WCS Environmental Engineering

MARLOWE Environmental Services

HIPAF
OPERATION & MAINTENANCE MANUAL

SITE NAME:

REFERENCE NUMBER:

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Revision History:

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1 HEALTH AND SAFETY

1.1 United Kingdom Health and Safety at Work Act 1974

The Health and Safety at Work Act 1974 (also referred to as HSWA, the HSW Act, the 1974 Act or HASAWA) is the primary piece of legislation covering occupational health and safety in Great Britain. The Health and Safety Executive, with local authorities (and other enforcing authorities) is responsible for enforcing the Act and a number of other Acts and Statutory Instruments relevant to the working environment, legal and other binding regulations for accident prevention have to be observed and instruct in addition to the operating manual.

Several work activities bring workers into contact with sewage and sewage products. Each year, some workers will suffer from at least one episode of work-related illness. The majority of illnesses are relatively mild cases of gastroenteritis, but potentially fatal diseases, such as leptospirosis (Weil's disease) and hepatitis, are also reported.

1.2 Who is at risk?

If you work in one of the following areas, your health, or that of your employees, may be at risk:

- Local authority employees involved in sewer inspection and maintenance work.
- Construction workers who repair or replace live sewers.
- Water company employees who work with sewage treatment plant.
- Agricultural and forestry workers who may be exposed to sewage sludge.
- Sludge tanker drivers/operators and associated maintenance staff.
- Plumbers or employees who clean and maintain the underside of railway carriages and empty aircraft sewage compartments and other types of portable lavatories.

1.3 What are the health risks?

Exposure to sewage or its products may result in a number of illnesses. These include:

- Gastroenteritis, characterised by cramping stomach pains, diarrhoea and vomiting.
- Weil's disease, a flu-like illness with persistent and severe headache, transmitted by rat urine. Damage to liver, kidneys and blood may occur and the condition can be fatal.
- Hepatitis, characterised by inflammation of the liver, and jaundice.
- Occupational asthma, resulting in attacks of breathlessness, chest tightness and wheezing, and produced by the inhalation of living or dead organisms.
- Infection of skin or eyes; and/or rarely, allergic alveolitis (inflammation of the lung) with fever, breathlessness, dry cough, and aching muscles and joints.

1.4 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.

1.5 Safety

- Sewage gases are potentially explosive and toxic, therefore any attempts to gain access to the interior of the tank must be carried out by suitably trained and qualified personnel and after strictly meeting all health and safety requirements.
- Before carrying out any maintenance work, the equipment must be electrically isolated.
- Do not leave covers open for 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.
- Normal safety precautions must be taken and appropriate procedures observed to avoid accidents.

1.6 Vaccinations

To avoid illness, it is recommended that site personnel have the following vaccinations. (Your doctor may recommend further).

- Hepatitis A
- Hepatitis B
- Polio
- Tetanus
- Typhoid/Cholera (probably carried out as a child).

1.7 Work at Heights

Employers and those in control of any work at height activity must make sure work is properly planned, supervised and carried out by competent people. This includes using the right type of equipment for working at height. Low-risk, relatively straightforward tasks will require less effort when it comes to planning. Refer to The Work at Height Regulations 2005 for more details.

1.8 Confined Spaces

A confined space is a place which is substantially enclosed (though not always entirely), and where serious injury can occur from hazardous substances or conditions within the space or nearby (e.g. lack of oxygen).

Under domestic law (the Health and Safety at Work Act 1974) employers are responsible for ensuring the safety of their employees and others. This responsibility is reinforced by regulations.

2 RISK ASSESSMENT NOTES

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. WCS EE 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 regulations 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.
- Failure to comply with any regulation may result in pollution, odour and 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, boreholes 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.
- Failure to maintain the ability to discharge may result in pollution, odour and nuisance and health hazards, which may lead to legal action. WCS EE cannot be held responsible for failure to discharge due to poorly designed, constructed or positioned soakaways and discharge pipework systems.
- 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.
- 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.
- WCS EE 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.

- 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.
- 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, WCS EE 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 OF THE PLANT

3.1 Plant loading data

3.1.1 Design Influent Conditions

Design Influent Conditions	
DWF: m^3/day	
PFT: L/sec (m^3/day)	
Unsettled BOD Load kg/day	
NH_3 Load kg/day	
Minimum Process Temperature	7 ^{O}C
pH= (Subject to sufficient alkalinity being present in the raw sewage)	7 to 9

3.1.2 Design Effluent Discharge Standard (95%ile)

Parameter	Package Plant Design Effluent Consent: mg/L
Biochemical Oxygen Demand	
Total suspended solids	
Ammonia	

3.2 Scope of supply

WCS EE Limited is supplying the following:

3.2.1 HPxxxxxxxxx

HPxxxxxxxxxxx installed below ground.

(PRIMARY Unit)	
Length	x,xxxmm (x,xxx mm with pipes)
Depth	2,880 mm
Height	3,200 mm
Weight	Dry Weight x,xxx Kg's Operational Weight x,xxx Kg's
QTY.	1

3.2.2 HP

HPxxxxxxxxxxx installed below ground.

(HP)	
Length	x,xxxmm (x,xxx mm with pipes)
Depth	2,880 mm
Height	3,200 mm
Weight	Dry Weight x,xxx Kg's Operational Weight x,xxx Kg's
QTY.	1

3.2.3 SAF (Submerged Aerated Filter) Blowers

SAF Blower	
Manufacturer	
Type	
Mode	
QTY.	
Power Specification	
Weight	Kg's each

3.2.4 Kiosk

X Large GRP Kiosk	
Length	2,100 mm
Width	1,300 mm
Height	1,000 mm
Weight	450 Kg's

3.2.5 Control Panel

Control Panel - 01	
Length	400 mm
Depth	200 mm
Height	400 mm

WCS EE control panel, containing all control systems to enable the automatic running of the sewage treatment plant. Refer to wiring diagram for further details.

3.2.6 Fan

Fan serves for cooling interior of the kiosk where duty/stand by blower are placed as well as for bringing fresh air. The fan is working when the panel is energized.

Fan	
Voltage 50Hz	230 V
Nominal Power	0.10 kW
FLC	0.6 A

4 PLANT OPERATION

The plant is designed to operate automatically with minimum maintenance after it has been commissioned. The plant will provide effluent within the designed discharge consent standard after an initial start-up period, up to 10 weeks depending on the water temperature and site conditions. It is important that the sewage - input conditions are kept within the plant design criteria.

4.1 Primary Settlement Tank Operation

4.1.1 Operation

Raw sewage gravitates to the primary settlement tank where about 30% of the BOD (Biological Oxygen Demand) load is anticipated to settle down. The primary settlement tank is equipped with internal baffles to prevent any floating scum entering the biological phase of the treatment and reducing treatment efficiency.

4.1.2 Emptying

Typical emptying frequencies vary depending on solids loading rates seen in the waste water but the primary sludge should NOT stay more than 180 days inside of the tank as it gets septic.

For more information on de-sludging and amounts, see cap 11 – Desludging.

4.2 Bio-zone Operation

Partially treated flow gravitates to the SAF (Submerged Aerated Filter) to pass through high voidage plastic media where both carbonaceous and nitrifying processes take place. Air to oxidise the influent is introduced continuously below each chamber by a series of diffusers. Each diffuser is capable of being removed for maintenance without the necessity to shut down the plant.

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

There are two main types of bacteria: -

- Carbonaceous bacteria which, as the name suggests will break down the carbon-based solids.

- Nitrifying bacteria which break down the ammonia to nitrite and nitrite is oxidized to nitrate.

The carbonaceous bacteria are more prolific and also less prone to damage by chemicals (cleaning agents) than the nitrifying bacteria. Both are adversely affected by low temperatures or low pH which may be found in soft water areas. The nitrifiers are more critical and cease to be effective in temperatures below 10 deg C or pH below 7. Low

temperatures are not normally found in domestic sewage, this will rarely drop below 10 deg C unless the pipe runs are very long or the flow very small.

WCS EE plants generally produce a Phosphate concentration of 3-6 mg/l from municipal type influent. This can be further reduced using a dosing system if necessary. (Not supplied for the project)

Following biological treatment, the effluent flows into the humus settlement zone incorporated in a single GRP tank with biological stage where the excess biomass settles down. The humus settlement tank is equipped with an airlift operated sludge draw-off system which will automatically transfer accumulated sludge to the primary settlement tank.

Air required for biological treatment will be provided by **a duty/ standby blower.** Air supplied is monitored by an alarm system that alerts operators via SMS messages or illuminate kiosk's beacon.

4.2.1 Maintenance of the Bio-zone Tank

Maintain the bio-zone tank as described below of this manual. If you are in any doubt, please contact WCS EE office.

4.3 Fan Operation and Control

The fan supplied is working when the panel is energized.

4.4 Blower Operation and Control

The Air Blower(s) operate on a duty or duty/standby configuration. If running duty/standby, an in panel timer will ensure that blowers changeover every 7-10 days applying even wear.

In the event of a failure by overload trip, the standby blower will automatically take the duty role. Any of the above failures will send a signal illuminating the alarm beacon to the operator.

Process air requirement is supplied by duty/standby air pump arrangement. Two blowers of xxxx, model "xxxx" are pre fitted, powered and also connected to the manifold using 2in high temperature hose. Blowers operate either by:

4.4.1 Automatic Control

Automatic control is achieved by setting the air blower Hand/Off/Auto switch to "Auto"; these switches are located on the panel fascia. This will activate the pre-set timers within the panel activating blowers' rotation program.
Following a blower failure or power loss, and when the general reset button has been pressed; the duty/standby program will resume functionality when Hand/Off/Auto switch pointing 'Auto'. When set to Auto, the blowers will have a weekly changeover.

4.4.2 TIMER

There is a timer positioned inside the control panel on the back side of the door. It is to reduce the power consumption by turning off and on the blower(s) in 15min intervals, during normal operation. (Note:- the Blowers should be running 24/7 for the first 6-8 weeks or until the plant is fully seeded).

Only the site operator should adjust the settings.

4.4.2.1 Timer Set Up

To set up the timer, follow the below steps:

- Selecting the "A" letter on the bottom left of the timer, means the timer is in the "Auto" position. (As indicated in Picture 1 below). This set-up will allow the timer to be in operation.

- When the main switch (located on the front of the control panel) is in the "Auto" position, the low air pressure switch will be automatically inhibited to OFF for a certain period of time when the blower stops, so the beacon will not flash showing a fault.

Picture 1

- On the Timer, Once the "Auto" mode is selected, select the cycles required for the blower ON/OFF times. This will be done by moving the switches from the circle of yellow tabs to the outwards position for ON and the inwards position for OFF (see Picture 2 below).

- The Initial set-up is for 15min OFF and 15min ON. If the quality of effluent is deteriorating, increase the blower ON time by moving more yellow tabs to the outwards position.

Picture 2

- On the Timer, selecting the letter "I" on the bottom left of the timer mode will run the blower in manual setting, (as indicated in Picture 3 below).

Picture 3

- On the Timer, selecting the letter "O" on the bottom left of the timer, will switch the blower OFF and no air will go to the plant, (as indicated in Picture 4 below).

Picture 4

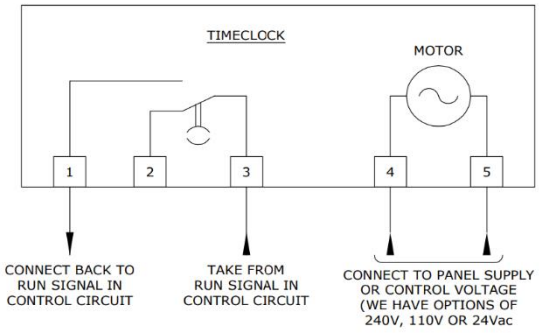
4.4.2.2 General Requirements

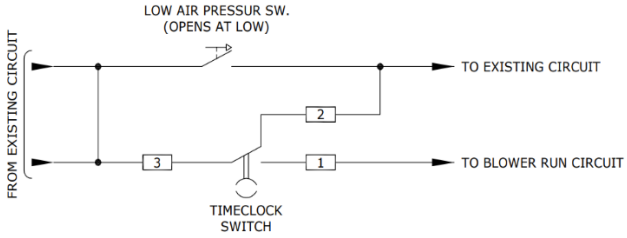
All timers retrofitted in existing panels must be installed by WCS EE, or the process of the sewerage treatment plant will not be guaranteed by WCS EE.

On factory fitted timers, a visit is required after 2 months in operation to check the D.O. (Dissolved Oxygen Levels) and to visually inspect the effluent.

4.4.2.3 Electrical Connections

Below shows the electrical details of the timer controls.





4.4.3 Manual Control

Setting the Hand/Off/Auto switch to 'Hand' will terminate the automatic control and set the blowers to operate manually using 'Start' and 'Stop' buttons in the panel fascia. 'Reset' button must be pressed firstly if the blower has been repaired after a failure to resume blower operation under manual control.

5 COMMISSIONING

5.1 Start Up

Depending on various environmental, chemical and biological conditions, it could take from 4-6 weeks for the process to reduce BOD (Biological Oxygen Demand) levels and additional 4 weeks for Ammonia reduction. After 10 weeks maximum, the plant generates the discharge standard as designed.

During commissioning notice the following:

- It is very important that the air blowers are switched on before any sewage is allowed into the bio-zone.
- Do not seed the bio-zone with activated sludge as this will block the media.

As soon as partially treated flow enters the bio-zone; the carbonaceous break down will start almost immediately which will produce large quantities of foam. During this period the quality of the effluent will initially be poor with little treatment until the biomass has established itself on the media.

5.2 SAF Air Distribution Adjustment

The air distribution within the bio-zone is sensitive to air diffusers capacity and control. Ideally equal quantities of air should come from each of the distribution points; this can be achieved by regulating ball valves to ensure even bubbles distribution. This can be judged quite effectively by observing the streams of bubbles from ground level above the bio-zone.

This is a trial-and-error process on the initial installation and thereafter adjustments should be rare.

The whole manifold assembly can be withdrawn from the unit, after disconnecting the air supply hose, and adjustments take place at ground level. The assembly is then lowered into the bio-zone and the process repeated.

5.3 Airlifts Principle of Operation

An airlift works by aerating the liquid in a tube and causing this mixture to be less dense than the surrounding water. Thus, the aerated liquor moves up the tube by the pressure of the surrounding non-aerated water which forces it to rise. There is a limit to which an airlift will be effective.

5.3.1 Forward feed.

The forward feed should not be set to operate for too long otherwise it can hydraulically overload the design of the plant. The forward feed provides a balancing function, lowering the primary tank so that peak flows to the bio-zone are smoothed out. For forward feed timer valve settings, see following table.

5.3.2 Sludge Return.

Particles settled and accumulated to conform sludge should be returned to the primary treatment stage as part of the whole biological treatment process. For humus return timer valve settings, see table below.

Airlifts Timers Settings	
Forward Feed	2 min On 8 min Off
Sludge Return 1	4 min On 45 min Off
Sludge Return 2	3 min On 45 min Off
Sludge Return 3	3 min On 45 min Off

6 ROUTINE MAINTENANCE

The following routine maintenance tasks should be carried out on the plant over the time period stated:

- **DE-SLUDGING THE PRIMARY TANK (between 2 to 4 months) 60 days and no longer than 180 days**
- **COMPRESSOR MAINTENANCE ACCORDING TO TYPE FITTED**

Weekly checks:

- Check that both of the blowers are functioning correctly.
- Check for any irregular noises coming from the blowers.
- Note the running currents of the blowers to ensure they aren't drawing an undue load. Note: this will give an indication of filter condition and internal lubrication issues. If you notice that load is significantly higher than the blower in clean/new condition it would be recommended to switch the blower to the off position and ensure that the standby

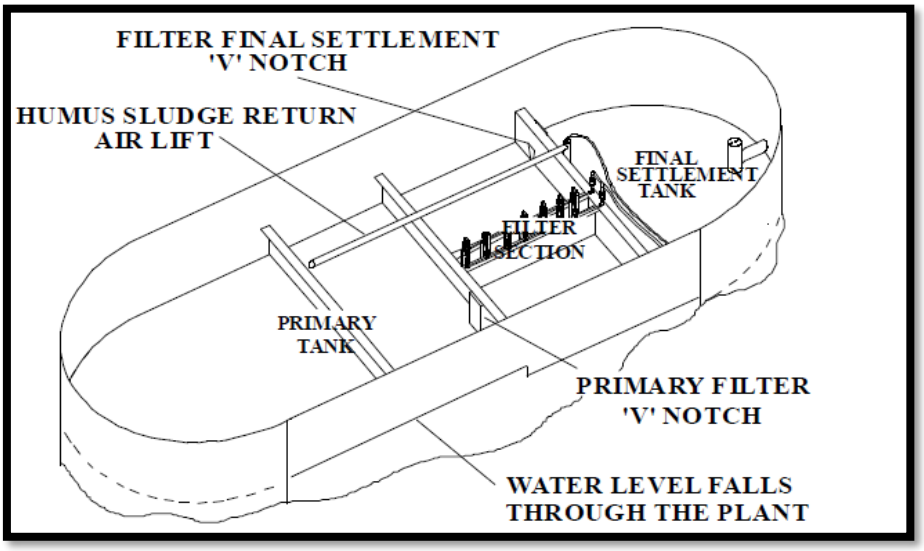
blower is running. The plant should never be left without a source of air for a period longer than 48hrs. If a period of longer than 48hr's is anticipated WCS EE should be contacted.
- Check the operation of the fans and that the thermostat activates them correctly. If fans are fitted to the motor shaft ensure that they are running correctly, drawing air in through the louvers.
- Remove any debris from the louvers.

Six Monthly

Carry out the weekly checks with the addition of the following:

- Check the operation of the extractor fans in the blower enclosure and that the vents are not obstructed.
- Note the running current of the blowers, comparing them to the initial values for the 'clean condition' blower.
- Check the operation of the pressure relief valves and non-return valves fitted within the blower enclosure.
- Inspect the inside of the blower enclosure for obvious leaks or damage.
- Check the operation of the pressure switches by adjusting them to the operating level so that they latch and then ensuring that they can be reset in the main control panel.
- Remove and inspect the air inlet filters, cleaning and grading their mechanical integrity. If the filter shows signs of excessive clogging, then it would be recommended that it be replaced.
- Inspect the air distribution manifold checking for leaks or any damage to the pipework, repairing if required.
- Check that all of the trips and requisite alarms are initiated when the failures occur in the system.
- Check the operation of the plant under full flow conditions.
- 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 desludging the primary tank.
- 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.

- 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.



Yearly

Carry out all of the above checks with the addition of the following:

- Test all of the control panel functionality, ensuring that all of the safety features work correctly.
- Simulate faults and ensure that they can be re-set and brought in to operation
- Check the operation of the fan and service/replace if required.
- Check the air inlet filter and replace if required.
- Refer to Elmo Rietschle / Charles Austen operating instructions for blower maintenance.

7 WARRANTY LIMITATIONS

The warranty period for this plant is 25 years for manufacturing defects and 2 years for the air blower. However, WCS EE shall not be liable for any labour involved for the removal or replacement of its equipment or the subsequent transportation, handling or packaging of any part or parts thereof. In no case will WCS EE be liable for loss incurred because of interruption of service or for consequential damages, labour or expense required to repair defective units, nor shall this constitute a cause for the cancellation of the contract of purchase and sale. Specifically exempt from this warranty are limited life of consumable components subject to normal wear and tear, such as air pump vanes, diaphragms and filters.

8 NON-WARRANTY SERVICES

Service charges will be incurred (including parts and labour), due to the following:

- Unauthorised alteration.

- Accidental damage, caused by plant or movement on site outside of WCS EE's control.
- Improper use.
- Abuse.
- Tampering.
- Failure to follow installation instructions or failure to follow operating and maintenance procedures.

The above will not be covered by WCS EE warranty. All service visits for non-warranty work are chargeable at the standard engineer day rate plus mobilisation. This warranty gives specific additional benefits. Statutory rights are unaffected.

WCS EE will not uphold the guarantee on the purchased equipment if the routine maintenance has not been performed and documented. WCS EE strongly recommends that the installation of the purchased product is carried out by a qualified and experienced installer. Dependent on the site a qualified civil engineer may need to be consulted for the construction of suitable base slab to support the imposed load.

9 PROBLEM SOLVING

9.1 Poor Effluent

Compressor not running	Refer to 12
No Air bubbles in filter chamber	Refer to 10
Poor air distribution	Refer to 10

9.2 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.
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
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

9.3 No air bubbles showing on the surface of the filter section

Symptom	Corrections
Compressor not running	Refer to 12
Compressor running	Check all valves are open in the kiosk and main unit. Check that the airlines are not broken or leaking. Find where the air is escaping from pipework and repair. Check inlet filter(s).

9.4 Blockages

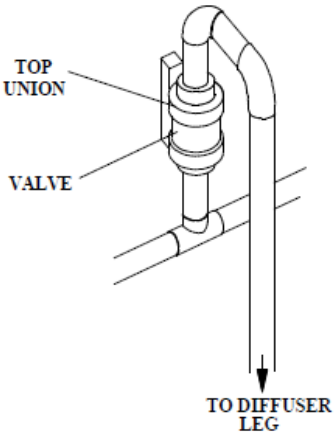
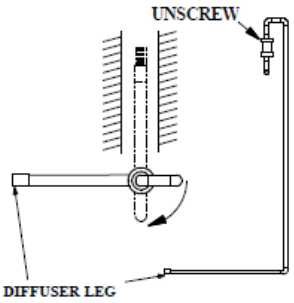
Symptom	Correction
Level in sections is higher than normal	If the plant has been flooded due to high water level or other cause, the 'V' notches may have become blocked. These should be cleared of any debris and the material should be returned to the primary settlement tank.

9.5 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'.

10 Poor Air Distribution over the Filter Section

Cause	Correction
Blocked air Diffusers 	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^{O} 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. 
Filter media partially blocked by excessive biomass	This indicates that the plant is overloaded, check design loading and contact supplier for advice.
Filter media partially blocked with sludge	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.
Floating scum layer on final settlement tank	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 figure 1 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. CAUTION: DO NOT INCREASE THE SLUDGE RETURN EXCESSIVELY AS THIS COULD CAUSE A HYDRAULIC OVERLOAD RESULTING IN POOR QUALITY EFFLUENT.

11 DESLUDGING

The process entails removal of the sludge from the primary tank, into a tanker for disposal. All such matter must be removed, as 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.

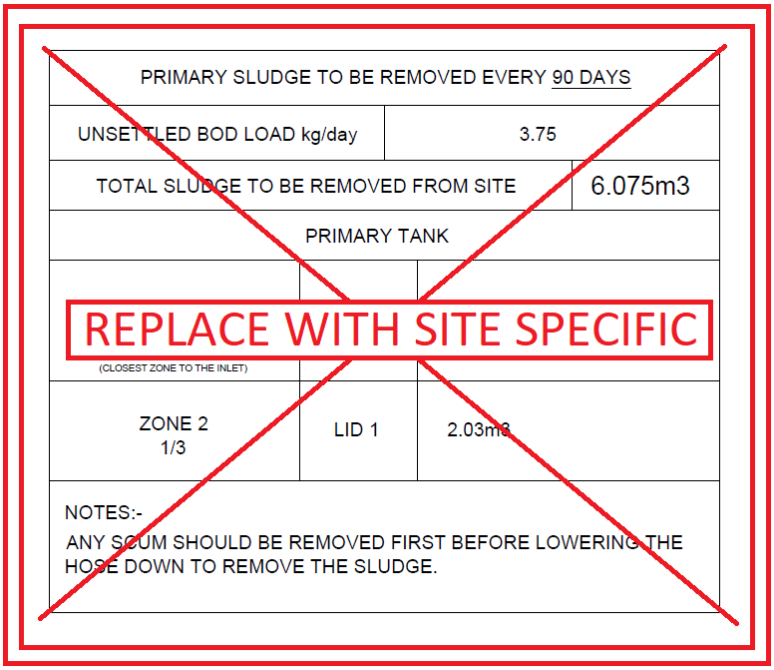
Remove the scum layer first (this is normal to see), as shown in the images below.

(Image showing HIPAF Hatch (left) & lid (Right) with turret extensions)

Once removed in all sections of the Primary tank, place the hose to the bottom of the Primary tank and suck out the settled sludge, as shown in the images below.

The amount should be approximately divided 2/3 and 1/3 between the front and subsequent sections. 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 tanks may vary, and is dependant based on the incoming flow. Please see the table below for the exact de-sludge amounts for each zone through each lid/hatch.



PRIMARY SLUDGE TO BE REMOVED EVERY 90 DAYS		
UNSETTLED BOD LOAD kg/day	3.75	
TOTAL SLUDGE TO BE REMOVED FROM SITE	6.075m3	
PRIMARY TANK		
REPLACE WITH SITE SPECIFIC (CLOSEST ZONE TO THE INLET)		
ZONE 2 1/3	LID 1	2.03m3
NOTES:- ANY SCUM SHOULD BE REMOVED FIRST BEFORE LOWERING THE HOSE DOWN TO REMOVE THE SLUDGE.		

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

NOTE:-

- If the water table is very high or flood conditions have recently been present **DO NOT DE-SLUDGE** the primary tank. Please contact WCS EE for advice.
- Do not fully empty the Primary tank. Only remove the required amount.

12 COMPRESSORS/BLOWERS

Compressors are supplied to suit individual plants. There is no further information within this manual. When your 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 WCSEE for another set.

13 APPENDIX I – Plant Description

1. Plant Description

The HiPAF may be supplied as a one-piece unit, internally divided into 3 sections, or for larger plants can be in multiple discrete units. The function and operation are 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 humus 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

WCS EE's innovative 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 the airlift. The airlift is controlled by a timed valve, please note the correct standard settings below.
To assist in collecting the sludge, the end of the section is conical and the sides slope to concentrate the sludge into a small area around the airlift pipe.

14 APPENDIX II – Forward Feed and Sludge Return

Air Lift Timers

Standard Settings

With	Forward Feed	**1st**	**2 Minutes on**	**8 Minutes off**
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**

15 APPENDIX III - 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. This will also 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 affected by low temperatures or low pH that may be found in soft water areas. The nitrifies are more critical and cease to be effective in temperatures below 10°C or pH below 7. Low temperatures are not normally found in domestic sewage, this will rarely drop below 15°C 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.

The effluent quality is defined by a group of two or three figures as BOD:SS:NH_3 (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 of 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 recycle 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.

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