OWNERS MANUAL

bioSystem 2000 Aerobic Treatment Unit

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1.0 Introduction

The bioSystem aerobic treatment unit is a package sewage treatment plant for domestic and commercial applications where mainline sewerage is not available. It provides a safe and viable alternative for treatment of wastewater and produces an effluent that can be reused for irrigation purposes.

The bioSystem 2000 ATU is approved to process up to 1,800 L/d which is more than adequate for the modern 4 bedroom x 2 bathroom home. The plant consists of a single tank (concrete) 2.5 m in diam. and 2.3 m high. The tank weighs 5.5T.

The system is designed to meet Health Department of Western Australia effluent discharge criteria for effluent disposal.

< 20 mg/L BOD_5
< 30 mg/L Suspended Solids
Faecal coliform counts are not applicable as the discharge is below surface.
Total P discharge levels have not been specified, however, typical TP discharge levels would be approx. 7-9 mg/L.
TN discharge levels have not been specified, however, typical discharge levels would be in the range of 20-80 mg/L.

2.0 Plant Description

Sewage effluent from the facility will gravity flow into chamber 1 of the ATU (sewer invert at 775 mm from lid of tank) where primary effluent settlement occurs. From here the wastewater gravity flows into chamber 2 for aeration processing.

Air is introduced into this tank by means of an air manifold and fine bubble air diffusers located close to the floor of the chamber. In addition, the chamber has attached growth media submerged below water depth. The aerated wastewater exits the aeration chamber and gravity flows into chamber 3, which is a clarifier. The clarification chamber allows for secondary settlement where remaining solids settle to the bottom of the tank. The settled sludge, is pumped automatically by means of an air venturi system back to the Primary Tank for re-digestion, this is called the Returned Activated Sludge (RAS).

The flow from the clarifier then gravity flows into the final chamber for disinfection/pump out.

The treated water is then pumped automatically to the designated disposal area as determined by the client and/or Council approval conditions.

3.0 Effluent Disposal

Health Department of WA and Local Council requirements dictate that a minimum area of 150 m^2 is necessary for disposal of the treated wastewater.

Please note that the effluent disposal area must be a minimum of 30 m away from any bore or water course destined or available for potable water extraction.

4.0 Process Description

The design of efficient, economical biological wastewater treatment systems requires an understanding of the biological principles on which they are based.

4.1 Aerobic Biological Process

Successful biological treatment depends on developing and maintaining an appropriate active mixed microbial population in the system. This microbial

population may be present either as fixed film attached to some form of support media or as a suspended growth system.

The aeration chamber of the bioSystem ATU is fitted with a fixed submerged media. This media provides additional surface area for the housing of the microbial population in the activated sludge process and thus greatly enhances the degradation of the waste through microbial activity.

Environmental factors that influence biological growth include temperature, pH, mixing intensity and the presence of toxic agents. Temperature may affect growth rate of microorganisms to the extent of doubling the reaction rate for each $10^{o}C$ increase in temperature.
Different organisms predominate at different temperatures however there is little difficulty in Australian conditions to develop a suitable organism population.

The pH for optimum biological should be in the range of 6.5 to 7.5 although growth will occur over the range of pH 4.0 to 9.5. Toxic materials should be avoided where possible.

Any deficiency in nutrient or environmental factors will inhibit biological growth, and will lead to loss of process efficiency. Process efficiency should be maximized by maintaining all conditions of operation as constant as possible.

4.2 Clarification

Clarification is the process by which any excess settleable solids contained in the effluent from the aeration chamber is separated from the effluent by setting under gravity. The clarifier is designed with a large enough surface area to provide sufficient capacity to produce a clear effluent provided the treatment plant is well maintained.

The clarifier base is slightly tapered to provide for the accumulation of settled sludge. The accumulated sludge is pumped via air ventri method and returned to the primary tank for re-digestion and re-circulation

4.3 Disinfection

The system is supplied with a chlorine tablet dosing unit. Treated effluent will overflow from the clarifier and pass through the unit. The tank is sized to ensure there is a minimum of 30 minutes detention time at peak flow for the chlorine to react and remove pathogenic organisms.

4.4 Pump Out

Post clarification, the treated wastewater is pumped automatically to the disposal area.

5.0 Handy Hints – Homeowner Resposibilities

To ensure maximum operating efficiency of your bioSystem:

- Power to the system should ***never*** be turned off (even during holiday breaks. Contact your service provider for advice if for extended durations).

- Do not use an in-sinkerator or garbage grinder unit as it will have a detrimental effect on the system as well as being illegal in Western Australia.

- When purchasing household detergents, check that the product is either biodegradable or safe to use in septic tanks.

- Where possible choose a liquid soap for washing clothes rather than powders as some of these contain recycled plastics as filling agents. If using a powder use a concentrate.

- Spread your washing loads over the week so as not to overload the system.
- Avoid using strong caustic agents or chemical detergents as these may have a detrimental effect on the natural biological process of the system.
- If possible use phosphate free detergents as these are less harmful to the environment.
- Do not put newspapers, sanitary napkins or condoms into the system.
- Do not dispose of yeast into the system (eg raw dough from bread making) as this will have a seriously detrimental effect on the system.
- Do not dispose of medicines or antibiotics into the system.
- Avoid the use of antibacterial agents such as hand cleaners, washing powers as these may have a detrimental effect on the system.
- Avoid using products containing eucalyptus oil or lavender oil as these are natural antibacterial agents and will impact on the system.
- Do not wash animals (dogs/cats) in the bath or laundry trough, excessive animal hairs will block the discharge filter.
- Do not dispose of animal faeces into the system.
- Do not dispose of chemicals into the system eg paint thinners, battery acid, solvents, pesticides, engine oil and the like.
- Do not overload the system either hydraulically (too much water at once) or organically (too much grease and fats). This may cause the system to become foul smelling and not work efficiently leading to early pump out of the system.
- If there is a spa bath, turn the plug over to slow the emptying of the bath.
- Do not interfere with the operation of the system as this may void the warranty.
- With a new system it takes time for the bacterial population to build up. This may take 6-8 weeks during which time some odours may be noticed.
- The bioSystem ATU is a natural biological process, so care must be taken not to destroy the bacteria within the system. With a little care, you will help the system and protect our environment.

6.0 PROCESS CONTROL MONITORING

Grab samples, which are most often used in evaluating the performance of package treatment plants, should most appropriately be taken during the midpoint of the daily peak flow. They give only a general indication of plant performance under stress conditions and do not represent the plants average performance.

6.1 COLOUR

Much can be learned about the condition of the treatment plant by simply observing the colour of liquid in the aeration tank.

When the treatment plant begins operating, liquid in the aeration tank will be grey in colour, similar to dishwater. As solids build up in the aeration tank, the colour of the liquid changes from grey to light brown. Eventually, as the process matures, the colour changes to a golden brown or dark chocolate brown.

A good indication of treatment plant performance may be obtained from records of colour changes of the liquid in the aeration tank.

- If the colour changes from dark brown, solids are probably being lost from the system and effluent quality will be reduced.
- A change in colour from dark brown to light brown may also indicate that solids are accumulating in the settlement tank and not being returned to the aeration tank.
- Colour changes from dark brown to dark grey or black indicates septicity because of a lack of dissolved oxygen.

6.2 ODOUR

Odour can be a good indicator of a treatment plant's condition. During start up odours are similar to dishwater. When a light brown liquid forms in the aeration tank, it will generally be odourless or have a slight earthy smell. When the dark brown/golden brown colour develops, the liquid will have a sweet earthy odour.

If however, the liquid in the aeration tanks turns black, an odour similar to that of rotten eggs will develop indicating the air supply should be increased. If the colour of the aeration liquid is grey, the odour is likely to be a sweet very sickly odour indicating more likely that toxic conditions exist with inefficient biological activity occurring.

6.3 SETTLEABILITY

A simple settling test is possibly the most important of all tests operationally. It may be used to indicate the physical condition of the sludge within the system. It is a measurement of the sludge's zone settling rate. This is influenced by sludge concentration and physio-chemical characteristics of the system, such as the food to microorganism ratio and the intensity and period of aeration.

This test is best carried out in a graduated one-litre measuring cylinder, but other vessels can be used. The cylinder is filled to the 1000 mL mark with mixed liquor taken from between the inlet and mid-point of the aeration vessel.

Immediately after collection the sample should be left to stand undisturbed for 30 minutes, after which the volume of sludge settled in the lower part of the cylinder is noted.

A well operating treatment plant will have a densely granulated, dark brown sludge which after 30 minutes settles to a relatively small volume. Liquid above the settled sludge will contain a few light suspended particles but otherwise be clear.

The settled volume will increase over time because of a gradual build up of solids in the aeration tanks. The sludge thickening tank is important to allow wasteage of some of the build up of solids.

Clarity of the supernatant above the settled sludge in the mixed-liquor sample and of the effluent is an excellent indicator of the degree of treatment occurring.

If the treatment plant is not operating properly, an aeration tank sample may or may not have a dense settling sludge but it will have a turbid supernatant liquor above the sludge, and an effluent sample will generally be cloudy and contain more solids than normal.

Generally if both samples are cloudy, the problem is inadequate dissolved oxygen in the aeration tanks or overloading. Dark grey or black sludge indicates insufficient oxygen. If the supernatant in the aeration tank is clear but the effluent is cloudy, the trouble – usually is an inadequate rate of sludge return in the clarifier.

If the volume of sludge in the aeration tank sample is relatively low, the supernatant clear and the effluent sample clear but containing relatively large amounts of settled sludge, the problem is probably hydraulic overloading ie sewage flow exceed the systems design capacity.

If, after 30 minutes and the sludge in the aeration tank sample has only settled slightly and appears light and fluffy and the supernatant is clear, the likely problem is biological. This occurs when the sludge is bulking or when undesirable organisms such as fungi are present in the plant. These usually thrive if the aeration tank's pH or dissolved oxygen levels are too low.

6.4 pH

As part of the routine maintenance of the system, pH checks should be made of the wastewater, aeration tanks, clarifier water and final pump out effluent. Particularly if significant quantities of cleaning product type wastes are entering the unit (either acidic or caustic in nature).

Domestic wastewaters have pH which is normally near neutral (7.0) but is affected by the pH of the water supply. Values substantially outside the ranges of 6.5 to 7.0 may indicate the presence of acidic or caustic waters. Values less than 6.5 may indicate nitrification.

Generally, wide and frequent fluctuation of pH in a plant is detrimental to the process. Satisfactory biological activity is difficult to maintain below a pH of about 6.0 or above 9.0. Radical changes of influent pH should be investigated.

7.0 Alarm Procedures

7.1 General

The electrical control box recognizes several alarm conditions;

- High level in the Irrigation Tank
- Pump failure of the irrigation pump
- Pump failure of the sludge return pump
- Air blower failure

These situations require the attention of an operator. The wall mounted alarm panel has operating and fault detection lights. If the alarm trips, it remains activated until the situation is remedied. The Power light (Red) indicates that there is power to the bioSystem. A flashing green light (Water) indicates a fault with the pump or discharge line. A flashing Red light (Air) indicates a fault with the aeration component of the system.

Also associated with the alarm is an audio buzzer. This will attract the attention of the home owner to the alarm panel to assess which fault light is activated.

ATTENTION - *FAILURE TO ATTEND TO THE ALARM AND CONTACT THE SERVICE PROVIDER IMMEDIATELY, MAY RESULT IN A COSTLY PUMP OUT OF THE SYSTEM IF IT BECOMES FLOODED.*

7.2 Air Blower Alarm

On the wall mounted alarm panel is an operating/fault detection light – Red and marked AIR. In the event of the air fault light activating, possible causes could be:-

a. Failed motor bearings or seized driven equipment
b. Incorrectly set overload switch
c. Black 4 mm plastic tubing from air manifold to electrical control box has separated
d. Damaged or broken air manifold causing excessive air leak

7.3 Irrigation Tank high level alarm

On the wall mounted alarm panel is an operating/fault detection light – Green and marked Water. The irrigation tank has an alarm level switch set at imminent over flow level. If this alarm is activated possible causes could be:-

a. In-line filter (black cartridge) on irrigation discharge line blocking (clean filter). Cause of 90% of Water alarm activation.
b. Irrigation pump failure
c. Kinked or blocked irrigation line
d. Blocked drippers or sprays in irrigation area
e. Faulty float level switch

8.0 Trouble Shooting

8.1 Problems in Aeration Tank

8.1.1 Septic odours, most likely resulting from under-aeration caused by:

a. Air blower malfunction – possible blocked air intake filter – remove, clean or replace filter;
b. Organic overload – possible cause – primary settlement tank over loaded with sludge: too many people using the WWTP exceeding organic design loading – check sludge level (> 400-500 mm) and remove excess sludge by tanker;
c. Fine bubble diffusers blocked – check for even distribution of aeration pattern in aeration tank.

8.1.2 Excessive foam on surface of aeration tank.

a. Possible cause from excessive detergent use – check cleaning products and excess usage use of detergents for clothes washing.

8.2 Problems in Irrigation Tank

8.2.1 Irrigation tank high level, possible causes

a. Discharge pump malfunction from blocked impeller – check pump casing and clean impeller – determine nature of material blocking impeller and determine source of material;
b. Failed motor – generally will require replacement of pump;
c. Electrical control failure – check motor overload;
d. In-line filters blocking. The filters can block over time reducing the ability of the pump to discharge the wastewater quickly enough – turn isolation switch off at rear of electrical box, undo black filter cartridge and clean filter.

8.3 Excessive turbidity in final effluent

a. Inadequate sludge return rate. Bulking of solids in the clarifier indicate overloading of the clarifier – increase the sludge return rate back to the primary tank(service contractor).
b. Hydraulic Overload. Excess influent flow rates results in overflowing of the Primary Settling Tank and Aeration Tank, whereby sewage does not spend sufficient residence time in the tanks to allow proper treatment.
c. Toxic shock. This is where excessive use of harsh cleaning and other chemical agents entering the system can cause stress to the biofilm to the extent that it is killed and carried over in the effluent – check sewage source for possible contamination and check cleaning products.

WARRANTY

Every bioSystem 2000 ATU comes with a full manufacturers warranty. There is a 15 year warranty on the pre-caste concrete tank and a 12 month warranty on all electrical and mechanical components. Please note, the submersible pump has a two year manufacturers warranty.
The irrigation components come with a 12 month warranty.
The warranty does not cover damage cause by negligence, misuse, failure to keep the system clean or adhere to the manufactures guidelines.