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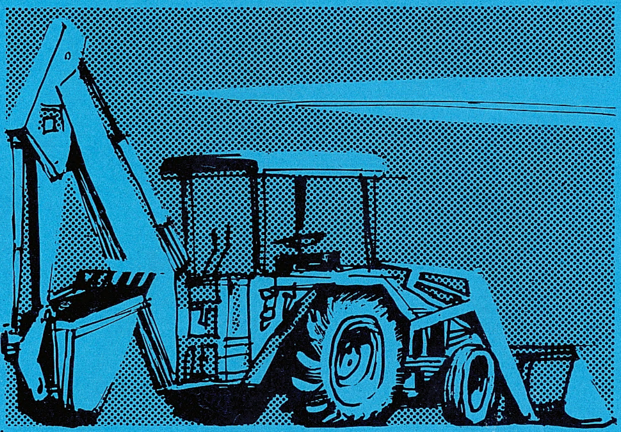

Sewage Pumps and Pumping Stations

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Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

Canada

SEWAGE PUMPS AND PUMPING STATIONS

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SEWAGE PUMPS AND PUMPING STATIONS

1.0 INTRODUCTION

Sewage pumps and pumping stations must provide continuous and reliable service. It is very important to understand pump capacities, and to select the right pump for the materials to be pumped and the systems to which the pump discharges. Information can be obtained from the plans, specifications, engineering studies, shop drawings, manufacturer's data and operation and maintenance manuals.

2.0 DEFINITIONS

Activated Sludge: aerated sewage containing aerobic bacteria (bacteria that live in air).

Cavitation: the formation of a cavity in a structure or of bubbles in a liquid, or of a vacuum in a liquid.

Diaphragm pump: a pump in which a flexible diaphragm, generally of rubber or other flexible material is the principal feature. The diaphragm is fastened to the edges of a vertical cylinder. When the diaphragm is raised suction is caused and when it is depressed liquid is forced through a discharge valve.

Head: the difference in elevation between two points -- this can be expressed in terms of feet, or pounds per square inch.

Suction head: the difference in height between the water level in a well and the centre of the pump impeller (without loss due to friction).

Positive suction head: when the well water level is above the impeller centre.

Negative suction Head: when the water level is below the centre of the impeller.

Discharge head: the vertical distance between the centre line of the pump and the elevation at the discharge side, disregarding friction.

Impeller: a set of vanes designed to rotate causing a mass of fluid also to rotate.

Pneumatic: of, or acting by means of compressed air.

Prime: to pour liquid into a (pump) to make it start working.

Pump: a mechanical device for causing flow, raising or lifting water or other fluid, or applying pressure to fluids.

Sheave: a grooved wheel in a pulley block for the rope or belt to run on.

Wet well: a compartment in which a liquid is collected and to which the suction pipe of a pump is connected.

3.0 TYPES OF PUMPING STATION

3.1 Wet Well Pumping Station

In the wet well pumping station, one compartment holds both the incoming wastewater and the pumping equipment. The bottom of the wet well is smooth and has a slope to help move solids to the pump (see Figure 1).

3.2 Dry Well Pumping Station

In the dry well pumping station, there are two wells or compartments. The wastewater is collected in one well, called the wet well. The pumping equipment is kept in the other, the dry well (see Figure 2).

Usually there are two or more levels in the dry well. Pumps, valves and pipes are on the lower floor. Controls and motors are on the upper floor. This protects equipment from flooding or leaks.

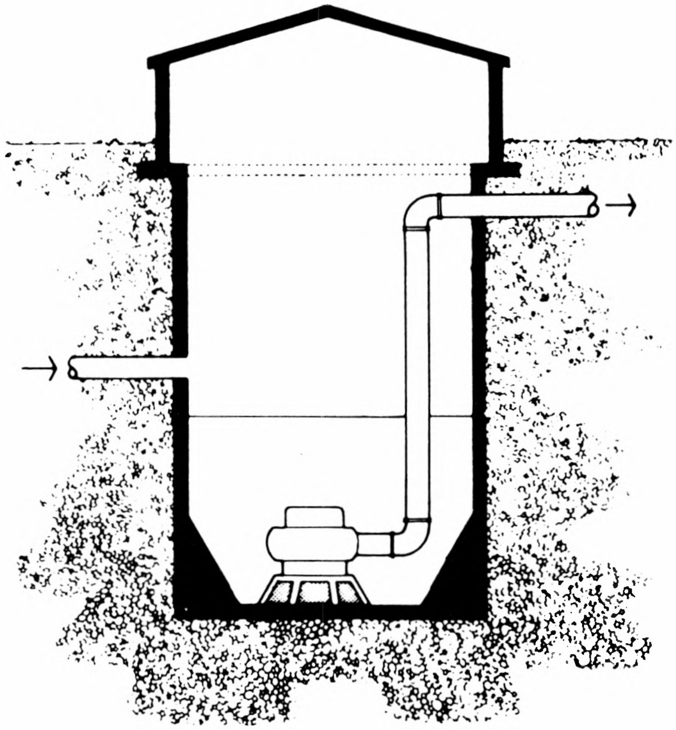


Fig. 1 Wet Well Pumping Station

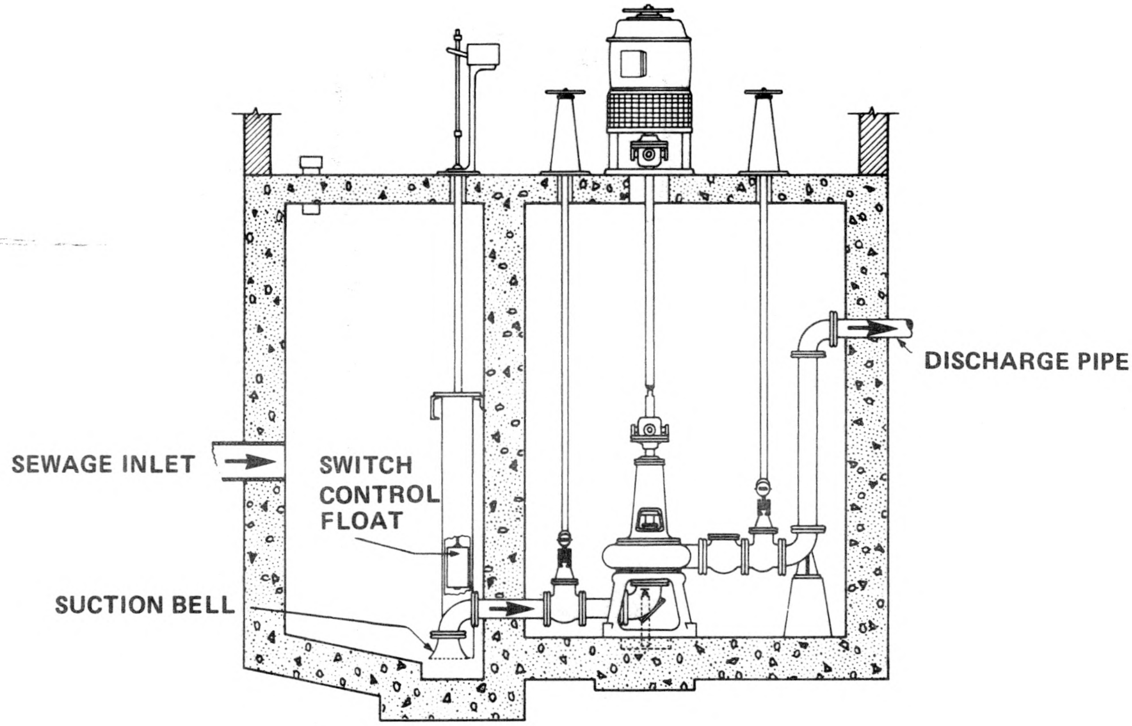


Fig. 2 Dry Well Pumping Station
(Courtesy Fairbanks-Morse Pump and Electric Div.)

4.0 CLASSIFICATION OF PUMPING UNITS

Pumping units can be classified according to the following:

a. material pumped:

(1) raw wastewater, or
(2) processed wastewater;

b. pumping system:

(1) head, or
(2) capacity; or

c. pump type:

(1) centrifugal,
(2) positive displacement pump, or
(3) air lift pump (ejector).

5.0 REASONS FOR USING PUMPS

As much as possible, we use gravity to bring wastewater to a treatment plant. If wastewater has to be moved from a lower to a higher elevation a pump must be used. The difference in elevation between the two points is referred to as head (see Figure 3). Pumps are also used to move sludge, feed chemicals, and so on. Different pumps are used for different applications. The building where the pumps and pumping equipment are kept is called a pumping station or lift station.

6.0 EQUIPMENT DESCRIPTION

6.1 Centrifugal Pump

6.1.1 How the Pump Works

A centrifugal pump has one moving part: an impeller rotating within a casing. The impeller is mounted on a shaft that is supported by bearings and coupled to a

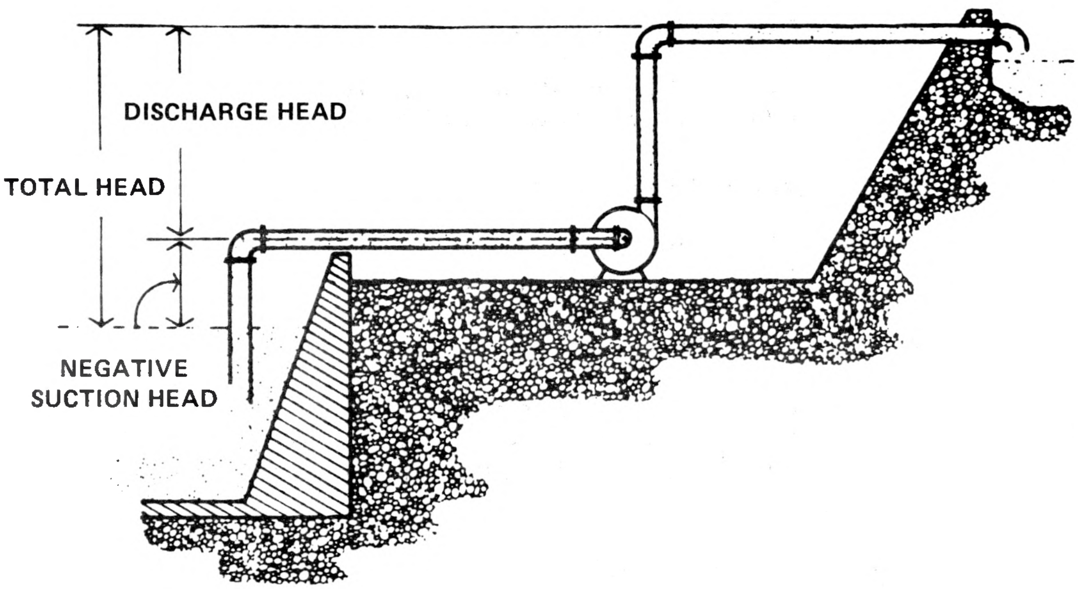
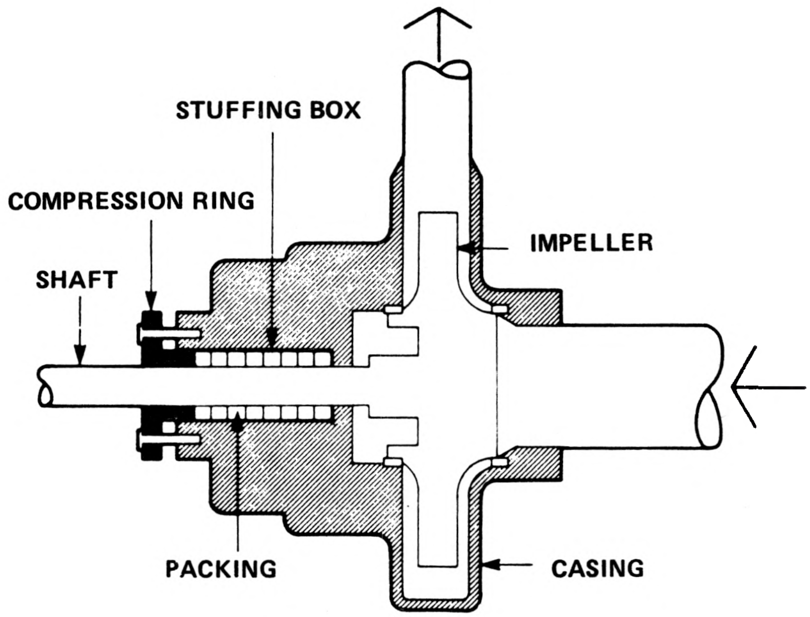


Fig. 3 Basic Concept of Head

drive (see Figure 4). The drives on Indian reserves are usually electric. Pumps can deliver a wide range of flows depending on the design and speed. The manufacturer's pump performance curve will provide information on discharge, power requirements, and head characteristics for a specific pump.



CENTRIFUGAL PUMP – CROSS – SECTION

Fig. 4 Basic Parts of a Centrifugal Pump

Figure 5 shows how an impeller works. Note that the wastewater is being thrown out of the pump. This means that a centrifugal pump can be run for a short time with the discharge valve closed in order to reduce the volume of liquid being pumped. The intake valve must always be kept fully open -- running the pump with a closed intake valve could damage the pump, or even cause an explosion.

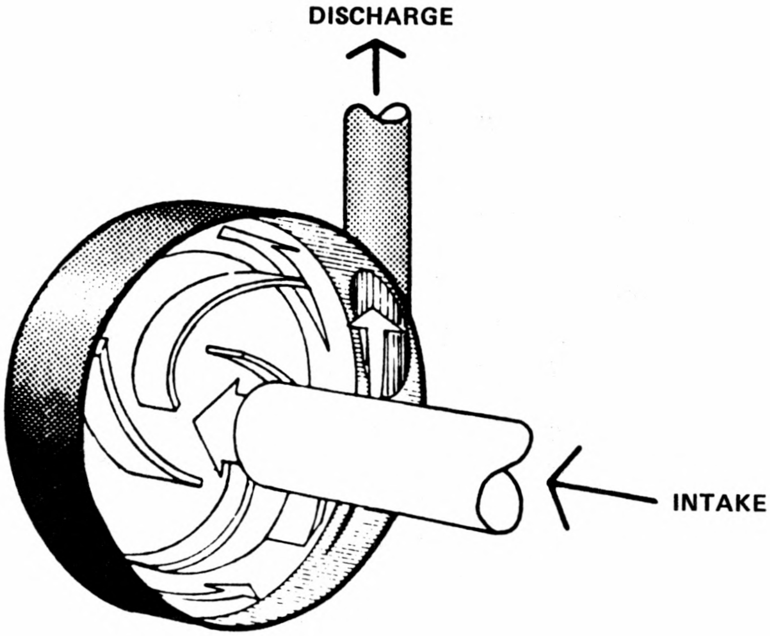


Fig. 5 How the Impeller Works

The working parts of the pump are the vanes. The number of vanes can vary. If the vanes are placed between two discs or shrouds, it is called an enclosed impeller. If only one disc is used, it is called a semi-enclosed impeller.

The open and the semi-enclosed impellers are the most common methods of pumping wastewater. They do not clog easily, and work well with stringy materials and liquids with high solids content.

Before the centrifugal pump can be started, it must be primed. Any air trapped inside the pump will cause the pump to lose its prime. Even a self-priming pump has to have the casing filled, at least on the first start.

6.1.2 Seals

6.1.2.1 Stuffing Box and Packing Seal

A special seal is used to reduce the amount of leakage around the drive shaft as shown in Figure 6.

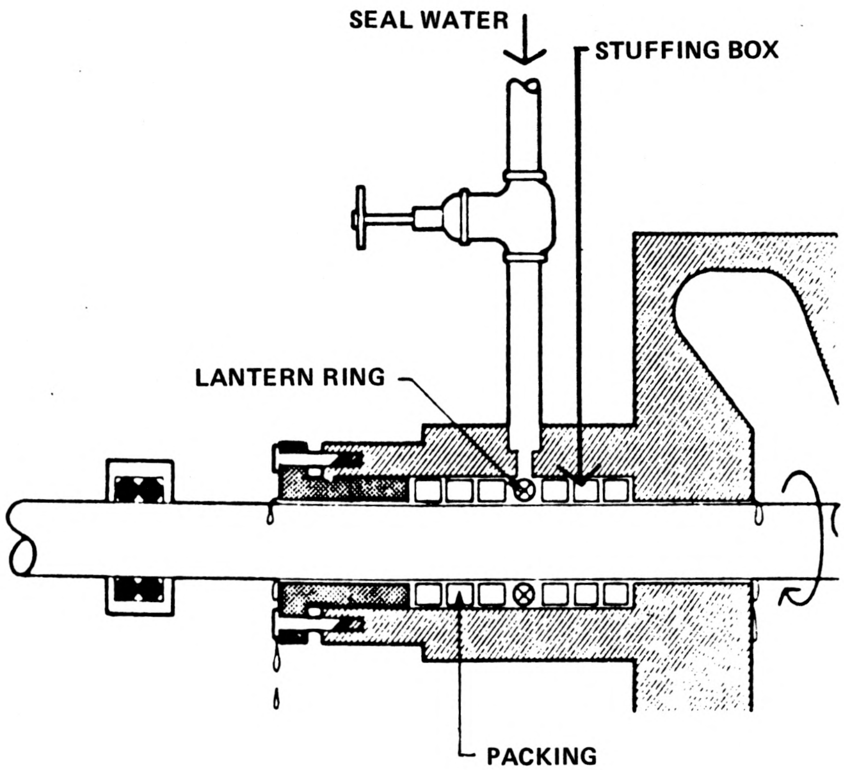


Fig. 6 Stuffing Box with Packing

A number of layers of packing are placed inside a stuffing box. A compression ring or packing gland is used to tighten the packing. This compression ring should never be tightened completely. A slow leak helps prevent damage by keeping the shaft and the packing clean and cool. Clean wastewater or water from another source should be used for this, because grit would quickly damage the shaft.

6.1.2.2 Mechanical Seal

One face of the mechanical seal does not move. The other is attached to the shaft and moves with it. Both faces are very smooth. They are kept together by a spring so that water cannot leak out of the pump. Clean water is fed along the shaft to prevent it from becoming damaged. Compared with the stuffing box and packing seal, the mechanical seal lasts longer and very little leakage occurs (see Figure 7).

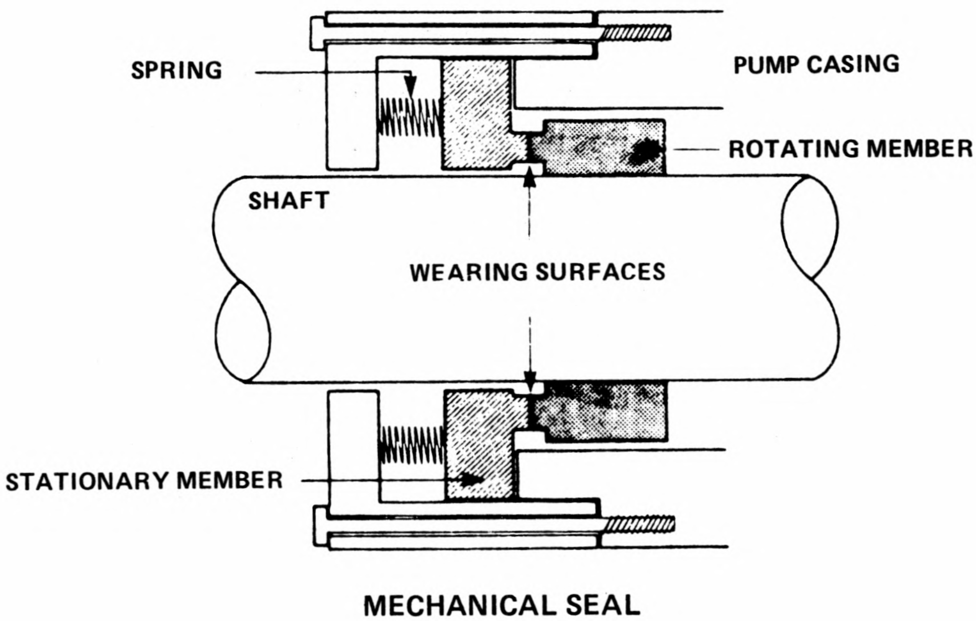


Fig. 7 How The Mechanical Seal Is Used

6.2 Mixed and Axial Flow Pumps

Of the many types of centrifugal pumps, the mixed flow and axial flow are the most widely used in wastewater applications. In mixed flow pumps, the head is developed partly by centrifugal force and partly by the lift action of the impeller blades (see Figure 8). The axial flow pump, sometimes called a propeller pump, develops head by the lift action of the propeller blades (see Figure 9).

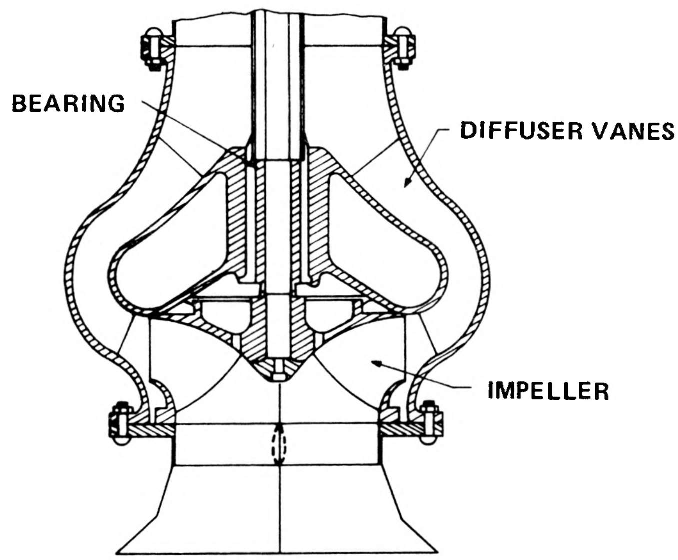


Fig. 9 Impeller For Mixed Flow Pump

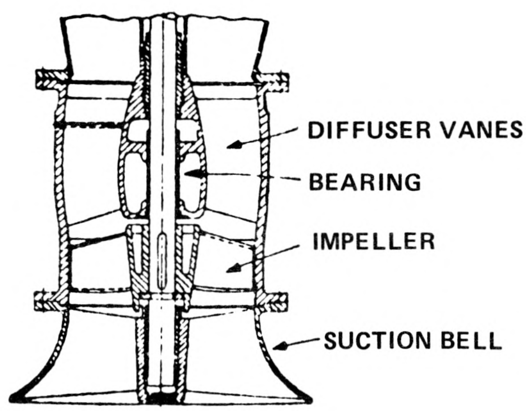


Fig. 8 Typical Axial-Flow Propeller Pump

6.3 Air Lift Pumps

Air lift pumps have been used for water that is comparatively free of solids, such as effluent from treatment plants and building sumps. They can also be used to recycle activated sludge in small plants (see Figure 10).

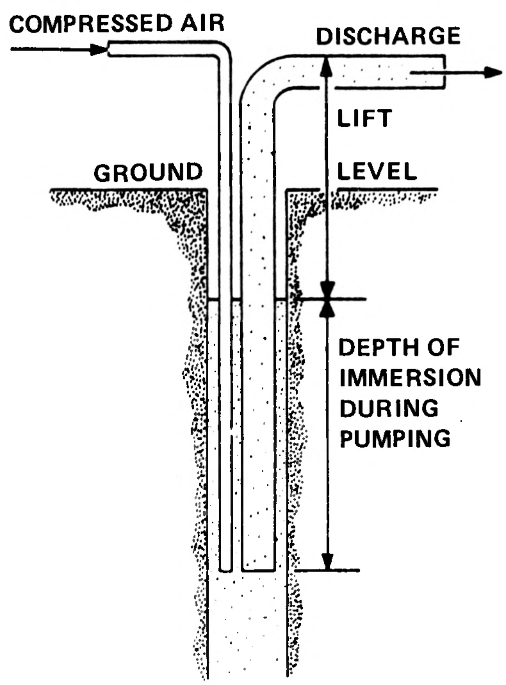


Fig. 10 Air Lift Pump

6.4 Air Lift Ejectors

Because of a unique design, air lift ejectors have no rotating parts to jam and are especially suited to pumping solids-laden unscreened raw wastewater, scum and grit. The ejector is made up of a sealed chamber, the bottom of which is usually conical, which connects to inlet and discharge lines containing check valves. The ejector also has a compressed air inlet, an automatic compressed air shutoff valve, and a vent valve for depressurizing the chamber.

The pumping capacities of pneumatic ejectors range from 1.3 to 31.6 L/s (20 to 500 gpm) and heads of approximately 15 m (50 ft.) may be obtained with air pressures of 3.5 kg/sq cm (50 psi).

Pneumatic ejectors have proven to give trouble-free operation over an extended time and have been used extensively for small installations requiring rugged equipment.

6.5 Positive Displacement Pump

Positive displacement pumps are most frequently used to pump heavy sludge. There are four basic types:

- plunger,
- diaphragm,
- progressive cavity, and
- screw lift.

The most common type used in wastewater treatment is the reciprocating type of plunger pump. A plunger or piston moves back and forth inside a cylinder. Figures 11 and 12 show how it works.

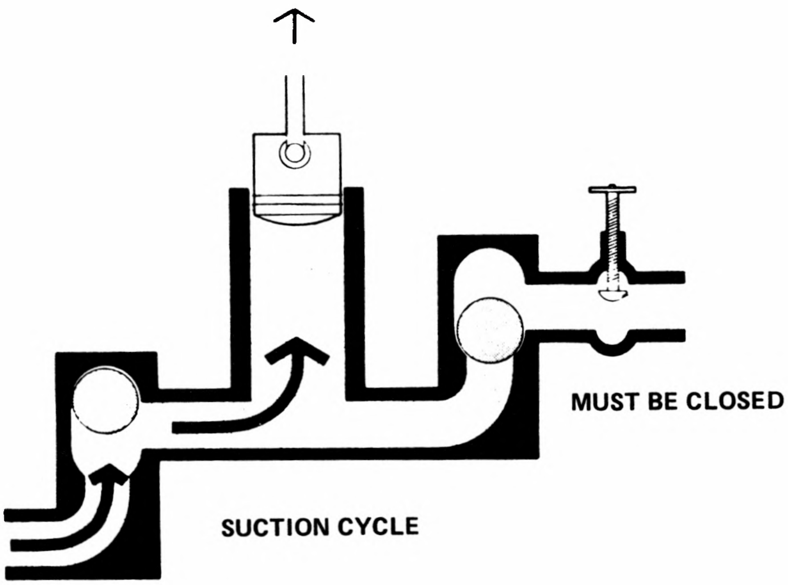


Fig. 11 Plunger or Piston Pump Showing Suction Cycle

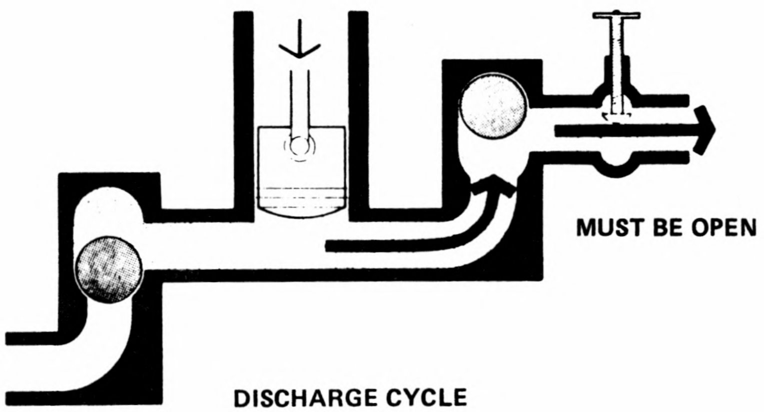


Fig. 12 Plunger or Piston Pump Showing Discharge Cycle

As the plunger moves out of the cylinder, the suction check valve is lifted and liquid is sucked through the suction line into the cylinder. When the plunger moves back, the suction check valve closes. The liquid is forced past the discharge check valve into the discharge line. The plunger pump can never be operated against a closed discharge valve.

6.6 Diaphragm Pump

The diaphragm pump uses the same idea as the plunger pump, except that a flexible diaphragm is used to cause suction and discharge. Figure 13 shows how the diaphragm pump operates. When the diaphragm moves up, liquid is sucked into the cylinder. On the downstroke, liquid is forced into the discharge line. Check valves control the direction of flow.

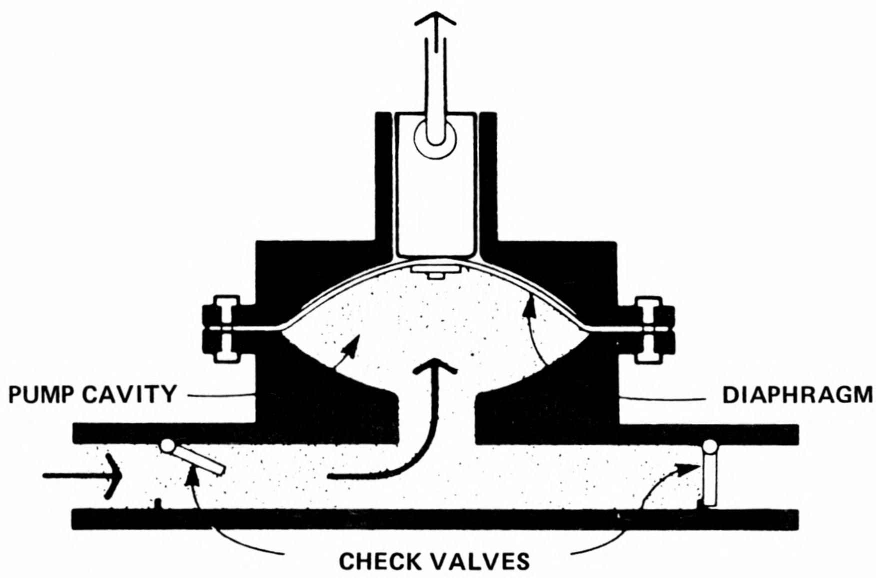


Fig. 13 A Diaphragm Pump Showing Suction Stroke

6.7 Progressive Cavity Pump

The progressive cavity pump must never be run empty. It can be damaged in only a few minutes. The shaft turning inside the casing forces the sludge through (see Figure 14).

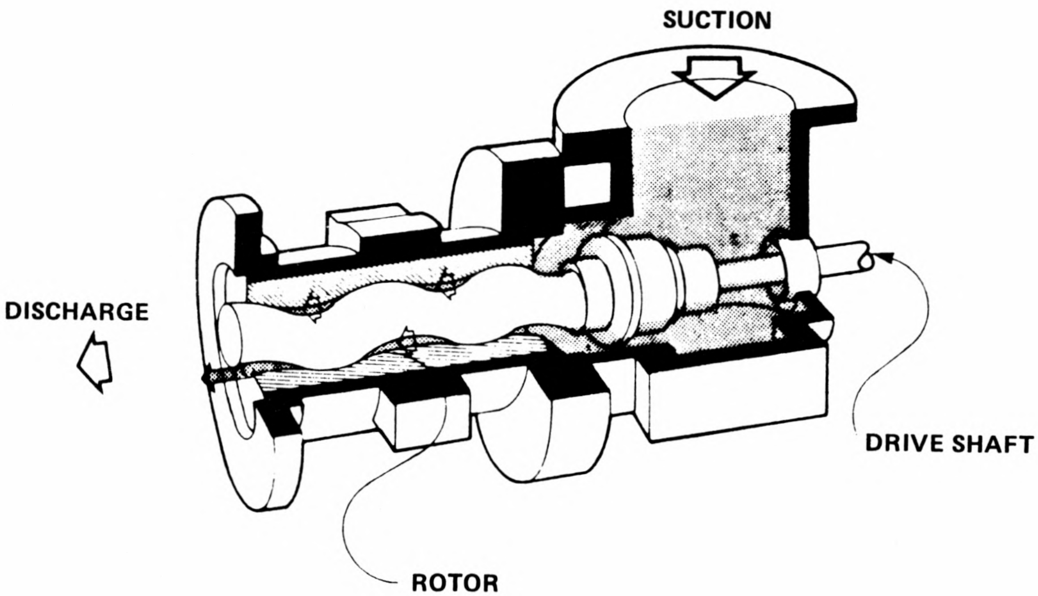


Fig. 14 How a Progressive Cavity Pump Works

6.8 Screw Lift Pump

Screw lift pumps have been used to pump unscreened raw wastewater, sludge and treatment plant effluent. A screw lift pump usually consists of a revolving spiral set in a semicircular channel, the longitudinal top half of which is normally open (see Figure 15).

Because of its simple open design, a screw lift pump can easily handle the typical solids found in raw wastewater.

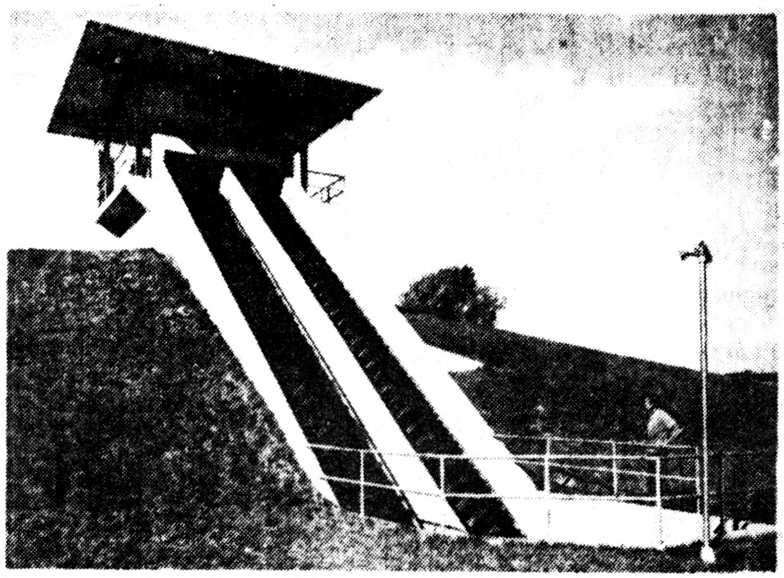


Fig. 15 Screw Lift Pump

7.0 OPERATION AND MAINTENANCE

7.1 General Remarks

Pumps are the heart of any pumping station. Operators must not only be familiar with the essential workings, such as bearings and impellers, but should also run flow checks at least once a year to ensure correct pump performance.

Maintaining a pumping station requires a considerable amount of skill which can only be acquired by experience, study and practice. All maintenance programs should start with good housekeeping. Operators should:

a. keep a neat, clean and orderly plant;

b. establish a systematic plan for carrying out daily operations;

c. establish a routine schedule for inspection and lubrication;

d. keep data and records of each piece of equipment, pointing out unusual incidents and faulty operating conditions; and

e. observe all safety measures.

7.2 Good Practice

The following are good practices:

a. Set up safe and efficient methods for starting, running, and shutting down pumps.

b. Make sure bearings, wearing rings and impellers can be reached for inspection. This will minimize operating and maintenance costs.

c. It is often a good idea to start and stop pumps, and open and close valves, automatically, even in an attended station.

7.3 Pump Start-up

7.3.1 New Installations

Before starting up a "new" centrifugal or screw lift pump, do the following:

a. Inspect the bearings for proper lubrication and grease the mechanical seals if necessary.

b. When possible, turn the shaft by hand first to make sure that it will rotate freely.

c. Make sure the coupling shafts are aligned.

d. If the unit is belt driven, check the alignment and belt tension to make sure they conform to the manufacturer's specifications.

e. Check the thermal overload elements in the motor, start and reset if necessary. Start the motor for a moment to make sure it turns the pump in the direction indicated by the directional arrow on the pump.

7.3.2 Pump Priming

Depending on the pump installation, and assuming that pump suction is not submerged, it may be necessary before actual start-up to prime the pump by filling the casing with water or wastewater. This will eliminate air that may have accumulated since the last time the unit was operated. This priming operation is for centrifugal pumps only. An air injector driven by steam, water under pressure, or compressed air, can be used to evacuate the suction line and pump casing. If an air ejector is used, the pump may be started as soon as water comes out of the ejector waste pipe continuously.

It is generally preferable to have the pumping unit located below the water level so that the need for priming can be eliminated. In such cases, make sure that the suction valve is operable so that the pumping unit can be isolated from the system to permit repair.

Because the methods of priming and start-up may differ with the make, rating, and type of pump and pump drive, the manufacturer's instructions should always be consulted before a pump is started.

If separate water seal units are used, turn them on and observe the packing gland boxes to make sure the seal water is leaking properly before you start the pumps.

Some pumps have an automatic system for seal water. The controls are incorporated into the pump starting circuitry and the seal water system opens automatically. When these are used it may be necessary to operate the seal water system continuously to maintain the required vacuum.

Pumping units designed for wearing flushing water require a system to supply water to the wearing rings. It may be automatic or manual. Automatic systems should include alarms to indicate a failure of the flushing water system.

Manual systems will have some means of checking flushing water flow visually.

7.4 Pump Shutdown

If a centrifugal pump is to be shut down for an extended period of time, shut the valves on the suction, discharge, ring flushing water and water seal lines tightly. Then drain the pump by removing the drain plug and opening the air vent valve. Draining the pump to remove sludge and other debris eliminates the possibility of gas building up to pressures high enough to rupture the pump casing.

In pumping systems incorporating automatic discharge valve opening and closing, during the pump shutdown period, check that the switches, vacuum system, seal water system and wearing ring flushing water systems are all operating properly.

7.5 Pump Controls

Generally, for a raw wastewater pumping station to operate effectively, it is desirable to match the instantaneous pumping rate with the instantaneous rate of flow into the station. This is most easily done in a facility equipped with automatic controls. However, almost all installations that are smaller and less elaborate have a wet well as a hydraulic buffer before the pumps. Single speed pumps (or even multiple speed pumps) can then be used with on/off cycling and relatively simple control equipment to match the pumping rate to the inflow. When manual control is used, the correlation of outflow to inflow requires visual observation of the pumping operation, monitoring of the instrumentation, and flow chart analyses.

7.6 Pump Protection

Wastewater pumping units require protection from abrasive material and objects that may cause damage internally or obstruct the flow of the suction lines.

For this reason, screening and grit removal facilities are usually used ahead of the pumps when they are used for pumping raw wastewater.

If sand accumulates in the wet well, it should be removed to prevent it from entering the pumps. If sand is allowed to enter the pumps, problems will follow. Unless effective water seals are provided, pumped sand may also enter the stuffing box packing, damaging the packing and the pump shaft sleeve. On submerged pumps, the lower sleeve bearing may wear out within a few weeks. Because most damage to pumping units is caused by abrasive and stringy material carried in the wastewater, it is important to be able to examine the piping and pumping units. Inspection hand holes should be provided. Inspect the units frequently and look for erosion, corrosion, and build-up of solids.

7.7 Grease Control

If grease is allowed to accumulate on the walls of the wet well, large chunks will eventually break loose and clog the pump suction line or the pump itself.

Suspended grease concentrations may also prevent the liquid level controls on the pump from operating properly within the float guide chamber or cage. Clean the wet well frequently with a high-pressure water hose or by scraping. If necessary, dewater the wet well, then scrape the grease from the floor. Dewatering should be done slowly, however, to prevent the grease from entering and clogging the dewatering pump.

8.0 OPERATING PROBLEMS

Operating problems can be separated into two categories: pumping equipment failure and control system failure. To make sure the equipment is used properly, the operation and maintenance manuals, written for the plant and for the specific equipment used at that plant, must be read and understood.

Typical equipment and control problems occurring in pumping stations follow:

a. Vibration: a measurable limit for vibration may have been specified. This should be checked periodically.

b. Noise: pumps are ordinarily specified to operate quietly. Try to develop a workable means of identifying excessive noise during operation.

c. Bearings: the type, design, and lubrication of all bearings should be known and they should receive the required attention.

d. Wearing ring: generally, wearing ring clearance should be sufficient to permit operation without rubbing and to avoid a rapid drop in efficiency after a short period of operation.

e. Seals and packing: operators should be familiar with the system and, if necessary, suggest modifications which would increase accessibility or improve the materials used for packing and seals.

f. Assembling and dismantling: all facets of the design and arrangement of pumping units should be understood so that they can be dismantled and reassembled for inspection and maintenance operations with a minimum of inconvenience.

g. Replacement parts: a reasonably adequate supply of replacement parts should have been supplied with the pumping equipment. These must be maintained in good condition and be available when needed.

Trouble shooting checklists for the different types of pump can be found in the appendices.

9.0 MAINTENANCE PROGRAM

9.1 General Remarks

To make sure the plant operates and performs at maximum efficiency, the preventive maintenance procedures outlined in the operation and maintenance manual for the plant must be performed as frequently as scheduled. The basic requirements for an effective maintenance program are described below.

9.2 Inspection

Inspect all operable equipment by sight and sound for indications of possible malfunction as often as recommended by the preventive maintenance procedures in the operation and maintenance manual. Typical things to look at and listen for include the following:

a. Observe the operation of all moving mechanisms to determine if they are aligned properly, moving at constant speeds, and producing no unusual vibrations. Feel bearings and motors to detect overheating.

b. Listen to all moving mechanisms for normal operational sounds (screeches could indicate lack of lubrication; thumps could indicate broken or loose components).

c. Observe the flow from the air lifts to determine if the unit is effervescing (giving off bubbles of gas), with excessive pulsations of flow causing a "burping" effect.

d. Study the records to determine if the control system is cycling too often or if one pump operates more than another.

e. Look for leaking or dripping water to determine if cracks or other openings have developed.

f. Watch cycling time of the air ejectors to be sure that the control system is working properly.

g. Make sure that the auxiliary (seal) water is flowing, that instrument air reservoirs are full, and that the vacuum receivers and priming devices are at the proper pressure.

h. Check sumps and sump pumps.

9.3 Lubrication

Pumps and their associated motors and drives must be lubricated in accordance with the manufacturer's recommendations. This means that specific lubricants are to be applied to specific points at specific time intervals. The pumping units should be lubricated during shutdown, not while in operation, unless otherwise specified by the manufacturer. When oil is being changed, the bearings should be cleaned and examined for possible wear.

9.4 Packing

The manufacturer's instructions will state how often packing should be removed. These instructions must be followed. They will also explain how to remove the packing nuts, clamps and glands in order to renew the packing.

9.5 Belt Drives

When belt drives are used, the sheaves require accurate alignment. Any misalignment will shorten the life of the belt and, at the same time, will increase the power consumption. Belts must be adjusted so that they are just tight enough to carry the load without slipping. Manufacturers usually indicate the proper adjustment by specifying the distance that the belt should move inward when thumb pressure is applied at the centre between the sheaves. With some variable-speed drives, however, proper belt tension is maintained automatically.

9.6 Liquid Level Controls

Systematic inspections must be made of all liquid level controls, which include the float, pressure and electrode level sensors, and the switches turned on by them. Routine checks must be made of the actual water levels at which the level controls cut in and cut out.

Much of the level control pumping problems encountered will be caused by a loss of signal or inaccurate signals. Possible causes include the following: coating on the probes, float hang-ups, leaks in the bladders, and fouling in the bubblers.

10.0 ELECTRICITY

All plants depend on electricity and cannot operate continuously without a maintenance program that ensures electrical units function efficiently. Studies indicate that 90% of motor failures were due to four causes - dirt, moisture, friction and vibration (see Table 1).

Table 1

The Four Causes of Failure in Electrical Motors

Cause	Method of Prevention
Dirt	Routine cleaning program.
Moisture	Minimize condensation - operate lights and blower with cover open and turn manual switch off when you leave pumping station. Check dehumidifier for operation and icing.
Friction	Proper lubrication.
Vibration	Daily checks.

If operators feel they are not fully qualified in all classes of electrical checks, regular preventive maintenance programs should be performed by reputable electrical contractors.

11.0 DAILY MAINTENANCE GUIDE FOR SEWAGE LIFT/PUMP STATIONS

1) Operate lights and blower with cover open. Make sure manual switch is off when leaving the station as excessive ventilation will cause condensation.

2) Check air supply at air storage tank.

3) Check rate of bubbler flow.

4) Check operating levels.

5) Check operation of sump pump. Clean out pit if necessary.

6) Check dehumidifier for operation and icing.

7) Check filter on seal-water-supply, by bleeding seal while pump is idle. DO NOT OPEN BLEEDER/VALVE WHILE PUMP IS OPERATING.

8) Check all reset buttons.

9) Listen for peculiar noises.

10) Feel pumps and motors in operation for overheating.

11) Observe action of check-valves.

12) Test stand-by pump operation.

13) Check mechanical seal for leakage. DO NOT RUN PUMP WITH SEAL LEAKING. THIS CAN DAMAGE THE SLEEVE OR SHAFT.

14) Be SURE station is operational before you leave.

ATTENTION to this routine is essential for successful operation.

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APPENDIX 1

Trouble Shooting Checklist
Centrifugal Pumps

Problem		Cause	Solution
1. Pump inoperative, no motor current drawn.	(1)	Defective control circuit.	Using meter, check starting, stopping and switching circuits. Replace as necessary.
	(2)	If bubbler type controls are used and the switching circuit is normal, check to see if air compressor defective.	Switch to stand by unit.
	(3)	Defective motor.	Turn motor control to OFF-LOCK-OUT and replace motor.
2. Pump inoperative, motor runs at no-load current.	(1)	Broken coupling.	Turn motor control to OFF and replace coupling.
3. Pump inoperative, circuit breaker will not reset.	(1)	Overload caused by clogged pump or closed valve on discharge line.	Check discharge line valves, turn motor control to OFF-LOCK-OUT, isolate pump by closing suction line valve, remove inspection hand hole and clear obstruction.
4. Pump operative, but at reduced discharge.	(1)	Pump air-bound.	Prime according to instructions. In pumps with submerged suctions, check air-bleed pipe from high point of pump volute (spiral casing) to make sure bleed pump is not clogged.
	(2)	Partially clogged impeller.	Turn motor control to OFF-LOCK-OUT, and isolate pump by closing suction and discharge line valves, remove inspection hand hole and clear obstruction.
	(3)	Air leaks in suction line or packing box.	Tighten seals or replace packing as required.
	(4)	Pump drawing air from wet well through suction line.	Set low level cut-off point of pump higher by readjusting float switches.
	(5)	Discharge check valve stuck partially open.	Turn motor control to OFF-LOCK-OUT, isolate discharge line, and clean, repair or replace check valve.
	(6)	Damaged impeller.	Turn motor control to OFF-LOCK-OUT, isolate pump by closing suction line valve, remove suction line, take pump apart to replace impeller.
	(7)	Water seal plugged.	Turn motor control to OFF-LOCK-OUT, and take apart as required to clear obstruction.
	(8)	Wearing rings.	Check to determine whether clearance is excessive.

Problem		Cause	Solution
5. Excessive power consumption.	(1)	Pump is short-cycling (discharge valve stuck open draining force main back into wet well).	Turn motor control to OFF-LOCK-OUT, isolate discharge line, and clean or replace check valve.
	(2)	Partially clogged pump.	Turn motor control to OFF-LOCK-OUT, isolate pump by closing suction line valve, remove suction line, and clear obstruction.
	(3)	Improper or worn impeller.	Replace.
	(4)	Pump running at too high a speed.	If belt driven, check pulleys and change if necessary. If motor is new, check proper speed.
	(5)	Operating at lower head than designed.	Consult manufacturer's instructions and adjust accordingly.
6. Noisy pump.	(1)	Incomplete priming.	Prime according to instructions.
	(2)	Inlet clogged.	Turn motor control to OFF-LOCK-OUT and clear as required.
	(3)	Worn impeller.	Turn motor control to OFF-LOCK-OUT, isolate pump from inlet and discharge lines and take apart as required to replace impeller.
	(4)	Pump drawing air from wet well through suction line.	Reset low-level cutoff of pump higher by readjusting float switch.
	(5)	Cavitation occurring at eye of pump impeller because suction lift is too high.	Reset low-level pump cut-off as in (4) above.
	(6)	Extension shafting for vertical pumps with ground level mounted motors out of alignment.	Check shafting and repair as required.

APPENDIX 2

Trouble Shooting Checklist
Air Lift Ejectors

Problem	Cause	Solution
1. No discharge.	(1) No compressed air.	If air compressor is normal, replace air inlet or vent valve in ejector.
	(2) Inlet or discharge check valve stuck closed.	Isolate ejector from inlet and discharge lines and clean or replace check valves.
2. Reduced or slow discharge.	(1) Low air pressure.	Check air compressor and pressure-regulated on-off switch; repair as required.
	(2) Outlet check valve stuck partially closed.	Isolate ejector from inlet and discharge lines and clean or replace check valve.

APPENDIX 3

Trouble Shooting Checklist
Screw Lift Pumps

Problem		Cause	Solution
1. Pump inoperative - no motor current drawn.	(1)	Defective control circuit.	By using meter, check switching circuits and replace as required.
	(2)	Defective motor.	Turn motor control to OFF-LOCK-OUT and replace motor.
2. Pump inoperative, motor runs at no-load current.	(1)	Defective coupling or speed reducer.	Turn motor control to OFF-LOCK-OUT and repair or replace coupling or speed reducer.

APPENDIX 4

Trouble Shooting Checklist
Air Lift Pumps

Problem		Cause	Solution
1. Pump inoperative, no bubbles evident.	(1)	Defective air compressor.	Switch to standby unit while repairs are made.
	(2)	Defective level sensor-switch.	Draw down sump and replace level sensor/switch.
	(3)	Broken or leaking air line.	Repair or replace.
2. Reduced discharge.	(1)	Low air pressure.	Switch to standby air compressor while repairs are made.
	(2)	Clogged eductor pipe.	Try back-flushing. If necessary draw down sump and clear obstruction.
	(3)	Broken or leaking air line.	Repair or replace.