

**OPERATION AND
MAINTENANCE MANUAL
FOR
DIAMOND C PLANTS**

OPERATION AND MAINTENANCE OF DIAMOND PLANTS

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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.

Leptospirosis

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

Weil's 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, which 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 bacteria can enter your body through cuts and scratches and through the lining of the mouth, throat and eyes.

1.3. 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 immediately prior to applying any 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.

1.4. Vaccinations

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

- i. Hepatitis A
- ii. Hepatitis B
- iii. Polio
- iv. Tetanus
- v. Typhoid/Cholera (probably carried out as a child).

1.5. Safety

Sewage gases are potentially explosive and toxic. **DO NOT** enter any of the below ground compartments of the Diamond C **UNLESS PROPERLY QUALIFIED AND EQUIPPED TO DO SO.**

2.Introduction

The DIAMOND system consists of two treatment chambers in a single tank. The centre aeration chamber is a circular tank with a sloped, open bottom, which empties into the bottom of the outer clarifier chamber. Located in the centre of the aeration chamber is an eight-inch diameter draft tube, which extends to four inches from the bottom of the clarifier. Air is released at the bottom of the draft tube through a disc plate diffuser. As the diffused air rises in the draft tube, it causes an upward flow of process fluid. This draws the settled solids from the bottom of the clarifier up through the draft tube where they are discharged at the surface of the aeration chamber. The design of the draft tube insures continuous and complete mixing of oxygen with the sewage. This allows for the growth of various aerobic organisms that biologically degrade the wastewater contaminants.

Gravity causes the aerated solids to settle back to the bottom of the tank where they are again drawn back up through the draft tube. As raw sewage enters the aeration chamber, it displaces biological solids from the aeration compartment to the clarifier. Quiescent conditions in the clarifier allow the digested solids to settle to the bottom of the clarifier where they are returned back to the aeration compartment. The clarified (treated) effluent flows slowly up through the clarifier and over a weir that extends around the periphery of the tank. The effluent collects in an outer trough where it discharges through a 110mm-pipe connection. A scum baffle located inside the overflow weir prevents floating solids from passing over the weir.

3.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.

The air blower runs continuously to aerate the sewage and there are two essential tasks:

ANNUAL DE-SLUDGING THE PLANT BLOWER MAINTENANCE ACCORDING TO TYPE FITTED

4.Routine Maintenance

4.1. Weekly

Check that the motor is running on the air blowerr indicating that it is operational.

4.2. Six Monthly

The DIAMOND C system requires routine, periodic inspection and maintenance to ensure continuous, trouble-free operation. At a minimum, the DIAMOND C should be inspected every six (6) months, assuming it is serving a typical single family residence. More frequent inspections may be required if mandated by local or stated regulatory authorities; or, if the DIAMOND is used on a non-residential application.

4.3. **It has been observed on some lightly loaded Diamond plants, that a thick scum or crust can build up in the clarifying section between the aeration chamber and the scum baffle. At the six-monthly inspection this scum should be returned to the aeration chamber by means of a scoop or ladle.**

4.3.1. **Air blower - Standard Checks for all Models**

Check filters for cleanliness. Clean or replace if necessary.

Check temperature for signs of excessive overheating (maximum 37-40 degrees Celsius).

Check for air leakage at fittings or in air supply line.

Check for excessive noise or vibration.

Check for moisture or mud accumulations, which could indicate possible flooding or direct rainfall on air blower.

Check air pressure and/or flow with the appropriate gauge. Under normal operations the air pressure should be between 250 and a maximum of 350mb. This pressure is variable particularly when a desludge has just been completed and the tank is not yet fully operational. Flow should be measured against the data sheet for the model supplied. If in doubt please refer to your installer or the manufacturer

If using a rotary vane compressor, check carbon vanes for excessive wear. Replace as required.

4.4. Yearly

4.4.1. **Treatment Plant Aeration Chamber**

Check for presence of septic odour.

Check for colour of aeration chamber contents (see section 7.1).

Check for excessive sudsing or foaming.

Check for excessive accumulation of grease balls and non-biodegradable material. Using a wire skimmer basket, remove such material and dispose in a proper manner.

Check air supply at aeration chamber, especially if odours or septic conditions exist. Air check can be performed by observing amount of turbulence. If necessary, check diffuser for clogging.

Check aeration chamber mixed liquor suspended solids (MLSS) by collecting a sample of aeration chamber contents while compressor is running. Observe rate of settling, volume of settled solids and clarity of the clear part. See Section 8 for further details.

4.4.2. **Clarification Chamber**

Check depth of scum layer and remove to aeration chamber if required.

Check colour and clarity of effluent. If there is no flow an effluent check can be done by running water from a garden hose into the aeration (centre) chamber.

4.4.3. **Miscellaneous items to be checked**

Check access lid to ensure that it is properly fastened.

Check all peripheral equipment such as chlorinaters, dosing pumps, filters, etc.

Check effluent disposal system.

Check air blower cover if installed outside. The cover should be adequately fastened over the compressor; be well ventilated; and protect the compressor from direct rainfall.

5. Air Blowers

5.1. General Information

Please ensure that this manual is kept with your air blower, or in a convenient location for reference to the maintenance of your air blower.

! WARNING Solid or liquid material exiting the air blower can cause eye or skin damage. Keep away from air stream.

! WARNING do not pump flammable or explosive gases or operate the unit in an atmosphere containing them

! CAUTION the air blower is designed for air only. Do not allow corrosive gases or particulate material to enter the air blower. Water vapour, oil-based contaminants or other liquids must be filtered out.

! CAUTION Close supervision is necessary when any appliance is used by or near children.

! WARNING always disconnect the power before servicing. The motor may be thermally protected and will restart automatically when it cools if the thermal protection switch is tripped.

! CAUTION do not operate units above recommended pressures or vacuum duties. To do so will damage the unit.

! WARNING Air blower surfaces can become very hot during operation. Do not touch these surfaces until unit has been shut off and allowed to cool. Ambient temperatures should not exceed 40 degrees Celsius. For operation at higher temperatures consult WPL.

The air blower's function is to blow air and under no circumstances should it be used to pump any other gases, the pumping of fluids, particles, solids or any substances likely to cause explosions.

The moving parts of the GAST SPP and Thomas LP Range of air blower consist of an actuating rod supported by two special synthetic rubber diaphragms which vibrate laterally, permitting long-term continuous operation. Operation is based upon the principle of electromagnetic vibration, which eliminates the need for sliding parts, thereby minimising power consumption and offering high efficiency.

**ALL AIR BLOWER'S SUPPLIED WITH WPL'S DIAMOND PLANT
DO NOT REQUIRE OILING.
NEVER LUBRICATE THESE OIL-LESS PUMPS**

Starting

If the pump is extremely cold let it warm up to room temperature before starting. If the pump does not operate properly, see the troubleshooting guide.

Servicing

Each plant despatched is unique and has its own air blower supplied. Please follow the procedure in the manual supplied with your treatment plant.

6.Problem Solving

A - SYMPTOM	B - CAUSE	C - REMEDIAL ACTION
1. Air blower is running but little or no turbulence is observed in aeration chamber	Insufficient air supply to aeration chamber because of:	
	1. Blocked air diffuser	1. Disconnect air pipe at the union and clean or replace air diffuser
	2. Blocked air hose or pipe	2. Inspect hose and pipe for blockages, especially at joints. Unblock as necessary
	3. Leaking hose or pipe joints	3. Inspect all hose and pipe joints and tighten as necessary
	4. Kinked, crushed or split air hose or pipe	4. Inspect and replace as necessary
2. Aeration chamber contents have a greyish (dishwater) appearance	5. As B 1-4	5. As C 1-4
3. Noticeable odour and poor effluent quality	6. As B 1-4	6. As C 1-4
4. Aeration chamber contents are grey/brown to black. Slight to strong septic odour. Air blower is running and good turbulence is evident. Effluent quality is poor and is grey	7. Heavy hydraulic surge flows from laundry or kitchen activities	7. For commercial applications, install a surge tank before the Diamond
		8. For residential applications, reduce the frequency of laundry to 1-2 loads per day
5. Aeration chamber has a clear appearance with very few suspended solids (<5%). White suds observed. Effluent is clear with no odour	8. Light loading resulting in total digestion of solids	9. No action required if effluent quality is acceptable. Typical of intermittent use.
		10. If effluent quality is unacceptable, slow down the oxidation by providing a timer on the air blower. Contact WPL for on/off periods
6. Aeration chamber as 5, but with very fine particles in the effluent causing it to appear turbid or murky	9. See B 8	11. See C 9-10
7. Aeration chamber contents have a grey appearance and slightly septic odour	10. System is lightly loaded and has been in use for less than 3 months	12. Continue start-up regime of minimal laundry and minimal cleaning chemicals. 13. See C 1-4
	11. Insufficient organic matter present in the influent resulting in a slow start-up	14. "Seed" plant with fresh activated sludge to help initiate start-up
	12. See B 8	15. As Item 5, Remedial Action
8. Aeration chamber contents are grey to black. Effluent is grey and has a strong septic odour	13. Organic overload due to excessive use of waste disposal unit	16. Refrain from discharging food scraps, grease, oil, etc into the waste disposal
	14. As B 1-4	17. As C 1-4
9. Grease balls are observed in the aeration chamber contents	15. Excessive laundry use	18. As C 4
	16. As B 1-4	19. As C 1-4
	17. Insufficient Dissolved Oxygen (DO)	20. At the time of a peak flow, turn air blower off for 15 minutes and check DO with a metre. If DO is less than 1.0 part per million, contact WPL for assistance

10. Effluent contains brown suspended solids, more noticeable during peak flow periods	18. Heavy build up of mixed liquor suspended solids (MLSS), due to normal, long-term usage	21. De-sludge the Diamond
	19. Excessive (>125mm) of scum has accumulated in the clarifying chamber. The scum is being carried under the scum baffle	22. Remove scum back to aeration chamber with a scoop 23. As Item 1, action a, b, c, d
11. System requires de-sludging on a more frequent basis	20. Excessive use of powdered laundry detergent	24. Use liquid detergents or “concentrated” powders
12. Effluent contains excessive suspended solids. Aeration chamber contents have a normal chocolate brown colour, but sludge settles slowly in a jar and forms a light floc	21. Overabundance of “filamentous” bacteria that prevent compaction and settling of the sludge	25. Contact WPL for specific recommendations

7.De-sludging

Bacteria and other microorganisms present in the wastewater utilise the soluble organic material as a food source, converting it into a non-soluble mass. This non-soluble mass or floc is comprised of living microorganisms, sewage particles, as well as inert (non-biodegradable) material. As the process matures, the numbers of microorganisms increase until there is an adequate biomass to metabolise or digest all of the soluble organic material in the incoming sewage. At this point, competition for food results in the dying (due to starvation) of organisms as new organisms are formed. These dying organisms in turn are metabolised, thereby reducing the overall sludge volume.

The volume of solids will gradually increase due to the accumulation of the inert remains of dead organisms (ash), combined with the non-degradable material in the raw wastewater. As the solids increase, the mixed liquor (i.e. contents of the aeration chamber) becomes thicker, developing an increasing darker brown colour. Periodically, the excess solids must be de-slugged (wasted) from the DIAMOND in order to ensure continued plant efficiency.

7.1. De-Sludging Frequency

The rate at which the solids (biomass) accumulates in the DIAMOND, and the subsequent rate at which the excess solids must be removed, is dependant upon on the total volume and strength (i.e. BOD) of the wastewater entering the plant. The typical residential system will need to be de-slugged annually.

7.2. Determining De-Sludging Frequency

In order to ensure optimum treatment efficiency and effluent quality, it is necessary to maintain the level of aeration solids (MLSS) within a suitable range. A low level of solids in the aeration chamber (i.e. during plant start-up) reduces the treatment plant's ability to provide adequate treatment during peak operating periods. Excessive solids, on the other hand, may result in poor settling during periods of hydraulic surges; or, in the development of septic conditions in the plant. In order to determine when the DIAMOND system should be de-slugged it is necessary to perform a solid settlement test (30-minute) during each semi-annual service check:

Procedure:

Mark a large transparent jar into 10 equal portions.

While the compressor is running, fill the jar with the liquid (MLSS) from the aeration chamber. This sample should be collected at mid depth in the tank. Do not collect sample from within the draft tube.

Allow the sample to sit for 30 minutes. If the sample settles slowly, allow it to sit for 24 hours in order to ensure complete settling.

Observe the volume of the settled sludge as a percentage of the total volume of the sample. Occasionally, after the sample sits, a portion of the settled sludge may float to the top of the sample. If this occurs, add together the volume of settled sludge and the volume of floating sludge,

Check the percentage of settled sludge (i.e. sludge volume) to the clear liquor. The optimum level of solid settlement is normally between 5-50%. Whenever the sludge volume exceeds 50%, the plant should be de-slugged.

Sludge Characteristics

It is important to observe the MLSS (mixed liquor suspended solids) sample that is collected from the aeration chamber. As the sample settles you should note the following:

What is the colour of the sludge?

Do the sludge particles clump together in a dense floc that settles rapidly?

Is the liquid above the settled sludge (supernatant) clear?

Does the sample have a noticeable odour?

A good healthy sludge should have a chocolate brown colour. It should form a dense floc that settles rapidly leaving a clear, odourless supernatant. A sludge sample that has a grey/black colour, settles slowly, has a cloudy supernatant, or has a supernatant containing very fine, suspended particles, usually indicates poor treatment plant operation. Therefore, it is important to compare your observations of the DIAMOND plant, as well as the sample of mixed liquor suspended solids to the conditions to determine if the plant is operating properly or if any corrective action needs to be taken.

7.3. Procedure For De-Sludging The Diamond

- a. Remove access cover.
- b. Carefully lower the tanker hose into the inner (aeration) chamber. Slide the hose down the wall of the inner tank until it rests on the bottom of the outer tank (clarifier). Do not insert the hose down the draft tube since this will damage the diffuser and airline.
- c. Pump solids from the bottom of the outer tank. This will lower the liquid level in both the inner tank and outer tank simultaneously.
- d. As the liquid level drops, the scum layer between the inner tank and scum baffle will normally break loose and drop to the bottom of the tank where it can be sucked out. With a garden hose, flush any remaining scum or residue to the bottom of the tank.
- e. Unless the plant is septic or there is an excessive scum build-up, it is not necessary to pump the DIAMOND totally dry. Leaving a small amount of sludge in the bottom (5-10 gallons/22-45 litres) will reduce the normal start-up period.
- f. In areas with a high water table, immediately re-fill the tank with clear water to prevent shifting or flotation

8.De-sludge volumes

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

Unit	Total Internal Volume Litres
DMC6	2271
DMC7	2271
DMC8	3028
DMC9	3974