Description of the Iron Bridge Facility

Introduction

The Iron Bridge Water Pollution Control Facility is designed to service about 400,000 people in the Cities of Orlando, Winter Park, Maitland, and Casselberry, and unincorporated portions of Orange and Seminole Counties. This volume of flow is equal to about 727,300 55 gallon drums! The facility was built to help protect the Central Florida environment, mainly the local surface waterway ... Little Econlockhatchee River. The effluent/reuse water from the Iron Bridge Facility is split between two locations, first, the pristine Little ECON River, and second, the City's artificial wetlands project. The wetlands effluent flows by gravity to a portion of the St. John's River. The benefit of the Iron Bridge plant, as well as each of the City of Orlando's Water Reclamation facilities, is equal to its goal ... to ***preserve the environment*** and to ***protect public health***. This is also in harmony with the City of Orlando's mission ... ***"Serving Orlando with Innovation, Responsiveness, Knowledge, Professionalism and Courtesy."***

Facility Overview

The Iron Bridge Water Pollution Control Facility is a regional wastewater treatment plant that is operated and primarily owned by the City of Orlando. Although the majority of the wastewater treated by Iron Bridge is from the City of Orlando, flows are contributed from other sources, including parts of Winter Park, Maitland, Casselberry and unincorporated portions of Orange and Seminole Counties.

The total permitted capacity of the Iron Bridge facility is 40 mgd. The plant was developed in three phases to meet the needs of the rapidly growing service area. The first phase was the Rotating Biological Contactor (Phase I RBC) plant, which began operating in 1982. Originally designed to treat 24 mgd, the facility was rerated to 28 mgd in 1986, and subsequently derated to 16 mgd when the Phase III Bardenpho plant was completed (12 mgd for the RBC plant, and 4 mgd for the Hyacinth ponds).

The Phase II plant, which began operation in 1989, is a 12-mgd Bardenpho plant. The plant was constructed to treat additional flows from Orlando and other contributing communities. The third phase has been termed the Phase III "RBC Replacement" plant. Phase III is also a Bardenpho plant and essentially a mirror image of the Phase II Bardenpho facility, this plant was designed to replace 12 mgd of capacity lost by the derating of the Phase I RBC plant, and was placed into service in 1991.

Phase I RBC Plant

The Iron Bridge plant was originally designed to treat 24 mgd of wastewater to advanced waste treatment (AWT) levels, defined as follows:

Biochemical Oxygen Demand (BOD) 5 mg/1

Total Suspended Solids (TSS) 5 mg/1

Total Nitrogen (TN) 3 mg/1

Total Phosphorus (TP) 1 mg/1

The RBC facility includes the following components:

- Master pump station and east force main
- Backwash/Recycle pump station
- Aerated grit chambers
- Comminutors
- Primary clarifiers
- Equalization system
- RBC's (BOD removal & nitrification)
- Submerged denitrification RBC's
- Denite pumpback pump station
- Denite blower building
- Final clarifiers

- Wetlands pump station
- Automatic backwash filters (ABW)
- Chlorination/dechlorination
- Post-aeration & River discharge

Influent Flow Enters the Plant

All raw wastewater enters the plant at the Master Pump Station. The wastewater passes through bar screens with 6 mm openings for removal of large solids and debris. Screenings removal provides protection to downstream pumps, pipes, and valves from plugging with debris. The screenings are disposed in a dumpster then hauled by private contractor to an approved landfill disposal site.

Capital Cost of the Iron Bridge Facility

Year	Phase / Size	Dollars
1982	Phase I RBC Plant / 24 mgd	$75 Million

The capital cost for Phase I included collection system interceptors.		
1989	Phase II Bardenpho / 12 mgd & Solids Handling Processes	$47 Million
1991	Phase III Bardenpho / 12 mgd	$16 Million
Total Capital Cost		$138 Million

Iron Bridge Facility

Annual O&M Budget - 1996

$7.3 Million

Mixed liquor from the reaeration basin discharges to the appropriate Bardenpho Alum Mix Box. Alum is added to the mix box based on the soluble phosphorus concentration in the clarifier effluent. Alum addition may be required in order to remove residual phosphorus that cannot be removed by luxury uptake in the biological process.

Secondary Clarifiers

Mixed liquor from the Alum Mix Box discharges to the clarifier influent Splitter Box, where the mixed liquor is then distributed to the secondary clarifiers. The clarifiers are center feed peripheral draw units with suction withdrawal mechanisms for sludge removal. Sludge is withdrawn from the clarifiers at a rate controlled by individual telescoping valves and discharged to RAS pump stations. Pumps in the wet wells return the settled solids to the fermentation basins of the Bardenpho process trains. The settled solids from the clarifiers are discharged to the RAS pump station and are returned to the Bardenpho Trains.

Sludge is wasted from the system by waste activated sludge (WAS) pumps located in the RAS pump station wet wells. The sludge from both wet wells is wasted in a common header to the sludge holdings tanks. Scum collected by rotating arms on the clarifiers is withdrawn by pneumatic scum ejectors. The captured scum is discharged with the WAS to the sludge holding tanks.

Effluent Filtration

Treated effluent from the secondary clarifiers flows by gravity to the deep bed filter (DBF) splitter box. A weir gate in the splitter box allows flow from the Bardenpho system clarifiers to be applied to either the Deep Bed filters, or the ABW filters.

Solids removed by the DBF'S are backwashed from the media and discharged to the recycle backwash pump station. The recycle backwash pump station returns the solids to the RBC pretreatment structure. Effluent from the filters mixes with the effluent from the ABW filters and discharges to either the chlorine contact chambers, or the Wetlands Pump Station.

The dechlorinated effluent leaving the contact chambers passes through the post aeration basins before entering the final discharge channel to the river. Floating surface aerators in the basins are used to increase the dissolved oxygen concentration of the effluent prior to river discharge.

Phase II & III Bardenpho Facilities

The Bardenpho plant includes both the Phase II (Trains 1 and 2) and Phase III (Trains 3 and 4) systems. Each of the trains has a treatment capacity of 6 mgd producing a combined Bardenpho design capacity of 24 mgd. The Bardenpho system was designed to produce an effluent, after clarification and filtration, with the following characteristics:

· $CBOD_5$ = 5 mg/1 · TSS = 5 mg/1 · TN = 3 mg/1 · TP = 1 mg/1

Preliminary Treatment

After screening, raw wastewater is pumped from the master pump station through the west force main to the Bardenpho pretreatment structure. The pretreatment structure is designed to remove grit from the raw wastewater to reduce the potential for damage to downstream mechanical equipment and prevent accumulation of grit in downstream tanks. The grit is removed in four mechanically induced vortex grit removal units. The dewatered grit is hauled by the City to an approved disposal site.

Bardenpho Activated Sludge Process ...

BNR ... Biological Nutrient Removal

Pre-treated effluent from the forced-vortex grit chambers discharges to the two Bardenpho process systems (Phases II & III).

These are 5-stage Bardenpho systems where anaerobic/anoxic/aerobic activated sludge environments remove nutrients biologically. Each Phase consists of 2 sets of parallel process trains and clarifiers.

Each Bardenpho process train consists of five basins as follows:

- Fermentation Basin
- First Anoxic Basin

• Aerobic (Nitrification) Basin

• Second Anoxic Basin

• Reaeration Basin

Preliminary Treatment

From the Master Pump Station, wastewater is pumped through the east force main to the RBC plant pretreatment structure, and through the west force main to the Bardenpho pretreatment structure. The RBC plant pretreatment process includes an aerated grit removal system and comminutors. Grit is a combination of sand, cinders, egg shells, and other inorganic material in the influent wastewater. Grit removal provides protection of downstream pumps, pipes, valves, etc., from erosion and premature wear; also, grit removal minimizes sand from accumulating in the downstream tanks and maintains the valuable capacity within the tankage. Grit removed from the pretreatment structure is hauled by the City to an approved landfill disposal site. Material ground by the comminutors is discharged into the RBC plant.

Primary Treatment

After pretreatment, the wastewater enters the primary clarifiers. The primary clarifiers are settling basins used to separate large solids and reduce TSS and BOD to a level at which the RBC process can operate efficiently. Sludge is drawn from the clarifiers and pumped to the anaerobic digesters for volume reduction and Class "B" stabilization.

Following the primary clarifiers are two 2 MG aerated equalization tanks. When flows to the downstream RBC's exceed a predetermined amount, the equalization tanks are used to store the excess. When flows decrease, the wastewater in the tanks is pumped to the RBC's. Using this system, large diurnal variations in flow are dampened.

Rotating Biological Contactors (RBC's)

The RBC'S are a fixed film (attached growth) treatment system similar to trickling filters designed to provide BOD removal and nitrification. The plant uses 19 parallel trains of air-driven RBC'S with nine shafts per train. The first three RBC shafts in each train have standard density media while the remaining six have high density media. The number of trains in service is determined by the operating efficiency of the process From the RBC's, wastewater flows through the methanol mix box to the denitrification (denite) RBC's.

There are six trains of denite RBC's with six shafts per train. The RBC's are submerged to prevent contact of the microorganisms with air and to promote

anoxic conditions. The denite RBC's are a fixed film system that uses methanol as a carbon (BOD) source so that facultative microorganisms may convert nitrate-nitrogen to nitrogen gas. The aerators in the final bay of each train are used to strip nitrogen gas from the wastewater to the atmosphere.

Parameter	**Limit / Range**
Permit Limitations - Little Econ River Outfall 001	
Permitted Flow Capacity	28 mgd
$CBOD_5$	5 mg/L
TSS - before disinfection	5 mg/L
TN	3.6 mg/L
TKN	2.5 mg/L
TP	1.1 mg/L
Fecal Coliform	Less than 200 per 100 ml

pH	6.0 to 8.5
D.O. (Temperature Dependent)	Minimum of 3.81 mg/L
Pre-Chlorination Total Chlorine Residual	Minimum of 0.5 mg/L with 15 minutes D.T. @ peak flow
Final Effluent Total Chlorine Residual	Less than 0.01 mg/L
Permit Limitations - Wetlands Influent Flow	
Permitted Flow Capacity	20 mgd
$CBOD_5$	10 mg/L
TSS - before disinfection	15 mg/L
TN	6.0 mg/L
TP	0.75 mg/L
pH	6.0 to 8.5

Total Chlorine Residual	No less than 1.0 mg/L
Permit Limitations - Wetlands Effluent Flow Outfall 002	
$CBOD_5$	10 mg/L
TSS - before disinfection	15 mg/L
TN	2.31 mg/L

Secondary Clarifiers

Wastewater leaving the denite RBC's flows to the pumpback station from where it is pumped through the polymer mix tank to the clarifiers. Alum is added to the pump station discharge line for phosphorus removal. Polymer is added in the mix tank to increase solids flocculation and settling efficiency. Settled solids are collected in clarifier sludge hoppers and pumped to the sludge holding tanks prior to further processing in the anaerobic digestion system.

Effluent Filtration

Effluent from the RBC secondary clarifiers flows to the automatic backwash (ABW) filters. The ABW filters have sand media and are equipped with automatic traveling carriages for backwashing of the media. The RBC effluent entering the pre-filtration Junction Box can be mixed with the discharge from the Bardenpho clarifiers that is not processed through the deep bed filters.

Effluent Disinfection

The effluent discharged to the wetlands is chlorinated in the wetlands force main by a chlorine injection system located in the wetlands pump station inlet well. The effluent discharged to the Little Econlockhatchee River (Little Econ) is chlorinated, and then dechlorinated, in the chlorine contact chambers.

The chlorination system serving the chlorine contact chambers is sized to accomplish breakpoint chlorination. Breakpoint chlorination is a process which oxidizes ammonia to nitrogen gas. The system was designed to remove up to 5 mg/1 of ammonia at a flow of 24 mgd. The process is extremely expensive and is normally used only when the upstream biological processes fail to remove sufficient ammonia to meet permit requirements. A caustic feed system is provided as part of the breakpoint system in order to produce the optimum pH required by the process.

All of the effluent leaving the chlorine contact chambers is dechlorinated using a sulfur dioxide injection system. Dechlorination is required in order to meet a permit limit of no more than 0.01 mg/1 total chlorine residual in the flow being discharged to the Little Econ River.

Sludge Handling and Stabilization

Sludge produced in the operation of the primary clarifiers, the RBC system and the Bardenpho process are stabilized in anaerobic digesters. The anaerobic digesters are the third distinct biological process at the plant and being anaerobic versus aerobic or anoxic require completely different operating procedures.

In normal circumstances the system is operated as follows:

- Primary sludge is pumped to the digesters.

- RBC sludge is pumped to either of two RBC sludge holding tanks, then to the gravity belt thickeners, and then to the digesters.

• Bardenpho sludge is pumped to either of two nutrient sludge holding tanks, then to the gravity belt thickeners, and then to the digesters

The digesters are used to stabilize the sludge by removing residual organic matter, reducing the volatile solids concentration and reducing the number of pathogens contained in the sludge.

The digested sludge is removed from the system and disposed of through land application. The system is equipped to dewater digested sludge, with belt filter presses, for disposal when wet weather prevents land spreading of liquid sludge. All filtrates and decants from the sludge handling system are returned to the Phase I RBC system.

Effluent Release

The Iron Bridge Facility has two effluent release locations: the Little Econ River, and the man-made wetlands. Both of these discharges are governed under the Environmental Protection Agency (EPA) and the Department of Environmental Protection (DEP) permits. Up to 28 mgd can be discharged to the Little Econ River, and 20 mgd to the man-made wetlands, as long as the discharge limits are met. These limits are summarized in the following table:

Raw wastewater mixed with RAS from the clarifiers enters the fermentation basin from the splitter box. The RAS mixed with the raw wastewater produces essentially anaerobic conditions, actually, it produces fermentation conditions, under which the microorganisms in the system release stored phosphorus. Microorganisms consistently exposed to such conditions developed the ability to store greater than normal amounts of phosphorus when reintroduced to aerobic conditions. The fermentation basins use mechanical mixers to gently maintain solids in suspension without dissolving any oxygen.

Flow from the fermentation basin enters the first anoxic basin where it is combined with internally recirculated mixed liquor from the aerobic (nitrification) basin. The nitrates produced in the nitrification basin are contacted with recycled sludge and raw wastewater. In the absence of oxygen, the bacteria use the incoming BOD as a carbon source and the oxygen available from nitrate to accomplish biological denitrification. Mixing is again provided to keep solids in suspension, prevent oxygen dissolution, and continue to maintain biological activity.

Flow from the first anoxic basin enters the aerobic basin (oxidation ditch), which is configured similar to a race track, where sufficient oxygen is provided to remove BOD not removed in the 1st anoxic basin, and to accomplish nitrification (bio-oxidation of ammonia to nitrate). At the same time, the microorganisms developed in the fermentation stage undergo a "luxury uptake" of phosphorus. The stored phosphorus is removed from the system when sludge is wasted from the Bardenpho process. Two-speed mechanical aerators (two for each basin) maintain aerobic conditions and provide mixing. Wastewater leaves the aerobic basin over adjustable effluent weirs that are used to control the D.O. concentration in the nitrification basin.

Mixed liquor leaving the aerobic/nitrification basin enters the second anoxic basin. The second anoxic basin is provided to reduce nitrate to levels of 0.5 to 1.5 mg/1. Mechanical mixing is provided in this basin; oxygen dissolution is prevented.

Mixed liquor from the second anoxic basin enters the reaeration basin where oxygen is added to prevent re-release of phosphorus. Additional phosphorus uptake, nitrogen gas stripping, and additional nitrification may also occur in this basin. Coarse bubble diffused aeration is used to maintain aerobic conditions.