CleanWaterWorks

A TECHNICAL JOURNAL of the THE NORTHEAST OHIO REGIONAL SEWER DISTRICT

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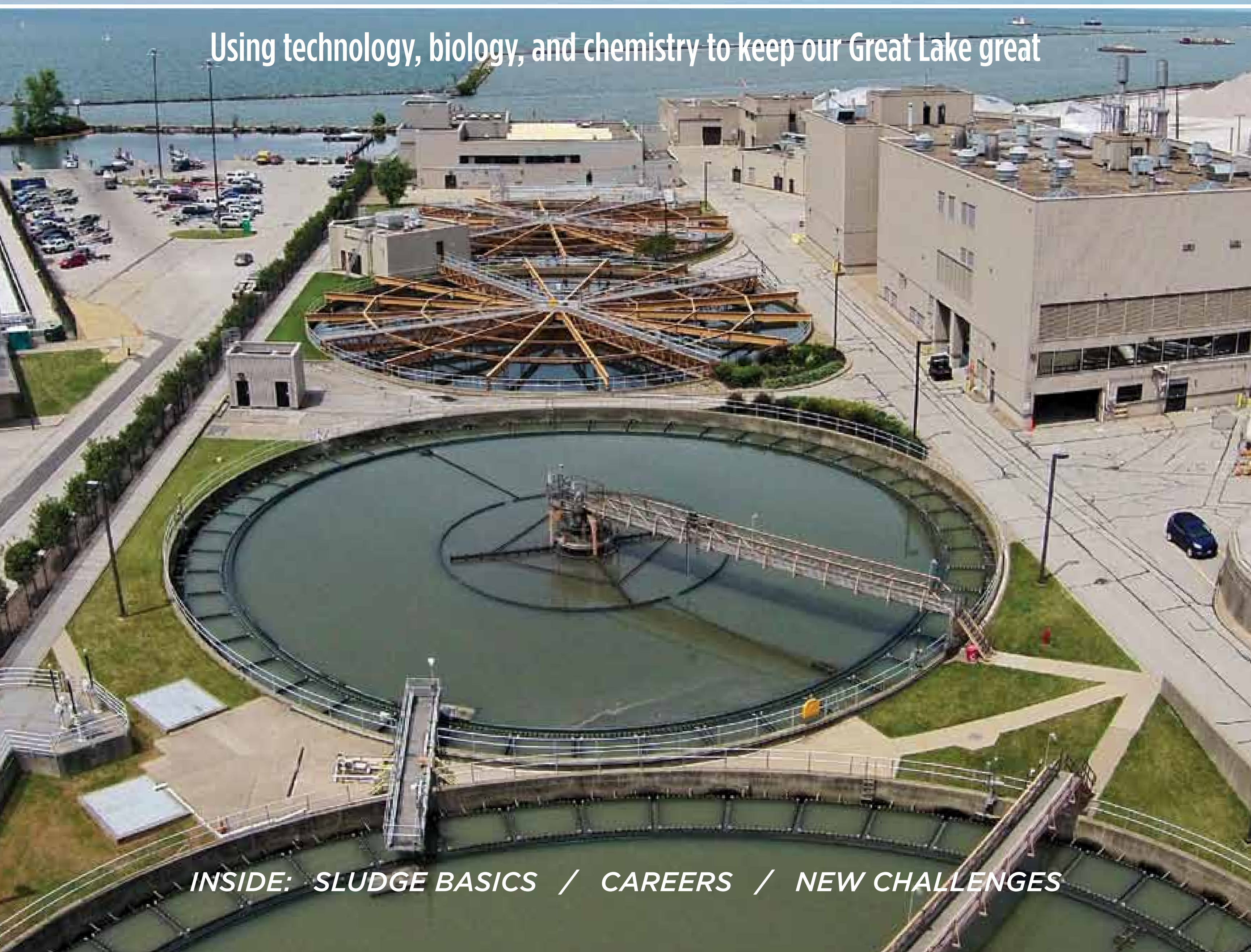
An introduction to PLANT OPERATIONS

Using technology, biology, and chemistry to keep our Great Lake great



INSIDE: SLUDGE BASICS / CAREERS / NEW CHALLENGES

FROM THE DIRECTOR OF OPERATION & MAINTENANCE

Dear Reader,

Welcome to the second issue of our technical magazine, **CleanWaterWorks**. This year's magazine focuses on the Operations side of our business—how our treatment plants treat the dirty water that comes from homes and businesses, and safely return it to the Cuyahoga River and Lake Erie. I'm sure you'll agree that it's a fascinating process, one that we often take for granted.

Our three wastewater treatment plants regularly achieve Peak Performance awards from the **National Association of Clean Water Agencies**. This is due to the expertise and diligence of our Operation & Maintenance staff, who oversee the District's complex wastewater treatment systems. It is their dedication to protecting our waterways that makes the **Northeast Ohio Regional Sewer District** an industry leader, and an organization that is essential to quality of life in our communities.

In preparing to recruit and train the next generation of plant staff, the Sewer District has established a training program for Wastewater Plant Operators, making it possible for employees to move decisively through the ranks, much as I advanced during my career here. Some of our operators are featured in this issue.

We hope you enjoy this introduction to wastewater treatment, and continue to join us in our efforts to keep our Great Lake great.

Feel free to send us feedback at **waterworks@neorsd.org**.

Raymond Weeden

Raymond Weeden has served as the Sewer District's Director of Operation & Maintenance since 2012. He is responsible for the overall administration, planning, direction, and coordination of the operation and maintenance of the District's three wastewater treatment plants. Mr. Weeden has worked at all levels of plant operations during his tenure at the District. He holds a bachelor's degree from Cleveland State University.

The MISSION of the Northeast Ohio Regional Sewer District is to provide progressive sewage and stormwater management through innovation, fiscal responsibility, and community partnerships.

Our VISION is to be the environmental leader in enhancing quality of life in the region and protecting its water resources.

This annual magazine gives subject-matter experts the opportunity to explain in greater detail our work and that of our partner agencies.

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Wastewater treatment basics

The Sewer District's treatment plants take wastewater and, through mechanical, biological, and chemical processes, clean it and return it safely to Lake Erie. Here's how it happens.

COVER STORY PAGE 5

DATA PAGES:

WEB RESOURCES:

- >> **neorsd.blogspot.com**
- >> **neorsd.org**

ON THE COVER: Final Settling Tanks at the Sewer District's Westerly Wastewater Treatment Plant.

ABOVE: The District's Easterly Wastewater Treatment Plant is undergoing extensive construction to increase plant capacity.

Aerial photos of treatment plants by John Quinn (**www.sunartist.com**)

PROJECT CLEAN LAKE
GREAT LAKE • GREAT FUTURE

10 big green projects. 260+ million gallons.

By 2019, we will have constructed 10 large-scale green infrastructure projects that will control more than 260 million gallons of stormwater every year to reduce combined sewer overflow.

Northeast Ohio Regional Sewer District

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PITCH THOSE PILLS!

Flushing pills down the toilet is harmful to our water supply and the environment. Wastewater treatment plants are unable to remove pharmaceuticals, so these medications end up in our waterways threatening the environment and public health.

The best way to dispose of unwanted or expired medicine is at a local drug collection site. To find a location near you, dial 211 or visit RxDrugDropBox.org.

The basics

by Andrew Rossiter

Our plants use mechanical, biological, and chemical processes to treat wastewater. Here's a quick overview.

The purpose of a wastewater treatment plant is to protect the public health by preventing the release of pollutants, toxins, and pathogens from domestic and industrial sewage into lakes and rivers. This also protects the wildlife that lives in, and depends upon, clean water.

Waterborne pollutants may be in the form of organic human waste and natural waste products, inorganic material, garbage, chemicals, and many other substances which are in and of themselves detrimental to the environment, or which unbalance natural processes (one example being algal blooms caused by unnaturally high nutrient levels).

The most basic processes of a wastewater treatment plant are *preliminary treatment, primary treatment, secondary treatment,* and *disinfection.* In addition, the processes can be divided between *liquid processes* and *solids processes.* Liquid processes work on or with the sewage water in the various stages of the plant. Solids processes work on or with the *sludge* that is collected from the liquid processes.

PRELIMINARY TREATMENT

The purpose of *preliminary treatment* is to remove larger solids—such as trash, rags, wood, leaves, grit, and even bricks from decaying sewers—that would cause equipment damage or process problems if permitted to continue on to the treatment plant processes. For example, a brick could damage a pump if it were to be caught in the pump suction. A buildup of trash and rags may reduce the available volume of a flow channel or tank and cause septic conditions.

Some preliminary treatment may be done in the collection system (at netting facilities in the intercep-

PRELIMINARY TREATMENT
removes large debris like trash, leaves, wood, and bricks from the water.

PRIMARY TREATMENT
slows the water to let solid waste sink to the bottom and grease float to the surface, where it is removed.

SECONDARY TREATMENT
introduces microorganisms to eat the organic waste that is dissolved in the water.

DISINFECTION
removes pathogens right before the water is returned to the Cuyahoga River and Lake Erie.

tor sewers and streams) to remove large items carried by the sewage flow. Here, the wastewater flows quickly, so that inorganic material will not settle out and create flow restriction issues.

In preliminary treatment, the flow is reduced so that smaller inorganic solids (like grit) can settle out, while the organic material will still be carried along in the wastewater. The solids removed from preliminary treatment are generally disposed of in landfills.

PRIMARY TREATMENT

The purpose of *primary treatment* is to remove solids that either float on the surface of, or are suspended in, wastewater. The process of settling out suspended solids is known as *sedimentation*, and takes place in Primary Settling Tanks (also known as *clarifiers*).

By the time wastewater reaches primary treatment, its velocity is greatly reduced, and the organic particles are given time to settle out of the sewage. At the same time, floatables such as grease separate out and float to the top of the settling tanks. The treatment plant will employ a means of collecting these solids—now referred to as *sludge* and *floatables*.

Some organic solids will not settle out, remaining in the wastewater flow as it proceeds to the next step.

SECONDARY TREATMENT

Secondary treatment uses any number of strategies (activated sludge, rotating bacteriological filters, and trickling filters, among others) to bring the remaining organic waste into contact with microscopic organisms, which will consume it as food. These microscopic organisms are used as a "strainer" to collect the remaining organic waste, allowing the clean water to pass through.

DISINFECTION

The wastewater will still contain a small amount of particles and microscopic organisms, some of which may be pathogenic. *Disinfection* will kill off these pathogens. This is done chemically using chlorine, bleach, ozone, or by ultraviolet radiation.

Since chlorine and bleach also kill beneficial organisms in our lakes and streams, these chemical disinfectants must be removed before being discharged into the environment. This process is called *dechlorination*.

TERTIARY PROCESS

Some wastewater treatment facilities have *tertiary processes* to further remove specific pollutants from the wastewater. For example, the District's Southerly Wastewater Treatment Plant uses effluent sand filters in its solids-removal process. **CWW**

Andrew Rossiter is Assistant Superintendent of the Easterly Wastewater Treatment Plant of the Northeast Ohio Regional Sewer District.

The process

A tour of the ***Easterly Wastewater Treatment Plant***

The **Easterly Wastewater Treatment Plant** became Cleveland's first *activated sludge* treatment facility, in 1938. While variations exist among wastewater treatment plants today, a walk-through of Easterly provides a basic understanding of modern treatment methods. Easterly's Assistant Superintendent **Andrew Rossiter** *(right)* took us on a tour of the facility and explained processes by which wastewater from homes and businesses is treated and safely returned to Lake Erie.

1

Under the front yard of Easterly, three huge underground interceptor pipes carry sewage flow into the plant. Diversion gates *(pictured)* make it possible to divert some interceptor flow to different channels into the plant.

2

In the Submarine Room, raw sewage comes into the plant. During heavy rains, if the hydraulic capacity of the plant is exceeded, a combination of sewage and stormwater will overflow the sides of the channels and discharge directly to Lake Erie.

3

In the Screenings Building, bar rakes collect trash, and conveyor belts carry it to a trailer to be hauled to a landfill. Removing rags, branches, and other large debris protects Easterly's equipment and eliminates septic pockets where biosolids can collect.

4

In this detritor tank, wastewater flow is slowed to less than two feet per second. Heavy inorganic material (like grit) settles out. The collector arms slowly rotate and sweep the grit into a sump. The remaining flow pours over weirs at the edge of the tank.

5

The collected grit is mixed with non-potable water into a slurry to prevent it from packing together like concrete. The slurry travels to this *cyclone de-gritter*. It creates a vortex in which the water from the slurry moves outward to a drain and is returned back into the treatment process.

The grit proceeds forward and falls down into a second trailer, to be hauled to a landfill.

6

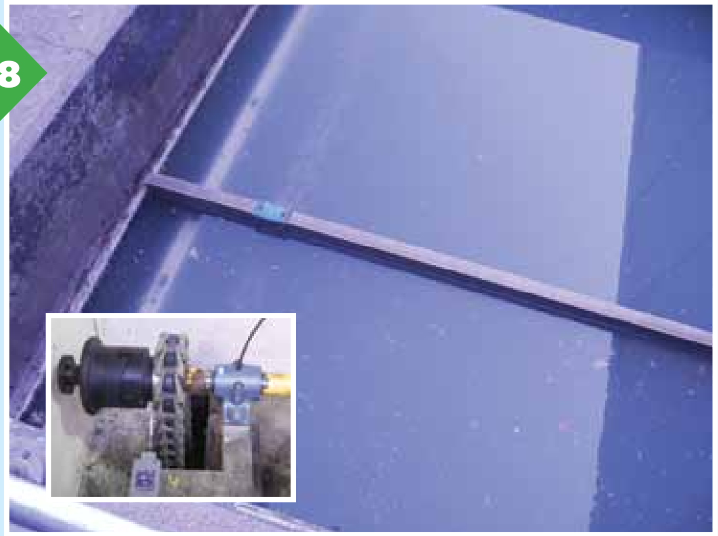
At several points during the treatment process, wastewater samples are collected for laboratory analysis. Temperature, pH, and other data is recorded. If operators notice a spike in pH, or unusual odors or colors, they will call the District's **Water Quality & Industrial Surveillance** staff to investigate. Operators may check the influent channels in the Submarine Room to determine which interceptor is the source of the problem—someone dumping illegal waste, for example.

PRIMARY TREATMENT

7

By this point, most of the inorganic material has been removed. The flow proceeds to the Primary Settling Tanks, where it is further slowed, allowing the heavy organic material to settle out. The solids are sent to the Sludge Storage Tanks.

8



Grease and plastics float to the top of the Primary Settling Tanks. Chain flights skim the top of the surface and the bottom of the tank in a continuous loop. Pictured is one of the metal arms, along with the chain that drives it *(inset)*.

9

Grease from the Primary Settling Tank is pushed into a collection trough and pumped to the Grease Handling facility. Additional grease removal occurs in the De-aerating Floatation Tanks. Compressed air is injected into the bottom of the tank, and as the air bubbles rise, they attach to grease particles, making them more buoyant. The grease floats to the surface, where it is skimmed off. This process may be repeated several times.

10

The grease and skimmings are heated and mixed in this tank to keep it pliable. The mixture is chopped and ground, and then pumped to a tanker truck to be transported to our Southerly plant for incineration.

11

The organic solids collected from the Primary and Final Settling Tanks are pumped to these Sludge Storage Tanks. *(For more explanation about sludge and how it circulates through the treatment process, see page 18.)*

12

This is a Force Main Pump, which pushes a portion of the sludge a distance of 13 miles to the District's Southerly Wastewater Treatment Center, where it will be incinerated or put into that plant's Headworks to provide bugs and food for Southerly's secondary treatment process.

SECONDARY TREATMENT

13

In the *activated sludge* process, the remaining organic material is removed by biological processes. This occurs by recirculating *return activated sludge* containing microscopic organisms ("bugs") and providing the proper conditions in aeration tanks for them to thrive. These tanks can be thought of as a buffet, where the returning bugs eat the light organic solids.

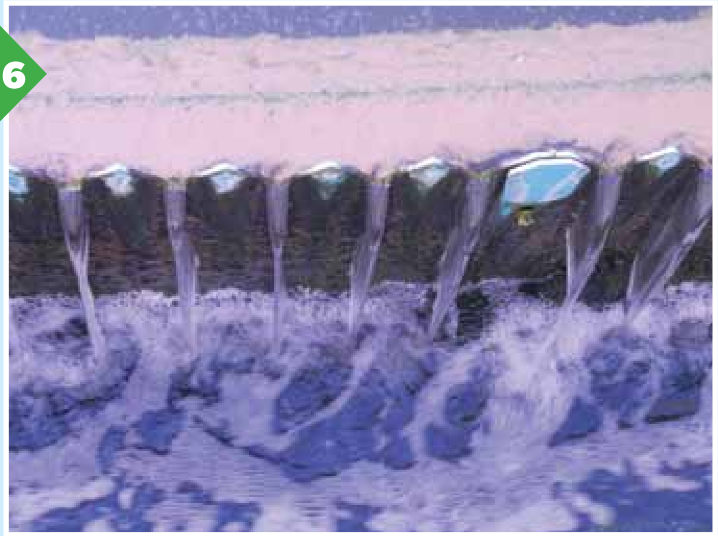
14

Air diffusers, visible in this photo of an empty tank, inject compressed air into the flow, mixing with the bugs and *primary settled sludge* (the "food" for the bugs) into what is called a "mixed liquor." (The diffusers create small air bubbles, which generate greater surface area for oxygen transfer.)

15

The mixed liquor proceeds to the center ring of a Final Settling Tank. Here, the flow is very slow. The food-laden bugs sink to bottom of the tank, where they are collected and returned back into the process. Plant operators take care to maintain a proper food-to-microorganism ratio, sending some of the activated sludge to the Sludge Storage Tanks.

16



Having passed through secondary treatment, the *effluent* (treated wastewater) is rid of organic material, and travels to the Chlorine Contact Tanks for disinfection.

DISINFECTION

17

Industrial grade bleach (sodium hypochlorite) is introduced into the effluent to kill pathogenic organisms. In these Chlorine Contact Tanks, sufficient contact time is provided to kill the pathogens.

18

The effluent proceeds to the final stage of treatment, *dechlorination*. Sodium bisulfite will be added to neutralize the hypochlorite before the effluent is returned to Lake Erie. (Residual bleach would kill aquatic life if it was not rendered harmless.)

19

20

Easterly's Screw Pumps complete the final task in the wastewater treatment process: mixing sodium bisulfite with the effluent and lifting the final product out into Lake Erie. CWW

EASTERLY

WASTEWATER TREATMENT PLANT

SERVES: 333,000+ residents
AVERAGE FLOW: 85 million gallons per day (mgd)
FLOW CAPACITY: 236 mgd (full) / 400 mgd (primary)

The oldest of our facilities, Easterly is located in Cleveland, where it has stood since 1908. The plant treats wastewater from homes and businesses, as well as stormwater from combined sewers which have existed under Cleveland in some areas for more than 100 years.

Currently, Easterly is undergoing major construction to expand its secondary treatment capacity to 400 mgd, a requirement of our Project Clean Lake consent degree with the U.S. EPA.

What's in wastewater?

by Andrew Rossiter

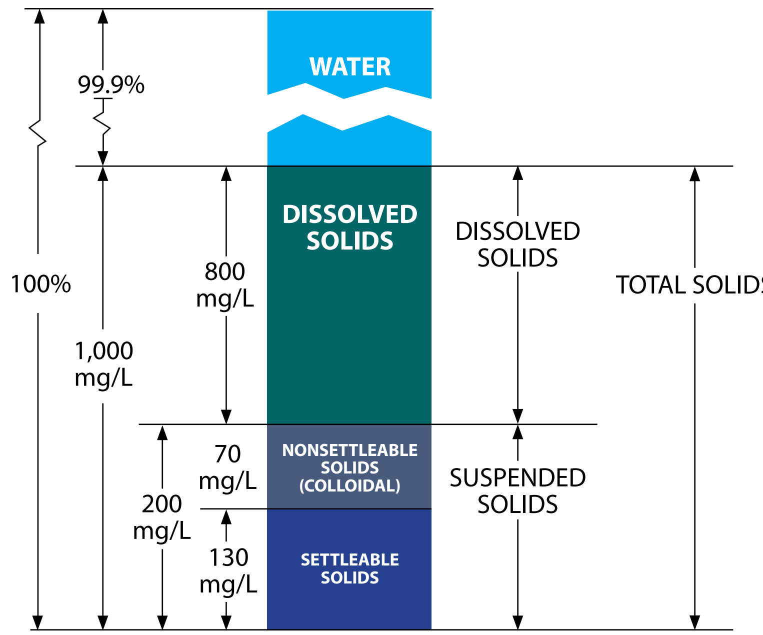
Up to 99.9% of wastewater can be pure water. The remaining 0.1% is composed of "total solids," which is what remains of a wastewater sample that is completely dried.

Total solids are classified as either *dissolved* or *suspended solids*, determined by a standardized test that involves passing wastewater through a porous filter. The portion of solids which passes through this filter are *dissolved* and the portion that does not pass through are *suspended*.

Suspended solids can be further classified as either *settleable* or *nonsettleable*. Settleable solids will drop out of a suspension within a specified period of time. Settleable and floatable solids (such as oils and grease) are typically removed by gravity sedimentation in primary wastewater treatment. Nonsettleable and dissolved solids will proceed to secondary wastewater treatment processes.

Solids (both suspended and dissolved) are also classified as to whether they are *organic* or *inorganic*. Organic compounds, which contain carbon, are associated with life. Either the organic compound is found in living tissues, is a resultant waste product of life processes, or is a necessary component of life processes:

> Organic compounds are normally composed of a combination of carbon, hydrogen, and oxygen, together with nitrogen in some cases. The organic matter in wastewater typically consists of proteins (40 to 60 percent), carbohydrates (25 to 50 percent), and oils and fats (8 to 12 percent). Urea, the major constituent of urine, is another important organic compound contributing to fresh wastewater. . . . Along with [these components], wastewater typically contains small quantities of a very large number of different synthetic organic molecules, with structures ranging from simple to extremely complex. (Tchobanoglous, Burton, & Stensel, 2003).



Typical composition of solids in raw wastewater
(floatable solids not shown)

OFFICE OF WATER PROGRAMS, COLLEGE OF ENGINEERING AND COMPUTER SCIENCE, CALIFORNIA STATE UNIVERSITY, SACRAMENTO

Other elements present in organic compounds include oxygen, nitrogen, hydrogen, phosphorus, sulfur, potassium, sodium, calcium, magnesium, chlorine, and iron. Nitrogen and phosphorus cause special concern, as they can cause aquatic biological activity to increase, resulting in low dissolved oxygen and eutrophication of lakes and rivers.

Oils and greases require special treatment processes, as these materials will float to the surface of tanks. Excessive buildup on tanks may cause odors or block oxygen transfer between the water in the tank and the atmosphere.

Fecal coliforms are microorganisms associated with human feces and live in the human digestive tract. Some species, such as *E. coli,* may cause diseases. The presence of fecal coliforms in wastewater indicates that pathogens may be present. Wastewater treatment plants may therefore be required to disinfect effluent streams to protect the public health.

Wastewater may also contain concentrations of metals such as mercury, chromium, zinc, and aluminum. Some metals may be residual concentrations from iron and copper pipes. In general, wastewater treatment plants will not have the capability to remove metals, and certain metals may reach a threshold concentration that may be harmful to the biological processes of the treatment plant. Therefore, industrial users may be required to pre-treat their wastewater prior to discharging to the sewer system.

WORK CITED:

Tchobanoglous, G., Burton, F., and Stensel, H. (2003). *Metcalf & Eddy, Wastewater Engineering, Treatment and Reuse,* 4th Ed. McGraw-Hill, New York.

On the front line

by Michael Uva

Plant Operators keep their eyes on the wet weather ahead

The work of a **Wastewater Plant Operator** (WPO) is characterized by keen observation, quick reaction, and intuitive adjustments to best utilize a treatment plant's equipment in the face of uncontrollable and unpredictable forces—namely, the weather.

"Here at Westerly, when there's a rain event, the flow comes in extremely fast," said Shift Supervisor **Dave Kelly**. "Our operators constantly make changes to the treatment process and they always have to be thinking about what is coming next."

The smallest of the Sewer District's three treatment plants, the **Westerly Wastewater Treatment Plant** has enough hydraulic capacity and pumping capabilities to accept 100 million gallons per day (mgd). If the plant receives additional flow, the WPOs will divert it to the plant's **Combined Sewer Overflow Treatment Facility** (CSOTF), which can hold up to 12 million gallons and provide primary treatment to 300 mgd. "Once the rain stops, our dewatering pumps will move the wastewater from CSOTF back into the plant for treatment," explained WPO **Gregory Glover**.

Weather forecasts on Doppler radar screens allow the operators to get a jump on incoming storms. "When we see bad weather on the way, we start setting up the Headworks Building, where the incoming water is," said Glover. "We'll put additional trains in as needed, make sure all of the channels are ready, and then set up CSOTF."

Additional personnel can be recruited within a few hours' notice. "At Westerly, we have two crews with four WPOs each, and two crews with three," Glover explains. "When we anticipate a high-flow situation, we'll call somebody in, because there's so much to do in preparation for a storm," said Glover. "There are a lot of things that can go wrong, and it's also helpful to have an extra person to assist at the Headworks when the screens become blocked."

Alarm systems notify the operators of malfunctions or high-flow levels. "We have to react immediately to prevent flooding or a permit violation," said Glover. Introduced in 1972 with the **Clean Water Act**, the **National Pollutant Discharge Elimination System** (NPDES) program sets strict limits on pollutants in the treated wastewater returning to the Cuyahoga River and Lake Erie. Our plants consistently receive "Peak

Gregory Glover explains the computer interfaces that control Westerly's treatment processes.

Performance" awards from the **National Association of Clean Water Agencies** for permit compliance.

CHLORINATION

During recreation season (from May to October), the WPOs add sodium hypochlorite to the treated wastewater to kill bacteria. Then, sodium bisulfite is added to neutralize the hypochlorite. "Chlorination and dechlorination are the final steps to meet EPA permit requirements," Glover said, pointing to a computer screen schematic. "From here, we can set the dosages and feed rates for the hypochlorite and bisulfite."

The wastewater mixes in the chlorine contact tanks for up to 90 minutes to kill pathogens. But during rain events, the high flow makes it necessary to reduce that contact time. The WPO will add more chemicals in order to make up for lost time in the contact tanks.

MAINTAINING PH

Another factor that must be maintained 24/7 is pH, or acidity. You may recall from high school chemistry that water's pH is 7.0; anything lower than that indicates acidity. Westerly's NPDES permit states that pH cannot drop below 6.0. The weather plays a big factor in maintaining pH, since rain dilutes the wastewater, causing it to lose its alkalinity. To elevate pH back to an acceptable level, plant operators will introduce another chemical, sodium hydroxide.

INCINERATION

Another aspect of Plant Operations at our Westerly and Southerly plants is the incineration of solids removed in the treatment process. Ten tons of sludge can be burned and reduced down to one ton of ash, which will be taken to a landfill.

"Incineration has to be carefully coordinated with the rest of the process," said Incinerator Operator **Martin Langer**, who also oversees Westerly's heating and air handling systems in the colder months. "If the WPO has to interrupt feeding solids into the incinerator, there's no cool fuel coming in, so I have to make adjustments to make sure temperatures don't take off."

OTHER TASKS

In addition to operating the equipment controls from desktop computers (using **Wonderware** and **Cimplicity**

Operator Richard Wolf monitors storm activity via Doppler radar screens.

Shift Supervisor Dave Kelly and Shift Manager Michael Dolsen ensure Westerly is adequately staffed for an incoming storm.

software), WPOs regularly walk through the plant to check the wastewater sampling equipment and make manual adjustments to the chlorination process and the pumps when high-flow situations warrant it.

Operators are diligent in keeping written logs and collecting samples, the daily analysis of which will determine modifications to the treatment and disinfection processes. "There's a lot of sampling in the process to make sure we're following EPA guidelines and meeting our permits," said Glover.

The most physically demanding job, according to Dave Kelly, is cleaning out the CSOTF tanks, which are notoriously difficult to maintain due to the heavy solids that collect there. "That job is tougher than anything," he said.

AN OPERATOR'S SCHEDULE

Operators work 12-hour shifts, two days on and two days off. Every two weeks, each of the members in any one crew will rotate into a new Operations unit, from Headworks, to Solids Handling, to Secondary Stage. "That way, we don't get stale," said Glover.

Glover said that the most important and positive change he's seen in his 28 years at the District was this transition away from a schedule that entailed six days on and two days off. "You couldn't even get a day off for months because you'd have to cover for someone," he said. "Today you have more time with your family, and it's easier on your body. You have fewer health issues and better morale."

DEMANDING YET FULFILLING WORK

"The backbone of wastewater treatment is Operations," said Glover. "The operators are running the plant 24/7, working on weekends and during holidays and inclement weather. The pay is definitely an incentive, but the job does require some sacrifice."

Dave Kelly, who has been at Westerly for 14 years, and whose son Ryan is an operator at the Southerly plant, recognizes this, but feels the sacrifice is worth it. "I recommend this job to anybody," said Kelly. "You get paid good money, and you can work your way up."

Kelly stressed that being an operator means taking ownership of equipment that ultimately contributes to protecting Lake Erie. "You're tired when you go home at end of the day, but you know you've accomplished something," he said. CWW

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*Michael Uva is a Communications Specialist at the Northeast Ohio Regional Sewer District. He can be reached at **uvam@neorsd.org**.*

WESTERLY
WASTEWATER TREATMENT PLANT

SERVES: 107,000+ residents
AVERAGE FLOW: 33 mgd
FLOW CAPACITY: 100 mgd

Our Westerly plant dates back to 1922, when treatment consisted merely of removing floatable debris and sediment before the flow was released to Lake Erie.

Today, Westerly's treatment processes are state of the art. The facility is located on 14 acres east of Edgewater State Park, serving more than 107,000 residents in Cleveland and surrounding suburbs.

Sludge: the ins and outs

by Andrew Rossiter

The heart of the wastewater treatment process is *secondary treatment*, where bacteria (often referred to as "bugs") are fed into the wastewater to eat organic solids ("food"). Different methods are used to bring the bugs into contact with the food. At our Easterly plant, the *activated sludge* process is used.

Sludge is a generic term that refers to solids in wastewater. Often, the term is qualified to convey the origin, destination, or type of solids contained in the sludge. *Primary sludge* originates in primary treatment. *Secondary sludge* originates in secondary treatment.

Primary sludge is composed of "heavy" or "settleable" solids. In primary treatment, the wastewater is slowed down, allowing organic solids to settle by gravity. The wastewater flow at this point still contains solids, but these are *dissolved solids,* which will not settle out of the wastewater by gravity alone, so microorganisms are introduced to remove them in secondary treatment.

Activated sludge is sludge that contains these microorganisms ("bugs"), much like some yogurts contain active cultures. These bugs occur in nature. The same microorganisms that inhabit activated sludge are found in natural waterways, soil, animals—even in your digestive tract.* (Fecal coliforms are bacteria that normally live in your intestines.)

The diagram at right helps explain the activated sludge process. Entering into the aeration tank at the left is the *settled sewage* flow, containing the dissolved solids that are food for the bugs. This flow is typically gray in color. Also entering into the aeration tank is the *return activated sludge*, which contains the bugs and is a rich brown color due to these microorganisms. ("Return" means that the destination of this sludge is back into the aeration tank.)

The mixture of settled sewage and return activated sludge (the gray and brown shaded area in the diagram) is referred to as *mixed liquor*. Here, the bugs are united with their food. Oxygen is also provided so the bugs can gorge themselves, prosper, and multiply. They group together and become heavy.

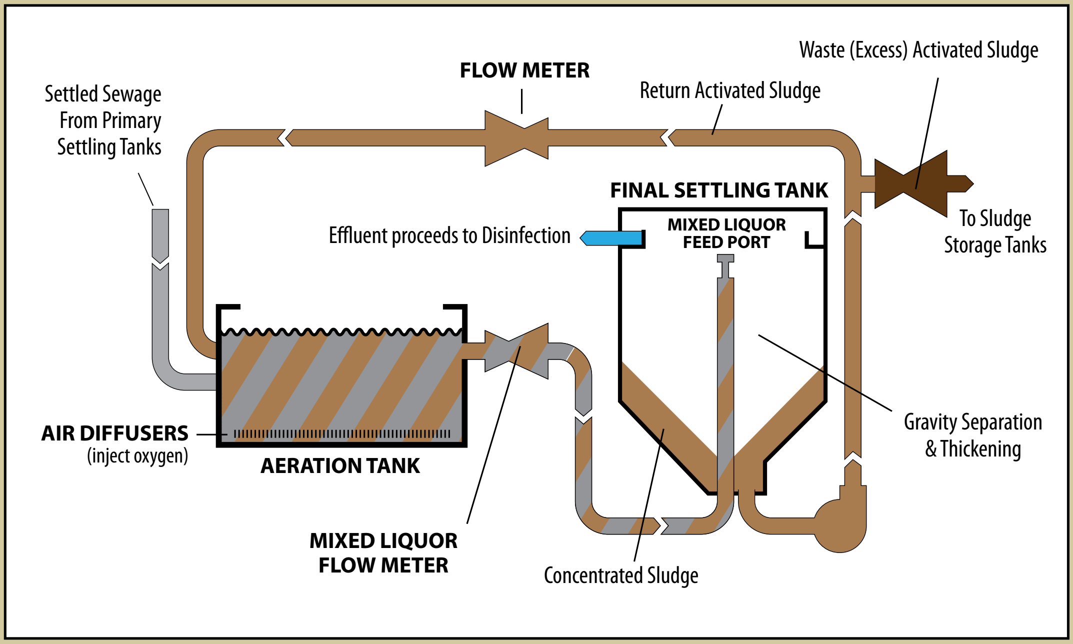
(Think of the aeration tank as a "bug buffet." The settled sewage from the Primary Settling Tanks is the food and the return activated sludge the customers.)

The mixed liquor then flows to the Final Settling Tank. As in the Primary Settling Tanks, quiescent (still) conditions allow the now-heavy bugs to settle out.

The bugs have eaten the dissolved solids and left clean water (blue, in diagram) in the process. This clean water then flows to the disinfection processes and out to Lake Erie.

But what happens to the bugs? Think how in your own body, some of the food you eat is converted into energy for pumping blood, breathing, and moving from place to place, and some is converted into body mass (cellular structures). Similarly, the dissolved solids ("food") in wastewater is used by the bugs to obtain energy or cell mass. Some of the bugs are returned to the aeration tank in the return activated sludge flow.

Some of the return activated sludge is removed from the process to maintain the correct ratio of food to bugs. The sludge removed from the activated sludge process is called *waste activated sludge (*or *excess activated sludge*). The removed sludge from both the primary and secondary systems are sent to solids handling processes. At Easterly, Sludge Storage Tanks hold the sludge prior to it being pumped to Southerly.



** However, there aren't enough bugs from these natural sources to consume the volume of waste from the sewer system. If raw sewage were released directly to the environment, the natural populations of these bugs would explode and use up all the oxygen in the water (eutrophication).*

Microscopic sludge analysis

by Lindsey Koplow and Carrie Millward

The Sewer District's ***Analytical Services*** *staff provide sludge analysis for our Southerly plant on a weekly basis. This is valuable because a change in the biology of microorganisms can indicate a change in the treatment process.*

Plant operators acquire samples of activated sludge from the first- and second-Stage aeration processes. The microorganism populations in these two stages are very different and have to be controlled differently. First-stage microorganisms are younger and used for carbonaceous biochemical oxygen demand (CBOD) removal. The second-stage microorganism population is older, aiding the nitrification process, which removes ammonia.

As the microorganisms change, so does their efficiency in removing CBOD and ammonia. When removal rates decline, the treatment process is upset and the treatment plant runs the risk of violating its permits. Therefore, our laboratory staff provide a great service to our plants.

The picture at right shows a well-developed group of stalked ciliates, which we at Southerly compare to a "bouquet of tulips." The bouquet indicates that the sludge is older—perfect for our second-stage process.

—Kevin Zebrowski, Assistant Superintendent, Southerly WWTC

The Sewer District uses a biological process to remove organic constituents from wastewater. This *activated sludge* process harvests various types of microorganisms in aeration tanks to consume the organic matter ("food") in wastewater. As these organisms (bacteria) grow, reproduce, and consume the organic material, they secrete a polysaccharide that allows them to clump together, forming small particles which are referred to as *floc*. Other microbes, such as protozoa and metazoa, begin to feed on the clumps of bacteria (floc).

The floc particles begin to grow in size and weight as the number of bacteria and other microorganism increase. This causes the particles to settle, leaving a *clear supernatant*. The tighter and more compact the floc particle, the better it settles, aiding in the removal of fine particulate matter. This mass of bacteria and other microorganisms, referred to as *activated sludge,* is allowed to settle and concentrate in tanks called *clarifiers*.

A portion of the settled sludge (activated sludge) from the clarifiers is returned to the aeration tanks to "seed" the incoming wastewater with hungry microorganisms. The tanks use fine air diffusers to supply the microorganisms with much-needed oxygen and to keep the activated sludge constantly mixing with the wastewater. Since the organisms are constantly producing new cell mass, it is necessary to "waste," or remove, sludge from the system to keep the system in balance. *(The diagram on page 18 illustrates typical activated sludge flow.)*

During the activated sludge process, a mixture of wastewater and activated sludge (sometimes called "mixed liquor") is sent to an aeration tank. Mechanical aeration keeps the activated sludge in suspension and in contact with the wastewater. After a certain period of time, the activated sludge is removed from the aeration tank and sent to a clarifier, where it is allowed to settle out, creating a clear supernatant.

In order to maintain an efficient process, the desired biological mass is constantly returned to the aeration tank to feed, while a portion of the activated sludge is removed from the system, or "wasted." The concentration at which the mixed liquor is maintained in the aeration tank affects the efficiency of the treatment.

The basic unit of operation of the activated sludge process is the *floc,* which consists of millions of aerobic microorganisms (bacteria, fungi, yeast, protozoa, and worms), particles, coagulants, and impurities that come together to form a mass. This mass helps remove both organic and inorganic constituents present in the wastewater. Well-developed, healthy, floc consist of filamentous and non-filamentous organisms, with the latter being the dominant species. A good, activated sludge will have a consistent light brown color. The floc particles will be similar in shape, and will clump together and settle at a uniform rate. Microscopic examination will reveal very few flagellates and amobae and a large number of free-swimming ciliates and stalked ciliates.

Stalked ciliates

The efficiency of the activated sludge process depends on a lot of different operating variables. In order to keep the activated sludge system healthy and efficient, there needs to be regular testing of the activated sludge, wastewater influent, and effluent. The following parameters are tested or calculated by the laboratory on a regular basis: Sludge Volume Index (SVI), Silt Density Index (SDI), Total Suspended Solids (TSS), Total Volatile Suspended Solids (TVSS), Biological Oxygen Demand (BOD), and Chemical Oxygen Demand (COD). These results, along with operational parameters, are used to keep track of the age of the sludge, how long an activated sludge particle remains in the system (MCRT), and the amount of food available for the microorganisms (F/M ratio).

In addition to these physical tests and constant monitoring of the operational parameters, it is recommended that a microscopic evaluation or visual inspection of the activated sludge be performed routinely or whenever critical process changes are made.

Additionally, frequent microscopic evaluation can determine when upsets in the process have occurred, and identify settling problems. A microscopic evaluation is performed using a compound microscope at various different magnifications and illuminations. Some things typically monitored include floc structure and color, filamentous bacteria, and the presence of activated sludge "bugs." There are also various staining techniques used to identify specific microorganisms and show the health of the activated sludge particle.

The activated sludge is often referred to as "bugs" that eat the "food." There are four groups of bugs that do most of this work: bacteria, free-swimming ciliates, stalked ciliates, and suctoria. The chart at right (Fig. 1) illustrates the dominant organisms found in activated sludge.

The larger bugs include protozoans known as *free-swimming* and *stalked ciliates* (Figs. 2 and 3). Free-swimming ciliates require more food for energy since they move around and graze on floc in order to keep the number of bacteria in balance. Stalked ciliates attach themselves to the floc and wait for food to come to them, and therefore have a lower food requirement. These organisms indicate a medium-aged sludge, and groupings of three to four stalks on average is an indicator of healthy sludge. The last group of bugs in the activated sludge food chain is *suctoria* (Fig. 4), which feed on the larger bugs and aid in settling. Another organism in this group is the *rotifer* (Fig. 5), which predominates after the stalked ciliates have declined in population, and which feeds on strands of bacteria.

Life forms such as amoebae, flagellates, and clear or light brown floc indicate a young sludge age. A young sludge produces fluffy, diffuse floc particles which settle very slowly in the final clarifier. Structures are weak, and mostly single-celled bacteria are present, with no higher life forms. At a medium sludge age, floc tends to be larger and compact, with a golden brown color. As it gets older, floc gets darker in color. Free-swimming ciliates, stalked ciliates, and crawling ciliates are dominant. A typical sludge age usually ranges from three to fifteen days.

Worms, rotifers, and filamentous bacteria with sulfur granules typically indicate an old sludge age (Fig. 6). Older sludge produces septic (anaerobic) areas, producing a more granular type of sludge particle and leaving a turbid effluent. As temperature rises, biological activity speeds up and available oxygen decreases. Low oxygen and warmer temperatures together create highly septic conditions.

Sludge age does not correlate with filamentous bacteria vs. floc formers. Both species of bacteria degrade organics, but filaments mainly indicate other conditions in the system, such as nutrients, dissolved oxygen, septicity, or grease.

The major causes of filamentous bacteria include: low dissolved oxygen, low food-to-mass ratio, low nutrients (i.e. nitrogen or phosphorus), septicity/sulfides, low pH, and oil and grease.

Filamentous bacteria (Fig. 8) grow in strands and are generally an indicator of some type of system deficiency or imbalance. In low numbers, they are beneficial in helping strengthen floc structures, creating a "backbone" for

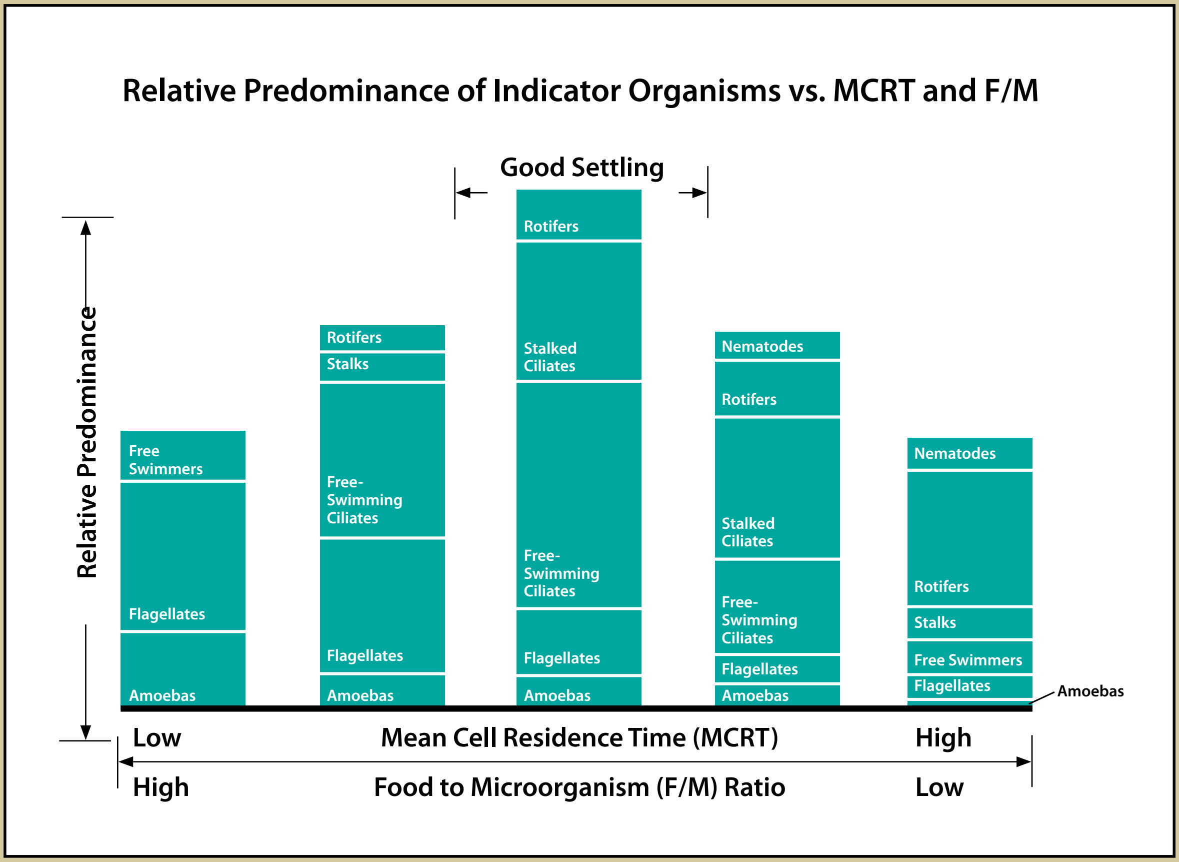


Fig. 1: Sludge quality and microorganism diversity

the floc that helps keep the structures together. But if these bacteria are overly abundant, filaments will bridge among flocs and hinder sludge settling, causing bulking. In large amounts, they can create a sponge-like structure that is very hard to de-water. Free-floating filaments can cause Total Suspended Solids (TSS) problems. These various problems are illustrated in Figs. 9-11.

Because the bacteria are the workhorses of the system, microscopic analysis is one of the critical components to monitoring the biological stage that takes place at the treatment plants. Differentiating the different species of bacteria that degrade organics and remove pollution are the key factors to optimal process control.

Lindsey Koplow is a Wastewater Analyst and Carrie Millward is a Biologist in the Analytical Services department of the Northeast Ohio Regional Sewer District.

Fig. 2: Free-swimming ciliate

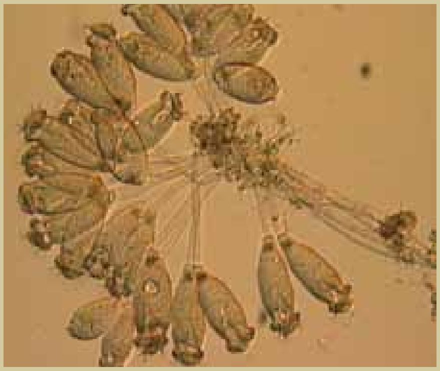


Fig. 3: Stalked ciliates

Fig. 4: Suctoria

Fig. 5: Rotifer

Fig. 6: Beggitoa with sulfur granules

Fig. 7: Worm

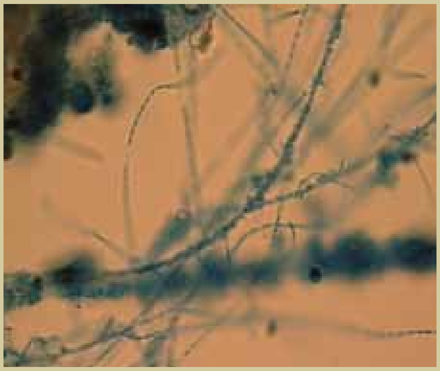


Fig. 8: Filamentous bacteria

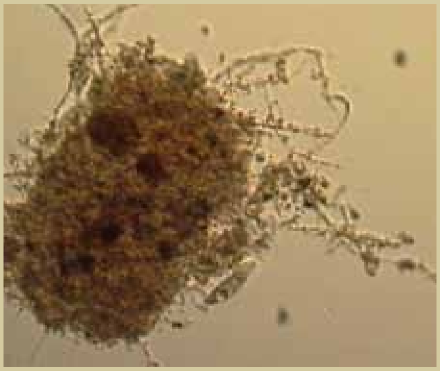


Fig. 9: Internal bulking of filaments

Fig. 10: Bridging of filaments

Fig. 11: Free-floating filaments

Fluidized Bed Incinerator, Southerly

Challenges ahead

by Michael Uva

Treatment plants face new regulatory hurdles

Among their many impacts on the environment and on the industrial community, the **Clean Water Act** and **Clean Air Act** established rules that limit discharges of hazardous materials from wastewater treatment plants (and other "point sources") into the waterways and the air. The Sewer District's three treatment plants consistently earn recognition for their compliance with these standards, but recent and upcoming changes to these rules could make it more difficult (and, for ratepayers, more costly) to meet those limits.

INCINERATION

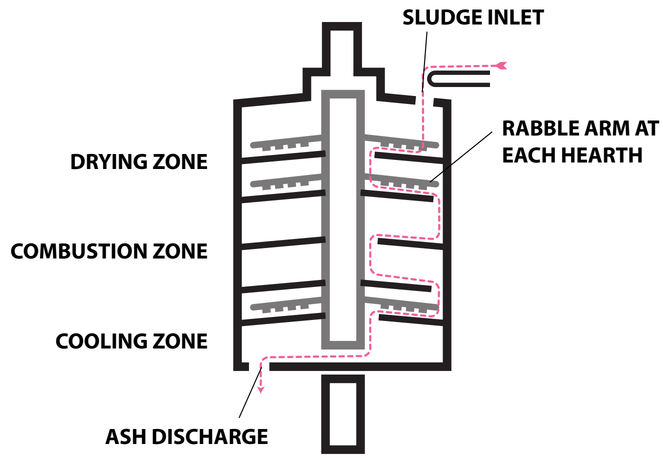
Until recently, sewage sludge was not considered solid waste, and its incineration fell under the **U.S. EPA**'s "Hazardous Air Pollutants" rules (Section 112 of the Clean Air Act). These limits have been relatively easy for the District to meet, given that our incinerators emit very small amounts of hazardous pollutants.

However, in 2011, the EPA changed the categorization of sewage sludge (arguing that it is "a direct by-product of the treatment of the domestic sewage that comes from the public"), so it is now considered solid waste. Solid waste incineration falls under Section 129 of the Clean Air Act ("Solid Waste Combustion"), which sets much stricter limits on incinerator stack emissions.

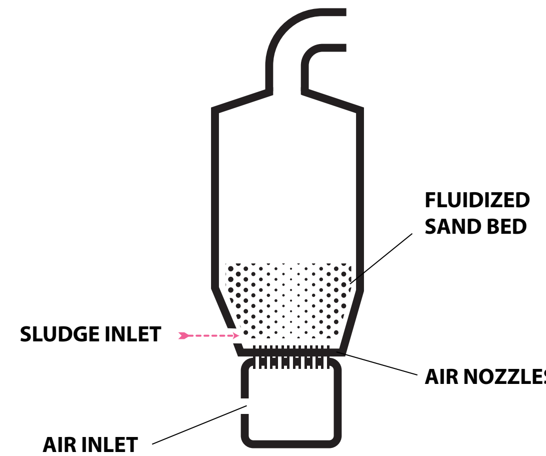
Furthermore, Section 129 makes distinctions between fluidized bed incinerators (or FBIs, such as those at the Sewer District's Southerly plant) and multiple hearth incinerators (an older technology, used at our Westerly plant). Southerly, with its brand-new FBIs, has to meet much more stringent **Maximum Achievable Control Technology** (MACT) standards than does Westerly. *(See page 23.)*

There are other problems with the new re-categorization under Section 129. "One difficulty is that sewage sludge has such variability in terms of differ-

Multiple Hearth Incinerator (MHI)



Fluidized Bed Incinerator (FBI)



*The Sewer District's Westerly and Southerly plants incinerate solid biological material collected during the treatment process. Westerly uses **Multiple Hearth Incinerators** (MHI), and Southerly recently replaced its decades-old MHIs with a **Renewable Energy Facility** (REF) containing three **Fluidized Bed Incinerators** (FBI).*

In a Multiple Hearth Incinerator, the furnace is divided into hearths (levels) and a "rabble arm" rakes the sludge towards the center of the furnace as it burns, until it drops through holes to the next level down. In the diagram, you see that the furnace is divided into three zones: drying, combustion, and cooling. The end product after combustion is ash.

The Fluidized Bed Incinerator does not have hearths. Instead, it has one large chamber with a layer of sand at the bottom. Sludge is fed at the bottom of the incinerator and air is also injected into the unit. The incoming sludge and the layer of sand is fluidized at a high temperature, which burns up the sludge. The sand can be reused, but eventually some of it is depleted and it will be replaced. The end product after combustion is ash.

Both types of units have a wet scrubber to control emissions leaving the incinerator.

—Sarah Rehner,
NEORSD Environmental Specialist

Westerly (MHI)

Pollutant	MACT Standard	Units
Cadmium	0.095	mg/dscm
Carbon Monoxide	3800	ppmvd
Dioxins, TEQ	0.32	ng/dscm
Dioxins, TMB	5.0	ng/dscm
Hydrogen Chloride	1.2	ppmvd
Lead	0.3	mg/dscm
Mercury	0.28	mg/dscm
Oxides of Nitrogen	220	ppmvd
Particulate Matter	80	mg/dscm
Sulfur Dioxide	26	ppmvd

Southerly (FBI)

Pollutant	MACT Standard	Units
Cadmium	0.0016	mg/dscm
Carbon Monoxide	64	ppmvd
Dioxins, TEQ	0.10	ng/dscm
Dioxins, TMB	1.2	ng/dscm
Hydrogen Chloride	.51	ppmvd
Lead	0.0074	mg/dscm
Mercury	0.037	mg/dscm
Oxides of Nitrogen	150	ppmvd
Particulate Matter	18	mg/dscm
Sulfur Dioxide	15	ppmvd

Westerly and Southerly Sewage Sludge Incineration (SSI) Maximum Achievable Control Technology (MACT) standards. The limits on Southerly's emissions are considerably lower, due to the fact that it has newer, more advanced incineration equipment.

SOUTHERLY

WASTEWATER TREATMENT CENTER

SERVES: 530,000+ residents
AVERAGE FLOW: 120 mgd
FLOW CAPACITY: 735 mgd

Situated on 288 acres, Southerly is the largest of the Sewer District's three wastewater plants, and one of the largest facilities of its kind in the country.

The first-stage activated-sludge process is similar to those used at Easterly and many other treatment plants around the world. The second-stage process uses specialized bacteria to remove ammonia and nitrogen, two compounds which deplete oxygen in receiving waters. As a final step, the flow passes through filters and is disinfected by a chlorination/dechlorination process from May to October.

ent pollutants," said **Robin Halperin**, the Sewer District's Manager of Regulatory Compliance. "There is a huge difference between sludge that comes from factories and that from non-industrial, residential areas. But all wastewater treatment plants across the country are subject to the same limits."

Especially problematic are the limits on mercury. Meeting Section 129's much stricter air emission limits pose a challenge for treatment plants, since mercury can slip by scrubbing devices in the incinerator stacks. (For comparison: when lead is burned, it adheres to particulates and gets removed by a scrubber unit on the incinerator stack. Mercury volatizes at a much lower temperature and does not stick to particulates, and therefore passes out of the stack.)

The District already has programs to minimize the amount of mercury coming *into* the plant: an Industrial Surveillance program that monitors hazardous-material pre-treatment in factories; specific requirements for industries that have been found to be significant sources of mercury; and a Dental Amalgam Separator program to reduce the amount of mercury used in fillings getting into the sewers—all parts of the District's Pollutant Minimization Plan for mercury.

"We are talking about very small amounts of mercury," said Halperin. "If a guy loses a filling in a bar fight, and that tooth ends up in the sewer, we could exceed the air limit. It's a big challenge. We need to be in compliance with the new rules by March 2016."

So far, Westerly's multiple-hearth incinerators are meeting most of Section 129's limits, and the District is moving ahead with a plan to add additional equipment at Southerly to achieve full compliance.

Meanwhile, the regulatory debate continues. In April 2014, the **National Association of Clean Water Agencies** (NACWA) and a number of industry groups filed a brief challenging the EPA's Non-Hazardous Secondary Materials Rule that designates sewage sludge as solid waste.

NUTRIENTS

Also of concern for treatment plants are potential changes to limits on discharges of nutrients, which contribute to toxic algal blooms in Lake Erie. In Ohio, the focus is on controlling phosphorus. "You need phosphorus and nitrogen to grow algae," explained **Elizabeth Toot-Levy**, Senior Environmental Specialist at the Sewer District. "In freshwater systems, by controlling the amount of phosphorus, we can control the amount of algae." Urban and agricultural runoff (fertilizer) are the main contributors to the overabundance of phosphorus in the Lake. *(See page 26.)*

The Sewer District's plants and other Great Lakes facilities are already held to very low phosphorus limits, compared to facilities in the Southern part of Ohio. Our Southerly plant has a phosphorus limit of 0.7 mg/L, and our Easterly and Westerly plants each have a limit of 1 mg/L. "We currently have no problem meeting those limits," said Toot-Levy.

But she fully expects the limits to drop. "The algal bloom problem is getting so bad, and even though treatment plants aren't a major part of the problem, they are a controllable part," said Toot-Levy.

The **International Joint Commission** (between **U.S. EPA** and **Environment Canada**) makes the rules on discharges to Lake Erie, and a 2012 IJC report calls for a 0.5 mg/L limit. Depending on the technologies in place at any particular facility, this could be a very difficult standard to meet.

Toot-Levy co-chairs the Ohio EPA's **Nutrient Technical Advisory Group**, which looks at how to make sensible nutrient criteria for Ohio's rivers and streams—and how to determine if a publicly-owned treatment works (POTW), or any other point source, is actually contributing to the problem. "If you consider the tons of phosphorus the Sewer District discharges, it's still only 2% of the total phosphorus going into Lake Erie," said Toot-Levy. "If we spend a lot of money to reduce that, is it really going to have a noticeable effect on algal blooms? There's no doubt that we should do our part, but we have to think about what is cost-effective, what makes sense."

Ohio EPA currently is working to come up with a more "holistic" system that looks at the conditions of a body of water and finds evidence showing what is causing the problem.

"There are always potential new water-quality criteria that wastewater agencies must anticipate," said Toot-Levy. "The Sewer District and groups like AOMWA and NACWA can say, 'This new rule isn't realistic,' and try to affect rules during their development, because by the time the state adopts those criteria, it's often too late. We're more likely to have an impact before the rules go into effect, so that we end up with rules that makes sense, that our plants and our ratepayers can live with." **CWW**

Q&A

by Michael Uva

An interview with ***Laura Johnson****, of the* ***National Center for Water Quality Research***

REMEGIO CONFESOR

Tell me about your work at the National Center for Water Quality Research.

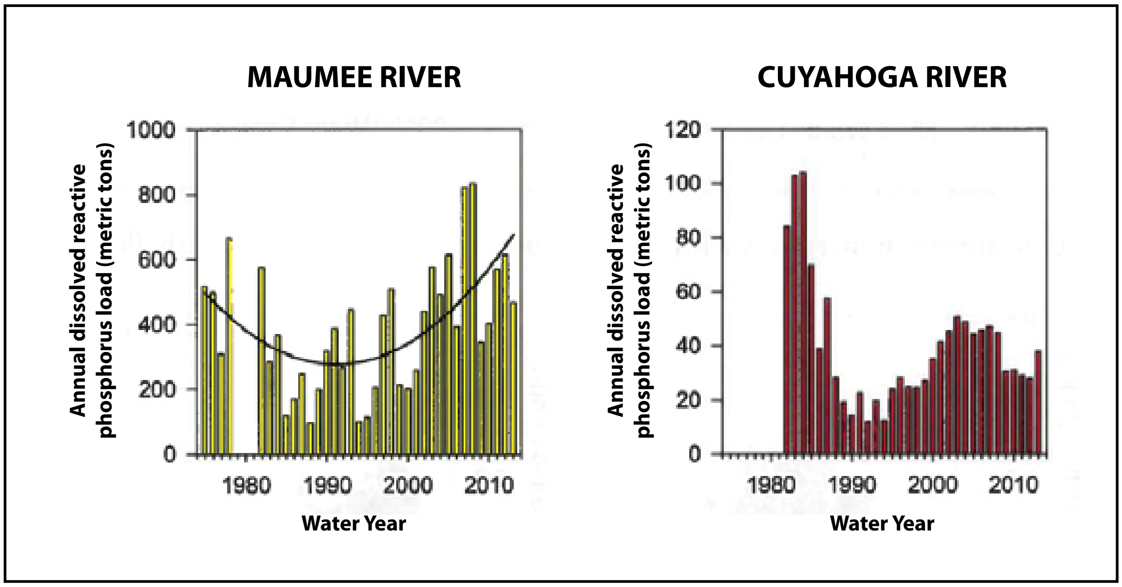
We monitor water quality in most of Ohio's major rivers. We've been monitoring the Cuyahoga River since 1982. The Sewer District began funding our Cuyahoga monitoring station in 2014.

And how long have you been tracking phosphorus in Lake Erie?

It started in 1969. Our lab started by tracking phosphorus, among other nutrients. For a long time, people had been told that phosphorus only comes from "point sources" *[see glossary, page 27]*. Our Emeritus Director, Dave Baker, found an opposite pattern. He measured stormwater runoff after a big storm and found very high concentrations of phosphorus. He contacted the Army Corps of Engineers and told them they might be underestimating non-point phosphorus sources getting to the lake. That got our monitoring stations up and going by around 1974.

What were the conclusions as to the non-point sources of phosphorus?

We monitor a number of watersheds. Some are primarily non-point, and others, like the Cuyahoga, are almost all point sources. Only about 20% of the phosphorus entering Lake Erie is from point sources. When we started monitoring, it was closer to 50%, so that has changed quite a bit. In the '60s and '70s, wastewater treatment plants weren't removing enough phosphorus. That has improved, and also the detergent phosphorus ban came along, so the lake got better.



Since 1995, dissolved phosphorus has been increasing in agricultural watersheds.
In the Cuyahoga, dissolved phosphorus has been low, compared to the early 1980s.

So now the majority of the phosphorus is coming from non-point sources?

Absolutely. And when it comes to dissolved phosphorus, which is the most highly available form of phosphorus for algae, we only see increases in non-point-source dominated watersheds. In comparison, phosphorus loads in point-source watersheds have gone down and remained low since the early '80s.

How do phosphorus levels in the Cuyahoga, which is in an urban watershed, compare to levels in the Maumee River, which is in a more rural area?

Since the mid-'70s, we've had drastic increases in phosphorus loading from the Maumee, whereas in the Cuyahoga, it has been going down. Concentrations in the Maumee increase during storms, due to land runoff. In the Cuyahoga, we usually see dilution of phosphorus with storms. And, if you look at data from the Maumee, you'll see that concentrations stay elevated for awhile after a storm—a strong indicator of sub-surface drainage.

There are an increasing number of indicators that non-point sources are the biggest contributor of phosphorus, and it's all getting delivered during storms.

And agriculture is the primary contributor?

The Maumee, which is almost all agriculture, is showing patterns we don't see in urban areas. Even if we have urban non-point source runoff, it's not increasing like in agricultural areas. It isn't simply from overfertilization of farm fields. We think the culprit is surface application of fertilizer, which has a higher potential to runoff as dissolved phosphorus.

GLOSSARY OF TERMS

ALGAL BLOOM: Excessive growth of algae in a body of water. Blooms cloud the water and reduce oxygen, threatening fish and aquatic life. Some algae species produce toxins that are dangerous to animals and humans.

NON-POINT SOURCE: Pollution inputs spread over a wide area and not attributable to a single source. Farms and stormwater runoff from streets and other hard surfaces are examples of non-point sources.

POINT SOURCE: A single, identifiable source of pollution, such as a pipe or a drain. A wastewater treatment plant is a point source because it discharges into a stream or lake.

JEFF SCHMALTZ/NASA

Harmful algal bloom visible in Lake Erie, October 2011

Now, there are situations where point sources do have an influence. For example, if you see beach warnings associated with *E. coli,* that would be either a failing septic or associated with a combined sewer overflow [CSO] following a storm. Those things are not agriculturally-related. So there are point-source influences, but we don't have the evidence to say that point sources are causing harmful algal blooms. It's the flow coming off the land that is the driver of the harmful algal blooms. Even if we turned off all point sources, such as wastewater treatment plants, we'd still have problems.

Even so, at the Sewer District, we are preparing for new, more stringent limits on phosphorus.

Currently, in order for treatment plants to make sure they never go over, say, 1 mg/L, they have to target for about half of that. So if the limits are reduced to, say, 0.5 mg/L, you're probably going to have to target 0.25 mg/L, which becomes a really big challenge for a wastewater treatment plant.

The data is pretty clear, but it's hard for people to accept the fact that CSOs are not a very big contributor to the algal blooms. Wastewater treatment plants are always going to be an obvious target. But there is going to have to be a lot of work done on the land for us to start meeting our targets to stop harmful algal blooms. **CWW**

heidelberg.edu/ncwqr

Laura Johnson is a research scientist at the National Center for Water Quality Research (Heidelberg University) where she works on watershed export and riverine dynamics of nutrients and sediment. She holds a Ph.D. from the University of Notre Dame.

Southerly, 1978

A polluted past

The origins of the Sewer District's three treatment plants

The Cuyahoga River and Lake Erie were the two primary features that led **Moses Cleaveland** to stake land at the mouth of the Cuyahoga in 1796. Along with the low banks, dense forests, and high bluffs, Mr. Cleaveland felt these features presented an ideal location for the capital city of the Western Reserve.

The business district of our early city exploited the river, where steamers, schooners, and canal boats exchanged imports and exports. The steel industry took off, and **John D. Rockefeller** began his oil empire on the shores of Lake Erie. Prosperity ensued, but polluted waters followed close behind.

Until 1856, most Clevelanders got their water from springs, wells, and cisterns, or in barrels filled with water from area waterways. Then city leaders built a new public water system to supply unfiltered Lake Erie water to a limited portion of the city. Twenty years later, the sewage and filth of a growing city added to the problem of industrial waste, thereby turning the water supply into a health risk. Several times, the intake pipes were relocated farther from the shoreline and sewer outlets to reduce the incidence of typhoid fever and other water-borne diseases, but the benefits of those changes were short-lived.

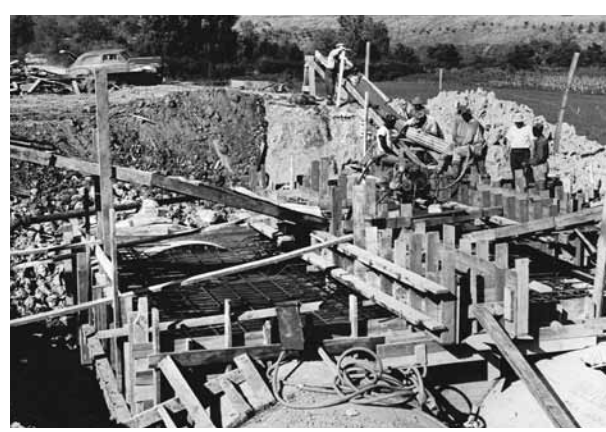
As early as 1881, **Mayor Rensselaer Herrick** declared Cleveland's riverfront "an open sewer through the center of the city." Despite a lack of public support, there began a series of public works to improve the quality of Cleveland life, including the construction of a public water system and drainage sewers.

One of the first sewer pipes that transported waste to the lake was the Easterly Interceptor (constructed in 1905), which ran parallel to the lake shore. At this time, the Cuyahoga River had 50 sewers emptying into it, along with manufacturing waste.

Until 1911, officials intended to ultimately collect sewage from the entire city in the Easterly Interceptor and discharge it into the lake, untreated. But that year, city officials seriously considered the lake's future.

Sewage treatment facilities at Edgewater Park, 1919

Easterly construction, 1932.



Southerly construction, 1951

They had doubts about the economy and wisdom of transporting sewage many miles from the Westerly and Southerly portions of the city to the main Easterly outlet, especially if the sewage required treatment.

They hired **R. Winthrop Pratt** to conduct a study of water supply and sewerage for the area. As a result of the study, they decided to collect and treat sewage and industrial waste from four general districts: Westerly, Easterly, Southerly, and Low Level. These districts were the forerunners of today's Westerly, Easterly, and Southerly service areas.

The **Easterly Sewage Testing Station** was established on the shore of the lake, next to the Easterly Interceptor outlet. Officials wanted to use this test site to determine the most effective method of treating the sewage so it could be safely discharged into the lake without causing unsanitary and unsightly conditions. Processes tested included hand-cleaned bar screens, grit chambers, sedimentation basins, roughing and trickling filters, and sludge treatment tanks.

Design and construction of full-sized preparatory works with chlorination facilities and a second submerged outfall for Easterly began in 1919, and the plant was completed and began operation in 1922. That same year, the **Westerly Wastewater Treatment Plant** began operating as a primary treatment facility, followed by the **Southerly Wastewater Treatment Plant** in 1927.

By 1930, Westerly and Southerly had been upgraded to provide higher levels of treatment, and the Easterly plant had become the subject of additional studies. With the intake for the proposed Nottingham water filtration plant just four miles from Easterly's outfall, considerable improvement in the plant's treatment capacity was necessary. The result was upgrading Easterly to become Cleveland's first activated-sludge plant, which went online in 1938.

Because Easterly was adjacent to the affluent community of Bratenahl, sludge from the plant was pumped (via a 13-mile pipeline that ran under the City of Cleveland) to Southerly for treatment.

The treatment plants were further upgraded and expanded through the years, with major improvements at Westerly in 1932, 1937, 1956, and 1993, and upgrades to Southerly in 1930, 1938, 1955, and the early 1960s and mid-1970s. Because of the comprehensive nature of its initial design, Easterly remained substantially unchanged until the late 1970s.

Upon its creation in 1972, the **Northeast Ohio Regional Sewer District** assumed ownership from the City of Cleveland of the Easterly, Westerly, and Southerly wastewater treatment plants. **CWW**

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*Excerpted from **Northeast Ohio Regional Sewer District: Our History and Heritage 1972-2007**, which can be viewed at **neorsd.org/history**.*

Q&A

by John Gonzalez

*An interview with **Christen Wood**, WPO*

*A former lab analyst and now second-year Wastewater Plant Operator-in-training, **Christen Wood**'s career path has led her from veterinary medicine to sewage treatment. We asked her about opportunities in Wastewater Operations.*

How did you get into wastewater?

I sort of fell into it! The local paper ran a column on the "brain drain" in Ashtabula, why we weren't able to get qualified candidates into jobs there. I wrote a thank-you letter to the editor for covering the topic, and as soon as the letter ran, the Ashtabula wastewater treatment plant called me and said, "We need you to apply now."

I had studied biology. Once I got into wastewater, I found it involved biology, chemistry, and physics. It was just a really good fit for me. Once I got into a lab position, I sort of missed being in touch with the plants. So I gave Operations a try, and fell in love with it.

What is it like training to be an operator?

You start by studying the units at the plant. We have seven units at Southerly. You pick one, and go through on-the-job training. You also have to pass three operator exams: Class I, II, and III. The Class I was especially intimidating. I have a master's degree, and these tests were the hardest I've ever taken.

What helped you early on?

In my early lab experience, every morning I would go out to get samples. I was out in the plant, smelling the plant. If you talk to the old-timers, that's how they did it. There were no numbers. That's a good skill to have as an operator, to be able to notice little things like that.

How did you know this was the right path for you?

I was actually excited to come to work. In other jobs I had, it was sheer drudgery. In wastewater, I actually engaged in what was going on around me. It only took me maybe six weeks before I knew I'd be doing wastewater for a long time.

What advice do you give?

When I participate in outreach, I freely tell people how much money I make. I compare it to other jobs they might be more familiar with, and they start to realize that our industry is a career option, not just a job you take until something else comes along.

A little bit of what I do is like detective work. If you enjoy looking for clues and putting together the big picture, Operations is a great way to do that.

What's the biggest misconception about the work you do?

It's not glamorous. My mom doesn't tell her friends that I work in sewage. I studied veterinary medicine at a top private university, so maybe that has something to do with it, but also I think there's a stigma out there.

But I am proud of what I do. When I talk to people, and I tell them how we clean wastewater and make it safe for the environment, and they ask questions, it is really cool. The fact that we can take sewage and turn it into clean water is incredible. CWW

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*John Gonzalez is the Sewer District's Senior Communications Specialist and Social Media Coordinator. Reach him at **gonzalezj@neorsd.org**.*

CleanWaterWorks *web extras:*

Training Programs Becoming a Plant Operator and even Superintendent are attainable goals for District staff with the ambition and persistence to succeed. Training and Development Program Manager **John Corn** explains the process by which District employees move up through the ranks.

Nutrients by the Numbers In Lake Erie, the annual phosphorus load has been reduced from 29,000 metric tons to less than 11,000, largely due to reductions from point sources. In 2013, NEORSD plants removed 745 tons of phosphorus. Explore these numbers, and more!

Read the full stories at neorsd.org/cleanwaterworks

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