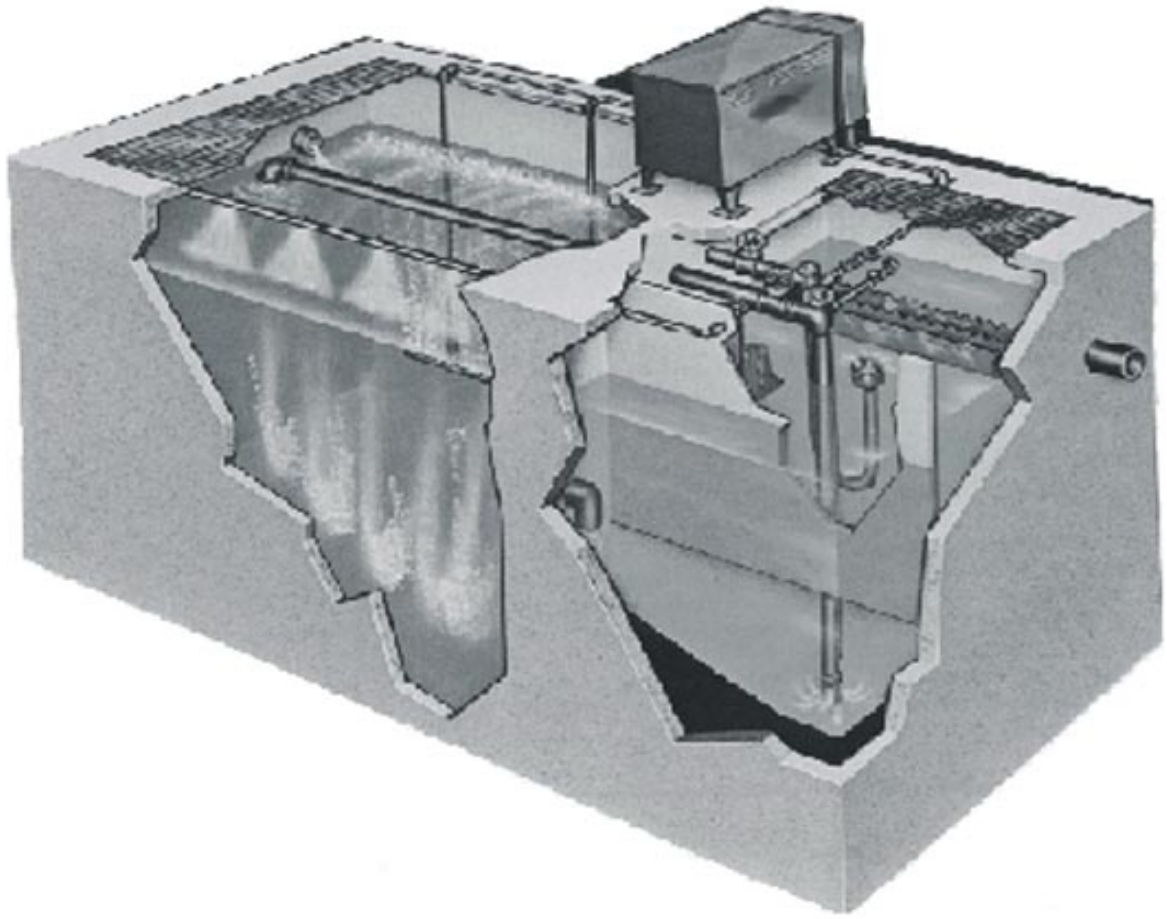
State of Ohio Environmental Protection Agency

OPERATION AND MAINTENANCE

GUIDE FOR OWNERS OF PACKAGE EXTENDED AERATION SEWAGE TREATMENT PLANTS



Division of Surface Water
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Lorain Co. Health Department, Portage Co. Health Department, Lake Co. Health Department, Geauga Co. Health Department, Medina Co. Health Department, Mahoning Co. Health Department, Ohio Water & Wastewater Inc., Mack Industries, Inc., Norweco, Inc., and E. C. Babbert Inc.

References Used:

1. Package Treatment Plants Operations Manual (1997)- USEPA
2. Operation of Extended Aeration Package Plants (1985)- OM-7 OWEA
3. Operation and Maintenance Manual for Owners of Package Extended Aeration Treatment Plants (1970) - ODH

I. UNDERSTANDING YOUR EXTENDED AERATION SEWAGE DISPOSAL SYSTEM

Your business is served by an individual extended aeration sewage treatment and disposal system. You must carefully operate and maintain this system to avoid creating a public health hazard and costly repairs. This guide is to help you assure that your system works properly and does not cause harm to the environment. It is important to remember that your sewage treatment system requires daily attention as a part of your routine facility maintenance program.

To implement the best operation and maintenance program, you should have a basic understanding of the processes taking place in your system. Most treatment plants are preceded by some type of **pretreatment device** which will remove some untreatable matter and prevent it from entering the waste flow (plastics, rags, rocks, etc.). The three types of pretreatment devices are: trash traps, bar screens, and comminutors. In addition, kitchen drains from food service operations should be discharged through a properly sized grease trap. **Flow equalization** may also be required in plants subjected to widely fluctuating hydraulic loadings. A flow equalization tank allows the flows coming to the plant to be held and pumped at a uniform rate to the plant.

The **aeration chamber** is the key part of the secondary treatment plant where 90% of the treatment occurs. This process operates under the following theory: Waste in domestic wastewater is generally organic (biodegradable), which means that aerobic microorganisms in the presence of oxygen can use the organic material as their food source. In nature, if the waste were discharged untreated to a stream, the bacteria in the stream would decompose the sewage and deplete dissolved oxygen levels to a point which could kill all aquatic life in the stream. Similar to nature, in an extended aeration treatment system, air (29% oxygen) is introduced by blowers and bacteria are grown to feed on incoming sewage from your business or dwelling. Bacteria in the aeration tank decompose the sewage to form a suspended sludge. The liquid in the aeration chamber, called mixed liquor, will have the consistency of a thin milk shake and a brown color similar to that of coffee with cream. However, it should be noted that the color will vary from system to system depending on the types of wastes.

A **settling chamber (clarifier)** is placed after the aeration chamber to allow the microorganisms that are grown in the aeration chamber to settle by gravity, forming a sludge on the bottom of the clarifier. Most of the microorganisms settle to the bottom of the settling chamber where they are then pumped back to the head of the aeration chamber. The microorganisms then begin the cycle of feeding on incoming organics in the wastewater. This material is known as return activated sludge (RAS).

The clear liquid at the top of the settling chamber (85-90% treated) will then usually flow to a **dosing pump station/ slow surface sand filter** or **polishing pond** where further treatment is provided (95%). The treated discharge is then disinfected with **chlorine,** and the chlorine is removed by a **dechlorination** unit. Some facilities are now replacing chlorination/dechlorination units with **ultraviolet** forms of disinfection. Disinfection is the process of killing disease-causing microorganisms. Final discharge is normally to a stream with sufficient dilution to safely assimilate the remaining 5% of the pollutants without measurable harm to the environment.

Poor operation and maintenance normally results in serious environmental and public health problems. Your sewage disposal system is not a magical device. It requires inspection and proper care and maintenance, much like your car or home, in order to operate effectively. Proper installation and maintenance of a sewage treatment and disposal system is essential to protect our water resources. A failing sewage system discharges a distinctive odorous black/grey liquid. This type of discharge is a health concern for humans and animals because it contains harmful bacteria and viruses. Drinking water sources can also be threatened by failing sewage system discharges. Sewage discharges into water-ways provide nutrients which can trigger algae blooms, reduce oxygen levels in the water, and lead to possible fish kills.

Most properly operated and maintained sewage systems have a functional life of over twenty-five years, and the replacement of a sewage system is costly. Taking care of your system is important to achieve expected functional life of your sewage system, to help avoid costly repair, and to protect your family's health and our environment. The following guidelines for installation, start-up, care and maintenance of your sewage system are minimum requirements of the Ohio Environmental Protection Agency.

II. INSTALLATION

The package treatment plant must be installed under the supervision of a professional engineer registered in the State of Ohio and in accordance with detail plans approved by the Ohio Environmental Protection Agency.

After the tanks and equipment are installed and the building or facilities are in use, the **MANUFACTURER should be notified to start the system**. The Ohio EPA and local health departments should also be notified for final inspections prior to placing the facility into service.

Assign one responsible person to maintain the system. This person will become familiar with the system, will be able to recognize problems when they arise, and will serve as a contact for the manufacturer's representative. It is generally advisable to designate more than one person to be familiar with the plant and its operation. The assigned maintenance person should be instructed by the manufacturer in the operation and maintenance of the plant during the "Initial Operation". An operation and maintenance manual should be provided by the manufacturer to assist in the operation and maintenance of the system.

A. Collection System

1. Insure that there are no connections of roof drains, catch basins or other storm water sewers into the sanitary collection system. Extraneous water connections will hydraulically overload the wastewater treatment plant and cause failure.

2. Check for signs of loose sewer joints or damaged pipes by observing initial flows during dry and wet weather.

B. Treatment System

1. Be sure that tanks are kept completely free of any mud, sand, gravel, rocks, boards, etc.

2. The plant must be installed level with proper bedding and/or pads.

3. If the plant is to be installed partially or totally below grade, to prevent floating, please consult the manufaturer for proper installation procedures.

4. Backfilling should be completed after tanks are set to avoid wall stress and ponding around the plant.

5. If the tank is metal, the cathodic protection must be connected prior to backfilling.

6. Be sure the tops of tank walls are sufficiently above a finished grade to prevent surface water from entering the plant.

7. A suitable perimeter fence is required for safety and to prevent vandalism. A building is required to house plants when isolation of at least 250 feet cannot be provided from the closest dwelling.

8. The plant site should be reseeded or covered with gravel or wood chips.

9. A suitable access road to the plant must be provided for adequate maintenance.

10. Make sure skimmers and sludge returns are equipped with proper valving.

11. Floats in dosing chambers must be set at elevations noted on the approved plans to insure proper dosing of the filter.

12. If the filter walls are block, the block voids must be filled with grout and walls sealed inside and outside with tar.

13. Filter sand must be certified as acceptable prior to placement (effective size 0.4 - 1.0 mm; uniformity coefficient less than 3.0).

14. Insure that the chlorinator/dechlorinator units are installed correctly with the weir properly in place and an initial supply of tablets.

C. Conformance with Approved Detail Plans

No field changes are acceptable without prior approval by the district office. The design engineer must also approve changes from OEPA approved plans. Site specific changes are to be annotated on the approved drawings retained by the owner.

GENERAL PLANT INSTRUCTIONS

The following list should be completed by the manufacturer or hthe manufacturer's distributor to indicate the equipment on your system. The manufacturer/representative should go over this with you and instruct you according to your system. The operation and maintenance manual should provide the manufacturer's suggested maintenance of each piece of equipment.

PLANT MANUFACTURER _____ BLOWER MANUFACTURER _____ C.F.M. _____

PLANT MODEL NO. _____ PRE-TREATMENT _____

SIZE _____ FOAM CONTROL_____

ELECTRIC POWER PHASE _____ SKIMMER _____

MOTOR H.P._____VOLTS_____ OTHER _____

INSTALLATION DATE _____ START-UP DATE_____

SERVICEPERSON _____ PHONE _____

III. INITIAL OPERATION - START-UP **

A. Equipment

1. Check blowers to be sure blower rotation is correct and check oil levels in blowers before starting up.

2. Make sure blower belts are properly aligned with proper tension.

3. Don't turn on froth spray pump before plant is completely filled. Foaming will usually subside after several weeks once solid levels are normal. Operation of the froth spray pumps should be discontinued once foaming subsides and restarted only as required.

4. Set skimmer and sludge returns initially at about 1/4 pipe flow; set skimmer depth at 1/8" below liquid level.

5. Make sure weirs are level to avoid short circuiting in the clarifier.

6. Air valves should be adjusted to obtain even mixing in the aeration chamber. The air valves should be ad justed to deliver the most air at the front of the aeration chamber while tapering lesser amounts as you progress towards the settling chamber.

7. Filter sand should be raked level, and only half of the filter should be operated at a time, allowing the beds to be alternated every 2 - 3 weeks. Rip rap should be placed around the splash pad to avoid scouring around the edges of the pad.

8. Pump float switches in equalization tanks and dosing chambers should be set in accordance with approved plans.

9. Chlorination/dechlorination chemicals should be filled and properly stored.

B. Operation and Maintenance Instructions

1. Equipment for continued maintenance should be available including a squeegee, extra blower belts, blower lubricant, supply of chlorine tablets, O & M Manufacturer's Manual, 30 min. settling test equipment, rake, and spare air filter. (See Section III of this guide)

2. Check to see if the operator has an understanding of the checklist of the required daily, weekly, monthly, and annual maintenance tasks.

3. If possible, a load of fresh sludge (seed) from another plant should be obtained to help speed up the start-up and development of a healthy biological culture to begin treatment. If this is not possible, then add a shovel-ful of dirt and a bag of dog food to the plant.

4. During start-up, sludge will be stringy and sticky until the plant obtains normal operational level, requiring daily scraping of the settling tank walls.

5. New blower belts have a tendency to stretch slightly and wear, check for slippage the first few weeks.

** These procedures also apply to existing plants which have been shut down for extended periods.

IV. PLANT MAINTENANCE PROCEDURE

A. Daily Procedure

1. Check to see that all mechanical equipment is operating.

2. Check **pre-treatment device**. The pretreatment devices consist of a trash trap, bar screen, or comminutor. The most commonly used trash trap removes grease, leaves, sticks, rags, rubber, plastics, and rocks. Have the trash trap pumped out once a year or more often if grease in the plant becomes a problem. If the pretreatment consists of a bar screen, rake screen and haul away the debris. **Do not throw rakings into the aeration tank**. If the pretreatment consists of a comminutor, check the cutter drum and clean out any solid objects or obstructions and dispose of them as previously stated.

3. Check aeration tanks for uniform roll. Adjust air according to Section IV under "Special procedures following plant shutdown". The blowers must be operated on a 24-hour basis, unless the facility is under the direction of a certified licensed operator, and the use of a timer is authorized by the Ohio EPA.

4. Check to see that **sludge pumps** are returning at a uniform rate in a steady stream. The sludge return pipe should be flowing 1/3 to ½ full. (Note: The color of returning sludge and aeration tank contents should be a rich brown. No objectionable odor should be noted.)

5. Check the final settling tank for surface scum. If the plant has an air lift skimmer, check to see that it is in working order. **Skimmers should be operated only often enough and long enough to remove the accumulation of scum from the settling tank.** The elevation of the scum return pipe should be adjusted so that the skimming edge or notches will be about 3/8" below the liquid level. Break up the floating scum to aid its return through the skimmer. If there is no skimmer, skim off floating debris from the surface with a leaf rake and place in a sealed container. **Excessive grease or scum must be removed from the plant.** It should be hauled away. Odors and unsightly appearances must be avoided.

6. Check the foam control system for proper operation. See Section VI under "Special procedures following plant shutdown".

7. Check the dosing tank and pumps, flow equalization tank and pumps, and tertiary (sand filters) for proper operation.

8. Check the chlorination and dechlorination for proper operation. Add tablets when necessary. Do not allow the supply of tablets in the container to become empty. The tablet feeders work best when filled with a maximum of 6-8 tablets at a time.

B. Weekly Procedure

1. Scrape the hopper walls of the settling tank to prevent an accumulation of sludge on the sides of hopper. (See "Sludge Problems" Section VIII) for an explanation and detail instructions. Do this as required, or at least weekly.

2. Check the oil level in blower. (See Lubrication Section VII)

3. Wash down the plant structures with water from a building connection or from a water hose connection on the foam control pump. Clean trash and weeds from plant area.

4. Check lubrication of comminutor gear box (if any).

5. The sand filter should be alternated on a regular basis. Clean surface sand filters, approximately every two weeks. Only ½ of the filter should be used at a time. This will permit the sand beds to be rotated for cleaning purposes and allow one side to dry out and rest while the other side is in operation. During the fall and winter months it is particularly important to keep both sides of the sand bed in good working order because the cold weather will significantly inhibit the ability to do maintenance. During bed cleaning all solids materials and weeds should be disposed of in an approved landfill.

C. Monthly Procedure

1. Check trash trap, if any, and have cleaned (pump out) when necessary. Trash traps should be pumped when scum and sludge occupy 35-40% of the liquid volume.

2. Lubricate blower bearings. (See Lubrication Section VII)

3. Check V-belts for proper tension and wear. Replace when necessary.

4. Check air filter and clean when necessary. Wash screen with fuel oil or kerosene.

5. If difficulties are encountered which cannot be handled by your maintenance personnel following this manual, service should be obtained from a qualified person such as the manufacturer's representative.

D. Annually

1. Wire brush and paint any rusted metal at least annually or when indicated.

2. Clean diffusers.

3. If the plant is located near trees, tarps should be placed over the tanks to prevent the intrusion of leaves which could clog plant equipment. This should be done in early fall. Tarps should remain in place in until the leaves are no longer a problem.

4. Check grading for structural integrity.

VISUAL CHECK LIST
AERATION TANK

Equipment Operation	Appearance of Liquids	Comments	Correction to Be Made
Aeration mixing is good adequate and blower is operating.	Chocolate brown color, little or no foam	Good - Probably aequate air and adequate solids	Continued same operation
Aeration mixing is good and blower is operating.	Soapy water Too much foam	Little or no solids in aeration. Low sludge age (young sludge). Foam control pump is not operating.	Reduce air input by adjusting valves on diffusers. Be sure to maintain uniform roll. Operate foam control.
Aeration mixing is good and blower is operating.	Black	Septic condition: Plant may be receiving large amounts of septic sewage or blower is not running long enough or both	Aerate heavily until brown color returns and then readjust for adequate aeration. Find source of any septic sewage and eliminate
Blower operating, but no aeration is occurring.	Black	The system has turned septic. The diffusers may be plugged or blower is not running long enough.	Balance the air supply to all diffusers and check air supply line. Check for plugged diffusers, and V belt slipping on the motor.
Blower operating, but air bubbles are only surfacing in only one end of the tank.	Chocolate Color	May not effect treatment but must be corrected.	Check air line balancing valves: or possible diffuser clogging: or “V” belt slipping on blower motor
Blower not operating and no air bubbles rising in aeration tank.	Black	Mechanical failure	Check for electrical failure: press motor starter re-set button. Check “V” belt drive

VISUAL CHECK LIST
SETTLING TANK

Equipment Operation	Appearance of Tank	Comments	Corrections To Be Made
All equipment functioning	Surface clean and effluent clear	Good: Ideal condition	Continued same operation
All equipment functioning functioning	Large chunks of floating sludge	Probably due to inadequate return of sludge or inadequate scraping of hopper	Scrape tank more often. Check air lift: increase rate of pumping
All equipment functioning	Visible sludge blanket 1' or so below surface	Due to inadequate return of sludge or too much sewage or too much skimming	Check air lift: Increase rate of pumping. decrease skimming by reducing air to skimmer
All equipment functioning	Heavy black sludge on bottom of tank	Inadequate return of sludge	Scrape more often-return more sludge by opening needle valve to increase flow to air lift
Skimmer won't skim	Large amounts of scum on surface	May be due to clog in air line or insuf-ficient submergence of skimmer head	If clogged, rod out line or blow out by shutting off discharge end and opening needle valve
All equipment functioning	Large amounts of slimy brown sludge on surface of tank. Seems to float immediately upon entering final Tank	Plant underloaded: not enough solids in plant	Raise inlet baffle in final tank to trap scum and skim by hand. Reduce air input by adjusting diffuser valves or by decreasing aeration period on timer system
All equipment functioning	Solids in effluent (excessive)	May be due to too much skimming and excessive sludge return	Decrease skimming and sludge return to increase clarifier retention period
Air lift sludge won't pump		See instruction manual section on "sludge problems"	Rod out air lift and/or air lift airline. Check for accumulation of mud in clarifier hopper

MONTHLY OPERATION AND MAINTENANCE RECORD

DATE	PRETREATMENT CHECKED Trash Trap, Comminutor	MOTOR & BLOWER WORKING	30-MINUTE SETTLING TEST-%	ODOR	AERATION TANK APPEARANCE	SETTLING TANK APPEARANCE	QUALITY OF EFFLUENT	CHLORINE SUPPLY MAY 1-OCT 31

DATE	SCRAPED SLUDGE	WASHED DOWN PLANT	CHECKED V-BELTS	CLEANED AIR FILTER	COMMENTS	LUBRICATION RECORD		
						BLOWER CHECK OIL	BLOWER BEARINGS GREASE	COMMINUTOR GEAR BOX

V. SAFETY

1. All gratings and fencing should be locked when unattended.

2. All gratings should be kept painted and inspected regularly for structural integrity.

3. Turn the power off when doing electrical work.

4. Become knowledgeable with the safety and storage requirements for any chemicals at the plant. (i. e. granular and tablet chlorine).

5. Do not smoke or eat until after thoroughly washing your hands. When possible gloves should be worn.

6. Do not enter a confined space without proper training in these potential hazards. Never enter a wet well or deep manhole without adequate ventilation. Do not enter a manhole while working alone.

7. Avoid wearing loose clothing around moving mechanical equipment. Do not get near motor blower belts when the blower is running or on automatic timer.

8. Keep the areas around the plant equipment weeded and mowed.

9. Be advised, one cannot swim in an aeration chamber which may be 10 to 15 feet. There is no buoyancy.

VI. SPECIAL PROCEDURES FOLLOWING PLANT SHUTDOWN

Should the plant be shut down at any time for any reason after the initial startup, the following start-up procedure should be followed:

A. With the power off, turn the pulley on the motor and blower to check mobility. If the blower pulley cannot be turned freely by hand, remove the air cleaner and spray kerosene or "liquid wrench" into blower and work pulley back and forth so that it can be turned freely by hand;

B. Push reset button and check fuses in the starter and/or disconnect;

C. Push "start" button or throw disconnect to "on" position;

D. When the blower starts, the air should enter each tank, producing uniform roll or agitation in all aeration tanks. If there is a noticeable difference, adjust the valves to the diffusers to allow more or less air depending on the need, or check for clogging in the diffusers. If clogged, turn the blower off, loosen the union at the top of header lines, remove header and diffuser, clean diffuser, and reinstall. Check air relief valve to make sure it moves freely. Use liquid wrench if necessary.

E. If the plant is equipped with foam-control equipment, test its operation to see if there is a uniform spray from all nozzles. If the flow is uneven, the nozzles should be checked and cleaned. Foam control sprays should be operated only when necessary to control foaming in aeration tank.

VII. LUBRICATION SECTION

A. Blower:

Before starting blower, be sure to check to see if oil has been put into the gear housing. To add oil or check oil level, turn off the motor blower unit, be sure the oil level pet cock is open, then add oil **slowly** until it begins to drip from open pet cock. Leave pet cock open until the oil has stopped running out. This avoids over-lubrication. Too much oil

causes overheating and oil leakage. Close the pet cock after checking oil or filling. Change or add oil as specified by the manufacturer.

B. Blower Bearings:

Bearings at the gear end of the blower are lubricated by the splash from the gears, however, bearings at **the drive end** are packed with grease prior to shipment. Renew this grease at the drive end as needed per the manufacturer's recommendations. On units fitted with grease cups, remove grease drain plugs and turn cap gradually until fresh grease appears at drain. If fitted for a grease gun lubrication plug, lubricate per manufacturer's recommendations. Replace all grease and drain plugs where applicable.

C. Blower Motor - Bearings are packed with grease prior to shipment and need no further lubrication unless grease fittings are present. Grease once a year, lightly.

D. Foam Control Pump - The foam control pump is a sealed unit and requires no additional lubrication.

E. Comminutor Gear Box - Should be checked weekly since it runs continuously. Add il and lubricate the gear box per the manufacturer's recommendations.

F. Communitor Motor Bearings - Most are equipped with sealed bearings requiring no lubrication (consult manufacturer).

VIII. MOST COMMON PROBLEMS AND PROBABLE SOLUTIONS

A. Motors Will Not Run -

1. General power outage.

2. Fuses blown. Replace or reset circuit breaker. If fuses blow repeatedly, have the power supply checked. **Do not replace fuses with those of a greater capacity than the name plate amperage.** Have an electrician check for motor run amperage verses the name plate amperage for proper operation.

3. Motors overloaded. Push reset button; check overload heaters if reset does not start motor.

B. Blower Cuts Out on Overload Protection

1. Inlet air filter plugged. Remove, clean, and replace air filter.

2. Low voltage - Check or have the voltage checked with volt meter **while unit is running**.

3. Air relief valve may not be working (balancing valve).

C. Excessive Foaming

1. Over-aeration. Reduce running time on timer system or adjust diffuser valves to reduce air input.

2. Lack of Solids - (Usually found only during first few weeks of operation.) Operate foam control and hose down.

3. Excessive use of detergents. Reduce amount used or change to soap or a low suds variety of detergent.

D. Foam Control System Not Working Properly

1. Foam control motor not running. Check power supply and push reset button.

2. Foam control motor running but not pumping. Pull pump and clean pump screen.

3. Foam control pumping but sprays not operating properly. Remove spray nozzles and clean.

E. Equipment Will Not Work on Automatic

1. Failure of time clock, if any. Have electrician check.

2. Overload may be released. Push reset button.

F. Sludge Accumulation on Top of Settling Tank

1. Air-lift skimmer not returning.

2. Sludge return pumps not returning or not returning enough. Check hoppers for sludge build up. If sludge lines are plugged, remove cap or plug at top of air-lift pump and clean the line with a pole or rod.

3. Excessive amount of grease. Check grease trap and clean, if necessary. Eliminate grease before it enters the plant. A large grease trap should be installed **outside** the building to intercept kitchen wastes only.

4. Refer to special section on "Sludge Problems".

G. Excessive Solids Going Over Effluent Weir

1. Sludge pumps not returning or not returning enough. Check air lines and sludge air lift pump for blockage.

2. Short circuiting between aeration and settling tanks due to high capacity return of air lift sludge return and skimmer. Close air valve on sludge pump slightly to lower capacity. (Return pipe should run 1/3 to ½ full). Raise skimmer so that it skims only as directed. Operate skimmer only often enough and long enough to keep final tank reasonable clear of scum.

IX. SLUDGE PROBLEMS

During the first few weeks of the plant operation, one of the most common problems is the accumulation of sludge on the sloping sides of the hopper of the settling tank (clarifier). This problem, like many other problems, may be almost completely eliminated by **proper care and maintenance procedures.**

The purpose of the settling tank is to settle out and separate the solids that pass through from the aeration tank. The liquid in the settling tank must be relatively still to accomplish this purpose. However, one of the characteristics of sludge is that it is likely to be stringy and sticky during the early weeks of plant operation. As it settles toward the bottom of the settling tank, the hopper slopes are the most convenient place for the stringy, sticky masses of sludge to stop settling and come to rest.

After a week or so, this continuous build up of sludge will become a spongy mass completely filling the lower portion of the tank. This will stop the normal movement of sludge to the hopper bottom so that it will not be picked up by the sludge pump pipe for return to the aeration tank for retreatment. After a short time gas will form in this spongy mass breaking it up into chunks of sludge that rise to the surface of the clarifier as scum. Here, if the condition persists, the scum will become a solid mass growing thicker as the sludge rises from the bottom. This solid scum accumulation prevents the equipment in the settling tank from performing properly. The skimmer, the foam control pump, and the final discharge

weir are all hampered in their operations. In addition, the scum will give off a very strong stench which makes for almost unbearable conditions in the surrounding areas.

These first paragraphs have been used to describe the undesirable sludge and scum conditions and their causes. The best cure is well covered by the old adage - “An ounce of prevention is worth a pound of cure”. Proper preventative maintenance is the “ounce of prevention”.

Every day during the first few weeks of operation, the operator or some responsible person must visit the plant to see that all equipment is operating and to check the aeration and settling tanks. The factory serviceman will provide a small scraper to be used to keep the hopper slopes free from sludge build up. The hopper slopes begin about three to five feet below the liquid level. The operator should **GENTLY** scrape (with a swimming pool brush or squeegee on an appropriate pole) all around the hopper with a slow, easy, downward motion, just enough to help move the sludge toward the bottom of the hopper where it can be picked up by the sludge return pump. **DO NOT STIR OR AGITATE SLUDGE ROUGHLY OR IT WILL BREAK UP AND RISE TO THE SURFACE**. If this happens, the chunks must be dipped back into the aeration tank for further treatment.

The above outlined procedure should be followed faithfully until the plant bacteria begin to “work” efficiently. This is usually from three to five weeks depending on the strength of the raw sewage coming into the plant. In almost every case the above procedure will prevent sludge problems.

After the plant begins to “work”, this procedure may be followed less frequently as the operator may determine from experience. The amount of sludge being returned to the aeration tank may be seen by watching the flow in the pipe or pipes that discharge into the aeration tank. The pipe (or pipes) should be flowing 1/3 to ½ full with a chocolate brown liquid and be free of objectionable odors.
In addition to sludge build-up, there are other associated conditions which may develop and need attention. It is possible for a sludge return pipe to be discharging clear liquid when there may be three or four feet of sludge in the hopper. This occurs when soft sludge packs solid almost to the hopper bottom except for a narrow channel running down through the mass to the pump intake. Clear surface liquid is pulled down through this channel and up through the pump without disturbing the sludge mass. Therefore, visual checking of the amount or volume of flow in the sludge return discharge is not sufficient, thus the necessity of **GENTLY** moving the mass downward to the pump intake.

Another common condition is a plugged sludge pump. Sludge, being heavier than water, will normally settle to the hopper bottom of the settling tank. If the sludge pump is not returning at least “one-third of a pipe full” to the aeration tank, the slower movement of sludge will tend to allow the sludge to pack in the one foot square area at the hopper bottom and pump intake, then sludge begins to build up inside the pump tube until it is stopped completely. This may be remedied by shutting off air supply to all other equipment and opening the air control valve to sludge pump wide open. If this procedure does not plug the sludge airlift, the plug must be removed from the top of the airlift and the pipe cleaned by rodding it out.

If mud should get into a plant, that which gets into the clarifier will sink to the hopper bottom where it mixes with the sludge and forms a heavier, more solid mass than sludge alone. **The sludge return pumps will not pump heavy mud**. Mud may be detected by **gently** pushing the scraper all the way to the hopper bottom and removing gently. If mud is present, it can be seen on the scraper. Its depth and density may be determined by probing with the scraper. If mud is deep and heavy, the liquids in the clarifier may have to be pumped with a power pump and the mud cleaned out manually. When the vertical airlift becomes clogged with mud or sludge it may be necessary to remove the pipe plug at the top and rod out the vertical airlift.

Care should be taken to see that air lines to pumps do not become stopped or restricted by sludge or mud that might back up through the sludge airlift into the air lines. If this occurs, the air lines and fittings must be removed and cleaned. After any cleaning or unstopping operations, be sure to set air valves for normal operations.

X. OPERATION AND MAINTENANCE SCHEDULE

Operational and Preventative Maintenance **Frequency**

Operational Controls	Daily	Weekly	Mo.	3 Mo.	6 Mo.	Yearly	As Needed
Perform necessary operational and control tests (settleability test, F/M, pH, DO, chlorine residual, etc.)							X
Perform tests as required by NPDES permit and Ohio EPA							X
Pretreatment							
Inspect trash trap			X				
Clean bar screen	X						
Clean comminutor cuttings	X						
Remove and dispose of rags and accumulations from bar screen and comminutor	X						
Check comminutor cutting efficiency and flow. Plugging may occur if rags are not cut up	X						
Clean comminutor of rocks and metal objects	X						
Sharpen blades when cutting edge is worn 1/8 of an inch	X						
Grease comminutor if required by manufacturer instructions							X
Check oil level of comminutor		X					
Aeration Basin							
Observe odor, color, and foam in aeration chamber	X						
Check mixing of the aeration chamber	X						
Visually check aeration system for an even air distribution, even roll across the aeration chamber, no dead spots or septic areas	X						
Clean spary nozzles		X					
Raise and clean rags from diffusers							X
Check oil level in blower gear case			X				
Check for air leaks around base and fittings	X						
Check valves for leaks	X						
Check belts for wear		X					
Check motor and blower casing for overheating	X						
Check aeration system for unusual noises or vibrations	X						

Operational and Preventative Maintenance **Frequency**

Clarifier	Daily	Weekly	Mo.	3 Mo.	6 Mo.	Yearly	As Needed
Scrape the side walls and sloping bottom of the clarifier		X					
Check sludge return for color (medium brown) and return amount (pipe should be 1/3-1/2 full)	X						
Check skimmer inlet setting and skimmer operation	X						
Remove any floating solids	X						
Check sludge blanket depth		X					
Check sludge blanket color in the settling chamber		X					
Check scum accumulation at the inlet baffle		X					
Check effluent weir level				X			
Clean and scrub effluent weir		X					
Paint weirs to prevent rusting						X	
Waste sludge per results of 30-min. Settleability test & F/M ratio		X					
Tertiary Treatment/Disinfection							
Check dosing pump operation	X						
Check float levels (pumping and high water level floats)		X					
Check operation of visual alarm	X						
Check distribution box for leaks		X					
Rake and clean sand beds of sludge and weed accumulation		X					
Alternate sand bed in use							X
Check the operation of the chlorine contact chamber	X						
Check tablet supply in the chlorination unit	X						
Check the operation of the dechlorination unit	X						
Check tablet supply in dechlorination unit	X						
Check operation of ultraviolet disinfection unit	X						
Clean surface of UV bulbs	X						
Replace UV bulbs per manufacturer recommendations	X						

Operational and Preventative Maintenance **Frequency**

Pumps	Daily	Weekly	Mo.	3 Mo.	6 Mo.	Yearly	As Needed
Check for blockage in return sludge pump	X						
Check pumps for clogging or near clogging condition	X						
Clean screen and intake of suction piping of pumps							X
Lubricate pump bearings per manufacturer recommendations							X
Check pump motors for overheating	X						
Blowers							
Check air valve settings on diffusers						X	
Check diffusers						X	
Check pulley alignment			X				
Clean air filter			X				
Check oil pressure relief valve in the blower			X				
Inspect V-belt for wear			X				
Check V-belt for slippage		X					
Check and lubricate pressure relief valve			X				
Motors							
Check electrical leads			X				
Inspect breaker, fuses, and resets			X				
Check blower oil level			X				
Grease blower bearing per manufacturer recommendations							X
Grease comminutor per manufacturer recommendations							X
Check comminutor oil level per manufacturer recommendations					X		
Sludge							
Turn off sludge tank air, settle, and return supernatent prior to wasting sludge		X					
Check sludge holding tank solids level and have pumped as needed			X				

XI. GLOSSARY

Absorption
The process in wastewater by which organic material is consumed by a microorganism by passing the material through the cell of the microorganism.

Activated Sludge
Sludge floc produced in raw or settled wastewater by the growth of microorganism bacteria and other organisms in the presence of dissolved oxygen (DO) and accumulated in sufficient concentration by returning floc previously formed. The term activated implies that the sludge is teaming with the active or living microorganisms or bacteria.

Activated Sludge Process
A biological wastewater treatment process in which a mixture of wastewater and activated sludge is agitated and aerated. The activated sludge is subsequently separated from the treated wastewater (mixed liquor) by sedimentation and wasted or returned to the process as needed.

Adsorption
The sticking of a solid in the wastewater to the surface of the microorganism.

Aeration
The process of bringing about the intimate contact between air and a liquid by bubbling air through the liquid by use of a diffuser.

Aerobic
A condition in which “free” or dissolved oxygen is present in the aquatic environment.

Aerobic Bacteria
Bacteria that requires “free” or dissolved oxygen for their life and growth.

Anaerobic
Requiring, or is not destroyed by, the absence of air or free elemental oxygen.

Anaerobic Bacteria
Bacteria that grow only in the absence of air or free elemental oxygen.

Bacteria
A group of universally distributed, rigid, essentially unicellular, microscopic organisms lacking chlorophyl. Bacteria usually appear as spheroid, rod-like, or curved entities, but occasionally appear as sheets, chains, or branched filaments.

Baffles
Deflectors vanes, guides, grids, gratings, or similar devices constructed or placed in flowing water, wastewater, to check or affect a more uniform distribution of velocities; absorb energy, divert, guide, or agitate liquid.

Biochemical Oxygen Demand (BOD)
A measurement of the amount of oxygen required by the microorganisms to metabolize or digest the organic material in the wastewater. An oxidation brought about by biological activity which results in chemical combination of oxygen with organic matter’ ‘ It is the quantity of oxygen used in the biological oxidation of organic matter in a specified time, at a specified temperature, and under specified conditions.

Biochemical Process
The process by which the life activities of bacteria and other microorganisms, in search of food, break down complex organic material into simple, more stable substances.

Carbonaceous Biochemical Oxygen Demand (CBOD)
A measurement of the amount of oxygen required by the microorganisms to metabolize or digest the carbonaceous organic material in the wastewater. An oxidation caused by the biological activity that results in chemical combination of oxygen with carbonaceous organic matter. It is the quantity of oxygen used in the biological oxidation of carbonaceous organic material in a specified time, at a specified temperature, and under specified conditions.

Chlorination
The application of chlorine to water or wastewater, generally for the purpose of disinfection, but also for accomplishing other biological or chemical results.

Chlorine Contact Chamber
A detention basin is provided primarily to secure the diffusion of chlorine through the liquid. It allows for the proper detention time for the chlorine to remain in contact with the liquid for the specified amount of time to ensure adequate disinfection occurs.

Clarification
Any process or combination of processes where the primary purpose is to reduce the concentration of suspended matter in liquid.

Clarifier
A unit where the primary purpose is to secure clarification. Usually applied to settling chambers, hoppers, sedimentation tanks, or basins.

Comminution
The process of cutting and screening solids contained in wastewater flow before it enter the flow pumps or other units in the treatment plant. Comminutors are installed as a pretreatment device.

Contact Tank
The tank in the contact-stabilization plant that receives wastewater and reaerated return sludge. Adsorption takes place in the tank.

Dechlorination
The partial or complete reduction of residual chlorine in a liquid by any chemical or physical means.

Decomposition of Wastewater
The breakdown of organic matter in wastewater by bacterial action, either by aerobic or anaerobic bacteria.

Detention Time
The theoretical time required to displace the contents of a tank or unit at a give rate of discharge.

Diffuser
A porous plate, tube, or device through which air is forced and divided into minute bubbles for diffusion in liquids. These diffusers are used in aeration tanks to diffuse air into various portions of the wastewater treatment process.

Digestion Tank
A tank in which sludge is placed to permit digestion to occur. Also referred to as an aeration chamber.

Digestion
The biological decomposition of organic matter in sludge resulting in the partial gasification, liquidification, and mineralization of the sludge while in the digester.

Disinfected Wastewater
Wastewater to which chlorine or other types of disinfecting devices or chemicals have been applied during or after treatment to destroy pathogenic organisms.

Dissolved Solids
Consist of organic and inorganic material that is present in true solution in the wastewater.

Effluent
Water, wastewater, or other liquid flowing or exiting from a basin, reservoir, or tank of the treatment process. This liquid is generally referred to as the final effluent when it is discharged from the last treatment process and enters the environment.

Grit
The heavy mineral material present in wastewater such as sand, eggshells, gravel, and cinders.

Influent
Water, wastewater, or other liquid that enters into a reservoir or basin of a treatment plant.

Inorganic waste
Waste material such as sand, salt, iron, calcium and other mineral materials which are not converted in large quantities by microorganism action. Inorganic wastes are chemical substances of mineral origin and may contain carbon and oxygen.

Microorganism
Microscopic living objects which require energy, carbon, and small amounts of inorganic elements to grow and multiply. They get these requirements from the wastewater and the sun and, in doing so, help to remove the pollutants from the wastewater.

Mixed Liquor
Used to refer to the mixture of wastewater and the return activated sludge in the aeration tank of an activated sludge system.

Nitrification
The conversion of nitrogenous matter into nitrates by bacteria.

Organic Matter
Chemical substance of animal or vegetable origin, or more correctly, of, basically carbon structure, comprising compounds consisting of hydrocarbons and their derivatives.

Oxygen Demand
The quantity of oxygen required to satisfy the oxygen requirement in a given liquid.

Overaerated
Sludge which remains for long periods in the aeration tanks with dissolved oxygen at 4.0 mg/l and above.

Overoxidized
Sludge which passes through the aerator and clarifier many times in one day due to high return rates.

Organic Wastes
Waste material which comes from animal or vegetable sources. Organic waste generally can be consumed by bacteria and other small organisms. Organic wastes contain mainly carbon and hydrogen along with other elements.

pH
A term used to express the intensity of the acid or alkaline sources. A pH of 7. 0 is considered neutral with acidity increasing as the pH decreases. The pH becomes more alkaline as the pH value increases. The normal pH for wastewater treatment is 6.5 to 7.5.

Residual Chlorine
Chlorine remaining in water or wastewater at the end of a specified contact period as combined or free chlorine.

Scum
The layer or **film** of extraneous or foreign matter that rises to the surface of a liquid and is formed there. It may also be a mass of solid matter that floats on the surface or is a residue that is deposited in a channel or container at the surface of the water.

Septic
A condition produced by the growth of anaerobic organisms. If severe, the wastewater turns black, giving off a foul odor and creating a heavy oxygen demand.

Septic Tank
A settling tank in which settled sludge is in immediate contact with the wastewater flowing through the tank and the organic solids are decomposed by anaerobic bacterial action.

Sedimentation Tanks
The sedimentation tank is used to collect the settled solids as they pass through the liquid wastewater and settle on the bottom of the tank. It is usually referred to as a hopper, settling chamber, or a clarifier when used in the final settling stage of the wastewater treatment process.

Settleable Solids
That matter in wastewater which will not stay in suspension during a preselected settling time period such as an hour. This material either settles to the bottom or floats to the surface.

Settleability Test
A determination of the settleability of solids in a suspension by measuring the volume of solids settled out of a measured volume of sample in a specified interval of time usually reported in milliliter per liter. The time requirement of the settleability test usually is 30 minutes, however, various other characteristics about the sludge quality can be determined by varying the length of time used for the settling test.

Sludge
The settleable solids separated from the liquid during clarification.

Sludge Age
The theoretical length of time that a particle of activated sludge will remain in the aeration system.

Sludge Bulking
A phenomenon that occurs in activated sludge plants whereby the sludge, occupies excessive volumes, will not concentrate readily, and will not settle in the final clarification process.

Sludge Digestion
A process by which organic matter in sludge is gasified, liquefied, mineralized, or converted to a more stable form by anaerobic or aerobic organisms.

Stabilization Tank
The tank in the contact-stabilization plant that receives return sludge from the clarifier for more aeration (reaeration). Absorption takes place here.

Squeegee
A device, usually with a soft rubber edge, used for dislodging and removing deposited wastewater solids from the walls and bottoms of sedimentation tanks.

Supernatant
Liquid removed from settled sludge. Supernatant commonly refers to the liquid between the sludge on, the bottom and the scum on the surface of any settling tank.

Suspended Solids
Solids that either float on the surface of, or are in suspension in water, wastewater, or other liquids and are largely removable by filtering.

Tile Field
A system of open-jointed tile, usually laid on a rock fill, used for dispersing wastewater effluent into the ground.

Total Solids
The sum of dissolved and undissolved constituents in water or wastewater, usually stated in milligrams per liter.

Wastewater
The spent water of a community. It may be a combination of liquid and water carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any ground water, surface water, and storm water that may be present.

Wastewater Decomposition
Transformation of organic or inorganic materials contained in wastewater through the action of chemical or biological processes.

Wastewater Oxidation
The process whereby, through the agency of living organisms in the presence of oxygen, the organic matter contained in wastewater is converted into a more stable or mineral form.

Weir
A diversion device that controls the level of the water and allows the effluent to pass over while prohibiting any solids from exiting the system. The primary purpose is to allow for an even steady flow of effluent to be discharge from the clarifier. The device has a crest and some side . containment of known geometric shape, such as a V. The liquid surface is exposed to the atmosphere' Flow is related to upstream heights of water above the crest, to a position of crest with respect to downstream water surface, and to geometry of the weir opening.

Weir Loading
In a solids contact or sedimentation unit, the rate in gallons per minute per foot of weir length at which clarified or treated is leaving the unit. This loading rate is used to determine the retention time and the discharge.

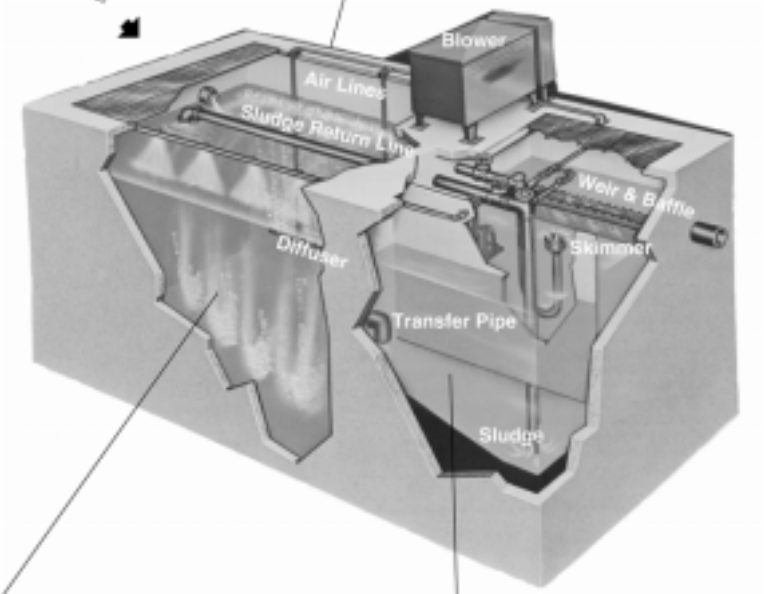
EXTENDED AERATION TREATMENT PLANT
This sewage treatment plant is an Extended Aeration or "Package" plant. This poster is intended to provide the layman with the basic information on operation and maintenance. The plant shown here is "typical." Yours may lack some of this equipment, or may have some not shown.

Ohio EPA
Division of Surface Water

1. TRASH TRAP
Removes heavy inert solids and floatable greases.

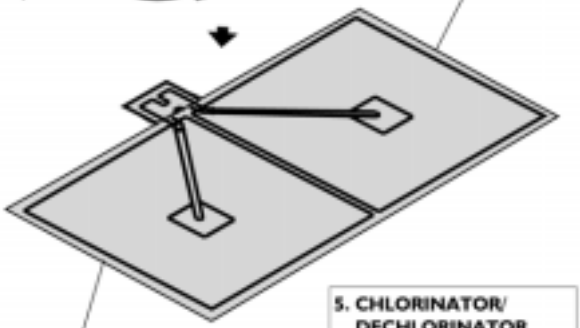
EVERY SIX MONTHS
Have it pumped

2. TREATMENT PLANT
Grows microorganisms (not insects, but usually called "bugs") that digest sewage. Need air CONSTANTLY to grow.

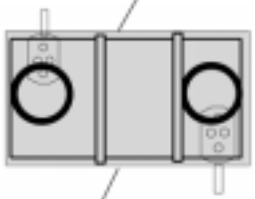


3. Dosing Chamber
Pumps water to filter

4. FILTERS
Removes finer solids from treated water.



5. CHLORINATOR/ DECHLORINATOR
Kills germs with chlorine, Then removes chlorine.



AERATION TANK(S)
DAILY CHECK:
COLOR Chocolate brown, not gray or black.
ODOR Musty, like compost; not a septic "rotten egg" smell.
AIR Blower should run all the time and keep the tank well-mixed.
MOTOR Check the belt and the air filter.
SLUGE Return pipe should be flowing about 1/3 full with chocolate brown liquid.

CLARIFIER(S)
DAILY CHECK:
NO FLOATING SLUDGE Use skimmer as needed to remove floating sludge.
SLUDGE LEVEL Water should be clear down to a depth of about 12".
WEEKLY:
SCRAPE SLUDGE off clarifier walls down to the bottom of the tank.
QUARTERLY-YEARLY:
PUMP OUT the sludge in the clarifier, based on 30-minute settling test.

FILTERS
DAILY CHECK:
PONDED? If so, switch to another filter.
REMOVE WEEDS and DRIED SLUDGE Lightly rake the sand smooth.
ALTERNATE BEDS Switch every two weeks.

CHLORINATOR/ DECHLORINATOR
DAILY CHECK:
Keep tablets in the feed tubes from May through October.

REGULAR MAINTENANCE

THE TREATMENT PLANT NEEDS MAINTENANCE like any mechanical equipment. If you can't do it yourself, hire a qualified operator to check it at least monthly.

TO FIND AN OPERATOR Check the Yellow Pages under Sewage Treatment, not "Septic Tanks."
-or-
Ask Ohio EPA or your County Sanitary Engineer or Health Department.

CHECK THE TREATMENT PLANT DAILY Even if you hire an Operator, you still need to check the plant every day. Call your Operator if there's a problem.

FOR HELP, CALL:

Ohio EPA Offices
CDO 614-728-3778
NEDO 330-963-1200
SWDO 513-285-6357
NWDO 419-352-8461
SEDO 614-385-8501