RECOVERY ZONE
FEBRUARY 2022

South Carolina Coastal Community Preparing for the Future… is DPR an Option?

Authors: F. Allan Clum, General Manager; Jestine Deepe, Laboratory Director, Mount Pleasant Waterworks, Dave MacNevin, Discipline Leader – Water Reuse; Anna Ness, Project Engineer, CDM Smith

Leading the Way for Membranes in South Carolina

Mount Pleasant Waterworks (MPW) led South Carolina in the adoption of RO membranes, when it started its first RO WTP in 1991. Over thirty years later, MPW now operates a total of four (4) RO WTPs, with 7.5 mgd of combined treatment capacity, desalinating brackish groundwater from the Charleston aquifer. MPW also purchases surface water to supplement groundwater usage.

While MPW's groundwater pumpage has not resulted in adverse effects to the aquifer, local regulators have adjusted local groundwater allocations among area users, reducing MPW's allocation below historical levels. With the decrease in available groundwater, MPW has the opportunity to consider supplemental sources of water supply, to maintain high utilization of MPW's water treatment infrastructure.

Figure 1. Example RO Train at Mount Pleasant Waterworks WTP #3

Considering options to further utilize its existing RO production capacity, MPW is again leading the way in South Carolina by investigating direct potable reuse (DPR) as a potential supply option. This article shares highlights from MPW's recent DPR feasibility study and a preview of potential next steps.

Reclaimed Water: A Valuable Water Resource with Different Treatment Requirements than Groundwater

MPW provides both water and wastewater services to nearly 42,000 customers. Wastewater is treated by the 3.7 mgd Center Street Wastewater Treatment Plant (CSWWTP) and the 9.2 mgd Henry Clay Duffie Water Resource Facility (HCD WRF). In 2021, MPW treated an average of about 8 mgd of wastewater effluent. A portion of the treated effluent from the HCD WRF is reclaimed for landscape irrigation; however, most of the treated effluent is discharged to Charleston Harbor.

MPW treated effluent has potential to be a high-quality water supply, with just 650 mg/L total dissolved solids (TDS). This salinity is less than half that of Charleston aquifer groundwater, 1,450 mg/L TDS. Thus, treated effluent could serve as an alternative supply to an RO WTP. Still, despite its relatively low TDS, MPW treated effluent contains several constituents at higher levels than in the Charleston aquifer, or constituents not detected in groundwater at all.

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Message From Our President

Greetings Everyone,

As we move forward into the first quarter of 2022, I hope you all are doing well. For most of us, 2021 has been a year of adapting and recovering; as things finally go back to normal, or what now we know as "new normal" and we are faced with a completely new approach on how to conduct our day-to-day business. Many Water utilities were impacted by the economic side effects of COVID, and the stress related to the extra workload. As we approach the end of the year, we can look back and appreciate our hard work and our commitment to provide the best service to our customers. I like to give a tribute all water professionals as this year made us stronger, and brought us together as a team, to be ready to face the new challenges that are still to come in the next year.

SEDA is working diligently to ramp up the live events in the upcoming New Year. We are very happy of the positive response and great attendance to all live events hosted this year. We are thankful to the speakers, sponsors and especially the plant hosts that provided venues for each class, without them, it would not be possible.

We will be transitioning the SEDA app and encourage all our members to use our member click portal https://seda.memberclicks.net/. Member clicks is a portal that is directly linked to our SEDA website; from here, you can renew your membership, or access numerous features that can be a great resource when looking to exchange information with other SEDA members. Please continue to provide comments and suggestions for training topics, articles for the Recovery Zone bulletin. If you are interested in serving on a committee or hosting an event, please reach out to any our board members.

Stay safe and keep up the good work!

Karla V. Berroterán Castellón
Village of Wellington
Water Treatment Facility Superintendent

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These include chemical constituents of emerging concern (CECs), found in typical municipal wastewater effluent, such as per- and polyfluoroalkyl substances (PFAS), pesticides, herbicides, pharmaceuticals, and personal care products. Using treated effluent as a supplemental supply for groundwater RO WTPs, would also necessitate pretreatment by ultrafiltration, to remove suspended solids prior to RO, for sustainable operations.

Testing the Waters: MPW Conducts Benchtop Treatability Testing to Evaluate an Advanced Treatment Train

Looking to evaluate the feasibility of using treated effluent from the HCD WRF at RO WTP #3, MPW and CDM Smith conducted a treatment technologies workshop in March 2020, where alternative treatment trains were compared, with the existing RO treatment process being at the core of the alternative treatment trains considered. After that workshop, MPW decided to proceed with benchtop testing of the ultrafiltration, reverse osmosis, and UV-chlorine advanced oxidation treatment train, on wastewater effluent from the HCD WRF.

The advantage of benchtop treatability testing is that it allows utilities to test advanced treatment technologies on their own water source, getting site specific data applicable to their specific source of supply. Benchtop treatability testing can be conducted more quickly and at less cost than a pilot study, while still answering some of the most basic questions about treatment process feasibility and uncovering any issues or challenges that might warrant further investigation.

On July 13, 2020, MPW collected batches of reclaimed water and groundwater for shipment to CDM Smith's Research and Testing Laboratory for benchtop treatability testing:
1. Reclaimed water was collected from the HCD WRF
2. Untreated groundwater was collected from the Charleston aquifer at RO WTP 3.

CDM Smith conducted the benchtop treatment tests evaluating treatment of two distinct blends of highly treated reclaimed water and brackish groundwater, as shown in Figure 2.

- Test #1: Treat 100% Reclaimed Water
- Test #2: Treat a Blend of 50% Reclaimed Water and 50% Groundwater

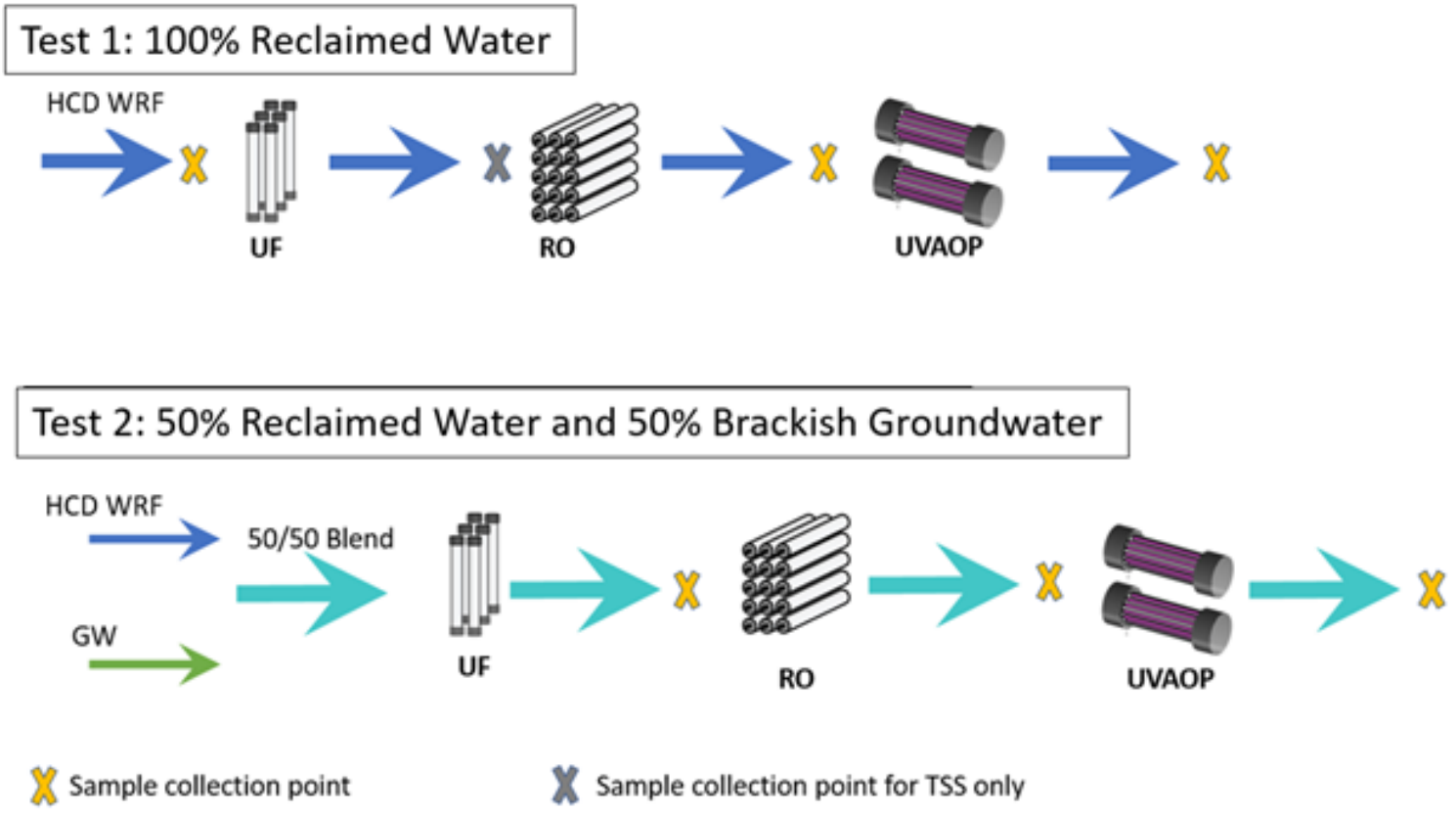


Figure 2. Test Summary and Sample Locations

The benchtop tests simulated a DPR treatment train of ultrafiltration (UF), reverse osmosis (RO), and UV-chlorine advanced oxidation (UV-AOx). Ultrafiltration was simulated using a SUEZ ZeeWeed 1500 Jr benchtop UF system with one (1) ZeeWeed® membrane module made of polyvinyl difluoride (PVDF) hollow fibers with 0.02 µm pores (Figure 3). The reverse osmosis treatment step was simulated using a single element Tomar TSM-400 bench top system capable of holding one (1) 2.5" diameter RO membrane. The RO unit was operated in batch mode with recycle and run to produce a permeate quality mimicking of RO membranes at MPW's existing RO WTP #3, which uses Nitto-Hydranautics ESPA2-LD membranes (Figure 4). CDM Smith worked with Nitto to obtain custom-wound 2.5" diameter RO membrane using ESPA2-LD membrane sheet. The UV-AOx process was simulated using a recirculating process with a Viqua Pro10 reactor with 100 watt lamp (not shown).

Benchtop Tests Indicated Effective Treatment of Both Regulated and Unregulated Contaminants

The benchtop tests included water quality sampling after every step of treatment (Figure 2). This included sampling for regulated drinking water parameters and constituents of emerging concern (CECs). CECs are not currently federally regulated or regulated in South Carolina. The CECs evaluated included 19 per-and polyfluoroalkyl substances (PFAS), pharmaceuticals and personal care products, endocrine disrupting compounds, unregulated disinfection byproducts, and other unregulated compounds.

The multibarrier treatment train produced purified water meeting all primary drinking water standards, while also removing measured CECs and PFAS below detection levels. No unacceptable membrane process performance degradation was observed from mixing of wastewater and groundwater. Post treatment of the purified water would be necessary for chemical stabilization and to enhance aesthetics.

A total of 37 constituents of emerging concern (CECs), including 6 PFAS were detected in the wastewater effluent before advanced treatment. All 6 PFAS were removed by RO below detection limits. After reverse osmosis treatment, all CECs except sulfamethoxazole (an antibiotic) were removed below detection limits. Nevertheless, RO removed 99.6% of sulfamethoxazole. Bisphenol-A (BPA) was detected after RO treatment; however, since no BPA was detected in source waters, this detect was likely due to leaching of the plasticizer from the plastic drums during the extended contact time associated with batch treatment. After UV/Cl2 AOP no CECs or PFAS measured during this study were detected in the purified water.

Figure 3. Ultrafiltration Benchtop Unit (Suez ZeeWeed 1500 Jr)

Based upon the results of the DPR feasibility study, this approach of blending treated reclaimed water into the intake of MPW's existing RO WTPs appears feasible to secure future water supplies. Benchtop treatability testing indicated that the proposed treatment train, utilizing current RO technology, could meet anticipated regulations and produce potable water of excellent quality. MPW is investigating the opportunity to construct a pilot-scale DPR demonstration facility to showcase the approach to the public and continue the conversation with regulators.

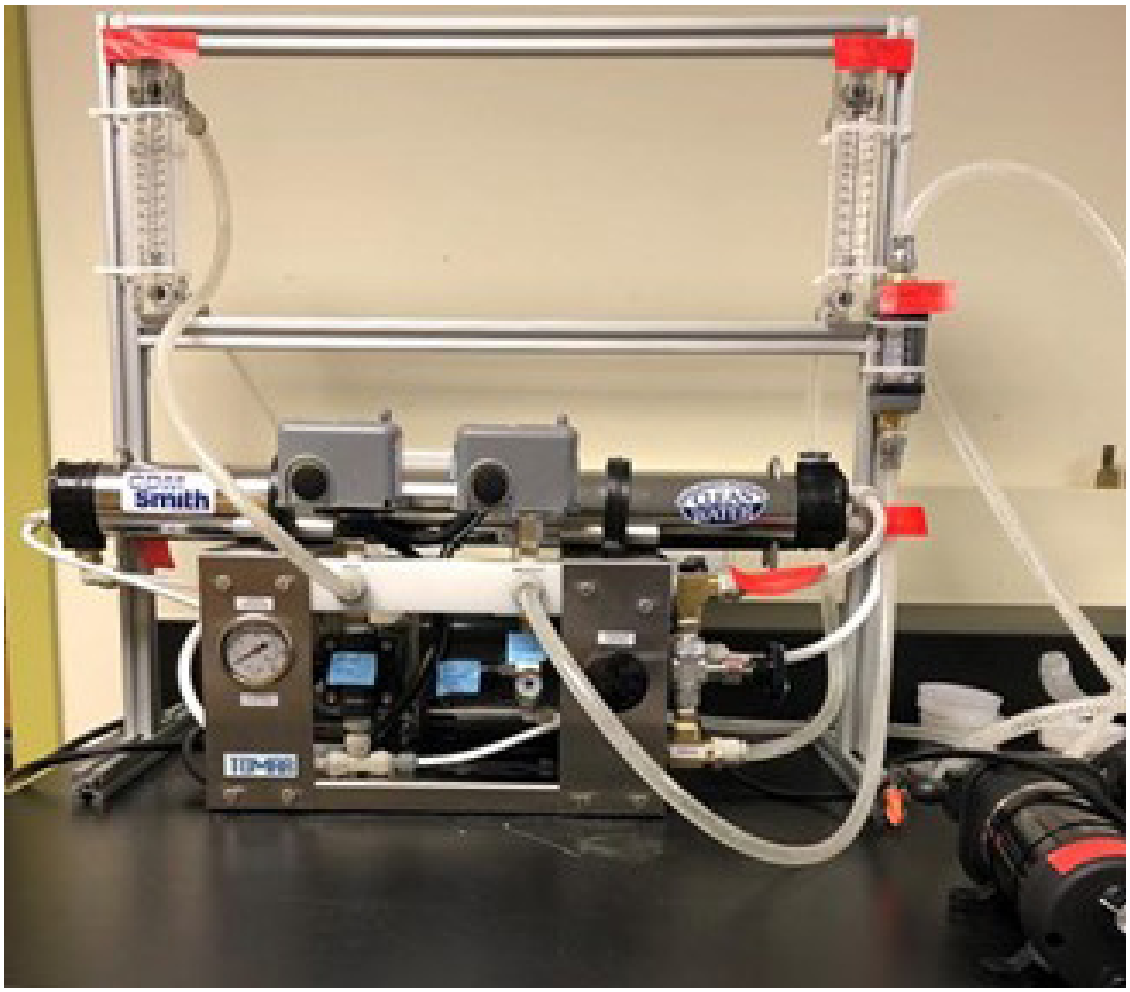


Figure 4. Reverse Osmosis Benchtop Unit (Tomar TSM-400)

No Distinct Regulatory Framework Yet for DPR in South Carolina, But Other States Provide Precedent

As a first part of the study, CDM Smith conducted a review of local and national regulations for water reuse. Although South Carolina has not yet developed regulations governing potable reuse, it was determined that there is still sufficient precedent from the experiences of other states and countries for MPW to plan for a potential, future South Carolina regulation allowing potable reuse and setting requirements. By taking a proactive approach to alternative water supply development and planning, MPW has been learning from the experience of numerous other utilities who have conducted similar evaluations, while crafting a potential program to MPW's own site-specific requirements and leading the way for other utilities in South Carolina to follow. As MPW considers proceeding beyond the initial DPR study phase to a demonstration facility, collaboration with the South Carolina Department of Health and Environmental Control (DHEC) will be critical for facilitating implementation once South Carolina passes appropriate legislation allowing reclaimed water to be used as a safe, sustainable water supply.

MPW is Planning a Demonstration Facility to Show the Safety and Feasibility of the Concept

As a follow up to the Feasibility Study, MPW directed CDM Smith to proceed with preliminary engineering for a 43,000 gallon per day (30 gallon per minute), demonstration facility. Figure 5 shows a conceptual rendering of the demonstration facility, which is designed to include two parallel treatment trains for both UF and RO, aiding in process research, optimization, and testing of multiple membrane products.

The facility is intended to provide MPW the opportunity to demonstrate the process over an extended period, amassing a large body of operating data and laboratory water quality results, to observe the reliability of the process, and to optimize design of a potential full-scale facility. The information collected from this facility would be essential for discussions with DHEC about the appropriate requirements for permitting a potential full-scale facility.

Figure 5. Conceptual Rendering of Mount Pleasant Waterworks' Proposed 30 gpm DPR Demonstration Facility

Finally, the facility is designed with public tour groups in mind. About half of the building area reserved for public educational displays, including a large video screen and a water tasting station. The facility would also be useful for educating students about careers in water treatment, while also providing opportunities for MPW to train its own operators in the advanced treatment technologies essential to DPR. By planning a DPR demonstration facility that will be informative, reliable, and inviting to the public, MPW is once again leading the way in South Carolina water resources, preparing for a future of more abundant water, investigating direct potable reuse (DPR) as a potential supply option.

Ask The Experts...

Author: Mo Malki, American Water Chemicals

Question:

Our RO plant doesn't have a neutralization tank for our spent CIP solution. Can we just neutralize while circulating through the membrane system?

Answer:

That is not recommended. A high pH cleaning solution is designed to dissolve membrane foulants and scales that are soluble in basic conditions. A low pH cleaning solution is designed to dissolve membrane foulants and scales that are soluble in acidic conditions. Neutralizing these cleaning solutions while circulating through the membrane system will precipitate most of the materials that were dissolved back onto the RO membrane surface, rendering the cleaning ineffective.

If you do not have a neutralization tank, you should neutralize the RO cleaning solution in your CIP tank, and drain. Then fill the tank with chlorine-free RO permeate, circulate through your system to displace more RO cleaning solution from the membranes, neutralize in the CIP tank again, and drain again. Repeat until you achieve a solution pH between 5 – 9, at which point, you can flush the membranes with feedwater to drain.

If you have any questions about membrane operation, pretreatment, CIP or troubleshooting, submit them to: admin@southeastdesalting.com

Andy F

Andy Fenske Retirement Day With a Golden Clipboard

1. How did your career in the Water or Wastewa

I started my career in the utilities industry as a wastewater the age of 18, by the City of Cape Coral as a Water Plant Operato plan to leave my operator job with the city once I finished my AA

However, very quickly after starting the job at what was the la world were visiting the plant and extremely interested in this rela situation where I was involved in something that was new and cu and deciding to make a more than 35-year career out of it, was the

After just a year of employment, I was given a key to the Super to review when they arrived in the morning. After several years of out with any plant related issues or projects.

I helped out with things like sampling plans and regulatory rep grammer (Rick Angelo), so I could back him up. I also assisted the Chief Operators (Lynn Stevens and Mark Seamans), Maintenanc Kopko). All were excellent employees, extremely knowledgeable, and great mentors who cared tremendously about the work they did right way to do things.

I obtained my "C", "B", & "A" level water plant operator licenses as soon as I could. All of the additional duties I took on at the p was promoted to at the age of 28. The plant operators and maintenance staff all went out of their way to help me succeed. I was lucky worked extremely well together. It was a supportive and motivated team and I'm very proud of the work we accomplished while I was

During that time, we helped improve the efficiency of the operations of the facilities by automating treatment processes as soon as th proving data collection and plant performance monitoring. Our team also implemented many cost savings initiatives like improved me drives (VFD's) on nearly every sized motor in the treatment process. Believe or not, feed flow to our original RO Trains was controll the flow back with the inlet valve! Same with the well pump motors. This was extremely inefficient, but common practice in the industr and over the years resulted in significant electrical cost savings.

The one change that we initiated, which I am most proud of, is the conversion of the disinfection process from chlorine gas to liq we were the first major utility in the state of Florida to get approval from FDEP and we led the way on making this change easier for us because we had a water plant operator, Dave Willis, die from a chlorine gas leak in 1989. And another operator, Chris Caglioti, ne motivated to get this conversion implemented.

Chris Caglioti and Andy Fenske with SEDA Award for North RO Plant

Other notable accomplishments were expanding the production 18 MGD while operating at near max day capacity. That was fun! Plant that went on-line in 2010. At the North RO Plant, we were a facility that is smart, simple, easily expandable (up to 30 MGD), a We call it a plant built by operators, for operators.

After the retirement of our Water Production Superintendent, capacity until my retirement at the end of August 2021 with more Kayatta, RichieJones, Robert Schreiber, Gus Dowd, Marco Parra, thus increasing water demand, the City of Cape Coral is fortunate

2. How long have you been a member of SEDA?

I joined SEDA shortly after it formed in 1994. My membe

3. What/who prompted you to join SEDA? How

We were excited that there was an organization solely dedi infancy and there wasn't as much information available to plant ope done several presentations, participated in discussion panels, hoste

FENSKE

ter Industry get started? And how did it evolve over the years to your retirement?

r package plant operator working for my father. In 1986, I decided to join the drinking water side of plant operations and was hired, at r Trainee at the city's 15 MGD Reverse Osmosis Plant. I was also attending college full time when I was hired and I had this brilliant Degree so I could attend a larger college out of the area.

rgest low pressure RO Plant in the world at that time, I decided I should probably stick with it. I noticed that people from all over the tively new water treatment process called reverse osmosis. It became obvious to me that I had the great fortune of being hired into a tting edge in the water treatment industry. I also saw the obvious career path potential. Staying with the job at the City of Cape Coral best decision that I ever made.

rintendent's office while working my Midnight to 8am operator shift so I could help to prepare and print out reports for the supervisors f working the overnight shift, I was brought to dayshift to not only help with operating the plant, but to assist wherever I could to help

orts, I also became very involved in learning how the plant's PLC's and SCADA systems worked. I worked very closely with the Pro e Supervisor (Wally Ilczyszyn), and Plant Superintendent (Shawn d. They all helped me to learn how our systems functioned and the

Andy Fenske - Late 1990's

lant helped me to prepare for the Chief Operator position, which I enough to be surrounded by outstanding team players and we all s in the role of Chief Operator for 18 years.

ne payback was reasonable to install these systems, and also by im- embrane cleaning procedures and installation of variable frequency led by operating the motor at 100% speed and manually throttling ry. Retrofitting these motors with VFD's started in the early 1990's

quid bleach (sodium hypochlorite) back in 1996. As far as I know, other larger treatment plants. The issue was somewhat personal to early lost his life trying to save his co-worker. So, we were highly

capacity of the original South RO Plant in 2007 from 15 MGD to And the design and construction project of the 12 MGD North RO ble to take decades of experience from the South Plant and build a nd built from the perspective of operations and maintenance staff.

Shawn Kopko, in 2013, I was promoted to that position, which was later retitled to Water Production Manager. I remained in that than 35 years at the city. The city's Water Production Division is in good hands now with key leadership from: Bob Woods, Mike Mandi Novosel, Don Nespoli, and Heidi Paquette. As the city continues to see rapid growth in its' population and customer base and to have this outstanding and experienced team in place.

r number is 29, so probably one of the early original members.

did you get involved in SEDA on a deeper level? Explain your history with SEDA.

icated to membrane treatment processes, especially at the time it formed in 1994, when large scale membrane treatment was still in its erators then. Over the years, operators and maintenance staff from our organization have attended many conferences and MOC trainings, d multiple training classes, hosted the 2021 spring symposium, and provided plant tours of our facilities.

4. How did being a member of SEDA benefit you? What did you enjoy the most about SEDA?

SEDA has provided a wealth of valuable information over the years that has benefitted the City of Cape Coral tremendously. The most obvious is the basic training to newer employees. It has also helped to spark our imagination to think of better ways to do things and got us started down paths that have led to some of our more innovative ideas and improvements.

SEDA has also motivated plant staff and made them feel like they are part of something important and it has helped them to take pride in the fact that they are membrane plant operators and what they do matters. What I have enjoyed most about SEDA are the opportunities it provided to network with other like-minded individuals in our industry that are as equally invested in what they do. These relationships with other plant operators, supervisors, and maintenance staff provide a network that amplifies the potential for success and improvement of all membrane treatment plants. offer a wide variety of relevant educational courses. Collectively, the training and educational staff share a tremendous amount of knowledge and are always willing to share with anyone interested in learning.

Membrane Element Loading - Mid 1990's

5. What do you enjoy doing in your free time?

Traveling more and spending more time with my family and friends.

6. What advice do you have for the younger generation in the beginning years of their careers in Water/Wastewater and SEDA?

My first piece advice is to talk to you supervisor about getting more involved and taking on additional duties. Secondly, work on building good relationships with your co-workers, be kind, supportive, and helpful.

From the start of my career, I made myself available to take on additional duties and responsibilities to help the organization, to make my job more interesting, and to build value for myself as an employee. I also made an effort to build good relationships with my co-workers. Making myself more valuable to the organization really paid off for me when promotional opportunities became available. And once in those higher-level positions, I had the support of the other employees I supervised because of the good will and trust that was already established and in place between us.

EPA Completes Roadmap for PFAS Regulation: Commitments to Action 2021-2024

Author: Dave MacNevin, PhD PE, CDM & Pierre Vignier, City of Pt St Lucie

There are communities in the United States exposed to the threat of PFAS exposure pollution in soil, surface water, and groundwater. Even though PFAS manufacturing is commerce, the EPA has created a four-year roadmap in how to regulate these PFAS contamination challenges in drinking water by establishing milestones in the rulemaking, life cycle of research, restrict, and remediate.

One important function of the implementation of the 2021 UCMR 5 is it will help the EPA in identifying communities that have high risk exposure in drinking water. Most of these communities fall under the low-income threshold and under restraint of remediation resources. Knowing the PFAS exposure levels in water supplies, the EPA can identify places where congress can provide remediation funds to reduce these pollution threats.

An important roadmap position that directly affects public utilities is the EPA goal of establishing a National Drinking Water Regulation for PFOS and PFAS. A proposed regulation deadline is set for Fall 2022. It will be open to for public comment soon after and by March 2023, it is expected that the EPA will be issuing a final regulation.

The roadmap demonstrates other tools such as how to hold PFAS manufacturers accountable for negligent pollution activities, establish manufacturing control of expired PFAS compounds and other prevention steps to reduce PFAS contamination of air, soil, and water by the authority of SDWA. Approaching PFAS exposure from upstream to downstream, strategically aligns all levels of legislative federal, tribal, state, and local governments. The success of this program can only continue if congress continues providing funding opportunities.

For more inquiry, please visit web link: https://www.epa.gov/system/files/documents/2021-10/pfas-roadmap_final-508.pdf

Tech Transfer

Author: Karla Berroteran

On November 4, 2021, SEDA held a workshop titled - Operations and Maintenance of Degasifier and Scrubber Systems. The workshop was held at the City of Wellington Water Treatment Plant. The class had a total of 29 participants. Attached are some pictures.

The first half of the day was taught by Duggan Jacobs, where he provided an introduction to design considerations, and operations.

The second half was taught by Neil Gorman, where he covered chemical and biological odor control systems (scrubbers), maintenance, troubleshooting and cleaning.

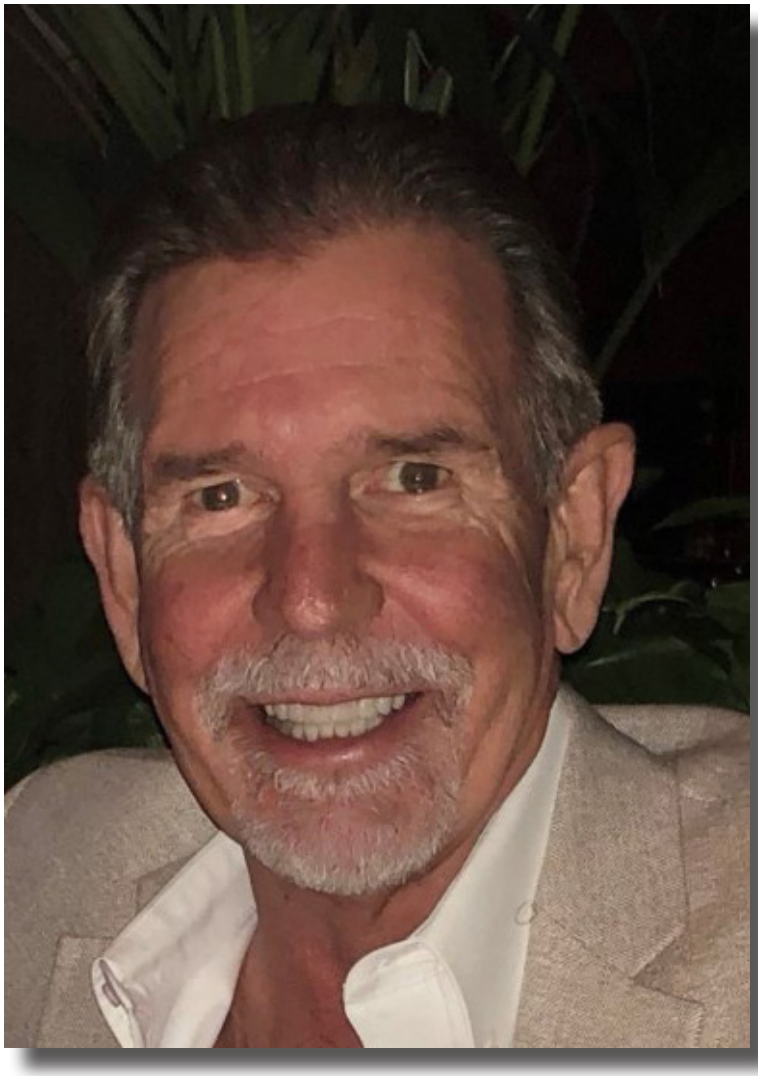
At the end of the class, the participants were taken to the onsite Degas scrubber system, were both instructors explained the process, the equipment, and answers questions.

At the end the workshop attendees were then taken on a tour of the City of Wellington Water Treatment Plant. The tour was given by Karla Berroteran (Wellington's Water Treatment Plant Superintendent).

Special thanks to the workshop sponsors:
TSC JACOBS
Hazen and Sawyer
ECS Municipal

In Memoriam: David Derr

David was a proud, native Texan, born and raised in Houston. He attended the University of Texas at Austin, earning his Bachelor of Business Administration in 1985--Hook 'Em, Horns! Following graduation, David returned to his beloved hometown of Houston, where he spent 37 years working alongside his brother, Mike, in the oil and gas industry as the Vice President for Afton Pumps, Inc.



David was well-respected by his peers, humbly accepting numerous awards in recognition of his hard work and professional knowledge. He was a founding Board Member of the South Central Membrane Association (SCMA), eventually serving as President. David received their Distinguished Service Award and accepted the Presidential Award on behalf of Afton Pumps, Inc., in 2013. David also was an active member of the American Membrane Technology Association (AMTA), where he served as a Board Member as well as 2nd Vice President. The AMTA honored David with the Recognition & Services Award and the Presidential Award. He was a member of the Southeast Desalting Association (SEDA), a national affiliate of AMTA. David was a longtime member of the University of Texas Longhorn Foundation and a member at St. Stephen's United Methodist Church, where he served as an usher.

No other title or accomplishment compared to that of being a "girl dad" to his beautiful daughters, Lindsey Rochele Derr and Leah Lynn (Derr) Markle. David considered it a privilege to be their father. In 2020, he became a grandfather to Adalynn Rose Markle and was lovingly referred to as Granddaddy. When not working, David enjoyed spending time outdoors, whether it was hunting, fishing, or going to Austin to watch Longhorn football games. David enjoyed traveling and spending time with his family. He especially loved just hanging out at home by the pool with Mary and their dogs.

Welcome to Our New Members

CLAY HAUSER
DARE COUNTY WATER DEPARTMENT

JOSEPH COSTINE
CITY OF LAKELAND

STEVE HILLBERG
CITY OF FORT LAUDERDALE

Save the Date

2022 SEDA Spring Symposium
Hutchinson Island Marriott, Stuart Florida
June 5th – 8th, 2022

SEDA QUIZ

By: Fred Greiner, City of Palm Coast Utility Chief Operator

1. What type of membrane cleaning chemicals have multiple ionic bonds and act like electrically charged claws pulling positively charged ions away?
   A. Sodium Hydroxide
   B. Sulfuric acid
   C. Detergents
   D. Chelating agents
2. Name 2 common types of chelating agents used in cleaning membranes?
   A. EDTA and citric acid
   B. Citric and Sulfuric acid
   C. EDTA and detergents
   D. Carbon dioxide and caustic
3. Chelating agents are primarily used at what pH levels to ensure their negative sites remain ionized?
   A. 3.0 pH
   B. Can vary between neutral to high pH levels
   C. Can vary between neutral to low pH levels
   D. Below 3.0 pH
4. What type of membrane cleaning chemicals are hydrophilic and act as a go between to allow water molecules to dissolve organics that typically would not interact with them?
   A. Detergents
   B. Caustic
   C. Lye
   D. Chelating agents
5. Why should H2SO4 be avoided during the membrane cleaning process?
   A. Dangerous high fuming properties
   B. Any H2SO4 left in the water will damage the membrane
   C. Will increase the sulfate concentration causing insoluble deposits
   D. All the above
6. Metallic corrosion is always the result of:
   A. Biological reaction
   B. Biochemical reaction
   C. Electrochemical reaction
   D. Cathodic reaction
7. Which type of solution has more (OH-) than (H2) ions?
   A. Acidic
   B. Anionic
   C. Cationic
   D. Base
8. Using the "general rule" for calculating osmotic pressure how much osmotic pressure is expected with a TDS of 4300mg/l?
   A. 51.6psi
   B. 34.1 psi
   C. 12.3 psi
   D. 4300 psi
9. Which of the answers below is not considered a part of the construction of a membrane?
   A. Membrane
   B. Product water carrier
   C. Feed spacer
   D. Permeate seal
10. Which of these is a primary cause of cracking an element
    A. High differential pressure
    B. Low permeate flux
    C. Reversed brine seal
    D. An SDI of 5.00
11. If the hydrogen concentration of a solution is .000000001 mol/liter. What is the pH of that solution?
    A. 1 pH
    B. 6 pH
    C. 9 pH
    D. 12 pH
12. Which of these are not a component of alkalinity?
    A. OH-
    B. HCO3-
    C. CO3-2
    D. CaCO3
13. Where would you expect colloidal particles to plug in an RO system?
    A. Colloidal particles pass through the process
    B. First elements of the of the Nano-filtration process
    C. Rear elements of the nanofiltration process
    D. None of the above
14. What does HCO3- convert to when the pH is lowered?
    A. OH-
    B. CO3
    C. O3
    D. CO2
15. When calibrating a pH probe which buffer should used first in the calibration process?
    A. 7.0
    B. 4.0
    C. 10.0
    D. 12

Answers can be found on the SEDA website at
http://www.southeastdesalting.com/members-only/quiz/

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Dedicated to the improvement of water supplies through desalination and other water sciences.

Inside Recovery Zone