

CHAPTER II

GENERAL PLANT OPERATION

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This Chapter of the Operation and Maintenance Manual is inserted to provide a brief resume of the plant operation and give some general instruction as to start-up and shut-down of the plant. The start-up of the various processes and equipment are further detailed in Chapter III of this manual.

Generally, the treatment plant is designed to treat wastewater from an abandoned underground bituminous coal mine at the rate of 4,500,000 gallons per day (3,125 gallons per minute). The mine wastewater in February 1973 had the following characteristics. Parameters in parentheses were used as a basis for design:

pH.....	3.8	(3.8)	
Suspended Solids .....	52 mg/l	(52.0 mg/l)	
Settleable Solids .....	0 ml/l	(0.0 mg/l)	
Dissolved Solids .....	2,320 mg/l	(2130 mg/l)	Total
Dissolved Iron .....	304 mg/l	(300 mg/l)	Total
Manganese .....	0.1 mg/l	(0.1 mg/l)	
Aluminum .....	4.0 mg/l	(22 mg/l)	
Turbidity .....	70 Units		
Sulfates .....	1,850 mg/l	(1500 mg/l)	
Acidity.....		(820 mg/l)	
Ferrous Iron.....		(165 mg/l)	

The treatment process is neutralization by the addition of lime, precipitation of the settleable material after neutralization and discharge to a surface stream (McKee Run). Since the plant is located in western Pennsylvania where temperatures range from -30°F to +100°F and rainfall occurs up to 2 inches per hour, certain precautions regarding plant start-up and shut-down must be considered.

A. START-UP: GENERAL

Prior to any portion of the plant starting up all tanks, pipelines, channels, flumes, etc. must be checked and cleared of all debris and substances that would inhibit operation. All machinery or mechanical equipment must be lubricated and be free for proper operation.

1. Raw Water Pumps

**CAUTION:** Open the chain operated plug valve (control room) on the raw water force main prior to pump start-up.

Initially the first item to be placed in service will be one of the Raw Water Pumps. This is started merely by turning the operating switch on the motor control center to either "hand" or "auto". The Raw Water Pump will discharge to a flume on the second floor of the Control Building which empties into a Flash Mixer. When the Flash Mixer is almost full, (say 2 feet from the top) stop the Raw Water Pump.

## 2. Lime Feeders and Slakers

The next step is to start-up the lime slurry manufacturing process. Open the chemical storage bin gate (we have assumed there is lime in the bin) and start the Lime Feeder from the adjacent control panel. After a few seconds of lime discharge to the Slaker from the Lime Feeder the Slaker can be started from the adjacent control panel. Assure that slaking water is available; during initial startup this will have to be water from the public water supply.

## 3. Lime Slurry Pumps

Whenever the Slaker discharges about 6 inches or more of lime slurry into the Lime Slurry Vat, the Lime Slurry Pump must be started and should be placed in the automatic operating condition. The Lime Slurry Pump will discharge into the Lime Slurry Tank on the second floor of the Control Building.

## 4. Lime Slurry Feeders

As soon as lime slurry is available in the Lime Slurry Tank (6 inches or more) the Lime Slurry Feeder is to be started. This will discharge lime slurry to the Flash Mixer.

## 5. Flash Mixers

The Flash Mixer agitating mixer should then be started (locally for a short period then at the motor control center later) so that the lime slurry becomes thoroughly mixed with the Flash Mixer Tank contents (raw water during start-up). The pH of the Flash Mixer Tank contents must be monitored and when it reaches about 8.0 the Raw Water Pump can then be re-started.

## 6. pH Monitoring

Re-starting the Raw Water Pump will cause the Flash Mixer Tank to overflow into the Aeration Tank. Continue to monitor the pH of the Flash Mixer Tank and adjust the lime slurry feed rate to keep the pH at or above 8.0 (optimum pH is estimated to be 8.25 in the Settling Tanks so about 8.5 will be needed in the Flash Mixer Tank.

## 7. Aeration Tanks

As the Aeration Tank fills the one Aerator should be turned on to begin aeration and mixing of the Aeration Tank contents. When the tank is half full or more, start the one Blower which will begin the Aeration Process in the Aeration Tank. Check all diffusers to assure equal distribution of the air around the tank, perimeter. Adjust effluent gates so that whenever the tank fills it will overflow to only one Settling Tank. Keep all other Settling Tanks out of service (empty of prepared liquor) until ready to be placed immediately into operation. Adjust blower speed to minimum.

## 8. Settling Tanks

Do not start Settling Tank scraping mechanism until the entire floor of the tank is covered with liquid. As soon as the liquid level begins to rise on the vertical walls of the tank, start the scraper. Continue filling the tank until it begins to overflow. As soon as overflow commences start the Sludge Recirculation Pump and recirculate 100% to the head of the plant (second floor of control building). Continue monitoring pH out of the Flash Mixer. Do not begin wasting sludge at this time. Sludge wasting should not occur until about one day has elapsed.

## 9. Miscellaneous

After the first Settling Tank is in operation, repeat the process with the second settling tank. Continue to monitor pH of the Flash Mixer Tank effluent and the Dissolved Oxygen of the Aeration Tank effluent (this D.O. should be about 5.0 mg/l, more than 5.0 mg/l is desired but may not be attainable).

Following operation of the second Settling Tank the second Raw Water Pump should be started. Then follow the process of monitoring for pH and D.O. and making adjustments to the lime handling system and the aeration supply to bring the liquor contents of each tank back into line with the recommended requirements.

If plant effluent water is to be used for lime slaking, the final tank should be pumped out (to the plant influent) to get rid of settlement that was deposited during start-up and before minimal removal efficiencies were attained. Start one Utility Water Pump (with discharge valve nearly closed) and gradually fill all utility water pipelines and hydropneumatic tank. Bleed off lines slowly to release air at various points. Place Utility Water Pump in automatic position after air make-up equipment to hydropneumatic tank is activated.

## 10. Instrumentation

Start instrumentation facilities by merely switching to "on" position. These facilities must be initially started and adjusted by factory trained personnel. Minor adjustments may be made by the operator as instructed by the manufacturer; however, most malfunctions will be handled under contract maintenance.

## 11. Sludge Wasting

Start wasting sludge by opening electrically operated plug valve at Settling Tank sludge box. Begin by wasting only a small amount (valve about 1/3 open). Increase wasting of sludge as plant efficiency reduces. For initial start-up and until maximum plant efficiency is documented, the amount of wasted sludge must be varied and test results obtained at various quantities of wasted sludge. It is estimated that about 15 gallons per minute of sludge will be required to be wasted from each Settling Tank when the plant is operating at 4.5 MGD raw wastewater.

## B. SHUT-DOWN: GENERAL

The plant is designed to operate continuously with all except the standby equipment operating; 24 hours per day, 365 days per year. Shut-down of certain portions of the plant may be needed for repairs, for cleaning of equipment or for piping or equipment replacement. A partial plant shut-down may be desired if the mine water lowers to a point where one-half the plant can effectively treat the wastewater production of the mine.

During the shut-down of any portion of the treatment facilities the operator must be careful and guard against freezing and plugging of pipelines and/or equipment. During the winter months, all pipelines, equipment and accessories in unheated areas must be drained completely. Pipelines, equipment, tanks, etc. handling lime slurry and sludges must be flushed clean, drained and perhaps given a vigorous scrubbing upon shut-down. This is necessary as a safeguard against a build-up of compounds; which, upon start-up, may restrict flow, damage equipment or even prevent operation.

### 1. Raw Water Pumps

When a raw water pump is shut-down, the water in the force main will drain back into the mine. Raw water pumps that are not programmed to operate should have their respective chain operated valve (just under the raw water flume - point of pipe discharge) closed.

### 2. Lime Bins

Lime Bins left out of service for an extended length of time (say several weeks) will probably pick up some condensation and cause lime flow problems upon start-up. Lime Bins should be emptied when not in use and inspected for moisture prior to filling.

### 3. Lime Feeders

The Lime Feeder should not require any special precaution upon shut-down. Preferably the unit should be operated after the lime feed is stopped to empty the feeder. If this is not done the lime in the feeder may cake if it gets damp. However, this caked lime should still be usable and be discharged upon feeder start-up.

### 4. Slakers

Slaker shut-down procedures must be in conformance with the manufacturers written instructions. Generally the slaker should be emptied of all lime slurry and lime and thoroughly flushed with utility water to clean the unit. In order to perform this, the slaker lime feed should be stopped, the flushing water applied to the unit and the slaker continued in operation until no slurry and/or lime remains in the unit. Also assure all grit is removed by continuing to operate slaker after lime feed is stopped. If grit still remains, a panel from the slaker may have to be removed to provide access for manual cleaning.

## 5. Lime Slurry Pumps

Prior to shut-down, turn off the lime slurry feed and open the utility water so that the pump will clean itself using utility water. This will also clean out the Lime Slurry Pump force main. If the pump malfunctions, the force main can be flushed with utility water independently of the Lime Slurry Pump.

## 6. Lime Slurry Feeders

Shut-off lime slurry to unit and flush with utility water. Assure inlet float is clean and free to operate.

## 7. Lime Slurry Vats and Tanks

Continue to operate Lime Slurry Mixers during shut-down. If mixers malfunction, drain and hose down vats and tanks.

## 8. Flash Mixers

Upon shut-down begin draining tank as soon as possible. Drain tank by pumping into other flash mixer. Clean tank and mixer impeller and shaft by hosing with utility water.

## 9. Aerators

Upon shut-down, begin draining tank contents as soon as possible while maintaining blower aeration. Pump contents to other Aeration tank. Clean tank and Aerator impeller and shaft by hosing with utility water.

## 10. Blowers

Blowers may be stopped with no special precautions on the Blower Units. However, if both blowers are out of service, a visual observation must be made of the Aeration Tanks to assure adequate aeration and mixing by the Aerators. Plant operation should be slowly brought to a halt since the Aerators cannot furnish adequate air to treat effectively.

## 11. Settling Tanks

Upon shut-down, begin draining tank immediately by pumping to another Settling Tank. If electric raise mechanism on Settling Tank is not in operation, raise the unit with the manual raise device to assure that scraper mechanism does not become lodged in sludge and to facilitate cleaning of tank bottom. After draining tank, hose and clean with utility water.

## 12. Sludge Pumps

When stopping the operation of any of the Sludge Pumps (either sludge recirculation or sludge waste) inflow to the pump well should be shut-off, the well drained by the sludge pump and utility water added to the well such that the sludge pump will clean itself using utility water. If the Sludge Pump is inoperable, the well must be pumped out using portable pumping equipment and the well hosed and flushed with utility water.

## 13. Utility Water Pumps

The Utility Water Pumps need no special precaution upon shut-down except that they are exterior of the building and in the winter (if both pumps are inoperable) the units should be drained. Each pump discharge contains a check valve which holds water in the force main upon stoppage of the pump.

## 14. Instrumentation

To stop the instrumentation merely cut the electrical power to the unit being stopped. The primary sensing device should be removed or raised from its normal position. The primary sensor and its accessories should be cleaned and wiped dry before foreign material build-up occurs.

## 15. Emergency Generator

No special precautions are needed for shut-down. Consult manufacturers operating manual for specific operational procedures.