BALLAM-WATERSLOT
(PTY) LIMITED

THE “GEM” ON-SITE SEWAGE TREATMENT PLANT

INDEX

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1. OVERVIEW

As our many, many customers will know, in the initial stages, we introduced the mini "GEM" which has proved itself and became very much in demand.

In those early days, we had already cast our eyes on the future in respect of a larger plant, bearing in mind that the mini was designed originally to accommodate a family of four adults. It was during the latter months of 2004, that we commenced the design of a plant to cater for up to 15 people and which plant is now known as the maxi "GEM". From the results of the prototype plant, we realised that we were hot on the trail of developing an affordable plant, constantly being requested of us, with a greater capacity than the mini "GEM".

The maxi "GEM" is now a household name amongst owners and developers of new residential properties. As previous viewers will have noticed, the mini consisted of two tanks only, one being an anaerobic tank and the other being an aeration tank, whereas the maxi now consists of four tanks. It incorporates an up-front anaerobic tank with a specialised form of snubbing of the volumetric flow into the secondary anaerobic tank, with a special feature to accommodate a short term overload in excess of 1.000 litres in the primary tank. Thus, the effluent passing from the first to the second anaerobic tank becomes broken down almost to a silky-like fluid, on average, and then, final digestion takes place in the second tank before passing on to the aeration tank. We have also incorporated an airlift sludge return pump at the end of the aeration tank, whereby any sludge not finally digested is returned, in equal portions, to both the aeration tank and the second anaerobic tank. The fourth and last tank is a holding tank incorporating a suitable submersible pump, equipped with a float switch.

2. INSTALLATION OF THE “GEM”

The instructions for installation are as follows:-

a. Siting

The site for the plant should be situated not less than four metres from the dwelling, and thereafter at the shortest distance possible away from the dwelling.

b. Excavation

The size of the excavation for the plant should be 7,5 metres in length, 1,8 metres in width and 1,2 metres in depth. This will ensure that the manhole covers protrude slightly above natural ground level and are readily accessible. The base of the excavation should be virgin soil and completely level from end to end.

Should the base soil be unstable, cast a level 75mm thick concrete slab at the bottom of the excavation, whilst maintaining the specified depth of 1,2 metres from natural ground level. Allow three days to harden. The invert level is 950mm from the base to the underside of the 110mm ø inlet pipe. It is essential that these parameters are strictly adhered to, so that, when installation takes place, it is a simple matter to slide all components together.

c. Pipe Connections

All rubber seals and related pipes should be coated in a lubricant, as specified by the manufacturers, or sunlight liquid soap, or soft soap. By virtue of the level base, complete installation takes only a few hours.

Wherever the site is located, a member of our staff will perform the installation and commissioning of the system, to ensure that all items are correctly connected and settings are at optimum levels. Time on site is limited to a maximum of 4 hours.

If this plant is being installed at a new homestead, do not connect the sewer to the plant until *all* contractors have left the building site. Contractors are notorious for washing all types of items down the drain, including paint, cement, rags, cement bags, sand and any other type of building by-product. Give the sewer a thorough flushing before connecting it to the sewage plant.

The first or primary tank has an inlet at the top, of 110mm ø, for connecting to the sewage input. The outlet of the first or primary tank consists of three pipes, each of which has a welded socket at one end. The two lower pipes are 50mm ø, and the upper pipe is 110mm ø.

The second tank has inlet pipes to match the outlet pipes of the first tank. When sliding the second tank to join with the first tank, use pvc solv-weld to coat all unwelded sockets before mating each pipe with its partner. The importance of a level floor will become evident during this exercise.The second tank has two outlets, the lower one being a 110mm ø pipe and the upper one being a 50mm ø pipe.

The third tank, which is the aeration tank, is the foundation member of the entire plant. When sliding this tank up to the second tank, both unwelded sockets should be similarly welded as before, and married up to the second tank.

The exit end of the aeration tank (third tank) consists of a 110mm ø pipe, to which a socket and reducer from 110mm-50mm is fitted. The reducer accommodates the input end of the chlorinator.

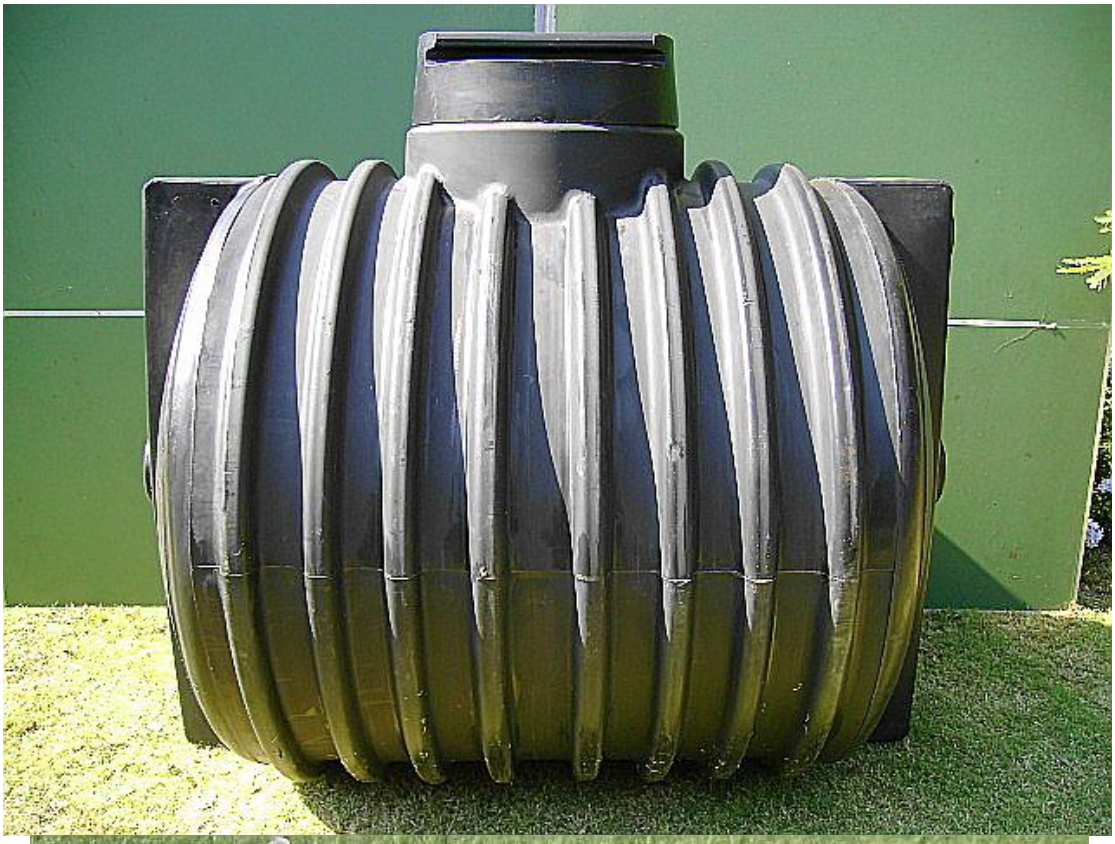
At the front (input) end of the third tank is a small hole to allow entry of the silicone pipe from the blower to the air control panel inside the tank. This panel is controlled by two taps, one of which allows a specific amount of air to enter the aeration mat and the other allows air to enter the airlift sludge return pump. The aeration mat should be laid flat in the bottom of the tank at all times.

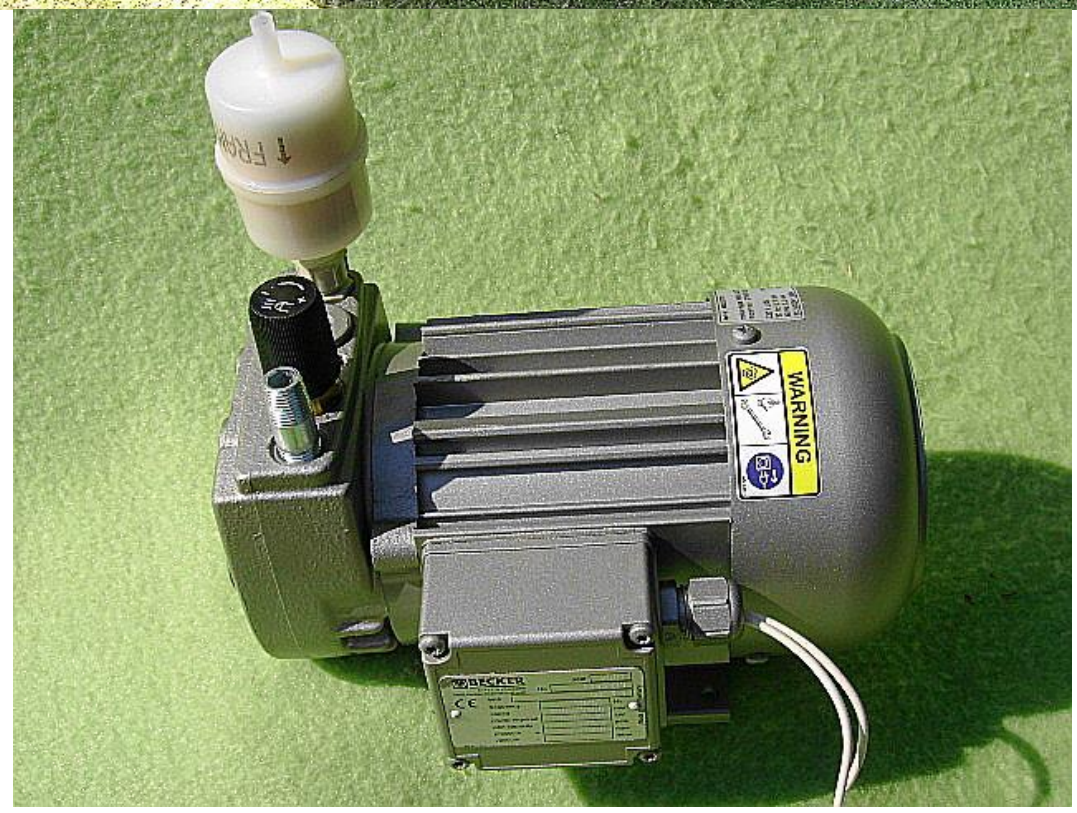
The taps will be set during commissioning of the system. Under no circumstances should the user make any adjustment to the mechanisms of the aeration tank without prior consultation with Ballam-Waterslot.

The next item for attention is the fitting of the chlorinator, or Ozone inlet, which is in a circular housing with lid. A 50mm ø pipe protrudes on opposite sides of the housing. The outlet of the chlorinator/Ozone inlet, with the access heel (cleaning eye), connects to the inlet of the fourth tank. Use non-pressure cement (for uPVC piping) to attach the chlorinator/Ozone inlet pipe to the reducer fitted at the outlet of the third tank.

Lastly, we move to the fourth or holding tank which is the final tank of the plant. At the front upper part of the fourth tank is a 50mm ø rubber seal, which should be coated with a lubricant, such as soft soap or sunlight liquid soap, to allow the 50mm ø outlet pipe from the chlorinator/Ozone inlet to enter the final tank.

On the top part of the outlet side of the fourth tank is a small hole. This hole is typically 25mm in diameter for the outlet pipe from the submersible pump. Most submersible pumps have adaptors to accommodate 25, 32, 40 or 50mm pipes, which size will be drilled to suit the customer's requirements At the end of the fourth tank is a 50mm ø hole, complete with seal, to which should be fitted the 2 metre length of 50mm pipe supplied. This provides an emergency overflow in the event of a power cut or a lightning strike. A 1 x 1 x 1 metre hole, filled with rocks, to which the emergency outlet pipe can be connected creates the necessary soakaway.





d. Blower Connection

The blower requires a standard 230V power supply, which plug can be fitted inside the blower housing. Ensure that the blower filter is correctly fitted. The silicon pipe from the third tank can now be joined to the blower outlet.

The blower is housed in a perforated, circular container with lid. It is essential that the blower remains dry and the ventilation holes unobstructed at all times. It is strongly recommended that the blower housing be set on/in a concrete platform above natural ground level to ensure that any surface water does not get to the blower.

e. Submersible Pump Connection

The submersible pump will be suspended on a nylon rope approximately 150mm above the bottom of tank number 4. This arrangement facilitates the removal of the pump if and whenever necessary. A length of the rope should be allowed to protrude over the edge of the manhole cover for easy access.

Ensure that the float switch will not hook on the internal stabiliser bar and prevent the pump from switching on or off.

The electrical cable and nylon rope for the pump fits through a small V-shaped notch cut in the side of the manhole, on the side of the exit end of the tank, near the water pipe hole. This cable should be connected to the 230 Volt power supply in the Blower housing.

The static head and capacity requirements of the pump will be discussed at the time of order. Depending on the type of pump supplied with the “GEM”, the hole in the top of the exit end of the tank will be 25, 32, 40 or 50 mm in diameter. The pipe size is determined by the fitting on the pump. Ensure that the pipe is securely screwed or clamped into the pump and connected to the irrigation piping before turning on the pump.
This completes all the pipe and electrical connections.

f. Back-filling

It is important that the back-filling instructions are followed closely. The back-fill should consist of fine selected soil, preferably river sand, in a dry mix with 5% cement, although a slightly damp mixture will suffice. If the size of the excavation was made according to the dimensions in section b, then the following volumes of river sand and cement will be required to fill the remainder of the hole. River sand – 10 cubic metres, cement – 0,5 cubic metres = 15 bags of 50kg each. (Mix 20 wheelbarrow loads of river sand with 1 wheelbarrow load of cement).

As back-filling takes place, water should simultaneously be placed in each tank to equalise pressure both inside and outside the tank. This is applicable to all four tanks.

The back-fill material, as described, should be firmly rammed around each tank. Once the water level inside the tanks has reached the halfway level, the filling of water can be stopped and the tanks covered with back-fill up to the prescribed level, which is approximately where the manhole protrudes from the top of the tank. Under no circumstances should the soil interfere with the settling of the manhole cover, which is tapered specifically to prevent any odours escaping, or surface water entering the tanks.

For all practical purposes, the installation of the “GEM” is now complete.

OPERATION OF THE “GEM”

a. Blower

For the purpose of aeration, a Becker blower is supplied. We emphasize that this must be housed in a damp-free area and situated where an airflow can keep the compressor cool at all times. It must also be noted that the blower should be connected to a power system, as it will be in operation for 24 hours per day, 365 days a year.

The small air filter on the blower must be changed regularly (depending on dust conditions). Failure to change the filter timeously will result in the blower overheating and burning out. Needless to say, this is an expensive piece of machinery, and every precaution must be taken to abide by the foregoing warnings.

The aeration tank (tank 3) will be half filled with water, (done during the back-filling operation). The blower should be tested whilst the water is still transparent. Check if air is bubbling (small bubbles) from the aeration mat, as well as from the airlift pump. Air from the airlift pump, together with the water it will be pumping, should be visible through the three 30mm holes in the sludge pipe in the aeration tank (tank 3). The blower should be switched on permanently once the system has been in operation for approximately 3 weeks.

After an extended period of operation, the population of activated sludge bacteria may increase to unacceptably high levels. This is usually visible as a thick dark-brown “soup” in the aerobic section (tank 3). When this occurs, the black pipe surrounding the holes in the 50mm return activated sludge pipe should be turned through 90° to close the 3 holes for a period of approximately 30 minutes to 1 hour. During this period the activated sludge will be returned to the anaerobic tanks (tanks 1 & 2), where the anaerobic bacteria occupying these tanks will consume it. Remember to open the 3 holes in the return activated sludge pipe after this operation.

There is no need to introduce any supporting bacteria/enzymes into the system. There are sufficient bacteria in human waste to perform this function. Also keep in mind that the population of bacteria will swiftly build up in the system. Do not expect perfect effluent within the first two months. After a while, the effluent water quality will stabilise and will become a non-offensive water source, which can be used quite safely for irrigation purposes, as discussed later on in this document.

b. Chlorinator

Situated between the aeration tank exit and the inlet to the holding tank is a custom-made chlorinator/Ozone inlet. It is of the highest quality and encased in an attractive housing.

A cartridge package, containing ten chlorine pills, is spring-loaded in the housing. The only maintenance required, at regular intervals, is to ensure that the spring-loaded cap is screwed down to its maximum, so that the pills remain in contact with the water flowing through the housing.

The chlorine cartridge should be replaced before the last pill becomes too much of a paste and blocks the pipe.

c. Ozone

As an alternative to the use of chlorine to kill the bacteria, we now offer ozone as a more efficient and cost effective solution. Ozone has the advantage of not only destroying bacteria twenty times faster than chlorine, but leaves no lingering odours. Additionally, it assists in the rehabilitation of the water by reducing, even further, both the chemical and biological oxygen demand.

Although ozone costs marginally more than the equivalent chlorine-based system, it is more cost effective in the long run, as it requires no on-going maintenance.

4. MAINTENANCE OF THE "GEM"

Although the attempt was made to make the "GEM" as maintenance free as possible, periodic maintenance is required. Please adhere to the following maintenance procedures:

After some months of operation, a thick scum layer will develop on the surface of the primary anaerobic tank (tank 1). Do not attempt to break this layer as it forms an effective barrier, which excludes oxygen from the water below.

Keep track of the amount of fat and grease being disposed of through your kitchen sink. The bacteria can degrade most fats and greases, but the process is much slower than the degradation of other solids. Excess fats in the sewer will become evident in the primary section of the anaerobic tank. Excess fats will also cause sewer blockages, as the liquid fat washed down the kitchen sink will cool down and congeal further down the sewer pipe, and create a progressive narrowing of the pipe.

Although it is not mandatory, we strongly recommend that a grease trap be incorporated in the system, so that all waste water from bathrooms, kitchens, showers, etc. passes through a gulley head fitted over a grease trap, before entering the main inlet to the plant. The grease trap should be cleaned first thing in the morning, while the grease, fat, etc. is still cold and in a solid form and can be easily scraped from the basket.

We strongly emphasize that only bio-degradable items pass through the plant. Therefore, when purchasing cleaning materials, ensure that these items are clearly marked “biodegradable”, “suitable for septic tanks”, or, “septic tank friendly”. Should any cleaning material not bear any of these descriptions, it should be avoided. Alternatively, contact the manufacturer to ascertain the bio-degradability of the material in question.

Apart from disinfectants, avoid introducing any other items which are not readily biodegradable. This includes items such as sanitary and panty pads, which contain plastic material. Usually tampons are manufactured entirely from cotton and are therefore totally biodegradable and safe to use with your “GEM”.

Sand and gravel could also fill the anaerobic tank prematurely. When washing hands, dirty overalls, etc. that contain excessive amounts of sand, first rinse them and dispose of this water outside of the homestead’s sewer.

5. ENVIRONMENTAL MANAGEMENT

Although the “GEM” is intended to replace the septic tank / French drain system entirely in all areas not serviced by a municipal sewer, it was primarily designed to be used in areas where there is evidence of dolomite, clay or decomposed granite, or environmentally sensitive areas. An anaerobic septic tank does not purify sewage water to nearly the same quality as an aerobic process.

Never allow effluent to be discharged directly onto ground near any borehole. This is of particular importance if the underlying geology is dolomite. As a rule of thumb, provide for a distance of at least 100 metres from any borehole. In dolomite, however, there may be preferential access routes directly into the groundwater from much further distances. Also keep the distance from your neighbours' boreholes in mind!

If effluent water is discharged into an artificial wetland, always ensure that the wetland is constructed on impermeable soil or, alternatively, construct such a wetland using an impermeable lining.

Never allow any water to stand in a permanent unlined pond in areas with dolomite. This practice may lead to the formation of sinkholes and could also contaminate the groundwater.

Do not discharge the effluent produced by any sewage treatment plant directly into any public stream without a water license from the Department of Water Affairs and Forestry.

6. SAFETY CONSIDERATIONS

The final treated effluent is **not** suitable for human or animal consumption. It has not been treated to a drinking water standard. Mark all taps with effluent water with a clear "*non-drinking water*" sign.

Although chlorination is one of the most efficient methods used in the water treatment industry, do not assume that the effluent is safe. The chlorinator may not be adjusted correctly. Always treat effluent as if it may contain pathogenic bacteria.

When irrigating with the final treated effluent, never allow it to be sprayed directly onto people or animals.

Do not irrigate treated effluent onto vegetables or fruit that are normally eaten raw.

When effluent is used to irrigate sports fields, always allow for at least two days of drying in the sun before any sports activities are allowed on the field. This is especially important in the case of contact sports where people may fall and come into direct contact with the grass.

When there are children around, ensure that concrete ballast is cast in the lids of the manholes to prevent the children from opening the manholes. If a person falls into one of the units, drowning could result.

7. USES OF THE EFFLUENT

Although the effluent is not purified to General Standards, it is nevertheless safe and may be used in a variety of applications. There are many ways the final effluent produced by the "GEM" can be utilised.

The most useful application of the effluent is to irrigate it onto lawns, gardens, flowers, shrubs, trees or crops. Oscillating sprays are not recommended, as this type of spray tends to create a certain amount of vapour which is not exactly unpleasant, but is noticeable. The type of equipment recommended by us is a simple round static-type of spray, readily available from practically any hardware shop at low cost.

A second alternative is to dispose of the effluent directly into an artificial wetland. This wetland could ultimately discharge into a pond, or it could be constructed in such a manner that it would use all the water within the wetland through evapotranspiration. Please always keep in mind the environmental considerations discussed above, when designing and constructing such a wetland.

There are many other industrial and domestic uses for sewage effluent not discussed in this pamphlet.

8. Warranty

Ballam-Waterslot (Pty) Limited hereby warrants that the system supplied is free of material and/or manufacturing defects.

In the case of a Maxi “GEM” Sewage Treatment Plant, we warrant, in addition to the above, that the system, if commissioned by Ballam-Waterslot (Pty) Limited, was in full working condition at the end of the commissioning process. Since Ballam-Waterslot (Pty) Limited has no control over the subsequent use and maintenance of the system, we cannot be held liable for it’s continuing functionality. All operational and maintenance procedures are clearly detailed in the respective manual supplied with the system.

Further, we advise that the blower and submersible pump enjoy, respectively, a 6 month and 2 year manufacturer’s carry-in warranty (to Ballam-Waterslot (Pty) Ltd offices).

9. DISCLAIMER

Ballam-Waterslot septic tanks and sewage treatment plants are designed to operate under specific environmental conditions. Should the end user opt to ignore these physical parameters, then Ballam-Waterslot accepts no responsibility for any damages, or consequential losses, as a result of collapsed tanks, electrical surges, power failures, chemical poisoning of the system, or any other related cause.