CHAPTER III

DESCRIPTION, OPERATION

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The Description, Operation chapter of this Operation and Maintenance Manual must be considered a key element in the Manual. It is here that operating personnel find detailed descriptions of the unit operations and processes. Guidance on operating and controlling the wastewater treatment plant and its individual processes is outlined in this chapter. This chapter should be consulted when an emergency condition exists. New operating personnel will need to study this chapter to learn about the treatment system.

The purpose of this chapter is to assist the reader in understanding the Construction Drawings, the Specifications, the purpose and functions of the treatment plant, and to state the Design Engineers' concept of operation and control of the wastewater treatment plant processes.

A. RAW WATER

1. Description

The raw water for the wastewater treatment plant is located underground in an abandoned bituminous coal mine. The abandoned mine is producing sufficient water to cause the water to rise to such an elevation that it comes to the earths surface and relieves itself into Crooked Creek through three (3) bore holes. Raw water pumping at the plant is intended to be adequate to lower the water table below the bore hole elevations so that the water will not discharge untreated to the waters of the Commonwealth of Pennsylvania.

Six (6) holes were drilled and cased into an abandoned mine heading that goes under the wastewater treatment plant site. Raw water is lifted from the mine through these holes (via pumps) and discharged to the front end of the plant (influent). The plant processes begin on the second floor of the Control Building where the Raw Water Pumps discharge the mine water into a receiving trough. and parshall flume.

The mine water contaminants are principally the acidity, the high dissolved solids, the high iron content and the high sulfate content. Pilot plant studies have indicated that these contaminants (or pollutants) can be economically removed or reduced to satisfactory levels by lime neutralization and aeration. A waste residue (called sludge) will be produced as a plant by-product which is discussed under paragraph G of this chapter. Sulfates are partially removed by the formation of gypsum.

2. Major Components

a. Raw Water Pumps

Six (6) vertical turbine type raw water pumps are installed in the holes bored into the mine heading. Pumps are manufactured of stainless steel with two-stage impellers inside an eight (8) inch column. Each pump has a rated capacity of 780 gallons per minute. The bore holes are cased with 16" diameter fiberglass reinforced plastic well casing. The pump motors are set on top of an underground concrete vault. The vault is provided to facilitate pump removal.

b. Force Mains

Six (6) force mains lead from the raw water pumps underground to the control building; then up to the second floor of the building where they discharge into a receiving trough. The force mains are made of ten (10) inch fiberglass reinforced plastic with removable couplings. Each Raw Water Pump has its own force main. The force mains lie under the ground floor of the control building in a concrete trough filled with sand. The trough is covered with a concrete slab which may be removed if the force mains need exposed for any reason. Each main is fitted with a chain operated shut-off valve located in the control building.

c. Raw Water Troughs

Two (2) raw water troughs are located on the second floor of the control building. The troughs are made of concrete with fiberglass reinforced liners. One trough receives three (3) force mains and the other trough receives the other three (3) force mains. One trough discharges to flash mixer #1 and the other trough discharges to flash mixer #2. Slide gates are located in the troughs to divert flows. It is here where the flows can be directed into either half of the plant (the plant is split into two (2) halfs, either one which is independent of the other). The raw water troughs are connected to parshall flumes which are used to assist in, measuring the quantity of raw wastewater entering the plant. The flow rate is transmitted to the operating console via transmitters located at the flumes.

3. Operation

a. Normal Operation

Of the six (6) raw water pumps only four (4) are required to furnish the capacity of the plant. The pumps are split into two (2) groups of three (3) pumps. Not more than two (2) pumps in any one group should operate at any one time.

Both raw water troughs should be in operation during normal conditions, each carrying one half (1/2) the total flow pumped. The raw water is to be split into two directions through the plant. During a low mine water level condition the plant operation should be reduced accordingly.

Operation of the raw water pumps is automatic with manual selection of the standby pump in each group. Pumps will automatically start as the water level rises to a predetermined level in the mine and automatically stop as the water level lowers in the mine to a predetermined level.

b. Emergency Operation

A standby raw water pump is provided in each group; however, should two pumps in any group fail, that half of the plant can either be operated at partial capacity (using only one pump) or the stop gate separating the raw water troughs may be opened to allow design flows to proceed throughout the treatment plant.

If there is an electrical failure, pump control failure or force main rupture, the above paragraph also will apply.

If a high mine water level condition occurs (Elevation 1034 or higher) and four pumps operating will not lower the water level, the operator may start either or both the standby pumps in the "hand" position and use all six raw water pumps.

4. Controls

a. Manual

The operator has the option of selecting the standby pump in each group of raw water pumps. This is done at the motor control center by the selection of the proper combination of "plug-in" leads.

Manual controls also consist of regulating the back-pressure on the pumps by throttling the force main plug valves (this should not be done unless necessary to prevent flooding of floor areas).

The slide gates in the raw water troughs are adjusted manually which selects the direction of raw water flow.

b. Electrical

Each group of raw water pumps is controlled by a primary bubbler type sensing device with electrical contacts to start and stop various pumps at different water levels in the mine.

The bubbler system senses the mine water level by releasing air out of the end of a submerged pipe. The pressure needed to release this air is proportional to the depth of pipe submergence (this pressure is called back-pressure). The back-pressure is then monitored by the pump motor control contacts in the motor control center. As the mine water level rises, more back-pressure is created which starts up the lead pump motor. If the mine water level continues to rise above another predetermined point (this point is set at another elevation - or back pressure reading) the second raw water pump will start. If both pumps are operating and the mine water level continues to rise, the third (or standby) pump will not come on. All pumps will stop operation at a predetermined low mine water level. A mine water level gauge in the operating console indicates the mine water level and is connected to the bubbler system.

It is suggested that the following start-stop schedule be performed. All adjustments are field accomplished and if made properly during plant start-up should not require any major revision.

START-STOP SCHEDULE
(on rising water)

Mine Water Level	Regular Pump Operation	Alternate Pump Operation
1022.0	Stop All Pumps	Stop All Pumps
1022.5	Start Pump No. 1 (or No. 3)	Start Pump No. 4 (or No. 6)
1026.0	Start Pump No. 2 (or No. 3)	Start Pump No. 5 (or No. 6)
1034.0	Sound High Water Alarm	Sound High Water Alarm

In the above schedule pump No. 3 is the standby pump. In the alternate group of pumps, pump No. 6 is the standby pump.

Any one or all six pumps may be started and stopped either automatically or manually at the motor control center. The disconnect switch should not be used as a means to start and stop the pumps in that this type use may burn the contacts and make the equipment unusable.

Since the bubbler controls (automatic side) will only operate four pumps at any one time; if six pumps are to be operated, two must be placed in the manual mode.

c. Laboratory

There are no laboratory analyses that are used to control the raw water process.

Observation of the raw water instrumentation equipment in the operating console will provide data regarding mine water level and raw water flow rates. This data will be used to anticipate plant process adjustments.

5. Start-Up

The raw water pumps are started by manually turning the HOA switch to the "H" or "A" position. At the "H" position, the mine water level must be above elevation 1022 or the pump won't start. At the "A" position, the bubbler system must be in operation and conditions satisfactory for pump operation must exist.

Only one raw water pump should be started at a time. It's operation and liquid discharge should be monitored to assure satisfactory operation. The operator should observe such things as:

i. Direction of rotation (initially)
ii. Motor speed (visually)
iii. Pump discharge volume
iv. Unusual sounds
v. Unusual smells
vi. Motor temperature (by touching)
vii. Lubrication system
viii. Force main leakage

The manufacturer's operating instruction manual should be consulted for detailed raw water pump start-up procedures.

6. Monitoring

The raw water pump operation can be monitored several ways. Each way may suggest a particular function or operation deficiency.

a. Water Level Gauge

Should the mine water level gauge, located in the operating console, indicate that the mine water is rising or has risen appreciably over a period of time; this could be a signal that the raw water pumps are not pumping sufficient water, or that the bubbler system is malfunctioning.

b. Raw Water Flow Instruments

The raw water flow instruments, located in the operating console, indicate, record, and totalize the raw water that passes through each of the two primary instruments (parshall flumes). A check on these instruments will enable the operator to monitor the raw water pumps output.

c. Indicator Lights

Running lights on the operating console permit a quick observation as to which pumps are running and which are not running. The operator is cautioned that a failure other than electrical control failure may permit the running light to burn but the pump may not be operating satisfactorily.

d. Time Meters

Each raw water pump is equipped with an elapsed time meter which totalizes the running time of the pump. This compared with the raw water flow quantity will show whether the pumps are pumping at their design point.

e. Alarm

A high water alarm will sound should the mine water level rise to elevation 1034 or a no-flow condition exist in the raw water flumes. This will activate the telephone dialing system if it is on.

B. FLASH MIXING

1. Description

Flash mixing is done in order to adequately provide a distribution of lime slurry throughout the flash mixer tank. It is here that the neutralizing agent (lime mixed with water) is combined with the raw water (and perhaps some recirculated sludge).

Each tank is fitted with a mechanical mixer to stir the tank contents and keep the settleable material in suspension. Provisions have been made to recirculate settled sludge from the settling tanks to the flash mixers. This feature should accelerate the settleability of the solids as well as provide for a reduction in lime usage.

Two (2) flash mixer processes are provided. Each are independent of one another. The plant design is such that both processes will be used simultaneously by splitting the raw water flow in half. Should the raw water flow through the plant fall to 2.25 MGD or below, one flash mixer should be taken out of service and the total flows passed through the other half of the plant, except during adverse weather conditions, etc.

The flash mixer tanks are also used as a discharge point for the control building sump pumps.

2. Major Components

a. Flash Mixing Tanks

Two (2) reinforced concrete circular tanks have been provided. The tanks are coated with a chemical resistant paint to prevent deterioration of the concrete. The inlet is across the tank from the outlet to prevent short circuiting. The slurry enters near the tank inlet. Any recirculated sludge enters near the inlet.

Tanks are equipped with a weir outlet system. The weirs may be adjusted by cutting off or raising at a later date if desired; however, this will decrease or increase the detention time. The outlet system provides for pH monitoring.

Each tank has an overflow opening into its outlet box which will prevent the tank from overfilling and spilling onto the control building floor. The tanks are covered with a one quadrant fiberglass walkway.

b. Mixers

Each tank is provided with one (1) center mounted vertical mixer. The mixer is a heavy duty unit equipped with a right-angle spiral-bevel-gear speed reducer designed for continuous (24 hrs/day) operation. The mixers are intended to agitate and stir the tank contents to provide for thorough mixing. The rate of agitation is such to prevent settling yet not too much to destroy any floc which begins to form.

3. Operation

a. Normal Operation

Both flash mixers are to be operated simultaneously and continuously. Feed and discharge is gravity with a detention time of approximately 10 minutes at design flow (without regard to recirculation).

Mixing equipment is to be operated continuously. Lime slurry is to be fed with automatic feed rate adjustment based upon outlet pH. Mechanical equipment should be placed in the "automatic" position for normal operation.

b. Emergency Operation

Should the mechanical mixer fail or the flash mixing tank be out of service for cleaning, painting, etc. the flash mixing operation must be taken out of operation. There are two (2) flash mixing processes but each has capacity to only meet the demands of one-half plant design flow. Therefore, when a mixer is down, only one half the plant can be operated and consequently the raw water flow must not exceed 2.25 MGD.

The mixers operate from the emergency generator power in the case of a utility power outage.

4. Controls

a. Manual

Manual operation of the mixer may be accomplished by moving the HOA switch on the operating console to the "H" position. This will permit starting and stopping of mixer from the console (remote) or with the push button station near the mixer.

b. Electrical

Each mixer is electrically operated. A gear type speed reducer is provided between the motor and impeller but this speed reducer cannot be changed to speed up or slow down the mixer.

5. Start-Up

To start-up the flash mixing process, merely fill the flash mixing tank with raw water or recirculated sludge and begin the operation of the mixer. The operator should observe the mixer operation and particularly watch for:

i. Direction of rotation (initially)
ii. Motor speed (visually)
iii. Unusual sounds
iv. Unusual smells
v. Motor temperature (by touching)
vi. Lubrication system (grease; oil in gear box)

The manufacturer's operating instructions manual should be consulted for detailed mixer start-up procedures.

6. Monitoring

Flash mixer monitoring can be accomplished by several methods which have been built into the plant. Each monitoring system may suggest a particular function or operation deficiency.

a. Visual Check

Mixing can be viewed by standing above the mixing tank and observing the agitation of tank contents. After some experience in what this action should look like, the operator may be able to determine a malfunction of equipment operation prior to a complete stoppage.

b. Indicator Lights

Running lights on the operating console permit a quick observation as to whether the mixer is to be running. The operator should not rely totally on this since a running light bulb failure may show a malfunction that doesn't exist. Conversely a mechanical malfunction may occur but the mixer control circuit may still be indicating unit operation.

c. Time Meters

Each mixer is equipped with an elapsed time meter which totalizes the running time of the mixer. Recording of this reading will assist in determining running time and breakdown time.

d. Laboratory

Analyses of the tank contents in the laboratory will provide valuable data as to the functioning of the flash mixer process. Analysis comparison is perhaps the best method to spot a deficiency; therefore, past records should be consulted frequently.

e. pH

Each flash mixer process is continuously monitored for pH at the tank outlet. More detailed information is given on this under instrumention, paragraph H, of this chapter of the Operation and Maintenance Manual.

f. Alarm

An alarm system is tied in with the pH instrumentation. The telephone dialer is activated on either high or low pH of the flash mixer outlet liquid.

C. AERATION

1. Description

Aeration is done in order to adequately provide a distribution of oxygen throughout the liquid which will principally convert ferrous iron to ferric iron. The ferric iron under quiescent conditions (Settling Tanks) will settle out of solution. It is in the aeration tanks that air is added to the wastewater.

Each tank is fitted with a mechanical aerator (mixing unit), a fixed sparger aerator at the tank bottom and removable air diffusers along the tank perimeter. Provisions have been made to recirculate settled sludge from the settling tanks to the aeration tanks. This feature should accelerate the creation of floc and assist in the settleability of the liquid once it gets to the settling tank. Baffles are provided along the tank walls to prevent the tank contents from revolving.

Two (2) aeration processes are provided. Each are independent of one another. The plant design is such that both processes will be used simultaneously by splitting the raw water flow in half.

Should the raw water flow through the plant fall to 2.25 MGD or below, one aerator should be taken out of service and the total flows passed through the other half of the plant. One blower will provide enough air for two (2) aeration processes; the other unit is a standby unit.

2. Major Components

a. Aeration Tanks

Two (2) reinforced concrete circular tanks have been provided. Each tank has one inlet via a fiberglass trough. Each tank has two (2) outlets fitted with overflow weirs. Each outlet goes to a different settling tank. Therefore, one (1) aeration tank serves two (2) settling tanks. The tanks are exterior of the control building due to the aeration effect and the affect it would have on a building interior - too much humidity. Flows to a settling tank can be stopped by removing the opposite outlet weir.

b. Aerators

Each tank is provided with one (1) center mounted vertical mechanical aerator-mixer. The function of the aerator is to stir the tank contents by both agitation (impeller mixing) and aeration (impeller gas dispersing). The aerator is a heavy duty unit equipped with a right-angle spiral-level-gear speed reducer designed for continuous (24 hrs/day) operation. The rate of aeration and/or mixing (speed) cannot be changed.

c. Blowers

Located on the second floor of the control building are two (2) positive displacement type air compressors normally called "blowers". These units are designed that only one unit is to operate at a time; the other unit is a standby unit. The blowers are piped to both the sparge ring and the air diffuser units in the aeration tanks.

Air volume to each aeration tank is measured and recorded.

The blowers are mounted on shock absorbent pads, a concrete inertia block and fitted with inlet and discharge filters, silencers and snubbers. These features reduce vibration and noise transmission throughout the control building which would be extremely irritating to workmen inside the building

d. Sparge Ring

A sparge ring is permanently mounted to each aeration tank bottom at the center of the tank. This equipment is a perforated piece of pipe which emits air directly under the mechanical mixing device.

e. Air Diffusers

Along the perimeter of each aeration tank is an air pipeline from which drop pipes are taken. The drop pipes are then connected to a perforated horizontal pipe two (2) feet above the tank floor. Compressed air through these perforated pipes (diffusers) will be released through the holes in the pipes and rise in the tank in the form of fine bubbles. These fine bubbles mix with the tank liquid causing a chemical reaction (oxidation). The smaller the bubble the more surface area in contact with liquid and consequently more oxidation takes place.

The diffusers are made of polyvinylchloride (PVC) plastic materials which are light in weight and can be readily removed for aperture cleaning. Each unit has a shut-off valve and union for disconnection and removal.

f. Baffles

Vertical baffles along the inside of the tank wall prevents short circuiting and revolving of tank contents. Baffles are made of fiberglass and anchored to the walls. With the baffles one should be able to observe not only a revolving of tank contents but also a rolling - in a vertical plane - motion. The combination of these two (2) operations will provide for the most effective mixing and oxidation possible.

3. Operation

a. Normal Operation

Both aeration units are to be operated simultaneously and continuously. Feed and discharge is gravity with a detention time of approximately 40 minutes at design flow (without regard to recirculation). The Aerators are to be placed in the "automatic" operating position.

Only one blower is required. It is to be placed in the "automatic" operating position. Blowers should be alternated weekly to keep both units operable and to maintain equal running time for both units.

All air diffusers and sparge rings are to be supplied with air and kept in operating condition.

b. Emergency Operation

Failure of the sparge ring and one or two air diffuser units should not appreciably affect the aeration process. Even failure of the mechanical aerator will not warrant taking the process out of operation since aeration and agitation is also accomplished by the diffusers. During a malfunction period closer monitoring will be required to assure at least enough treatment to meet discharge requirements.

If the one process is out of service for cleaning, painting, etc. the process must be taken off line. There are two (2) aeration processes but each has capacity to only meet the demands of one-half plant design flow. Therefore, only a peak flow of 2.25 MGD should be put through one aeration tank, except for emergencies.

The aerators and blowers operate from the emergency generator power in the case of a utility power outage.

4. Controls

a. Manual

Manual operation of the aerators and/or blowers may be accomplished by moving the HOA switches on the operating console to the "H" position. This will permit starting and stopping of aerators or blowers from the console (remote) or with the push button station near the equipment. Manual regulation of valve openings to the sparge ring and air diffusers will regulate air quantity to the aeration tank.

b. Electrical

The Aerators and Blowers are electrically operated. The equipment has only an "on" and "off" electrical control. The operator may (through the instrumentation on the console) observe blower speed with blower output air and compare with raw water flows. A determination of air requirements will be made from past records of raw water flow vs. air flow vs. settleability of liquid vs. plant efficiency.

c. Laboratory

Laboratory analyses and records of plant performance will play a major role in controlling the quantity of air to be introduced into the wastewater. The best parameters for controlling aeration will be taken from laboratory analyses. Therefore it is recommended that good, accurate records be kept and cross-references made from time to time. The list of analyses affecting how much air to apply is as follows:

i. Temperature - affects quantity of oxygen in air
ii. Dissolved oxygen - indicates available oxygen in process
iii. pH - affects both chemical and physical processes
iv. Settleable Solids - gives results of pretreatment effectiveness
v. Iron - provides results of oxidation efficiency
vi. Flow - gives data regarding process adjustments

5. Start-Up

To start-up the aeration process, the aeration tank must first be filled with liquid. The aerator can then be started by activating the electrical power to the unit. The sparge ring and air diffusers are started by opening the valves on their respective pipe feeder lines. The blower can be started by activating the electrical power to the unit.

The operator should observe the aerator and blower operation and particularly watch for:

i. Direction of rotation (initially)
ii. Motor speed (visually)
iii. Unusual sounds
iv. Unusual smells
v. Motor temperature (by touch)
vi. Lubrication system (pressure & leaks)
vii. Blower temperature (increase)
viii. Blower oil pressure (decrease)

The manufacturer's operating instructions manual should be consulted for detailed aerator and blower start-up procedures.

6. Monitoring

Aeration tank monitoring can be accomplished by several methods which have been built into the plant. Each monitoring system may suggest a particular function or operation deficiency.

a. Visual Check

The contents of the aeration tank can be viewed from the walkway that spans over the top of the tank. Clogging of diffusers can be recognized by lack of air bubbles or mixing in certain areas. Experience in knowing what to look for will play an important part in visual monitoring and determining malfunctions.

b. Indicator Lights

Running lights on the operating console permit a quick observation as to whether the aerator and/or blower is to be running. However, an indicating light is not a foolproof monitoring system and should not be relied upon totally.

c. Time Meters

Electrically operated equipment is equipped with elapsed time meters located on the operating console. These time meters totalize the running time of the equipment. Recording these readings will assist in determining running time and down time.

d. Laboratory

Most of the laboratory monitoring is discussed under item 4c-Controls, Laboratory. The results of laboratory tests of liquid contents and flow quantities provide valuable data as to the operation of the aeration process and how other parts of the process are affected.

Possibly the best test for determining whether the proper aeration is being done is the iron concentration in the waste sludge. When no ferrous iron is present, adequate aeration is being accomplished. If the ferric iron content of wasted sludge is low, then the plant aeration process is inadequate and either the aeration needs to be increased or the detention time increased.

e. Alarm

The telephone dialer will be activated during times of no air flow from the blower unless that alarm system is shut-off by the operator.

D. SETTLING

1. Description

Settling is done in order to remove the settleable materials from the wastewater prior to discharging to the receiving stream. It is in this process that the results of all previous processes are precipitated. Any malfunction in a previous process will affect the settling process. Here all such things as iron, sulfates, etc. are to be removed. It is important to keep the water velocities low and equally distributed so that proper settling (clarification of the liquid) will occur.

Each tank is fitted with an inlet trough, center feedwell, radial overflow weirs and effluent troughs and a bottom scraper. Pretreated wastewater enters the feedwell where it must flow in a downward direction to get out of this area. Immediately under the feedwell, in the tank bottom, is a sludge pit that receives all the settled material (even the material that is scraped from the tank floor). As the wastewater then flows upward to the outlet troughs, the heavier materials drop out of the current and end up on the tank bottom. A scraper mechanism, driven by a motor on the walkway over the tank, then moves the settled material in a circular pattern to the center of the tank bottom (sludge pit). From this point the settled material (called sludge) is transferred by gravity through a 12 inch diameter fiberglass reinforced pipe to a sludge box. This procedure clarifies the tank contents and hence the term clarifier has frequently been assigned the settling tank.

Each settling tank is provided with a waste sludge box made of reinforced concrete and attached to the settling tank perimeter wall. The waste sludge box is slightly deeper (2'-0") than the lowest elevation of the settling tank, including the sludge pit, so that sludge will flow into the box by gravity. Sludge is wasted from the box up through a pipe to a trough leading to the waste sludge well. The head of water in the settling tank forces the sludge to be wasted up the pipe. An electrically operated plug valve on the pipe discharge regulates the quantity of the sludge wasted.

An effluent (outlet) box is attached to each settling tank to provide a point to take samples, observe the effluent quality and quantity and give means for cleaning the effluent pipeline.

2. Major Components

a. Settling Tanks

Four (4) reinforced concrete circular tanks have been provided. Each tank has one inlet and one outlet. Inlet flows come from one of the aeration tanks. Tanks are 66' diameter and are designed with an upflow rate of 0.25 gallons per minute per square foot. Detention time at 4.5 MGD and all tanks in operation is approximately 7.2 hours.

b. Effluent Launders

Each tank is fitted with eight (8) effluent launders (outlet troughs). These are radial to the tank center with flow over both sides of each trough. Troughs are made of fiberglass and fitted with adjustable "V" notch fiberglass weir plates. The physical location of the launders provide for a relatively equal distribution of the tank outlet.

c. Scraper

Each tank is provided with an electrically driven scraper mechanism. The scraper moves slowly to prevent agitation of tank liquid. The scraper moves settled material (sludge) to the center of the tank for further removal. Scraper cage and support truss mechanism is covered with rubber for long life and to facilitate sludge removal. Scraper arms have an automatic raise feature to lift the arms (max 12") in case of torque increase.

3. Operation

a. Normal Operation

All four (4) settling tanks are to be operated simultaneously and are required when the wastewater flow is 4.5 MGD. When the wastewater flow is at 3.375 MGD one tank can be removed from service if the wastewater is distributed equally among the remaining three (3) settling tanks. The operator must assure that the settling tanks do not become hydraulically overloaded as this affects the settling rates in the tanks.

The sludge scrapers must be in operation at all times the settling tanks are in service. The sludge scraper electrical controls should be placed in the "automatic" position.

b. Emergency Operation

A build-up of sludge on the settling tank floor will cause an extra drag (torque) on the scraper mechanism. This could either raise the scraper or shear the torque pin. The settling tanks must not be operated without their scrapers operating. An automatic raise system is provided which riases the scraper when extra torque is encountered. This feature provides limited amount of protection. Excessive torque on the scraper will shear the torque pin. When this happens, the settling tank must be taken out of service. An alarm system is connected to the torque measuring equipment.

The scraper mechanisms operate from the emergency generator power in the case of a utility power outage.

4. Controls

a. Manual

Manual operation of the settling tank scrapers may be accomplished by moving the HOA switches on the operating console to the "H" position. This will permit starting and stopping of scrapers from the console (remote) or with the push button near the scraper drive motor. The scraper speed cannot be changed since it is factory set through a gear reduction assembly.

Flows to the settling tank are stopped and started manually with the weirs in the aeration tank outlet box. Weir plate heights are manually adjusted for leveling the effluent launders.

The settling tank scrapers can be manually lifted from the tank bottom via a manual lifting device on the walkway over the tanks. This could be desirable when operating in the hand position and the sludge is thick enough to cause an excessive torque on the scrapers.

b. Electrical

The settling tank sludge scrapers are electrically operated. The scrapers are equipped with a torque monitoring device which, when activated with excessive torque, will automatically raise the scrapers while they are moving. The scraper mechanism is driven with a gear reduction unit attached to the drive motor. The speed of the scraper is fixed and cannot be changed by the operator.

The lift motor, which is independent of the scraper drive mechanism, can be operated manually with a local push button.

c. Laboratory

Laboratory analyses and records of the operation of the settling tanks are indicative of the proper or improper pretreatment processes. The results of these analyses will provide valuable information regarding adjustments upstream of the settling tanks.

5. Start-Up

To start-up the settling process one must merely permit pretreated wastewater to enter the tanks. As soon as the tank bottom is covered with liquid, before the tank is full, the settling tank scrapers must be placed in operation. Shortly thereafter sludge withdrawal should be initiated or else the high torque control will stop the scraper. Sludge withdrawal should go to recirculation or waste as determined by the sludge chemical content.

The settling tank scraper is perferably started by first turning the HOA selector switch on the operating console to "H". After the scraper appears to be operating satisfactorily, the selector switch should be turned to "A".

The operator should observe the scraper operation and particularly watch for:

- i. Direction of rotation (visually)
- ii. Equipment speed
- iii. Unusual sounds
- iv. Unusual smells
- v. Motor temperature (increase)
- vi. Lubrication system (leaks)
- vii. Torque position

The manufacturer's operating instructions manual should be consulted for detailed settling tank scraper start-up procedures.

6. Monitoring

Some settling tank monitoring can be accomplished by equipment that has been built into the plant. Other monitoring is done as desired by the plant operator.

a. Visual Check

The tank contents can be viewed from the walkway above the tank. After some experience in what the tank liquid should look like, the operator may be able to tell of a plant malfunction or deficiency in the settling tank or a pretreatment process simply by looking at the liquid in the tank.

The tank should be reasonably clear outside the feedwell ring for a depth of about twelve (12) inches. Wastewater overflowing the weirs on the effluent launders must not contain any visible solids.

A visual check of the torque indicator position will provide an assumption of the amount and/or quality of sludge in the bottom of the tank.

b. Indicator Lights

Running lights on the operating console permit a quick observation as to which scraper is to be running. However, this system is not foolproof, for example; if a mechanical failure occurs, the light may be on indicating satisfactory operation, since the light is part of the electronic control circuit, but the equipment is not operating properly.

c. Time

Each settling tank scraper is equipped with an elapsed time meter which to the running time of the scraper mechanism. This meter will not information regarding the running time of the "lift" motor.

d. Laboratory

Laboratory tests must be made of the tank contents and effluent; however, the results of these tests will not provide information relative to the settling tank operation, but rather to the prior treatment of wastewater before it enters the settling tank. Even tests of the effluent may not be indicative of the operation of the settling tank, but possibly the pretreatment.

e. Alarm

An alarm is tied in with the torque measuring apparatus. The telephone dialer is activated on high torque in any one of the settling tanks. A higher torque will shut down the scraper mechanism.

E. LIME HANDLING

1. Description

The lime handling operation begins at the point of delivery and ends in the lime slaker. There are several types and characteristics of lime. Since the Commonwealth of Pennsylvania will probably be bidding the lime purchase one does not now know which type and what characteristics will be involved. The plant design is based upon the use of quicklime (CaO) which is available and should be purchased in pebble form The recommendation is to use pebble lime which has a white-grey color, weighs 55 to 75 pounds per cubic foot, has a specific gravity of 3.2 to 3.4 and is 70% to 96% CaO. One pound of this quality lime will produce 1.16-1.32 lb. of $Ca(OH)_2$ with 2-12% grit, (depending upon purity).

Lime will be transported to the treatment plant site in trucks. The trucks must be equipped with unloading equipment that will force the lime to the height of the top of the chemical storage bins. Lime is stored in the bins until ready to be used. Lime stored for periods longer than 60 days may become moisture laden and delivery from the bin will be difficult.

Lime from the chemical storage bin will flow by gravity (except the third lime feeder will receive lime via a conveyor from the bin) to the lime feeder located directly under the bin. The feeder then will discharge the lime into the lime slaker which will make the lime slurry.

The lime slaker will require water for making up the slurry. Provisions are made to use either wastewater treatment plant effluent water or potable city water for this operation. The slaker will also remove impurities from the lime and discharge them to a container which will require removal to a landfill disposal area. These impurities are called grit. Slurry is discharged to a slurry vat which is further described later in this chapter under the next heading (Lime Slurry Handling).

2. Major Components

a. Transfer Equipment

Permanently mounted pipelines (one to each storage bin) have been installed from the control building loading dock area to the top of the chemical storage bins. The lime delivery vehicle must connect to one of these pipelines (at ground level) before beginning the truck unloading process. The lime will then be pumped (pneumatically) to the top of the chemical storage bin with the vehicle unloading unit.

b. Chemical Storage Bins

Two (2) chemical storage bins are located in the control building. The bins are twelve (12) feet in diameter and forty (40) feet high, including the hopper bottom with a capacity of approximately 3,800 cubic feet per bin. It is expected that 1-1/2 weeks of lime storage is available which means that lime deliveries should be expected to be once per week.

On the top of the chemical storage bins are dust collectors, lime entry fittings, a pressure-vacuum relief valve, ventilator and a manhole to permit personnel entry. The bins are accessable from the control building roof, via a ladder assembly attached to the top portion of each bin. The dust collectors are air cleaned and receive their air from the plant blowers located in the blower room on the control building second floor. See manufacturer's instructions for operation of equipment.

The bottom of the bins are hoppered to facilitate chemical removal at one point and to prevent lime from hanging up on the bottom. The hoppers are equipped with air pads that receive their air from the Butler blowers located in the compressor room. The air pads assist the lime in sliding down the bin hopper to the outlet opening.

c. Lime Feeders

Three (3) lime feeders have been provided; one under each chemical storage bin and a third (or standby unit) under an additional small lime storage hopper. Feeders are volumetric type which receive lime from the bin through the feeder top and discharge out the feeder side to a lime slaker located underneath. At plant design flow of 4.5 MGD it is estimated that about 31 cubic feet per hour of lime is required (15.5 Cu Ft/Feeder).

Each lime feeder is equipped with an SCR drive built into the lime feeder. The rate of lime discharge from the feeder is done by manually selecting a position on the speed control knob. The lime feeder must be paced with the lime slaker lime usage.

d. Lime Slakers

Three (3) lime slakers have been provided; one under each lime feeder. The third slaker is to be used as a standby unit. Lime slakers and feeders have capacity to use only one unit if desired. The slakers receive lime from the lime feeders, mix the lime with water and produce a lime slurry which is highly soluble in water. The slakers, in the process of making lime slurry, remove impurities from the lime (grit) and discharge these to a receiving container (garbage cans).

A water supply is required to each lime slaker. The plant plumbing is such that either plant effluent or city water may be used for making lime slurry. The city water supply may not be adequate at times to provide sufficient quantity of water; therefore, even though the use of this water will be more maintenance free, it should not be depended upon completely. The plant effluent (utility water) is the best source as far as quantity is concerned; however, during periods of poor effluent quality, plating of chemical compounds inside the slaker may occur.

The lime slaker is electrically operated but the lime and water feed rates are manually adjusted. The operator needs to regulate these feed rates each time the lime and water quality changes.

The lime slaking operation generates considerable heat. Some of this heat is utilized, by means of heat exchangers, to increase the slaking efficiency since lime is more soluable in hot water than in cold water. Should the slaker become overheated, a high temperature shut-down will occur. Slaking temperature should be within the 190°F to 210°F range for best results.

3. Operation

a. Normal Operation

The dust collector is utilized only during lime delivery truck unloading. The proper unit is activated by a switch located at the loading dock entrance to the control building. The chemical storage bins are fitted with indicators at their quarter full elevations to provide the operator with the amount of lime in each bin (indicator lights are on the console graphic). Chemical storage bin outlet gate is to be open at all times lime is desired since a limit switch on this gate stops the lime handling process when the gate is not fully open. The ventilating is shut down during lime delivery.

The lime feeders are to run continuously and be paced to feed lime at the proper quantity required by the lime slaker.

The lime slakers should be operated continuously, since starting and stopping causes the contents to cool and the process efficiency is affected. When stopping the slaker, unspent lime may solidify in the slaker. Grit may settle out and become difficult to remove and chemical coating of the slaker liner plates may become a serious problem. Therefore, to reduce maintenance, keep the slaker in operation. If necessary, slow the slaking process down to a point where the same amount of lime slurry is produced that is required in other plant processes.

As the lime slaker starts and stops a solenoid valve on the water line to the slaker automatically opens and closes to assure water and non-overflow of unit. Water quantity must be manually regulated by a throttling valve on the water line.

b. Emergency Operation

During the failure of one of the lime handling process equipment units, the standby unit may be utilized. Either chemical storage bin may be used. During the down-time of a chemical storage bin, one bin may be used and the standby feeder and slaker placed in operation with lime transfer via a conveyor from the bin to a small hopper over the third feeder.

If slurry cannot be produced the plant may have to be shut-down completely. If shutting the plant down will cause problems, lime may be placed into the flash mixer directly. This will require a lot of additional work, cause maintenance problems with equipment and lower the plant overall treatment capability. Therefore this procedure is recommended only during adverse weather, high mine pool level, etc.

Lime handling equipment operates from the emergency generator in the case of a utility power outage.

4. Controls

a. Manual

Hook-up of truck unloading pipes or hoses is manual. Lime bin gate opening is manual and the rate of lime feed is manually set on the lime feeder. Water supply rate to the slaker is set manually. The lime feed and slaking equipment may be manually started and stopped via a small console near the units.

b. Electrical

Lime transfer from truck delivery must be activated manually but will operate automatically once activated. This includes the dust collectors, vent equipment, etc. on the top of the chemical storage bins. Dust control equipment must be operating during truck unloading

Chemical storage bin level indicators are electrical and should always be in operation.

The lime bin gate (rotary gate at the chemical storage bin hopper bottom) is equipped with a limit switch that prevents operation of the lime feeders and slakers unless the gate is fully open.

Lime feeders are operated electrically but manually adjusted.

Lime slakers are operated electrically in conjunction with the lime feeders. Starting and stopping lime feeders will automatically start and stop the slakers respectively.

A high water level in the lime slurry vat will automatically stop the feeder and slaker associated with it.

5. Start-Up

To start the lime transfer portion of this process, simply turn on the switch at the loading dock door. Assure that all equipment is operating properly before introducing lime. Be sure the lime bin gate is closed and the chemical storage bin is empty, clean and dry. Lime pumping will be done by the lime delivery truck operator; however, the plant operator must assure that the plant equipment is functioning properly to receive lime before allowing unloading of truck.

The lime feeder and lime slaker work together as a unit during normal operation. Each should be placed through a "dry run" manually to assure electrical controls and mechanical features operate properly. The slaker should be operated with only water before introducing lime.

Fill the slaker about three fourths with water, adjust the water inlet throttling valve to slow down the water. Turn on the lime feeder and slaker manually. Open the bin gate and switch feeder and slaker to automatic mode. To prevent grit dumping on the floor place a garbage can under the discharge opening. Observe lime slurry consistency and readjust water supply to get proper mixture.

The manufacturer's operating instruction manual should be consulted for detailed start-up procedures of the lime slakers.

6. Monitoring

Lime handling is monitored in such a manner that the effective operation of the equipment is dependent upon adjustment of equipment in accordance with the results of monitoring.

a. Visual Check

The only visual checks are the lime being discharged from the lime feeder and the slurry being discharged from the lime slaker. After some experience in what to expect at each observation point, a quick frequent visual check should indicate something of the operation of the process.

b. Indicator Lights

Running lights on the operating console permit a quick method of determining whether the equipment is running. Chemical storage bin level lights are also displayed on the operating console graphic to give a visual observation of the lime level in the bins. A running light is burning whenever its respective item of equipment is operating. The chemical storage bin level lights are on continuously whenever the bin material is at an elevation to cover the sensing element.

F. LIME SLURRY HANDLING

1. Description

The lime slurry handling is a process of receiving the lime slurry from the lime slaker (equipment that makes the lime slurry) and ultimately discharges into the flash mixing tanks. The process is necessary in order to keep the lime in solution, have it available when and where needed and to get it from the point of origin to point of discharge.

Lime slurry is a product that is difficult to handle, therefore special pumping and feeding equipment is necessary. The slurry will settle lime out of the solution if not adequately agitated, mixed or kept moving. Pipelines handling lime slurry are subject to being coated with lime particularly at low velocities of slurry through the pipeline. Tanks, vats, containers, etc. must contain mixers to keep the lime in solution.

The lime slurry at this wastewater treatment plant is made on the control room floor (ground floor) of the control building. It must then be lifted to the operating room floor (second floor) where it is then fed in the proper proportion to the raw wastewater. This last step is done via lime slurry feeders into the flash mixing tanks.

2. Major Components

a. Lime Slurry Vats

Three (3) lime slurry vats, located on the floor of the control building first floor, receive the lime slurry from the lime slaker associated with the lime slurry vat. In the lime slurry vats the contents are agitated with mixers. The vats are made of steel with capacity of 200 gallons each and coated with a chemical resistant paint. Vats are fitted with a drain, overflow and a pump suction opening. Vats also contain a bubble type level controller which is discussed later in this section.

b. Lime Slurry Pumps

Three (3) lime slurry pumps, one attached to each lime slurry vat, have been provided. The lime slurry pumps are the progressing cavity type with chemical resistant materials that touch the lime slurry. The pumps discharge through polyvinylchloride piping to the lime slurry tanks which are located on the second floor of the control building.

The lime slurry pumps are equipped with a manually adjustable rate of speed drive. The pump will discharge more slurry than is required for use so that the velocity of lime slurry in the pipeline is high to reduce and/or eliminate settling deposits in the lines. The excess lime slurry is discharged back into the lime slurry vat.

c. Lime Slurry Tanks

Two (2) lime slurry tanks, located on the second floor of the control building, receive lime slurry from the lime slurry pumps. In the lime slurry tanks the contents are agitated with mixers. The tanks are made of steel, with about 2,000 gallons capacity each, and coated with a chemical resistant paint. Tanks are fitted with a drain, overflow and a gravity outlet to the lime slurry feeders, (Roto-dips) Tanks also contain a bubbler level controller discussed later in this section. Overflow is to the flash mixer.

d. Lime Slurry Feeders

Three (3) lime slurry feeders, located near the lime slurry tanks receive lime slurry, by gravity, from the lime slurry tanks and discharge the proper amount of lime slurry, via a pipeline, into the flash mixers. One (1) feeder is a standby unit. The other two (2) are used, one (1) for each flash mixer.

The lime slurry feeders are equipped with a manually adjustable rate of speed drive. This drive is also paced automatically with the pH meters on the flash mixer outlets as the primary sensing elements.

3. Operation

a. Normal Operation

The lime slurry handling equipment is designed such that two (2) lime slurry vats, two (2) lime slurry pumps, both lime slurry tanks and two (2) lime slurry feeders are operating continuously. All equipment rate of speed is to be adjusted so that continuous operation is effected. Although there are controls for stopping and starting pumps, etc. fine tuning of the related equipment should prevent these controls from runctioning any oftener than necessary.

Normal operation is performed by placing all equipment in the "automatic" position. Hand operation should only be required for initial start-up or for testing equipment.

b. Emergency Operation

Should any item of equipment fail, an emergency plan of operation must be utilized. Standby equipment is available to perform this operation. Since only two (2) lime slurry tanks are available; if one (1) is required to be taken from service, the other tank may be used alone. By opening and closing inlet and outlet valves in the piping system, the operator has numerous combinations of equipment available for use under emergency conditions.

Lime slurry handling equipment operates from the emergency generator in the case of a utility power outage.

4. Controls

a. Manual

Each item of equipment may be operated manually for start-up, testing or emergency operation. The rate of pumping of the lime slurry pumps is manually adjusted by changing the pump speed via the variable speed adjustment dial. The volume of lime slurry discharged to the lime slurry tanks is manually controlled with the throttling valve on the tank fill pipeline (the excess lime slurry is returned to the lime slurry vat).

b. Electrical

When the lime slurry vat is full (or at a pre-set high liquid level) the bubbler system will automatically activate and start the lime slurry pump. Should the lime slurry pump empty the lime slurry vat, the pump will stop pumping automatically via a low liquid level on the lime slurry vat bubbler. Thus the rate of speed of the lime slurry pump should be set (manually) to pump out of the vat at the same rate of volume of lime slurry that the slaker discharges to the vat.

A bubbler system senses the liquid level in the lime slurry tanks. Electrical contacts on this system will also provide for automatic control of the lime slurry pumps. At a present high liquid level in the lime slurry tanks, the lime slurry pumps will automatically stop. Any liquid level under this high point will permit the lime slurry pumps to be operated.

The lime slurry feeders are paced by the pH requirement of the liquid discharging from the flash mixers. A further description of the Instrumentation is given under Section H of this chapter. The feeders will speed up and slow down automatically based upon a signal received from the PH instruments. This control system begins at the pH sensors, goes to the motor control center to the operating console then to the lime slurry feeder. A set-point on the pH analyzer governs the signal sent to the feeder. A float control in each lime slurry feeder prevents flooding of the machine.

5. Start-Up

Start-up of electrically operated equipment should be made in the "hand" position until a check is made to ascertain that the equipment is operating properly. After switchover to the "automatic" position all emergency and failsafe features should be assimilated to assure all systems function as expected.

The lime slurry handling process starts with the filling of the lime slurry vat from the lime slaker. NOTE: It is suggested that the lime slurry handling process be trial run with water before lime slurry is added to the process. After the lime slurry vat is full, the lime slurry pump is to be started at its lowest speed. Adjust speed to assure discharge into the lime slurry tank. Next adjust rate of lime slurry return to vat with throttling valves in pipelines. Place lime slurry tank bubbler system in operation. Start lime slurry feeder at lowest speed and slowly increase speed manually to about one-half feeder capacity. After instrumentation is in operation, lime slurry feeder can be placed in "automatic" position.

After all systems that can be placed in "automatic" are placed in "automatic" operation, retrace the start-up procedure and make manual adjustments as necessary. NOTE: This process cannot be placed in operation until the lime handling process is in operation because lime slurry is needed for this process.

The manufacturer's operating instruction manual should be consulted for detailed start-up procedures of lime slurry pumps and lime slurry feeders.

6. Monitoring

Lime slurry monitoring will provide information that is important to the fullfillment of the process; which is necessary for proper operation of the wastewater treatment plant.

a. Visual Check

A sight check of the lime slurry vat, lime slurry tank and discharge of the lime slurry feeder is one method to assure a satisfactory operation of the process. The vats and tanks should be well mixed and have normal liquid levels (above one-half full). The lime slurry feed to the flash mixers should be of the same consistancy as that in the tank. A visual check of pipelines periodically is advisable to prevent buildup which could lead to plugging.

b. Indicator Lights

Running lights on the operating console permit a quick means whereby the equipment is in operation or not. The lime slurry mixers, pumps and feeders all have running lights on the console.

c. Time Meters

Elapsed time meters on the operating console provide valuable data regarding running time of equipment. The logging of this information will provide a method of monitoring time of operation of equipment.

d. Counter

The revolution counter on the operating console provides valuable data regarding running time of equipment. The logging of this information will provide a method of monitoring time of operation of equipment.

e. Alarms

The following alarm systems are connected to activate the telephone dialing system:

i. Flash Mixers - both high and low pH
ii. Lime Slurry Vats - high liquid level
iii. Lime Slurry Tanks - low liquid level

G. SLUDGE HANDLING

1. Description

Sludge handling may be divided into two categories: (1) sludge recirculation and (2) sludge waste. Sludge recirculation is the process of taking settled solids (sludge) from the bottom of the settling tanks and pumping it to one of three places (portions may be distributed to all three places): (1) Flash Mixer Influent, (2) Aeration Tank Influent, and (3) Settling Tank Influent. Sludge wasting is the process of taking the excess settled solids (sludge) from the bottom of the settling tanks and pumping it to the point of sludge disposal (back into the underground mine).

Sludge recirculation provides several benefits to the wastewater treatment system. Maximum benefit can only be ascertained by close monitoring of treatment processes and plant efficiency under various circumstances and degrees of sludge recirculation. Major benifits of sludge recirculation are:

i. Re-use of unspent lime resulting in a chemical purchase cost reduction.
ii. Mixing of flocculated materials with raw or pretreated wastewater enhances flocculation.
iii. Mixing of settled material assists in preventing shock loadings to the flash mixer, aeration tank and settling tank.

Sludge wasting is required to prevent build-up of excessive amounts of settled material in the various treatment processes. The quantity of sludge to be wasted will be dependent upon the efficiency of the wastewater treatment plant and its several processes under various loading conditions. Wasting is to the abandoned mine in a different area from which the raw water is taken.

2. Major Components

a. Sludge Boxes

One (1) sludge box is attached to each settling tank. The sludge box is made of reinforced concrete and covered with grating. The box is connected to the sludge center well in the center of the settling tank bottom with a twelve (12) inch fiberglass reinforced transfer pipe. The transfer pipe is fitted with a knife valve to permit dewatering of either the settling tank or the sludge box without dewatering the other unit. The sludge box serves as a place for mounting the sludge recirculation pump and for draining off sludge to be wasted.

b. Sludge Recirculation Pumps

A total of six (6) sludge recirculation pumps are provided. One (1) pump is mounted in the sludge box attached to each settling tank. Two (2) additional pumps have been provided which are standby units. These standby units have the same characteristics as those mounted in the sludge boxes and are available as replacement units. The pumps are submersible type and connected in such a way as to be removable without dewatering the sludge box.

c. Sludge Recirculation Force Mains

A four (4) inch fiberglass reinforced pipe force main is connected to each installed sludge recirculation pump. There are four (4) force mains. Tracing the route of pumped sludge, the sludge is lifted above the ground surface and enters a three (3) way plug valve under the steps between the aeration tank and settling tank. This plug valve permits sludge travel to the settling tank inlet (through a parshall flume) or to the concrete flume on the second floor of the control building. The flow may be split to cause a portion to travel each way at this three way plug valve. From the discharge point in the control building, flow is to the flash mixer (through a parshall flume) or to the flash mixer outlet box (to aeration tank by bypassing flash mixer). Direction of flow is regulated with slide gates to be adjusted by the operator.

d. Electric Valves

At each sludge box is an electrically operated plug valve on the six (6) inch waste sludge piping. These valves are used to regulate the amount of sludge wasted from each settling tank. The valves are normally opened, closed and throttled from the operating console; but are also fitted with a hand wheel for manual operation.

e. Sludge Troughs

From each settling tank sludge box a fiberglass sludge trough carries the sludge to be wasted to the sludge well. The troughs are open at the top to permit entry and are at ground level for easy access. At the sludge well end of the troughs is located a parshall flume which is used to measure the quantity of sludge transfered to waste.

f. Sludge Wells

Two (2) reinforced concrete sludge wells have been provided. One well is located on each side of the control building with top of well covered with grating and located at ground level. The sludge wells have hoppered bottoms which assist the sludge in getting to the sludge disposal pump suction. The sludge wells act as a holding tank for the sludge disposal pumps.

g. Sludge Disposal Pumps

A total of four (4) sludge disposal pumps are provided. One (1) pump is mounted in each sludge well. Two (2) additional pumps have been provided which are standby units. These standby units have the same characteristics as those mounted in the sludge wells and are available as replacement units. The pumps are submersible type and connected in such a way as to be removable without dewatering the sludge well.

h. Sludge Disposal Force Mains

Two (2) fiberglass reinforced six (6) inch pipelines are used for pumping sludge to the disposal pit. Each sludge well is fitted with one (1) force main. The force mains are underground and fitted with cleanout manholes at strategic points along the pipelines. The force mains are concrete encased under McKee Run and fitted with a blow-off near the stream bank. The force mains are cross connected with pipelines fitted with plug valves such that either or both mains may be used for sludge disposal.

3. Operation

a. Normal Operation

The sludge transfer pipe between the settling tank hopper and sludge box is fully open. Sludge is recirculated continuously to a point selected by the operator by running the sludge recirculation pumps. Quantity of sludge recirculation is selected by the operator anywhere between 0 and 50% of raw water quantity. Sludge is also wasted continuously by a throttling of the electrically operated plug valves. Sludge disposal pumps run continuously operating automatically off the liquid level in the sludge well. Only one sludge disposal force main should be used with the other main available as a standby unit. Valves on pipelines need to be used monthly to assure operation and re-adjustment when necessary.

b. Emergency Operation

An emergency relating to sludge recirculation is not as serious as an emergency relating to sludge wasting. Sludge, recirculation does not have to be performed; however, the treatment process will be affected by not having sludge recirculated. Sludge wasting is important in order to maintain the proper sludge concentration in the treatment plant units and to assure that plugging of pipelines and equipment does not happen.

Should the sludge wasting operation from a settling tank be impaired, it may be necessary to take that settling tank out of operation until all systems are functioning properly. The sludge valve (electrically operated plug valve) may be manually adjusted if an electrical failure occurs. The sludge disposal pumps may be operated manually if the "automatic" side malfunctions. Manual operation of the sludge disposal pumps may require frequent cleaning of sludge disposal force mains.

Instrumentation malfunctions will not seriously affect the treatment if the operator can "sight" the approximate waste sludge volume.

Electrically operated sludge handling equipment operates from the emergency generator in the case of a utility power outage.

4. Controls

a. Manual

The sludge transfer pipe valve is a manually operated unit (valve on pipeline between settling tank center hopper and sludge well).

The routing of recirculated sludge is done manually. In one instance its by rotating a plug valve and in another instance its by the operation of slide gates.

The routing of wasted sludge in the sludge disposal force main is done manually by the operation of the plug valves.

Hand controls are also furnished for the sludge recirculation pumps and the sludge disposal pumps. These manual controls are only used during start-up, testing or emergency operation. Normal operation of these pumps are in the "automatic" mode.

Cleaning of sludge troughs, etc. is manual. This may be required frequently as sludge accumulations appear. Sludge lines are fitted with removable couplings for sludge line checking and cleaning.

b. Electrical

The electrically operated plug valves on the waste sludge line are operated from the operating console. The valves may be opened and closed or partially opened and closed as required by manually pushing the "open-close" button on the console.

The pumping rate for sludge recirculation is variable (V.F.D.) and is controlled by the operator by selection of a speed or flow rate at the operating console. The volume of pumping from 0 to 400 gpm for each pump is manually selected and dialed in. The pump speed will increase and/or decrease as the speed selection dial is moved.

The sludge disposal pumps operate automatically from a bubbler type sensing device. The bubbler senses the liquid level in the sludge well and will automatically speed up or slow down the pumping rate of the sludge disposal pump in that particular well as the liquid level rises or lowers respectively. A low liquid level shut-down is also included to stop pumps in case a predetermined low liquid level is reached.

5. Start-Up

The sludge handling process should be started up by using water as the liquid to be pumped. The water may be city water or nearby creek water. If the operator starts up this process with sludge and there is an apparent immediate malfunction a large amount of cleanup and possible pipeline replacement may be required.

For sludge recirculation, the sludge recirculation pumps should be operated in the "hand" position until assurance of operation is evident. Pumping initially should be to the second floor of the Control Building with discharge to the flash mixer. The three-way plug valve should then be opened to permit a portion of sludge recirculation to the settling tank inlet trough. Recirculation to the Aeration Tank can be done anytime by regulating direction of flow with the slide gates. After placing electrical controls in "automatic" position, the rate of sludge recirculation needs to be adjusted by manually selecting a pump speed (this is done at the operating console). Pump speed selection will follow operation of the sludge flow instrumentation start-up.

For sludge disposal, the electrically operated valve on the settling tank must be partially opened. Again, it is suggested to use water as the liquid until satisfactory operation of all equipment is ascertained. The amount of sludge withdrawn by the electric valve will be governed by the laboratory analysis of the sludge, adjusted from the operating console and observed via the instrumentation provided on the operating console. Operate the sludge disposal pumps by "hand" until the system is operating properly, then switch to "automatic". Prior to automatic switchover, the bubbler system must be activated and adjusted for high and low water levels in the waste sludge well.

Observation for the following things must be done for each pump:

i. Direction of rotation (initially)
ii. Motor speed (visually)
iii. Pump discharge volume
iv. Unusual sounds
v. Unusual smells
vi. Lubrication system
vii. Force main leakage
viii. Valve operation

The manufacturer's operating instruction manual should be consulted for detailed pump start-up procedures.

6. Monitoring

The sludge handling process can be monitored several ways. Each way may suggest a particular function or operation deficiency.

a. Flow Instruments

Volumetric type flow instruments are provided for the sludge recirculation to the head end of the plant and for the wasted sludge. These instruments use parshall flumes as primary devices with the receivers located in the operating console. Recirculated sludge to the Aeration Tank must be measured manually in the rectangular channel. Recirculated sludge to the settling tank must be measured manually in the parshall flume.

b. Visual Check

The operator can estimate sludge quantity and quality by visual observation of the sludge flowing in open channels. Provisions have been made for accessability to the channels whereby the operator may observe the sludge. The operator will require some experience in what to look for in these channels to make this type monitoring effective.

c. Indicator Lights & Markers

Running lights on the operating console permit a quick observation as to which pumps are running and which are not running. A marker showing the position of the electrically operated waste sludge valve is also provided on the operating console. Observing this position marker with its respective flow instrument will provide the operator with information needed to properly adjust the quantity of wasted sludge.

d. Time Meters

Each pump is equipped with an elapsed time meter. Daily readings logged of the pumps will spot down-time of pumps and provide data relative to maintenance requirements.

e. Laboratory

Perhaps the best monitoring device to use to regulate sludge recirculation and sludge disposal is the analyses of sludge samples. These analyses will be the parameters which will tell the operator the amount of sludge and to where it should be placed. Laboratory results coupled with other monitoring devices will provide for efficient, effective treatment plant operation.

f. Alarms

The following sludge handling alarm systems are connected to activate the telephone dialing system:

i. Sludge Well High Water Level (Both Wells)
ii. Waste Sludge - No Flow (All four settling tanks)
iii. Sludge Recirculation - No Flow (Flumes)

H. INSTRUMENTATION

1. Description

Instrumentation devices are provided in the wastewater treatment plant to monitor certain operations and to control certain operations. Instrumentation devices provide totalizing, indicating and recording depending on the instrument function and use.

Each instrument is provided with a primary element, a primary sensing and transmitting device and a receiving device. The primary devices are located at the point of monitoring. All receiving devices are located in the operating console. Instruments are electrically operated units with transmission over shielded cable between primary and secondary (receiver) units.

Instrumentation such as pressure gauges, tachometers, elapsed time meters, revolution counters, etc. are not included in this portion of this manual. The devices included herein are:

- i. Raw Water Flow
- ii. pH Instruments
- iii. Recirculated Sludge Flow
- iv. Waste Sludge Flow
- v. Air Flow
- vi. Mine Water Level Indicator

2. Major Components

a. Raw Water Flow

The primary device is a fiberglass parshall flume with nine inch (9") wide throat. Flume is fitted with a stilling well which contains a float to sense the liquid level passing through the flume.

The float is connected to an electronic transmitter which sends a 4ma to 20 ma signal (4ma at 0 flow and 20 ma at maximum flow) to the receiver. The receiver converts the incoming signal via gears, dials, charts, etc to:

- i. Totalize on a counter the volume of raw water flow that has passed through the flume.
- ii. Indicate on a scale with a pointer the volume of raw water flow passing through the flume at that moment.
- iii. Record on a chart, in ink, the volume of raw water flow passing through the flume over a period of time (charts are good for 30 days).

The receivers (there are two of them) are located in the operating console.

b. pH Instruments

The primary device in the Flash Mixer Effluent Box is a submersible electrode type probe assembly which monitors the hydrogen ion concentration of the liquid leaving the Flash Mixers. The signal is transmitted to the receiver located in the operating console. The receiver converts the incoming signal via gears, dials, charts, etc. to:

i. Record on a chart, in ink, the pH of the liquid passing the probe assembly over a period of time. (Charts are good for 30 days).

The pH instruments are used to pace the lime slurry feeders (Roto Dips) located on the second floor of the Control Building.

c. Recirculated Sludge Flow

The primary device is a fiberglass parshall flume with six inch (6") wide throat. Flume is fitted with s stilling well which contains a float to sense the liquid level passing through the flume.

The float is connected to an electronic transmitter which sends a 4ma to 20 ma signal to the receiver. The receivers (two located in the operating console) convert the incoming signal via gears, dials, charts, etc to:

i. Totalize on a counter the volume of sludge that has passed through the flume (sludge recirculated to the Flash Mixer or diverted to the Aeration Tank).
ii. Indicate on a scale with a pointer the volume of sludge passing through the flume at that moment.
iii. Record on a chart, in ink, the volume of sludge flow passing through the flume over a period of time (charts are good for 30 days).

d. Waste Sludge Flow

The waste sludge flow instrumentation is identical to the recirculated sludge flow instrumentation except that there are four (4) devices and the parshall flumes have a three inch (3") wide throat.

e. Air Flow

The primary device is a stainless steel orifice plate located in the five inch (5") air supply line to each Aeration Tank. There are two (2) devices, one for each Aeration Tank. The primary device creates a situation where a pressure drop occurs as the air moves through the orifice opening. The pressure drop is sensed with a transmitter which sends a signal to a receiver mounted in the operating console. The signal transmitted is accomplished via the square root extraction method. The transmitter has an indicator where the flow can be read.

The receivers are designed to:

i. Totalize on a counter the volume of air that has passed through the orifice plate.
ii. Indicate on a scale with a pointer the volume of air flow passing through the orifice plate at that moment.
iii. Record on a chart, in ink, the volume of air flow passing through the orifice plate over a period of time (charts are good for 30 days).

f. Mine Water Level Indicator

The primary device is the bubbler system which controls the raw water pumps. The backpressure on the bubbler system is sensed, the head converted to an indicating dial and the dial shows, with a pointer, the mine water level. The dial is calibrated to read in feet of water with zero feet being the low water level of the mine. The indicator is located in the operating console.

3. Operation

a. Normal Operation

All instruments should be in service under normal plant operation. The instrument readings are dependent upon plant performance and operational conditions. An approximate position of instrument reading should be noted and used as reference to the various plant processes.

b. Emergency Operation

Should the instrumentation devices fail, the overall plant operation should not be impaired. Only the pH devices are used as automatic control units. Therefore; whenever a pH instrument is inoperable, lime slurry feed rate must be adjusted manually.

4. Controls

The instrumentation devices are not controlled by any signals independent of the instruments. All controls are part of the instrumentation package. The instrument readings are used to establish treatment patterns and should be evaluated by the operator in adjusting the various treatment processes in the plant.

5. Start-Up

Start-up of the instrumentation devices are always performed by a factory trained technician. The instruments require calibration and checking with monitoring devices beyond the scope of the operators schedule of work. The adjustments, in many cases, are microscopic and the parts of the instruments are delicate.

Prior to start-up service, the operator must assure the following items are available and functioning:

i. Electrical power is available
ii. Transmission wires between transmitter and receiver are connected.
iii. Ink and charts are available
iv. The various units of instrumentation are mounted correctly.
v. The primary devices have something to measure. e.g. blowers must be operable to start-up air flow meter, etc.
vi. Utility water is available for stilling wells.

I. UTILITY WATER

1. Description

Utility water is described as the water that is used in all areas except where potable water is used. Utility water is water pumped from the final tank into a pressurized vessel (hydropneumatic tank), and from there water is fed to such items as:

i. Slaker Make-up Water
ii. Hose Bibbs
iii. Yard Hydrants
iv. Flushing Water
v. Sludge Well Make-up Water

Since the utility water is taken from the final tank it consists of water that has been treated in the plant and is ready for discharge to the receiving stream. This being the situation, the treatment plant performance has an affect on the quality of the utility water.

2. Major Components

a. Final Tank

The reinforced concrete final tank of the wastewater treatment plant is a source of water for use as utility water. As a result, the utility water is not suitable for human consumption. The final tank is covered with grating to protect workmen in the area from falling into the tank. As long as the plant is operating (except during start-up) there will always be adequate utility water to fulfill the plant needs.

b. Utility Water Pumps

Two (2) vertical turbine type pumps have been provided for use as utility water pumps. One pump is a service unit and the other a standby unit. Each pump is rated at 200 GPM @ 230' TDH which will provide 200 gallons per minute at a pressure of 100 pounds per square inch. Pump components are made of iron and steel.

c. Utility Water Piping

Six (6) inch and four (4) inch piping is of fiberglass reinforced plastic and smaller lines are polyvinylchloride. Piping is coupled with fittings that facilitate removal of sections for maintenance.

d. Hydropneumatic Tank

The hydropneumatic tank is constructed of steel and located on the control room floor of the Control Building. The tank is fitted with a float-air device which automatically maintains the proper water-air volume ratio in the tank. Air is received from the instrument air compressor. The tank capacity is approximately 2000 gallons. The tank is designed to have water, under pressure, available at all times for the plant needs without running the utility water pumps continuously or having these pumps come on each time utility water is needed. Piping connections are such that this tank can be taken out of service and bypassed without the loss of utility water.

3. Operation

a. Normal Operation

Normally one utility water pump will be placed in the "automatic" position and the other unit "off". Pumps will start and stop automatically with pressure being sensed at the hydropneumatic tank. A low water bubbler system cut-off in the final tank also will shut-down the utility water pumps. With both pumps in the "A" position, the pumps will alternate operation via an alternator.

Slaker water is received automatically via a solenoid operated valve which opens when. the slaker starts and closes when the slaker stops.

Flushing water is applied where required by manually operating utility water valves near equipment plumbed with flushing water. In other areas flushing water is received from hose bibbs or yard hydrants on the utility water system.

b. Emergency Operation

A standby utility water pump is provided in case of failure of the service pump.

Utility water pumps operate on emergency power should the utility power be out.

A cross-connection to the city water supply may be made manually to temporarily utilize city water in lieu of plant effluent water if needed. A backflow preventer has been installed on the city water upstream of this connection to protect the city water from contamination in case of an operational difficulty of either system.

4. Controls

a. Manual

The operator has the option of selecting the standby pump. This is done at the motor control center by turning the standby pump to "off". The utility water pumps may be manually operated. This is usually done during start-up, testing, or when it is convenient to operate this way.

Hydropneumatic tank bypassing is accomplished by manually closing the tank inlet-outlet valve.

Flushing of lime slurry handling equipment is done by a manual manipulation of valves on the pipelines to and from the equipment.

Hosing down tanks, watering, cleanup, etc. is done via the hose bibbs and yard hydrants which are manually operated.

b. Electrical

Pumps are started and stopped with electrical contacts in the pump control wiring which are closed and opened in accordance with the low and high pressure respectively in the hydropneumatic tank.

A low water cut-off in the final tank (bubbler system) will stop all pumps if a certain predetermined low water level is reached in the final tank.

Slaker water is received as needed through electrically operated solenoid valves on the utility water pipeline to each slaker.

c. Laboratory

Should laboratory analyses of final tank water reveal high concentrations of iron, sulfates, lime, dissolved solids, etc.; this water should not be used as slaker make-up water since it will plate-out in the slaker under the high operating temperature and chemical characteristics of the liquid in the slaker. In this case city water should be used.

5. Start-Up

Start up must be preceeded by a full final tank. Either plant effluent (if it is analyzed and proven satisfactory for use), creek water or city water should be used to fill the final tank. The utility water pump should be started in the "hand" position and the following items observed:

i. Direction of rotation (initially)
ii. Motor speed (visually)
iii. Unusual sounds
iv. Unusual smells
v. Motor temperature
vi. Lubrication system
vii. Force main leakage
viii. Pressure build-up

The manufacturer's operating instruction manual should be consulted for detailed utility water pump start-up procedures.

Bleed air out of the pipeline system by opening valves at various locations. Open valves carefully and slowly, closing whenever water begins flowing out of the pipeline.

Start air bubbler system for final tank and air make-up for hydropneumatic tank before switching utility water pump to "automatic" position.

A lack of pressure in the hydropneumatic tank will activate the telephone dialing system indicating an emergency at the plant.

J. POTABLE WATER

1. Description

Potable water is described as water suitable for human consumption. This is the water obtained from the city water supply. It is used in the plant for:

i. Laboratory sink & eye wash
ii. Toilet area
iii. Service sinks
iv. Drinking fountain

In addition the potable water may be interconnected to the utility water system.

2. Major Components

a. Pipelines

Water is brought to the site with a two inch (2") polyvinylchloride (pvc) pipeline. This pipeline is fitted with a shut-off valve at the plant property line.

Water inside the pipeline control building is carried through copper pipelines to the various areas of usage.

b. Backflow Preventer

The backflow preventer is a combination of check valves and accessories to prevent water to flow from the plant to the city water system. The backflow preventer is located on the control room floor at the city water entrance to the Control Building.

c. Pump and Tank

The city water supply does not have adequate pressure for the wastewater treatment plant. Therefore a booster pump and pressure tank has been provided to increase the city water pressure to a satisfactory level.

3. Operation

a. Normal Operation

Normally the only usage for the potable water system is for the laboratory sink, toilet area, service sinks and drinking fountain. The system operates automatically via a set of pressure operated contacts at the pressure tank which starts and stops the booster pump as the pressure decreases and increases to a predetermined set-point respectively.

b. Emergency Operation

During a time when no city water is available, the potable water system is out of service. There is no back-up or alternate source of potable water.

The city water system may be connected to the utility water piping in the plant and used in place of plant effluent water. This should only be done when the plant effluent quantity or quality is not adequate or appropriate for usage (such as during initial start-up and when the plant treatment efficiency is low).

K. ELECTRICAL FACILITIES

1. Description

The wastewater treatment plant requires electricity for operation. Utility company power is brought to the site by the company. The company installed and must maintain a step-down transformer located on the plant site exterior of the control building. Power enters the control building through a main disconnect switch and is distributed throughout the treatment plant complex via wiring inside steel conduit.

The plant site is also provided with security site lighting.

2. Major Components

a. Main Power Distribution Panel

Located in the electrical room, the main power distribution panel contains the main power switch, distribution of power to the various plant electrical components and the transfer switchgear for use during operation of the emergency generator.

The panel is floor mounted and contains components that are not to be serviced by the plant operator. This unit should be entered only by a certified electrician due to the electrical shock hazards present in the unit.

b. Motor Control Center

Located adjacent to the laboratory, the motor control center provides ready access to the starters, control transformers, circuit breakers, etc. of each of the electrically operated equipment components in the wastewater treatment plant.

This unit should be serviced only by a certified electrician.

c. Operating Console

The operating console is located in the laboratory and provides the operator with a convenient location to observe a major portion of plant performance and permits operation of most processes in the plant from one central station. Above the console is a graphic display of the plant process schematic with a registry of operating lights for various items of electrically operated equipment. Also in the console are located the receiving instruments that totalize, indicate and record many of the plant operations.

d. Emergency Generator Set

A 565 Kilowatt Emergency generator set is located in the electrical room of the control building. The generator is driven by a diesel fueled engine connected to the generator. An underground storage tank is used for the fuel supply. A remote outside radiator is used for cooling the engine. The generator set is large enough to supply all the electrical power needs of the wastewater treatment plant.

3. Operation

a. Normal Operation

Power is furnished by the Utility Power Company. Power is metered at the building service entrance and billed according to plant usage with rates permitted by the Public Utility Commission. All electrically operated units provided with "automatic" controls should be placed in this position. Standby equipment should be turned to the "off" position (not the emergency generator).

For starting, stopping and testing of various plant components the "hand" position should be used on the electrical control circuits. Starting and stopping manually should always be done with the push button stations. Disconnect switches should be used to stop equipment only in emergency conditions and should never be used to start equipment.

b. Emergency Operation

Emergency power is provided in the wastewater treatment plant by the emergency generator set. This power is automatically supplied if an outside power failure occurs. A time delay in starting emergency generator set is built into the equipment to prevent false starting in case of a power momentary outage or loss. Also a "hold-in" type feature is included to continue the operation of the emergency generator for about ten (10) minutes upon restoration of outside power to prevent cycling in case of a momentary restoration or surge.

Hand controls are furnished for electrical motors, etc. to permit operation in case of control equipment failure.

Total power failure (both outside and inside sources) means plant shut-down.

4. Controls

All circuits, wiring, components are protected with breakers and grounds approved by the National Electrical Manufacturer's Association. The distribution of power requirements is accomplished by monitoring such as visual observation, bubbler systems, sampling systems, pressure systems, flow measurement systems, etc. Activation of powered equipment may be manual or automatic depending upon the process and its method of monitoring.

5. Start-Up

Start-up of electrical facilities should be done only by a certified electrician familiar with the electrical components in the plant. These facilities are limited to the four (4) major components discussed earlier in this section. Start-up motors and electrically powered process equipment throughout the plant may be performed by the plant operator. Since this manual is for the plant operators use, only electrical powered process equipment will be considered here.

First assure that all electrical connections are properly made and the circuit is grounded and protected with a fuse or circuit breaker. Throw circuit breaker or insert fuse to energize circuit. With control circuit turned to off, engage disconnect switch, then return to energize control circuit to "hand" position. Check out operation of push button stations first with control circuit in "hand" position. Finally engage "automatic" side of control circuit.

Always check equipment monitoring devices such as ammeters, tachometers, etc. immediately upon start-up. Replace any burned-out running lights.

Assimilate equipment malfunctions to test failsafe features provided. In case of malfunction, investigate the cause, make correction and assure that features are operable.

L. FAILSAFE FEATURES

1. Description

Failsafe features are items of equipment or accessories that will be activated by a primary device and alert the operator that an item has failed, is not functioning properly, is exceeding pre-set limits or that an emergency operation has been activated. The failsafe features considered here are those which activate the telephone dialing system. In addition to these, there are other emergency items at the plant used to assist in the protection of plant equipment such as; circuit breakers, fuses, thermal overloads, belts, shear pins, pressure contacts, running lights, etc.

2. Major Components

a. Primary Device

The primary device is a set of electrical contacts on a piece of monitoring equipment (usually part of the instrumentation). The contacts are energized when the preset limits are reached which will complete an electrical circuit.

b. Telephone Dialer

The telephone dialer is located in the motor control center in the room adjacent to the laboratory. The dialer is equipped with a switch to disengage the telephone dialing section but retain the audio portion of the instrument. This switch will allow only the buzzer to sound when the plant is attended and to allow telephone dialing when the plant is un-attended. A time delay relay prevents false activiation of the dialer.

3. Operation

The failsafe features are used only during a problem or potential problem at the plant. A telephone number priority must be established and up to five (5) numbers placed into the system. Upon the ringing of a telephone and no answer (after about 15 seconds) the next number is automatically dialed.

The dialer must be turned on each time the operator leaves the plant and turned off when he arrives at the plant. This will permit the dialer to function only when the plant is un-attended. It also will permit the audio (buzzer) to sound when the plant is attended.

The operation of the primary devices are dependent upon the instrumentation, bubbler system, etc. that monitors the item being checked. Should the primary device fail, then that failsafe feature is lost. For example; if bubbler system at waste sludge well is out of service, the failsafe feature for the "High Level" in the waste sludge well is not operable. In like fashion if a primary device for raw water flow is broken, the contacts for that device should be disconnected or the failsafe feature will be activated, since "No Flow" will be sensed in a broken flow meter.

4. Controls

The controls that activate the telephone dialer are listed in Appendix B, page 4 of this manual. Each of the conditions listed are designed to sound the alarm that the condition has been met.

5. Start-Up

To start the dialer system is to switch the system on.

M. STANDBY EQUIPMENT

1. Description

Several items of equipment have exact duplicate standby units which are not used simultaneously with the piece of equipment. In these instances, each item of equipment has the capacity of performing the plant design function on its own. In some cases the standby units are installed, hooked up and ready to be activated; in other cases the standby units are replacement items and are in inventory ready to be installed in place of the malfunctioning unit (an example of this is the spare sludge pumps). This paragraph deals only with those units that are installed, ready to operate.

2. Major Components

The standby equipment generally is an exact duplicate, containing all the accessories, functions, controls, etc. as the operating unit.

The following is a list of installed standby equipment:

- i. Two Raw Water Pumps & Their Force mains
- ii. Lime Feeder
- iii. Lime Slaker
- iv. Lime Slurry Pump
- v. Lime Slurry Feeder
- vi. Plant Blower
- vii. Utility Water Pump*
- viii. Sump Pump**
- ix. Waste Sludge Force Main

*Alternates with other pump.
**Alternates with other pump plus will assist other pump at high water level.

3. Operation

All standby equipment should be operated to keep the equipment in good condition and assure operation whenever needed. In fact the standby equipment should be alternated so that at the end of a year, each piece of equipment has an equal running time. For example, the operator should alternate to the standby equipment (suggested weekly) and run it just as if it was the operating unit and the operating unit was the standby unit. Running times for the major items of equipment can be monitored with elapsed time meters connected to the electrical control circuitry.

4. Controls

Standby controls are the same as the controls for the operating units.

5. Start-Up

Start-up procedures are the same for each unit. The standby unit should never be started up while the other unit is in operation.

N. SUMP PUMPS

1. Description

The sump pumps are non-clog extended shaft vertical mounted centrifigal units mounted on a base plate covering the sump pit with the impeller extended to near the pit floor. The unit is a duplex unit. All the building floor drains and drainage systems discharge to the sump pit. The sump pumps discharge into either or both the flash mixing tanks.

2. Major Components

a. Pumps

The pumps are heavy duty type designed for long life under severe operating conditions. Pumps will pump a 2" spherical solid and are designed for non-clog service.

b. Force Main

The force main is made of fiberglass reinforced plastic with quick disconnect couplings for observing pipe condition and/or cleaning pipelines.

c. Sump

The sump is below all control building elevations so that all flows to the sump can be accomplished via gravity pipelines. The sump is large enough for human access. The sump is lined with fiberglass for long life, surrounded by concrete and covered with a steel access manway.

3. Operation

Operation is automatic based upon the sump liquid level. Pumps alternate after each operation cycle and will both operate if influent flows to the sump are greater than the capacity of one pump. An adjustable high and low level setting is available on the controls.

4. Controls

Water level is controlled by a bubbler system which activates the pumps or stops the pumps. A high water alarm is installed and connected to the telephone dialer.

5. Start-Up

Follow regular pump start-up procedure for the sump pump system.

O. ENTERING AND LEAVING PLANT

There are specific areas of concern that the operator must take into consideration whenever the plant is left unattended. A summary list of items should be compiled and posted in the office so that all operating personnel can use the list as a "punch list" to assure that certain duties are accomplished. Two lists are to be made and given a title such as:

i. Procedures When Entering An Unattended Plant
ii. Procedures When Leaving The Plant Unattended

Provided here are some suggested entries for these lists. These suggestions should be expanded as the operator observes certain areas that are not listed, but are an important part of immediate plant monitoring and concern.

The list of procedures when entering an unattended plant should include the following:

i. Switch "off" telephone dialer
ii. Check for alarm lights on console & observe instrumentation
iii. Check bulbs on console by pushing "test" button
iv. Observe any unusual sounds, odors, etc.
v. Check slaker operation (control room floor)
vi. Check Lime Slurry Pump operation (control room floor)
vii. Check raw water troughs (operating room floor)
viii. Check Roto dip operation (operating room floor)
ix. Check Flash Mixer operation (operating room floor)
x. Check Aeration Tank Operation (outside)
xi. Check Settling Tank Operation (outside)

xii. Check Sludge Recirculation Operation (outside and inside)
xiii. Check Sludge Wasting Operation (outside)
xiv. Observe Final Tank Contents and Effluent and evaluate
xv. Inspect for vandalism
xvi. Observe liquid levels in Mine, sump, Lime Slurry Vats & Tanks
xvii. Observe chemical level in Chemical Storage Bins
xviii. Make adjustments to equipment if required
xix. Collect samples and perform analyses
xx. Perform routine housekeeping and maintenance duties

The list of procedures when leaving the plant unattended should include the following:

i. Check all equipment and process operations at the last possible time before leaving.

ii. Adjust all controls to the "Automatic" position.

iii. Readjust all thermostats (heaters & air conditioner) to the limits directed by the Owner.

iv. Switch "on" telephone dialer.

v. Turn out all lights except security lights.

vi. Lock all doors and secure plant site.