From left, operators Jerome Houston and Kyle Lerner, plant supervisor Mitch Stone, and operator Patrick Witcher near one of the plant's sequencing batch reactors from Aqua-Aerobic. (Photography by Parker Michels-Boyce)

Winning the Battle

THE TREATMENT PLANT IN THE HISTORIC VIRGINIA CITY OF APPOMATTOX USED A SIMPLE AND COST-EFFECTIVE SOLUTION TO ACHIEVE REDUCTION OF ZINC LEVELS IN EFFLUENT

By Jim Force

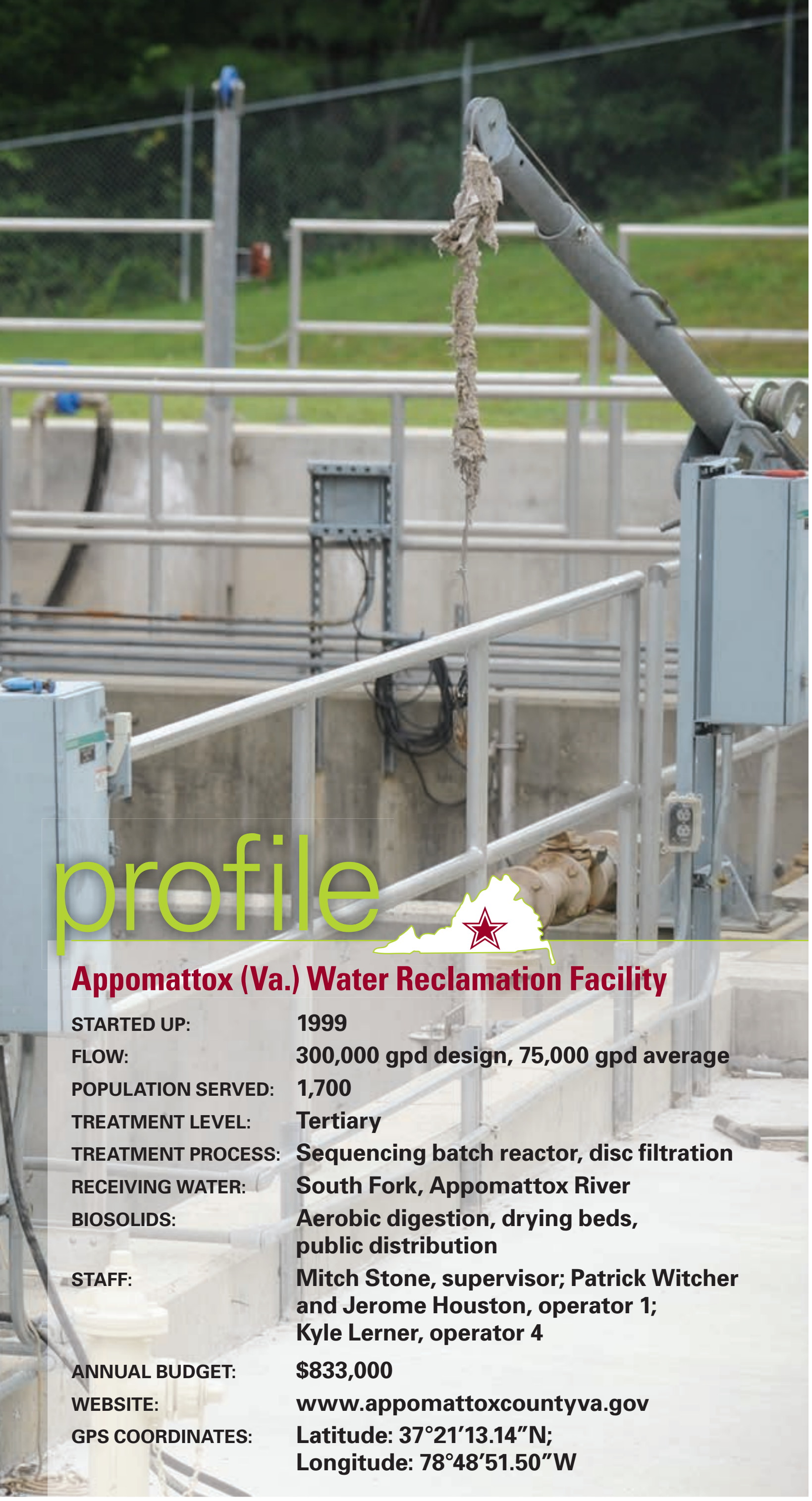
IN THE BATTLE OF ZINC, THE APPOMATTOX WATER Reclamation Facility is winning. In fact, it has already won. Using lime and soda ash, the plant has reduced zinc that can range from 150 to 220 μg/l in its influent to about 30 μg/l in the effluent.

The treatment approach, simpler and considerably less expensive than some of the alternatives, has enabled the plant to meet removal standards set in a consent order with the Virginia Department of Environmental Quality.

"They're happy with what we're doing," says plant operator Patrick Witcher. "And we're sharing our procedures with other plants that have zinc problems."

MODIFIED CYCLES

The Appomattox WRF is a sequencing batch reactor (SBR) plant with a design flow of 300,000 gpd. It is one of two small plants serving the community, both operated by the Appomattox crew, led by supervisor Mitch Stone.



profile

Appomattox (Va.) Water Reclamation Facility

STARTED UP:	1999
FLOW:	300,000 gpd design, 75,000 gpd average
POPULATION SERVED:	1,700
TREATMENT LEVEL:	Tertiary
TREATMENT PROCESS:	Sequencing batch reactor, disc filtration
RECEIVING WATER:	South Fork, Appomattox River
BIOSOLIDS:	Aerobic digestion, drying beds, public distribution
STAFF:	Mitch Stone, supervisor; Patrick Witcher and Jerome Houston, operator 1; Kyle Lerner, operator 4
ANNUAL BUDGET:	$833,000
WEBSITE:	www.appomattoxcountyva.gov
GPS COORDINATES:	Latitude: 37°21′13.14″N; Longitude: 78°48′51.50″W

Wastewater collected from about 700 users enters the plant through an influent channel with a Muffin Monster (JWC Environmental) grinder and a cyclone-type degritter.

There are no primary clarifiers: The flow passes directly to one of two SBR basins (Aqua-Aerobic), each with coarse-bubble diffusers mounted on the tank bottoms. The SBRs are used alternately — while one is going through its treatment cycle, the other is filling. During each cycle, both aeration blowers and mixers are initially turned on to treat the wastewater aerobically. "We keep our dissolved oxygen levels between 2.0 and 4.0 mg/l to facilitate nitrification," says Witcher. "Above 4.0, you really don't gain anything."

In the second step, anoxic treatment occurs as the contents continue to be mixed, but air is turned off. The DO level drops below 0.5, allowing denitrification to occur. After treatment, the contents settle and then are decanted. Treated water flows off the top and passes to an underground basin, where it is stored before being pumped to tertiary filtration and disinfection. Witcher says, it takes at least two decants to get the storage basin full enough to support flow to downstream treatment.

> "We cover for each other. We get along very well; we've got each other's backs."
>
> **PATRICK WITCHER**

The plant staff has modified the original cycling plan for the SBRs, which called for five cycles per day. "We run three eight-hour cycles each day," says Witcher. "We don't have as much solids coming through the system as in the original design, so this gives us a longer cell time. We don't waste as much, and we get good results on BOD, solids, and total nitrogen."

Appomattox uses disc filters (Aqua-Aerobic) to capture remaining suspended solids. The plant operators clean the filter regularly with a high-pressure water hose and disinfect the units about every two months with a solution of sodium hypochlorite. "We dechlorinate the filter with sodium hydroxide before we put it back online," says Witcher.

The flow is then disinfected in a two-bank UV provided by Trojan Technologies. Each bank contains 12 UV bulbs. Flow is directed to one bank while the other is turned off for maintenance or cleaning. For high flows (up to 500,000 gpd), both trains can be used. The staff uses the commercial product LIME-A-WAY to clean the bulbs once a week.

Final effluent is pumped through a two-mile pipe to the South Fork of the Appomattox River. The operation is controlled by a SCADA system and is staffed eight hours a day. A Verbatim (RACO) alarm system notifies the operators of malfunctions during off hours. The team of four operators mans both the WRF and a small trickling filter plant a mile and a half away. "We cover for each other," says Witcher. "We get along very well; we've got each other's backs."

NATURAL TREATMENT

Biosolids generated at the plant receive natural treatment. Collected at the bottom of the two SBR basins, waste activated sludge moves on to a pair of aerobic digesters (Aqua-Aerobic), each with coarse-bubble diffusers. After digestion, the solids (about 10,800 gallons per month) are pumped to the plant's reed beds for further treatment.

There are four beds and in total, comprise an area about the size of a football field. A layer of sand and gravel lies beneath each bed so that the liquid (supernatant) can drain from the biosolids and be returned to the treatment plant. The remaining solids dry in the open air to a dirt-like consistency and are classified as a Class A biosolids.

About every six years, the plant

Soda ash from General Chemical Performance Products is added to raise the pH as part of the plant's approach to reducing zinc in the effluent.

Operator Patrick Witcher records data into the plant operations log.

GOING OLD SCHOOL

Wastewater consultant John Hricko has worked closely with the team at Appomattox to help them solve their zinc-removal problem. He gives plant supervisor Mitch Stone, operator Patrick Witcher and the others high marks for their determination to improve performance. "They are a dedicated, committed group," he says. " They tried other methods that were very expensive or didn't work. But now, they're getting fabulous results."

The solution — adding lime — is an old-school technique that removes zinc while providing other benefits. Lime dramatically increases effluent hardness, reducing the toxicity of dissolved metals in the discharge.

Furthermore, Hricko says, the use of lime increases alkalinity, and that improves nitrification. "The number one call I get is from folks losing their nitrification," he says. "Most plants don't monitor alkalinity in their influent. Without alkalinity it's impossible to get the conversion of ammonia to nitrates. The calcium helps the bugs."

Hricko says that by using lime, the Appomattox team has saved the community hundreds of thousands of dollars versus some of the newer solutions. "It's an example of how much impact operators can have in implementing solutions at their level," Hricko says. "Success doesn't always require expensive engineered treatments or cutting-edge technology — just a true understanding of how some of the most basic treatment principles can work."

Appomattox Water Reclamation Facility
PERMIT AND PERFORMANCE

	INFLUENT	EFFLUENT	PERMIT
BOD	213 mg/l	2.3 mg/l	30 mg/l
TSS	373 mg/l	1.8 mg/l	30 mg/l
TKN	—	1.8 mg/l	5 mg/l
Zinc	150-225 mg/l	32 mg/l	53 mg/l

staff removes the material from the beds and piles it on a concrete slab at the rear of the plant, where area citizens come by and pick up various amounts for their gardens and lawns. "It's very popular," says Jerome Houston, plant operator. "We don't have much left a couple of years after we dig out the beds."

Reeds growing in each bed provide additional treatment, taking up nutrients and heavy metals. The plants can get up to 10 feet high. "We cut them back every year," Houston says. In dry periods, the beds are flooded to keep the reeds growing.

ZINC ATTACK

Operators can't identify any specific sources of the zinc dissolved in the influent to the Appomattox plant,

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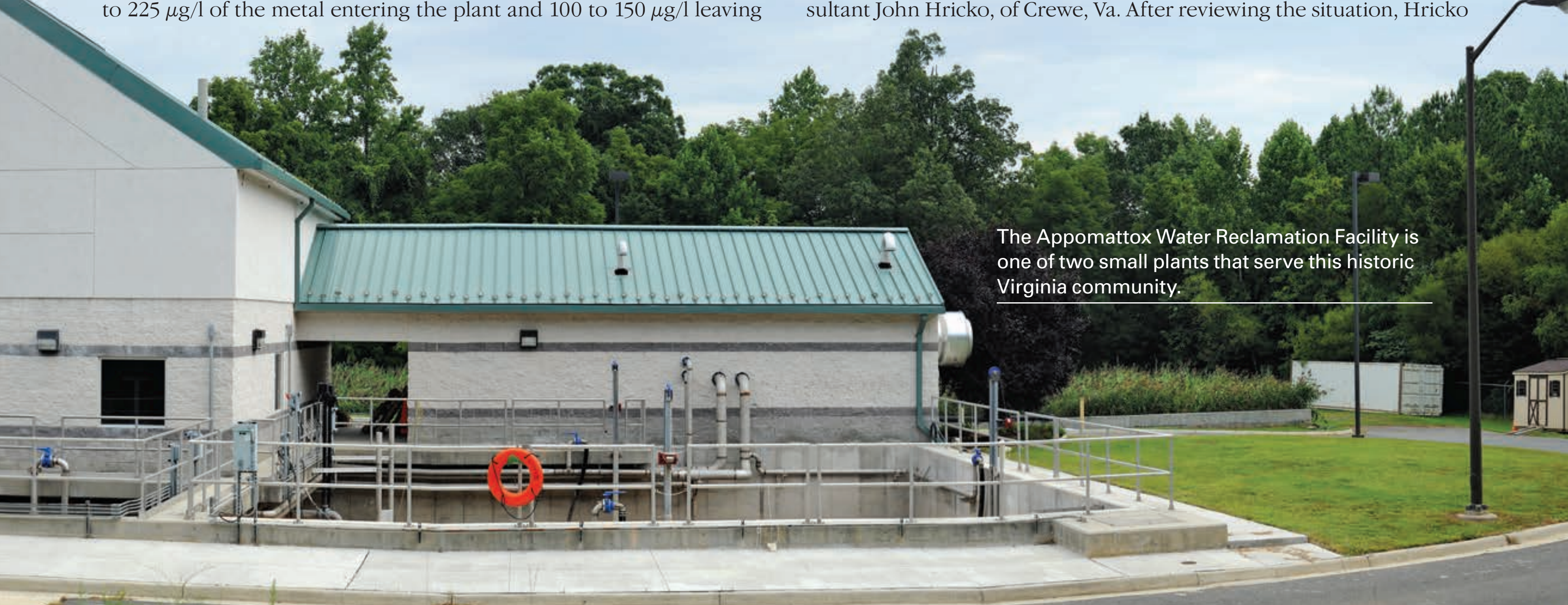
attributing it instead to the corrosive nature of the community's water supply, drawn from several wells. "We think the water dissolves zinc in pipes and plumbing," says plant supervisor Mitch Stone.

Whatever the source of the zinc, there is plenty of it. As the problem became apparent five to six years ago, testing indicated anywhere from 150 to 225 μg/l of the metal entering the plant and 100 to 150 μg/l leaving it. The DEQ consent order mandated that the plant reduce that to a level of 53 μg/l or less.

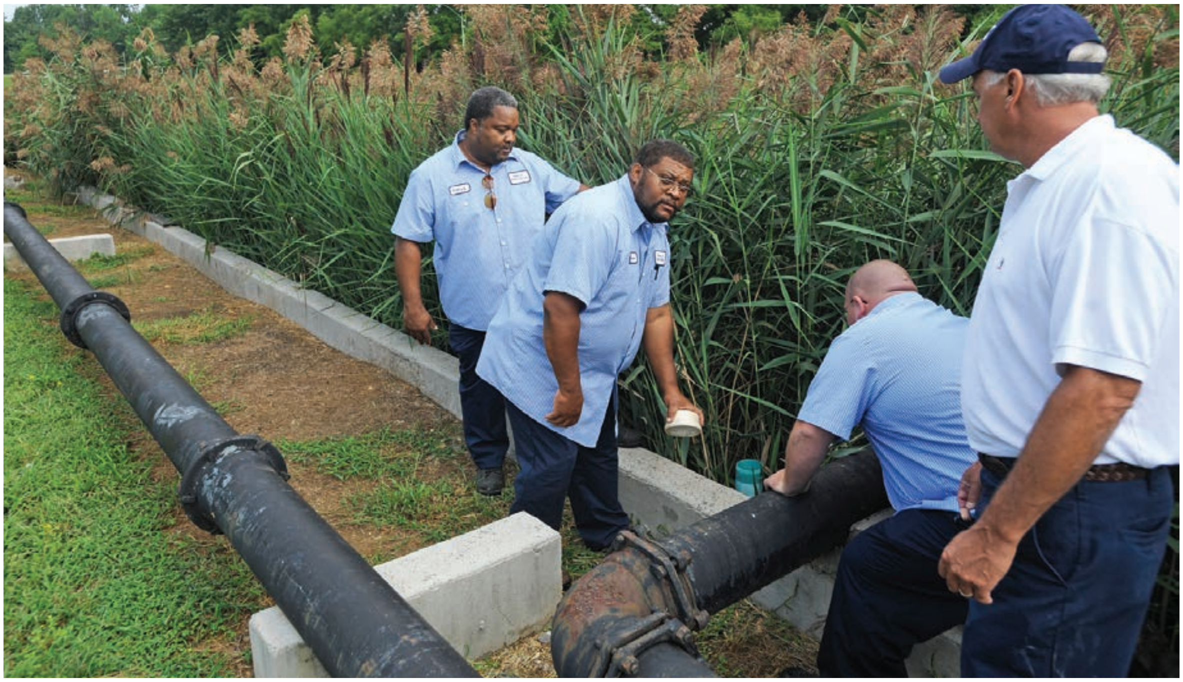
Zinc removal options abound in the wastewater profession. Some of the more high-tech solutions include carbon adsorption, ion exchange and electrocoagulation, a technology Appomattox had looked at seriously in the past, but found too involved and power-intensive.

A chemical feed system using magnesium hydroxide was another possibility. Appomattox had received a comprehensive proposal to supply a new chemical feed system based on magnesium hydroxide as the solution. Stone says the plant tested a pilot system, but found that the chemical clogged the disc filters.

In the end, Appomattox got together with wastewater treatment consultant John Hricko, of Crewe, Va. After reviewing the situation, Hricko



The Appomattox Water Reclamation Facility is one of two small plants that serve this historic Virginia community.



LEFT: From left, operators Patrick Witcher, Jerome Houston and Kyle Lerner and plant supervisor Mitch Stone check the water level of the reed beds used for biosolids treatment. BELOW: Stone checks the pH in a sequencing batch reactor basin. The plant team aims to maintain a pH of 7.8-7.9 to help with the zinc removal.

"Success doesn't always require expensive engineered treatments or cutting-edge technology — just a true understanding of how some of the most basic treatment principles can work."

JOHN HRICKO

recommended trying lime and soda ash addition to increase the hardness of the water and change the pH so that the metal would precipitate. It made even more sense because the treatment would use existing equipment.

"We had a dual-unit lime feeding system onsite, but previous plant staff did not have good luck with it," says Stone. "It scaled up after a few hours." Even though the system had been given up for dead, the plant team took Hricko's advice and decided to run the lime feed system around the clock. That avoided the plugging problems. At present, four 50-pound bags of lime are mixed with water and added to the plant flow on a continuous basis just ahead of the SBRs.

While one unit is operating, the other is shut down for maintenance. Staff member Kyle Lerner cleans the system, hosing it with high-pressure water while taking care to wear the proper protective clothing. In addition to lime, the Appomattox staff adds 100 pounds soda ash at the head of the plant using an existing building equipped with mixing equipment and feed pumps.

The results have been, in Hricko's word, "miraculous." The lime and soda ash have increased the hardness and raised the pH of the wastewater to around 7.8; zinc content in the effluent is consistently in the low 30s (μg/l), and sometimes as low as 22 μg/l. "The result was almost instantaneous," says Stone. "Zinc began to drop in a matter of days."

It has also been cost-effective. Lime is about one-fourth the cost of magnesium hydroxide, which Hricko points out would have provided the hardness sought after to lessen the toxicity of metals, but would not have adjusted the pH enough to actually remove the metals.

The zinc issue may go away in the next year or so. The village is planning to abandon its existing wells and import water from Appomattox County, anticipating that it won't be so corrosive and won't deliver high zinc content to the treatment plant. If that turns out to be true, and the zinc removal orders are lifted, maybe the paperwork should be signed at a local site where another more famous agreement was reached — the Appomattox Courthouse. **tpo**

Kyle Lerner checks process microbiology.

Jerome Houston loads the lime feeder. Lime addition is part of the zinc removal system.

more info:

Aqua-Aerobic Systems, Inc.
800/940-5008
www.aqua-aerobic.com
(See ad page 13)

General Chemical Performance Products LLC
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