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JANUARY 2012

Tom Pfiester
Wastewater division manager
Big Coppitt Key, Fla.

Bug-Driven *Performance*

CLOSE ATTENTION TO MICROBIOLOGY KEEPS THE BIG COPPITT RECLAMATION PLANT ON TRACK

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Teddy Knowles, lead operator at Big Coppitt, takes a grab sample of effluent after disinfection. (Photography by Johnny White)

Bug-Driven *Performance*

CLOSE ATTENTION TO MICROBIOLOGY HELPS THE BIG COPPITT RECLAMATION PLANT CONTINUOUSLY MEET STRINGENT WATER REUSE STANDARDS IN THE FLORIDA KEYS

By Jim Force

profile

Big Coppitt (Fla.) Regional Water Reclamation Facility

POPULATION SERVED:	2,500 (plus vacationers)
BUILT:	2007-2009
TREATMENT LEVEL:	Advanced tertiary
FLOWS:	0.323 mgd design, 0.100 mgd average
TREATMENT PROCESS:	SBR nutrient removal, deep-bed sand filtration
BIOSOLIDS:	Centrifuge dewatering, cake to landfill
ANNUAL BUDGET:	$400,000 (plant and collection system)
WEBSITE:	www.fkaa.com
GPS COORDINATES:	Latitude: 24°35'30.75"N; Longitude: 81°40'46.41"W

WASTEWATER PROFESSIONALS GO BY MANY TITLES: plant manager, chief operator, environmental coordinator. But "bug farmer"?

That's how Tom Pfiester, wastewater division manager of the Florida Keys Aqueduct Authority, describes his work at the Big Coppitt Regional Water Reclamation Facility. And with good reason.

"We look at our bugs every day with our microscope," he says, calling that instrument one of the most under-used tools in the industry. "It helps us stay proactive and really see what is going on in our mixed liquor. This is really a bug farm, and our job is to grow a good crop."

So far, Pfiester and his team have enjoyed excellent yields. Online for just two years, the 0.323 mgd (design) Big Coppitt facility uses a three-tank sequencing batch reactor (SBR) biological system, sand filtration, and disinfection to achieve a pristine product water. Recycled for irrigation and other nonpotable uses, the effluent helps the residents of Rockland and Big Coppitt Keys — just a few miles from Key West — deal with a scarcity of freshwater sources.

Big Coppitt's exceptional performance led the Florida Water and Pollution Control Operators Association to name the Aqueduct Authority its utility of the year in 2010. The plant also earned an award from SBR supplier Aqua-Aerobic for outstanding performance.

THE BAD OLD DAYS

It's no surprise that water and wastewater have presented challenges throughout the Keys, a string of small islands extending for 130 miles into the Gulf of Mexico southwest of the Florida mainland. Historians have documented secret "water holes" used by Keys Indians hundreds of years ago, but with groundwater almost nonexistent, residents have relied on rainwater, small desalination plants, tank car shipments, and water pipelines from the mainland.

For years before establishment of the Aqueduct Authority, wastewater was discharged directly to the ocean or to septic system leachfields. In 1998, the state legislature gave the Authority responsibility for wastewater collection and treatment, and plans for new sewer systems and treatment plants got underway in earnest. Today, the Big Coppitt facility is one of five treatment plants run by the Authority, and a sixth plant is under design.

COLLECTION AND TREATMENT

Wastewater heads to Big Coppitt through a collection system with 71,800 linear feet of gravity sewers, 34,500 linear feet of force mains, and 21 lift stations. The service area includes about 2,500 residents, and many more visitors during vacation season. At the treatment plant, a Hycor Helisieve Plus (Parkson) auger-type bar screen removes debris and large solids. The flow then moves on to the three-tank SBR biological system.

The tanks fill and decant every six hours, treating the wastewater in batches. In the first fill cycle, or mixing phase, influent enters the tank while only mixing takes place. In the oxic fill phase, influent continues to fill the tanks as both mixing and aeration occur. Fine-bubble diffusers on the tank bottom provide the air. Then the air is turned off, but the contents continue to be mixed as the fill cycle is completed in the anoxic phase.

Pfiester notes that the oxic fill and anoxic fill phases can be repeated depending on how the operator has set up the PLC-controlled timer and duration configuration. Once the fill cycle is completed, the system goes into the react mode, where the wastewater is mixed and aerated for an extended period. Then the solids are separated in the settling cycle before the decant cycle, where the clear water is drawn off and pumped to an equalization basin.

Pfiester explains that normal flows require the capacity of two of the

One of the plant's three sequencing batch reactors in an aeration cycle. The plant earned an award from SBR supplier Aqua-Aerobic for outstanding performance.

Big Coppitt Regional Water Reclamation Facility
PERMIT AND PERFORMANCE

	INFLUENT (Average-Peak)	EFFLUENT	PERMIT
CBOD	200-250 mg/l	2.1 mg/l	5 mg/l
TSS	265-320 mg/l	1.5 mg/l	5 mg/l
Total N	56-62 mg/l	1.85 mg/l	3 mg/l
Total P	9-11 mg/l	0.21 mg/l	1 mg/l

three tanks. During high flows, the third tank can be put into action. A submersible waste activated sludge pump moves a portion of the settled solids to the biosolids holding tank or digester.

The solids are thickened to 1.5 to 2.0 percent solids, using a cationic polymer. Andritz centrifuges dewater the material to 24 to 28 percent solids, and a private contractor hauls a load of dewatered cake to a mainland landfill about once every two weeks. "The centrifuge really makes this plant efficient, says Pfiester. "Before, we were hauling wet sludge all the way to the mainland for processing. It was very expensive."

Final polishing of the effluent takes place in three Severn Trent deep-bed sand filters. Sodium hypochlorite disinfects the product water before it is delivered to the water reuse system storage tank. The authority maintains more than two miles of reuse system piping, and residents have the option of connecting to it for nonpotable water for irrigation, boat and car washing, and other applications.

Roy Coley, director of operations for the authority, explains that the hookup is free to end-users. The recycled water consumption rate is 70 percent of the rate for potable water. About 25 percent of the residents in the Big Coppitt service area use recycled water. "They seem to like it," says Coley. "During the dry season, we have watering restrictions," and the recycled water is a logical alternative.

At the plant, excess effluent water can be pumped into a shallow injection well if the reuse tank is full, or if the water does not meet the specifications based on fecal coliform count. Coley says, however, that the plant produces reuse water "pretty much all the time." The plant maintains a Wonderware (Invensys Operations Management) control system that uses Active Factory software to tie all plant PLCs together and trend a wide range of data.

A FRESHWATER LIFELINE

A 130-mile-long freshwater pipeline, conceived of as far back as 1925, built by the U.S. Navy in 1939, and enlarged and upgraded in 1980, continues to supply freshwater to the residents of the Florida Keys. Through the years, it has survived hurricanes, damage from passing ships, and low flows due to inadequate pumping. It is truly a lifeline to the mainland.

"It might be a world record for length," observes Roy Coley, operations director of the Florida Keys Aqueduct Authority. The earliest plans for a water pipeline were scrapped after rail service was established in the 1920s, enabling tank cars to carry water all the way to Key West.

Ships and barges were used as well. But after a hurricane damaged the rail line in 1936, the Navy decided a pipeline was needed to assure a reliable supply of clean water to its base at Key West. Withdrawn from the Biscayne Aquifer on the mainland, water was pumped the length of the Keys through an 18-inch line that had to be tied to bridges at 43 channels and placed on the ocean bottom at 13 channel crossings.

It took six days for the water to reach Key West, and sometimes pumping problems caused the flow to essentially disappear before it got to the end of the line. Whatever water the Navy didn't use was sold to communities.

In 1976, the Navy sold the land, buildings, wells and pipeline to the Aqueduct Authority, which made plans, raised funds, and built a new 36-inch pipeline from the mainland to Marathon, stepping it down to 24 inches from Marathon to Upper Sugarloaf Key, and to 18 inches from there to Key West. Capacity is 30 mgd; average flow is about 19 mgd.

Since other communities and water authorities also use the Biscayne Aquifer mainland wells for water, the authority has constructed a recovery and storage system using a different aquifer to supplement the original source.

Coley says the authority has two full-time teams devoted to pipeline maintenance, repairs, flushing and coating. The main concerns are where the line passes over water on bridges, or beneath the surface at the channel crossings. Besides the risk of damage by ships or dragging anchor lines, the crew members fight corrosion, monitor valves, and stay on guard for hurricanes, which have a history of raising havoc with this vital connection to the mainland.

SBR EXPERTS

"We grew up on SBRs," says Pfiester. "We've had experience with many different types, but we really like the Aqua-Aerobic system. It's very flexible; we can operate it in series or parallel." Even so, the Big Coppitt crew has made modifications to the three-tank system to improve operations.

"Aqua-Aerobic provides a very nice PLC program with their installation," says Pfiester. "They are light-years ahead in controls. But we had them customize the programming in a few areas." One adjustment was single-tank operation with one of the other two tanks serving as an equalization basin. "This allows for a true batch process instead of decanting while filling (in the same tank) during single-tank operation."

Another change involved five additional timers (for a total of 10) to the fill and react cycles to allow for more operator flexibility. The Big Coppitt

The Big Coppitt team includes, from left, standing, Roy Coley, director of operations; Danny Price, operator; Elishea Strickland, administrative assistant; Jay Miller, mechanic foreman; Kanahou Alana, operator; Argelio Companioni, mechanic; Dan Hill, mechanic; Dave Hoffman, mechanic; and Tom Pfiester, wastewater division manager. Kneeling, from left, Theodore (Teddy) Knowles, lead operator; and operators Terry Ronget, James Money, and Jim Knafla.

"The ORP probes are a critical component for us, ensuring that we are creating the right anaerobic and anoxic conditions needed to denitrify within the SBR basins."

ROY COLEY

staff also worked with the engineering staff to design additional valves and piping, allowing the tanks to be gravity-drained, instead of pumped dry, when maintenance is needed on the fine-bubble diffuser headers.

"We also can reroute supernatant from the SBRs back to the headworks to be retreated if necessary," explains Coley. The size of the mudwell (or reject tank) was also increased to equalize the high-nutrient substrate from the centrifuge over the batch process. Otherwise, it could overload any single batch.

The Hach instrumentation package is another essential part of the success at Big Coppitt. The plant uses Hach sc1000 universal controllers networked with Hach probes that monitor TSS, nitrates, ORP (oxidation reduction potential), and dissolved oxygen. The sc1000s can accept extra probes for troubleshooting to each SBR basin.

"The ORP probes are a critical component for us, ensuring that we are creating the right anaerobic and anoxic conditions needed to denitrify within the SBR basins," explains Coley. "They also help us by determining when we can use the existing carbon coming in with the raw influent to meet nutrient removal requirements, as opposed to adding expensive chemicals. We challenge ourselves every day to use the incoming wastewater for our carbon source."

The DO probes control the variable-frequency drives on the blowers (Kaeser Compressors), assuring accurate control of the aeration systems — critical in the nitrification-denitrification processes. A ChemScan (ASA Analytics) nutrient analyzer records and plots effluent nutrient levels.

TEDDY THE SUPERMAN

Teddy Knowles

Florida Keys Aqueduct Authority operations director Roy Coley and wastewater division manager Tom Pfiester refer to Teddy Knowles, Big Coppitt plant lead operator, as "Superman."

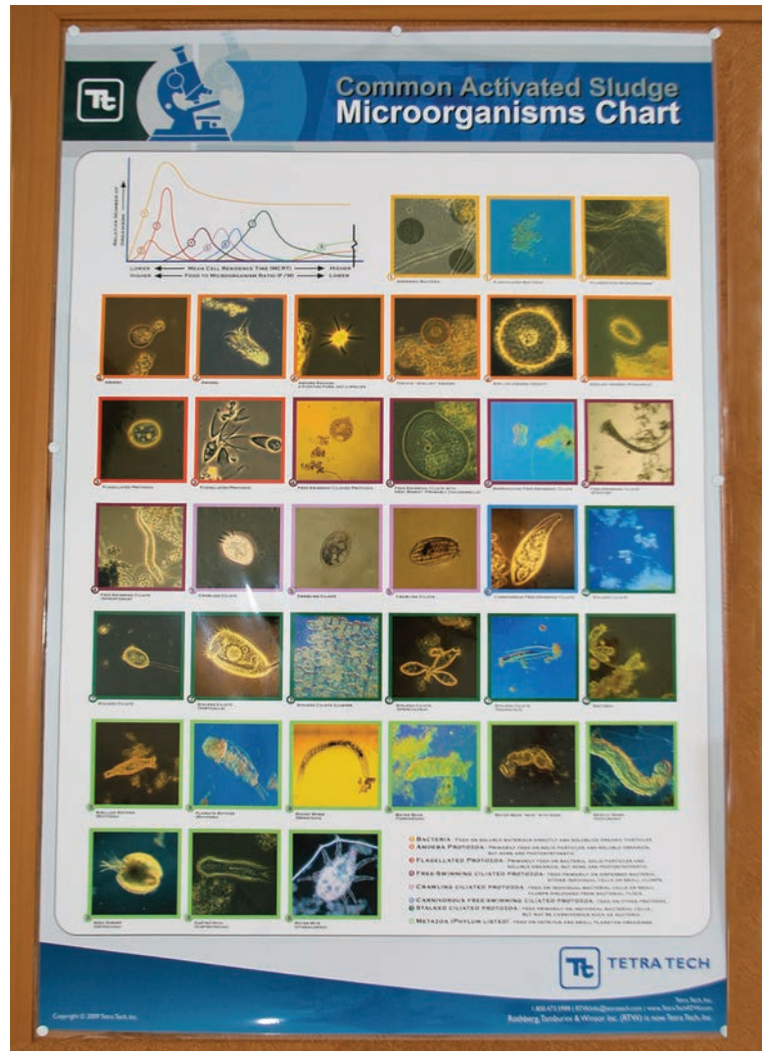
"He's a go-go type of guy," says Coley. "He doesn't know any other way." Knowles started out as an operator trainee, has obtained his level C state certification and is preparing for level B. "He came in with no experience or education in wastewater treatment," says Pfiester. "He gained experience, got his license and has become proficient in a very state-of-the art plant."

Coley adds, "There isn't anything he can't do. He handles budgets, optimizes our chemical usage, even runs the centrifuges."

Lead operator Teddy Knowles views a microscopic sample on an LCD screen mounted on the wall. The screen is used for training and tours, and as a resource when it helps to have more than one set of eyes to evaluate microbiology and decide on process decisions.

"We look at our bugs every day with our microscope. It helps us stay proactive and really see what is going on in our mixed liquor. This is really a bug farm, and our job is to grow a good crop."

TOM PFIESTER



A microorganisms chart from Tetra Tech is a quick-reference tool that helps plant personnel identify the F/M ratio and regularly make wasting decisions.

EFFECTIVE TROUBLESHOOTING

Nutrient removal, of course, is essential to meeting state standards for advanced treatment and producing product water that can be recycled to the community. The Big Coppitt team has developed a checklist of troubleshooting steps to make sure the system meets nitrification-denitrification standards. The key is extensive monitoring of alkalinity, pH, ammonia nitrogen and nitrates.

"We start by sampling for these in the idle phase, to see what's left from the last cycle, and we use that as a starting point for the next batch," says Coley. At the end of the mixed fill cycle, the plant staff samples again while monitoring for DO and ORP. These values in turn give a good indication of the amount of nutrient removal being achieved and whether cycle times need to be changed.

The same parameters are sampled in the oxic cycles to determine the proper amount of aeration, and in the anoxic and react cycles to confirm denitrification and BOD removal. The sampling and monitoring also help the plant optimize biological phosphorus removal throughout the steps, without degrading nitrification-denitrification. The addition of aluminum sulfate between the sand filters polishes off any remaining phosphorus.

In the end, however, it is the bugs that really tell the treatment story at Big Coppitt. Pfiester's staff performs a visual inspection of the plant biology every day. "We look at all our indicators — where we are on food-mass ratio, floc structure, floc color, filamentous growth," Pfiester says. "We identify the organisms we want to maintain, or increase, or decrease. We don't try to eradicate filaments, rather control them. Filaments are very good BOD removers and also help produce a very clear effluent.

"We run the plant with the microscope, rather than just turn the air on and run the equipment. It's a mixture of art and science." **tpo**

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