding channel (71) or a sliding plate by releasing the load and moving the vacuum bars (55, 54) apart, after which it is discharged into the sewage system via a discharge pipe (31).
3. Method for operating a device for separating the solids from a water closet (100) downstream of its siphon (108) according to claim 1, characterized in that
 - a) The solids are fed into a solids separation tank (3), in which they are broken down into a viscous slurry and lowered to its bottom (27),

- b) the viscous slurry is pumped by means of a solids pump (28) into a high-level solids tank (5),
 - c) the viscous slurry is released by means of a portioning device (6) in portions (69) through a valve (7) into the mouth (62), held open at the top, of a tubular bag (63), wherein the tubular bag (63) is produced at the bottom by a transverse weld (64) of a tube (51) of a roller (50) fed endlessly from below and is held by vacuum strips (54, 55) in the mouth region and is cut away from the endless tube (51) below the transverse weld (64) and then a support plate (75) is moved under the bag (63) and the bag (63) is placed on the same (75),
 - d) the bag (63) is closed by welding the mouth (62) after filling and blowing in air,
 - e) the bag (63) is dropped onto a sliding channel (71) or sliding plate by releasing the load and moving the vacuum bars (55, 54) apart, after which it is discharged into the sewage system via a discharge pipe (31).
4. Method for operating a device for separating the solids from a water closet (100) according to one of claims 1 or 3, characterized in that the solid excrements and the urine, if it is not drained off separately beforehand, after flushing of the gray water tank (13) arranged at the top from the toilet bowl (100) via siphon and rotary valve (21) into the solids separation tank (3), the solids mixed with gray water are pumped upwards via a riser pipe (4) into the one solids tank (5), the excess grey water flows back into the brown water tank (14) via an overflow pipe (78), the content of the brown water tank is lowered to 2 liters, a post-rinse from the fresh water tank (12) with approx. 2 liters takes place, for cleaning rinsing of the toilet siphon and this relatively clean water flows back into the brown water tank (14), and after completion of this second filling process, the brown water is conveyed into a UV disinfection system (19) arranged above, and the brown water tank is finally filled with fresh water as required.
5. Method for operating a device for separating the solids from a water closet (100) according to one of claims 1 or 3 to 4, characterized in that
- a) In the case of pure urine delivery, a small button triggers flushing through the fresh water tank (12) and a rotary valve (21) is set to the position where

the urine is conventionally discharged into the outlet pipe (31) and thus into the sewage system,

- b) in the event of a faulty manipulation with a large button, after no solids have been dispensed, a 4 liter grey water rinse is triggered, without fresh water rinse, and the unused grey water is fed into the brown water tank (14), after which the grey water is pumped back up into the grey water tank (13),
 - c) In the event of an overload, the system switches to emergency operation by switching a rotary valve (21) to position 2, so that flushing takes place from the fresh water cistern (12) and everything is discharged directly into the sewage system, and then switches to normal operation.
6. Device for separating the solids from a water closet (100) downstream of its siphon (108) according to claim 1, characterized in that it includes, downstream of the siphon (108), at least the following technical components for treating the siphon outlet within a closed system;
- A solids separation tank (3) for collecting the solids,
 - A solids pump (28) for conveying the separated solids upwards in a riser pipe (4) into an elevated solids tank (5) or a lift system with catch basket (121) for elevating and simultaneously dripping off the solids and tipping them out,
 - A portioning device (6) with valve (7) for dropping portions (69) of solids received from the solids pump (28) or the lift basket (121) into a tubular bag packaging unit (9) arranged thereunder,
 - A tubular bag packaging unit (9) for producing hermetically sealed and subsequently separated bags (63) with solids and an air content from an endlessly fed tube (51), for discharge into the sewerage system.
7. Device for separating the solids from a water closet (100) according to claim 6, characterized in that it comprises a lift system with a collecting basket (121) with slots (122) or holes in its side walls and a bottom (123) which can be folded down against spring force, which catch basket (121) can be conveyed upwards by a motor and guided on profiles (128) and can be swung out laterally about a transverse axis (130) in the uppermost position and its base (123) can then be folded out by a motor, for tipping out the solids contained therein through a dumping chute (131) into the portioning device located below.

8. Device for separating the solids from a water closet (100) according to claim 6, characterized in that it includes a fresh water tank (12) above the closet (100) and a grey water tank (13) for the successive flushing of the closet (100) first with grey water and then with fresh water, as well as a brown water tank (14) below the closet (100), which is fed by an overflow pipe (78) of the solids separation tank (3), and has a pump (32) for conveying the brown water into a UV disinfection unit (19) above the gray water tank (13), with a feed line (99) into the gray water tank (13), and wherein the gray water tank (13) can also be fed with a fresh water feed line (46).
9. Device for separating the solids from a water closet (100) according to one of claims 6 to 7, characterized in that the solids separation tank (3) for collecting the solids contains an agitator (26) with a paddle wheel for breaking up the solids into a viscous slurry, and has a bottom (27) which tapers conically at the bottom, in which region the solids pump (28) sucks in the solids slurry and the riser pipe (4) for conveying the solids upwards has an electrically operable shut-off valve (30) to prevent backflow when the solids pump (28) is stationary.
10. Device for separating the solids from a water closet (100) according to one of claims 6 to 8, characterized in that the portioning device (6) has a rotor housing (36) with an inlet opening (37) at the top and an outlet opening at the bottom, with a rotatable swivel lever (38) therein, and a rotor (43) in the rotor housing (36) has a through channel (39), and the portioning device (6) has an electric double drive (42) with two coaxial axes (47, 48) for rotating the rotor (43) and the swivel lever (38) in both directions of rotation.
11. Device for separating the solids from a water-closet (100) according to one of claims 6 to 10, characterized in that the tubular bag packaging unit (9) includes a tube (51) which can be fed endlessly from a roller (50) and is guided from bottom to top by two pressing rollers (52, 53) rolling on one another, and which have at the top two vacuum strips (54, 55), each of which can be moved towards and away from one another, of a sealing strip (56), and with these vacuum strips (54,55), the upper end of the hose can be gripped and pulled up by suction, and

can then be opened to form a rectangular mouth (62) by moving the vacuum bars (54, 55) apart, and which further has two lower welding bars (58, 59), for straight or arc-shaped transverse welding of the hose (51) below a bag length measured from the upper mouth (62), and a cutting device (65) for cutting off the hose (51) below the straight or arc-shaped transverse weld (64) produced.

12. Device for separating the solids from a water-closet (100) according to one of claims 6 to 11, characterized in that it comprises two pairs of arcuate welding bars (83, 84; 85, 86), namely a lower pair (83, 84) with the inner side of the arc facing upwards, and an upper pair (85, 86) of arc-shaped welding bars with the inner side of the arc facing downwards, for producing an initially lower arcuate welding of the bag material (51) and, after filling, for the upper arcuate welding of the bag material and thus producing an approximately round bag (63) bulging to the front and rear, and wherein the upper and lower pairs of arcuate welding bars (83, 84; 85, 86) are equipped with blades (73) extending radially outside the sealing bars, for separating off the film residues outside the approximately round bag (63) produced.
13. Device for separating the solids from a water-closet (100) according to one of claims 6 to 12, characterized in that the tubular bag packaging unit (9) includes an air tube (70) which can be lowered into the bag mouth, for blowing air into the bag (63) filled with portions of solids, it being possible to close the bag mouth (62) around the air tube (70) by moving the vacuum bars (54, 55), the bag mouth (62) can be closed around the air tube (70) and sealed by its sealing bars (56), and after pulling out the air tube (70) at the top, the location there in the mouth (62) can also be sealed, so that a hermetically sealed bag (63) containing air and solid portions (69) can be produced.
14. Device for separating the solids from a water closet (100) according to one of the claims 6 to 13, characterized in that it includes a sliding channel or a sliding channel (71) or sliding plate as an inclined plane for the hermetically welded bags (63), which can be retracted into the region below the bag (63) after the motorized removal of the support plate (75) under the bag (63), after which the bag (63) slides by relieving the vacuum bars (54, 55) on this sliding plate (71) into a

discharge pipe (31) with a spring-loaded odour flap (87) and, after passing through the latter, into the sewer.

15. Device for separating the solids from a water closet (100) according to one of claims 6 to 14, characterized in that it has, after the connection of the closet (100) to be equipped downstream of its siphon (108), an electrically operable 120° rotary valve (21) which forms a diverter with three positions, with a first position for normal operation, in which the incoming flushing material consisting of water, possibly urine if this is not separated, is collected, and solids such as excrement and toilet paper into the downstream solids separation tank (3), with a second position for fault operation, in which the rotary valve (21) discharges the flushed material directly into the sewer system in a conventional manner, and a third position for cleaning operation for backwashing the downstream solids separation tank (3), in which the rotary valve (21) and the solids separation tank (3) can be flushed through suitably arranged cleaning nozzles on the inside.
16. Device for separating the solids from a water closet (100) according to any one of claims 6 to 15, characterized in that it includes an electronic control unit PLC (18) for processing electrical signals from all components and for controlling them, and in that spray nozzles for cleaning dirt-prone areas and webcams are installed inside the device for recording the state of the device and the processes inside in real time.
17. Device for separating the solids from a water closet (100) according to any one of claims 6 to 16, characterized in that it includes an electronic control unit PLC (18) for processing electrical signals from the following components and for controlling them for electronic control:
 - a) the motorized 120° rotary valve (21),
 - b) the agitator (26) in the solids separation tank (3),
 - c) the solids pump (28) for lifting the solids or the lift system with the lift basket (121) that can be lifted and tipped out at the top,
 - d) the shut-off valve (30) in the riser (4),
 - e) the portioning device (6),
 - f) the valve (7) below the portioning device (6),

- g) the vacuum bars (54, 55; 83, 84) for the mouth (62) of the tubular bags (63), which can be moved horizontally and vertically by motor, their vacuum performance and their integrated sealing bars (56),
 - h) the vacuum bars (58, 59; 83, 84), which can be displaced horizontally and laterally by a motor, for transverse welding or arc-shaped welding of the bags (63) along their base to be produced,
 - i) the motorized support plate (75) that can be retracted under the hanging bag (63),
 - j) the sliding plate (71) or the sliding channel or sliding plate can be retracted as an inclined plane under a filled bag (63),
 - k) the brown water pump (32),
 - l) the UV disinfection unit (19),
 - m) all line valves,
 - n) All spray nozzles for sporadic internal cleaning of the device,
 - o) all monitoring elements such as cameras, sensors, etc.
18. Device for separating the solids from a water closet (100) according to one of claims 6 to 17, characterized in that the entire device with all its components is installed as a complete installation module (1) in a steel frame (49) and this steel frame (49) fits into the standard installation bay of a wall-mounted WC, i.e. measures a maximum of 750 mm in width, 280 mm in depth and 1500 mm to 2200 mm in height.