

**OPERATION AND
MAINTENANCE MANUAL
FOR HiPAF
RECTANGULAR PLANTS**

**OPERATION AND MAINTENANCE
OF HiPAF RECTANGULAR PLANTS**

INDEX

1	Health & Safety	3
2	Risk Assessment	4
3	Introduction	5
4	Plant Operation	5
5	Routine Maintenance	6, 7
6	Problem Solving	8, 9
7	Desludging	10
8	Compressors	10
Appendix I	Primary Tank Sizes	11
Appendix II	Plant Description	12
Appendix III	Sludge Returns	12
Appendix IV	Plant Start Up	13
Appendix V	If Discharge below consent is not allowed	14

1. HEALTH AND SAFETY

1.1. United Kingdom Health and Safety at Work Act 1974

Section 6a of this act requires manufacturers to advise their customers on the safety and the handling precautions to be observed when operating, maintaining and servicing their products.

The user's attention is drawn to the following:

All the sections of this manual must be read before working on the equipment.

Suitably trained and qualified personnel must carry out installation.

Normal safety precautions must be taken and appropriate procedures observed to avoid accidents.

The design factors for the lid loads and materials comply with the British Water Code of Practice, BW:COP.22.96. The lids have been tested with a load at 1.0Kn/m² and will withstand accidental passage. THEY ARE NOT DESIGNED AS PEDESTRIAN WALKWAYS.

Refer to WPL Ltd for any further technical advice or product information..

1.2. Health

The following is extracted from a health warning card supplied to all WPL Ltd. staff. It is the client's responsibility to ensure that all necessary protective clothing/ equipment is available.

1.2.1. Leptospirosis

There are two types of Leptospirosis that affect people in the UK:

Weils disease. This is a serious infection transmitted to humans by contact with soil, water or sewage that has been contaminated with urine from infected rats.

Hardjo-type Leptospirosis that is transmitted from cattle to humans.

Typical symptoms?

Both diseases start with flu-like illness with a persistent and severe headache, muscle pains and vomiting. Jaundice appears about the fourth day of illness.

How is it caught?

The disease can enter your body through cuts and scratches and through the lining of the mouth, throat and eyes.

1.2.2. Sensible Precautions

After having worked in sewage or with anything contaminated with sewage, wash your hands and forearms thoroughly with soap and water. If your clothing or boots are contaminated with sewage, wash thoroughly after handling them.

Take immediate action to wash thoroughly, with clean water, any cut, scratch or abrasion of the skin prior to applying a protective covering.

DO NOT handle food, drink or smoking material without first washing your hands.

If you contract the symptoms described after coming into contact with sewage, report to your doctor immediately and advise him/her of the circumstances.

1.3. Safety

Sewage gases are potentially explosive and toxic. DO NOT enter any of the below ground compartments of the HiPAF.

Before carrying out any maintenance work, the equipment must be electrically isolated.

Do not leave covers open for any longer than necessary. Temporary barriers and warning signs should be erected around any open covers or manholes as appropriate, in particular warning of deep water in the tanks.

Any visiting personnel must report to site office on arrival and fully acquaint themselves with safety regulations applicable.

2. Risk Assessment

This section of the manual is intended as a guide and as such does not cater for every situation that may be experienced on site. WPL Ltd assumes that the installer/end user has ensured that all necessary permissions have been sought and granted and that the installation procedures will be carried out observing the requirements of the Health & Safety at Work Act and will involve good building and sound civil engineering practice. Please ensure that due consideration has been given to and appropriate action taken with regard to the following:

- Planning permissions & Building Regulations and other regulating or interested parties.
- Environment Agency consent to discharge.
- The legal responsibility for the plant as far as operation and maintenance and ongoing discharge is concerned.
Note – failure to comply with any regulation may result in pollution, odour, nuisance and health hazards, which may lead to legal action.
- The size of the plant relevant to the number and type of people that will be using it, e.g. domestic, light industrial, etc. Consideration should be given to any unusual conditions such as B & B accommodation, special laundry requirements and frequent entertaining.
- Costs, legal implications and siting in consideration to shared systems.
- The whereabouts of wells, bore holes and springs used as sources of potable water; existing non-mains sewerage systems and soakaways; water courses, ponds and lakes and designated protected areas.
- The whereabouts of other services, pipes, cables, ducts, etc.
- Local ground conditions. Is specialist knowledge of civil engineering required to cater for unusual soil conditions such as underground rivers, running sand, chemicals in the soil, etc?
- The water table at the time of installation. Specialist knowledge is required when installing in an excavation that allows water to enter.
- The water table in winter. Special consideration should be given to installations that will be subject to high water table pressure or flood conditions. The treatment plant will need to be installed so that it cannot “float” out of the ground and provision made for continued discharge of treated effluent, should the discharge pipework/soakaway be under water.
Note – failure to maintain the ability to discharge may result in pollution, odour and nuisance and health hazards, which may lead to legal action. WPL can not be held responsible for failure to discharge due to poorly designed, constructed or positioned soakaways and discharge pipework systems.
- Siting. The plant must be sited within 30m of heavy vehicle access for de-sludging. The plant should, where possible, be sited above the high water table mark and above or beyond the flood plain. See items above and accompanying note. The plant should be sited as far from the habitable parts of the dwelling as possible. Many local authorities recommend 10m as a minimum, but easements are possible for smaller sites.
- Gas & odour ventilation. No special provision is made for venting the treatment plant as gas or odour formation should not occur with a correctly used and maintained plant. However, WPL recommend that the plant be vented. This can be via the vent pipe, normally attached to the building, or by additional venting (high or low level) off of the inlet or outlet pipework or the sample chamber.
- Sample point. A safe and adequate sampling point is usually a requirement of the Environment Agency. This can be an off the shelf item or constructed using standard drainage components. Open pipe discharges to ditches, watercourses, etc, through pipework of less than 5m in length, do not require a sampling point if the effluent can be sampled from the end of the pipe.
- Electrical supply. A qualified electrician (see Electrical Installation section) should only undertake electrical installation. A safe and reliable power supply is required at all times, as the air blower is required to run continuously. Adequate means of air or power failure indication should be provided. This can be an audible or visual alarm or by regular manual checks.
- Due to the health risks associated with raw sewage, WPL recommend that the sewage treatment plant is not used until the system is complete, commissioned and handed over.

Before carrying out any maintenance or installation work, the equipment must be electrically isolated. Do not leave covers open for any longer than necessary. Temporary barriers and warning signs should be erected around any open covers or manholes as appropriate, in particular warning of deep water in the tanks.

Any visiting personnel must report to site office or householder on arrival and fully acquaint themselves with safety regulations applicable.

3. INTRODUCTION

The HiPAF range of high performance aerated filters has been designed to treat the unscreened effluent from sites with population equivalents in the range of 60 up to 500 persons. The HiPAF is intended to serve remote rural communities, such as housing developments, hotels, camping and caravan sites, or any facility not connected to main sewers.

The process used within the HiPAF has been developed to meet the more stringent discharge consents now being imposed by the Environment Agency, particularly with reference to low ammonia levels. The HiPAF can achieve ammonia standards better than 10 mg/l.

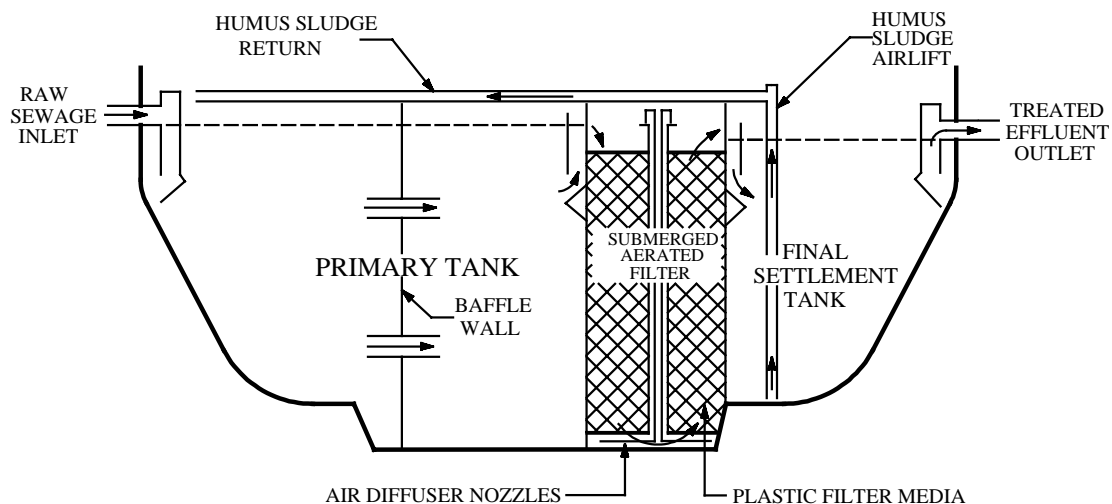
The plant is designed for in ground installation. Compressors and controls to provide the air are housed in a kiosk adjacent to the plant. All tanks covers and kiosks are manufactured in GRP for corrosion resistance and long life.

The sewage effluent undergoes 3 process phases in 3 distinct sections. For a full description of the process see appendix II

Primary settlement tank

Submerged-bed aerated filter

Final settlement tank



4. Plant Operation

The plant is designed to operate automatically with the minimum of maintenance after it has been commissioned. The plant will provide effluent within the designed discharge consent standard after an initial start up period, of 4 to 10 weeks depending on the water temperature. It is important that the sewage input conditions are kept within the plant design criteria. For details of Plant Start Up see Appendix IV.

The compressor is used to aerate the filter and runs continuously.

THERE ARE TWO ESSENTIAL TASKS

DE-SLUDGING THE PRIMARY TANK (between 2 to 4 months)

COMPRESSOR MAINTENANCE ACCORDING TO TYPE FITTED

5. Routine Maintenance

5.1. Weekly

Check that there is noise coming from the kiosk indicating that the compressor/s are operational.
If a warning alarm beacon is fitted it will flash to indicate a problem or lack of air to the plant.

5.2. Six Monthly

Carry out the weekly check plus:

Open the Kiosk and check the extract fan (if fitted) is operating and that the compressor and control panel are dry and in good working order.

Check that the compressor air filters are clean and knock off any collected dust or replace if necessary.

Check that the ducts and louvers, into and out of the kiosk, are clear and not blocked or restricted.

Open the Lids on the main unit. Check that there is an even distribution of air around the filter - indicated by an even distribution of bubbles on the surface of the filter section/s. Pass all the air through each bed in turn for 10 to 15 minutes to remove excess biomass from the media. Ensure the air distribution legs are clear.

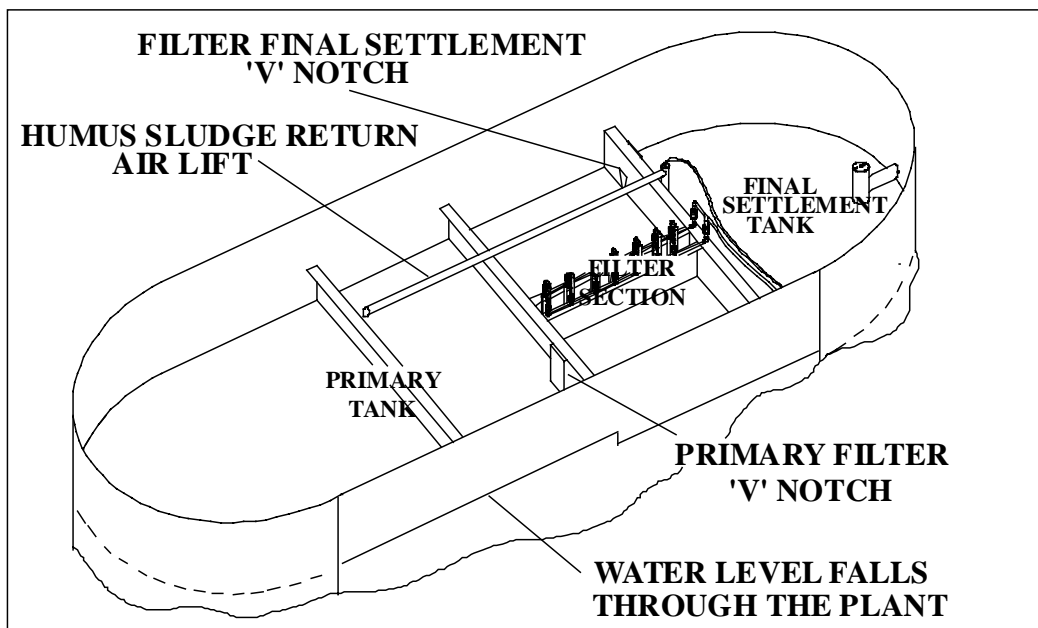
Check that there is drop in the level of the liquid between following sections and that the 'V' notches are clear of any debris.

Check humus sludge return airlift timer(s). See Appendix III.

Check that the liquid in the final settlement tank is clear and there are few floating solids. Any floating solids should be removed when de-sludging the primary tank (see desludging section 6.00 on page 9).

Check air lift operation by pressing 'TEST' on the solenoid valve or test button on control panel, and see that liquor is being returned to the primary tank and is running clear by the end of the cycle. If it does not clear see problem solving section 5.70 on page 9.

Primary settlement tank - check the sludge depth with probe. The floating sludge blanket should not be more than 200 mm thick and the top of the settled sludge should be at least 1m below surface; arrange de-sludge if required.



Operation & Maintenance Manual – HiPAF Rectangular Plant

5.3. Yearly

Carry out the monthly checks plus:

Thoroughly check over all the plant. If there is any scum or grease build up on the sides of the tanks or fittings it should be removed by pressure washing or removed with a wood or plastic scraper. **DO NOT USE A METAL SCRAPER.**

Check control panel and fan (if fitted) for correct operation. Service or replace as required.

Perform compressor maintenance and change air inlet filters

Check the air distribution over the filter surface, adjust position and/or clean air distribution nozzles as required. See faults section 5.61 on page 8.

The Compressor maintenance is carried out by checking the depth of the carbon vanes, see Table 2 Appendix I and grease if required.

Note: If a Compressor other than a Rietschle rotary vane type is fitted to your plant refer to the manufacturers instructions and follow their maintenance procedure.

6. Problem Solving

6.1. Poor Effluent

Compressor not running	Refer to 5.2
No Air bubbles in filter chamber	Refer to 5.3
Poor air distribution	Refer to 5.4

6.2. Compressor not running

Symptoms	Corrections
Power cut	If temporary (24/48 Hours) do nothing; if extended obtain alternative source of power or tanker sewage away. Important - on power being returned to three phase supplies check for correct rotation of compressors
Power supply fault	Switch off compressors, check fuses and any RCD breakers. On 3-phase supplies check for correct rotation. Switch compressors to ON and the compressors should start. If not, switch off and call electrician.
Compressor overload has tripped	Check for any obvious causes, reset overload and switch on; compressors should start. If not, switch off and call an electrician.
Compressor runs intermittently	Check that the cooling fan (if fitted) is running and the air ducts are clear. Overheating in the cabinet will cause the high temperature trip to switch off the power to all but the fan and beacon (if fitted.). Replace fan if it has failed. Temporary solution if the weather is fine: leave the kiosk door open but ensure that no-one can gain access to electrical or rotating mechanisms

6.3. No air bubbles showing on the surface of the filter section

Symptom	Corrections
Compressor not running	Refer to 5.2 Compressor not
Compressor running	Check all valves are open in the kiosk and main unit. Check that the air lines are not broken or leaking. Find where the air is escaping from pipework and repair. Check inlet filter(s).

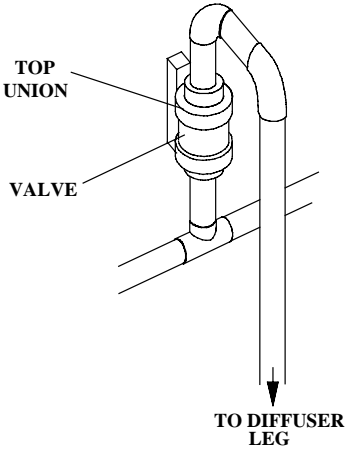
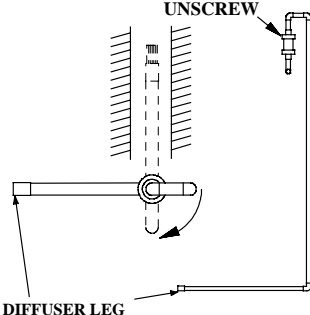
6.4. Blockages

Symptom	Correction
Level in sections is higher than normal	If the plant has been flooded due to high water level or other cause, the 'V' notches may have become blocked. These should be cleared of any debris and the material should be returned to the primary settlement tank.

6.5. Smell

Symptoms	Corrections
Smell escaping from the covers on the plant	If venting is via the inlet pipework, ensure that the outlet T-vent is closed and the inlet T-vent is open. If venting is via the outlet pipework, ensure that the inlet T-vent is closed and the outlet T-vent is open. Also check the seals around the covers and replace as necessary.
Smell escaping from the kiosk	Check that any ducts to the plant (holding tank or pump chamber if installed) are sealed with expanding foam.
Plant smells	Check that grease has not entered the treatment plant. Do all the 'Yearly Checks'.

6.6. Poor Air Distribution over the Filter Section

Cause	Correction
<p>Blocked air Diffusers</p> 	<p>Turn off all but one of the air diffusers at the valves. Then proceed to check the one that is on for the position of bubbles. The increased pressure should clear any blockage in the diffuser. If not, the diffuser can be removed by switching the air supply (compressor) off and disconnecting the diffuser tube at the top of the valve, turning through 90° and lifting up through the diffuser access slot. On early units the diffuser is screwed into the fitting on the end of the tube and can be removed for cleaning or replacement. Later units have a cap with a 5mm hole in the end. In addition there may be some cross-holes on the horizontal pipes. Clear all holes.</p>  <p>Repeat as required for any other suspect blocked diffusers, and then move the air diffusers by angling the tube as required to improve air distribution.</p>
<p>Filter media partially blocked by excessive biomass</p>	<p>This indicates that the plant is overloaded, check design loading and contact supplier for advice.</p>
<p>Filter media partially blocked with sludge</p>	<p>This indicates carry over from primary tank, check sludge levels and de-sludge if required. Also check for excessive flow, possibly due to ground water ingress into foul sewer.</p>
<p>Floating scum layer on final settlement tank</p>	<p>A check can be carried out by instigating extra return cycles. Depress the test button on the timer (mounted on the manifold pipework in the kiosk or on the control panel). Check that the returned liquor begins to clear by the end of a cycle. If it does not start to clear within the cycle, increase the on time by 1/2 a minute and continue instigating extra cycles until the humus return starts to run clear. If the return rate is low from the air lift, check the depth of the air line by sliding the tube into the top of the 'T' piece in the final settlement tank (see the diagram on page 5) whilst the air lift is running. Air should begin to bubble up, when this happens pull the tube back 200 mm and there should then be a reasonable flow.</p> <p>CAUTION: DO NOT INCREASE THE SLUDGE RETURN EXCESSIVELY AS THIS COULD CAUSE A HYDRAULIC OVERLOAD RESULTING IN POOR QUALITY EFFLUENT.</p>

7. De-sludging

The process entails the cleaning out of the sludge from the primary tank into a tanker for disposal. All such matter must be removed because any remaining sludge may go septic and start to cause foul odours. Also, excessive accumulation of scum may result in the carry over of solids to the filter section resulting in blockages in the filter media and a rapid deterioration in final effluent quality.

Remove scum layer then place hose to bottom and suck out the settled sludge. A guide to the quantity of sludge to be removed is given in table 1 of Appendix I. This amount should be approximately divided 2/3 and 1/3. The larger quantity should be taken from the first section of the primary and the remainder from the last section. The actual quantity of sludge taken from the primary tank may vary from the amount quoted in table 1 due to very large, thick scum layers that are removed first, which is quite normal in many cases. If however you are in any doubt please contact WPL for more information.

It is desirable to refill the primary tank with water as soon as possible. Do not leave the primary tank lower than normal level for more than one day.

To assist in refilling, the humus sludge return can be used to transfer liquor to the primary tank by manually running the air lift. (See 5.7) Alternatively, a submersible pump may be used.

N.B. If the water table is very high or flood conditions have recently been present
DO NOT DE-SLUDGE the primary tank. Please contact WPL for advice.

8. Compressors

Compressors are supplied to suit individual plants. There is no further information within this manual. When you plant is delivered to site it will be accompanied by an installation manual, operation and maintenance manual and a manual for the blower or blowers relevant to your equipment. If these have been lost please contact the supplier or WPL for another set.

Operation & Maintenance Manual – HiPAF Rectangular Plant

APPENDIX I

Table 1 - Primary Tank Sizes

Population Equivalent	Days Storage	Sludge to be Removed m ³ (Gallons)	Primary first Chamber 2/3 m ³ (Gallons)	Primary second Chamber 1/3 m ³ (Gallons)
60	90	8.8 (1936)	5.9 (1291)	2.9 (645)
70	90	10.3 (1936)	6.9 (1510)	3.4 (755)
80	90	11.8 (2596)	7.9 (1730)	3.9 (865)
90	90	13.2 (2904)	8.8 (1936)	4.4 (968)
100	90	14.7 (3234)	9.8 (2156)	4.9 (1078)
110	60	12.6 (2772)	8.4 (1848)	4.2 (924)
120	60	13.8 (3036)	9.2 (2024)	4.6 (1012)
130	60	14.9 (3278)	9.9 (2185)	5.0 (1093)
140	60	16.1 (3542)	10.7 (2361)	5.4 (1181)
150	60	17.2 (3784)	11.5 (2522)	5.7 (1261)
175	60	20.1 (4421)	13.4 (2948)	6.7 (1474)
200	60	23.0 (5059)	15.3 (3373)	7.7 (1686)
225	60	25.9 (5675)	17.3 (3800)	8.6 (1900)
250	60	29.2 (6427)	19.5 (4285)	9.7 (2142)
275	60	32.5 (6951)	21.7 (4767)	10.8 (2384)
300	60	35.8 (7567)	23.8 (5250)	11.9 (2625)
325	60	39.1 (8600)	26.1 (5741)	13.0 (2867)
350	60	39.1 (8600)	26.1 (5741)	13.0 (2867)
375	60	42.4 (9326)	28.3 (6217)	14.1 (3108)
400	60	45.7 (10097)	30.5 (6700)	15.2 (3350)
425	30	45.7 (10097)	30.5 (6700)	15.2 (3350)
450	30	45.7 (10097)	30.5 (6700)	15.2 (3350)
475	30	45.7 (10097)	30.5 (6700)	15.2 (3350)
500	30	45.7 (10097)	30.5 (6700)	15.2 (3350)

Note: The amount of sludge accumulated depends on the loading of the plant. Each site has its own specific characteristics.

APPENDIX II

This description is only supplied for interest and is not essential reading for plant operation or maintenance.

1. Plant Description

The HiPAF may be is supplied as a one-piece unit, internally divided into 3 sections, or for larger plants can be in two or three discrete parts. The function and operation is the same in all cases:

2. Primary section

This receives the flow of raw sewage directly from the foul sewer or pumping station. The design of this section reduces the upward flow velocity of the sewage to less than 0.9 m/hr at peak flows into the plant as specified in BS6297. At this low velocity any suspended matter is no longer carried and thus settles out as sludge in the bottom of the tank, to be removed by tanker as necessary. This settlement reduces the biological oxygen demand (BOD) of the clarified liquor flowing into the aerated filter section by up to 30%.

The volume of liquor in this section also serves to equalize the strength of the incoming sewage before it flows into the next section. The inlet and outlet to the tank are baffled to avoid disturbing the settlement of solids. This section also has a baffle across the flow from inlet to outlet to assist in holding back any floating scum that may occur.

The sludge return airlift removes settled solids and some aerated liquor from the final settlement section and returns it to the first part of the primary section. This treated liquor helps to keep the primary tank from turning septic and producing bad odours.

3. Submerged bed aerated filter section

WPL's innovated submerged-bed aerated filter houses a hybrid version of two well-established biological treatment processes. It is a combination of a fixed film reactor system and a suspended floc dispersed growth system for bacteriological oxidation, with the high transfer rates and operational control of the dispersed growth system.

The filter contains high voidage plastic media, on which a wide range of sewage digestion organisms develop. The process of biological oxidation gives off carbon dioxide and humus sludge as by-products. The supply of air is introduced at the bottom of the filter by a series of bubble diffuser nozzles. The humus sludge produced as a result of bacteriological oxidation in the filter bed is transferred with the liquor into the final settlement section.

4. Final settlement section

This section is designed to allow humus sludge produced in the filter section to settle out and be returned to the primary section by an airlift. The airlift is controlled by a timed valve, **PLEASE NOTE APPENDIX III WITH THE CORRECT STANDARD SETTINGS.**

To assist in collecting the sludge the end of the section is conical and the sides also slope to concentrate the sludge into a small area around the airlift pipe.

Appendix III

Humus Sludge Return Air Lift Timers

Standard Settings

With	1 Sludge Return Timer	1st	4 Minutes on	45 Minutes off
	2 Sludge Return Timers	1st	4 minutes on	45 minutes off
		2nd	3 minutes on	45 minutes off
	3 Sludge Return Timers	1st	4 minutes on	45 minutes off
		2nd	3 minutes on	45 minutes off
		3rd	2 minutes on	45 minutes off

APPENDIX IV Plant Start up

1. Introduction

The bacteria necessary to provide the biological oxidation are present in normal sewage and will rapidly multiply if given the right conditions. The process breaks down most of the sewage into carbon dioxide and water.

There are two main types of bacteria:-

- a) Carbonaceous bacteria which, as the name suggests will break down the carbon based solids.
- b) Nitrifying bacteria which break down the ammonia to nitrogen, and this will be partially converted to nitrogen gas before being discharged.

The carbonaceous bacteria are more prolific and also less prone to damage by chemicals (cleaning agents) than the nitrifying bacteria. Both are adversely effected by low temperatures or low pH that may be found in soft water areas. The nitrifiers are more critical and cease to be effective in temperatures below 10⁰C or pH below 7. Low temperatures are not normally found in domestic sewage, this will rarely drop below 15⁰C unless the pipe runs are very long or the flow very small.

The right conditions to grow bacteria are to have both oxygen and food available and these conditions are found in the Submerged bed aerated filter section of the HiPAF.

See Appendix II.2

The effluent quality is defined by a group of two or three figures as BOD:SS: NH₃ (Biological Oxygen Demand:Suspended Solids:Ammonia) All figures represent the concentration in ppm(parts per million) and the most usual requirement is 20:30 with no Ammonia standard. If the discharge point is very sensitive the standard may be as tight as 10:10:5

2. Start Up

It is very important that the air blowers are switched on BEFORE any sewage is allowed to flow into the Aerated filter section or the Humus section of the plant.

The plant will have been left full or partly full with water by the installers and as soon as sewage is introduced into the Primary tank to provide flow the bacterial action will commence. The carbonaceous break down will start almost immediately which will produce large quantities of foam. Although the process will have started the initial quality of the effluent will initially be poor with little treatment.

As the plant initially contained water the sewage will be diluted and usually it will be permitted to discharge effluent below the required level for a limited period. If however no discharge below the consent level is allowed it will be necessary to re cycle sewage through the plant to build up the bacteria. This can be done by using the Humus sludge return

In order to reduce the time to full treatment the plant can be seeded with activated sludge and / or proprietary bacteria, BUT a quantity of normal sewage will also be required.

3. Procedure:

- a) Switch on Blower(s) and check that air distribution is correct and sludge return airlifts or pumps are working.

IMPORTANT: on blowers with 3-phase motors check for correct rotation BEFORE CONNECTING THE HOSES TO THE BLOWER (S)

- b) Introduce sewage into the Primary tank at the normal or reduced rate.
- c) Check after 12 to 24 hour's that:
 - Blower(s) are running correctly and not overheating
 - Air distribution in the Filter section is correct and that foam is being produced
 - The Humus return system is working correctly.
 - Forward Feed is working and feeding forward at a rate of 1.2 to 1.5 times the design DWF (Dry Weather Flow), adjust the timer as required- preferably on every 10 minutes for a short time.

Appendix V

If discharge below consent level is not allowed

- Place bung in final outlet pipe to prevent discharge
- Switch on Blower(s) and check that air distribution is correct and sludge return airlifts or pumps are working.
- Lower the water level to approximately 1m below the normal water level to provide space for sewage or activated sludge.
- Introduce sewage or activated sludge into the Primary tank up to 150mm below the normal level. Check temperature of liquor and if below 15⁰C it is advisable to provide some form of heating to this temperature.
- Allow the plant to run for a few hours, keeping a watch on the liquor level in the Humus tank. If this starts to rise adjust the timer(s) on the Sludge return system until stable.
- Continue to fill the Primary Tank with sewage to near the normal level and then stop OR provide other storage for liquor pumped from the Humus tank.
- Allow system to recirculate for a few days, adding small volumes of fresh sewage or activated sludge to the primary tank to maintain feed to the filter section.
- If required to speed up the treatment process now is the most effective time to introduce proprietary bacteria, as per the manufacturer's instructions.
- Tests on samples taken from the Humus tank are worth starting after 7 to 10 days, but because of the high rate of recirculation the solids content may be high and adversely effect the results of both BOD and SS. If there is an ammonia standard, once this has been reached it is very likely that the BOD and SS will also be within the limits required.
- Once the samples give the required quality the bung(s) can be removed and sewage allowed to flow. This flow should be at a reduced rate initially and gradually introduced over a few days before the full load is reached.