



Lab technician Daren Putman tests water in the lab at Zone 7 Water Agency's Mocho Ground Water Demineralization Plant.

WORTH THEIR SALT

STORY: **TRUDE WITHAM**
PHOTOGRAPHY: **LEZLIE STERLING**

Extensive training on new technology spelled success for operators at a groundwater demineralization plant, while they faced challenges at three surface water plants

A 6.1 mgd water treatment plant in Northern California that uses reverse osmosis (RO) to soften groundwater has solved water-quality issues and made possible the future use of recycled water for irrigation.

It all started when salts were accumulating in the Liver-

more-Amador Valley's main groundwater basin in California. Zone 7 Water Agency partnered with Carollo Engineers to design and build the Mocho Groundwater Demineralization Plant, which went online in August 2009. Located in Pleasanton, Calif., the plant provides water to 200,000 residents.



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TOM SEACORD

The technology created challenges for the agency's 19 operators, who had no experience with RO or the associated SCADA system. Extensive training by Carollo and the vendors brought the operators up to speed. The RO plant requires minimal attention from those who operate it and the agency's three surface water plants.

In 2012, the demineralization plant received the Membrane Plant of the Year award from the Southwest Membrane Operator Association (SWMOA), based on exemplary safety records, clean premises, minimal permit violations and public education for plants having at least 1.0 mgd of membrane-based treatment.

The RO plant has proved easy to operate, freeing operators to deal with the widely variable source water at the surface water plants.

Salt management

Zone 7 manages water quality for the Alameda Creek Watershed above Niles in Northern California and has primary responsibility for managing the Livermore-Amador Valley surface and groundwater resources. Historically, it has managed the main groundwater basin by maximizing surface water deliveries, recharging the basin with low-total-dissolved-solids surface water, restricting groundwater pumping, and restricting wastewater disposal in the watershed.

The agency hired Carollo Engineers in 2000 to decide how best to manage the salt accumulation in the aquifer. Tom Seacord, Carollo asso-

ciate vice president, was project manager. “We looked at where the demineralization plant should be located, how the finished water was going to tie into the distribution system, and how to get rid of the brine, which is the waste stream that is produced,” he says.

Besides the treatment plant, Carollo designed a 28-inch high-density polyethylene pipeline that conveys water from four wells to the Mocho plant. “We looked at the chemistry of the groundwater when designing the RO system,” says Seacord. “The amount of brine produced can change based on the concentrations of salts in the groundwater.”

The plant removes minerals from up to 7.7 mgd of the groundwater pumped from Zone 7 wells in northern Pleasanton. That translates into 4,000 tons of salts removed annually. The plant operates at 80 percent efficiency, turning 6.1 mgd into softened permeate. This water is blended with other groundwater and surface-water supplies before delivery to retailers in Pleasanton and the Dublin San Ramon Services District (DSRSD). The remaining 1.6 mgd of brine is pumped to San Francisco Bay via the Livermore-Amador Valley Water Management Agency (LAVWMA) export system.

Demineralization plant

Nineteen operators support the Mocho groundwater plant and the agency's three surface water plants. Although all are involved with remote operation of the Mocho plant, three operators are assigned hands-on



FEATHER IN THE CAP

When the Zone 7 Water Agency's Mocho Groundwater Demineralization Plant won the 2012 Membrane Plant of the Year award from the Southwest Membrane Operator Association, the operators were thrilled. "It was a feather in our cap," says Rich Gould, water facility supervisor. "We put a lot of work into that plant."

An affiliate of the American Membrane Technology Association (AMTA), SWMOA is dedicated to improving the quality of water supplies through desalting, reuse and other technologies.

Says Tom Seacord, associate vice president at Carollo Engineers, who managed the Mocho plant design, "The operators do a really good job of monitoring the plant and tracking its performance. Operators are the ones giving out this award, and it is a real honor when plants receive recognition from their peers."

The Mocho plant conducts many tours, including one for the AWWA 2012 Spring Conference in Santa Clara, Calif. "Tour groups are generally 10 to 40 people, and we can adjust the tour content based on attendees' technical level," says Gould.

Zone 7 publicized the Mocho plant's award in its newsletter and online publication. "I feel that the operators deserved this award," says Gould. "They are energetic, enthusiastic and true professionals. They're always there when you need them. Plus, they really embraced the reverse osmosis technology."

duties: water plant operators Caroline Abram (T3 water operations license, seven years with the agency), Jeff Madden (T4 license, six years) and John Brixie (T3 license, one year). All operators report to Rich Gould, water facility supervisor, who has been with the agency for 32 years and holds a T5 water operator license.

From left, plant operator 3 John Brixie, plant operator 3 Caroline Abram, and plant manager Rich Gould, shown with the facility's reverse osmosis system (Layne Christensen).

Zone 7 Water Agency, Mocho Groundwater Demineralization Plant, Pleasanton, Calif.

FOUNDED: | August 2009

POPULATION SERVED: | 200,000

SOURCE WATER: | Livermore Amador Valley Main (Groundwater) Basin

TREATMENT PROCESS: | Reverse osmosis

KEY CHALLENGE: | Increase RO recovery to 85 percent

ANNUAL BUDGET: | \$1.5 million

WEBSITE: | www.zone7water.com



Operators flush the wells before directing water to the plant to remove sand. After cartridge filter pretreatment (Parker Hannifin), operators add a scale inhibitor for a higher RO recovery rate. The water is then sent to the RO system (Layne Christensen), which contains 1,092 membrane elements (Hydranautics). The RO permeate is sent to the degasifier (DeLoach Industries) to remove carbon dioxide. Caustic soda is added for pH adjustment, and chloramine for disinfectant residual.

The SCADA system (system integrator Wunderlich-Malec) uses Wonderware (Invensys) software and enables the plant to be permitted as an unstaffed facility. "Unlike the membranes at our ultrafiltration plant, the RO membranes don't require backwashing," says Gould. "We chemically clean the membranes once a year."

Lowering salt levels

The operators check the RO permeate conductivity from each vessel to make sure there are no issues with the membranes, such as unseated cartridge O-rings from system starts and stops. Once a week, an operator spends a few hours taking conductivity readings from each of the 156 pressure vessels.

If the permeate conductivity from one of the vessels is unusually high, operators insert a graduated tube into the problem vessel and then gradually retract the tube to sample the permeate water conductivity and determine which O-ring is unseated.

The demineralization plant is operating as designed. Incoming groundwater hardness (as CaCO_3) averages 474 mg/L and the TDS averages 692 mg/L. By contrast, finished water averages are 204 mg/L hardness and 311 mg/L TDS. The plant reduces the salt concentration in the drinking water, resulting in less salt at the wastewater plant.

Plant operator 3 Caroline Abram runs a turbidimeter verification (controller from Hach).



“Our SCADA system allows us to operate the plant remotely from our surface water facilities. It’s such a reliable plant, and we have redundancy on the equipment.”

RICH GOULD

“Customers don’t need their water softeners anymore, so the brine resulting from water softener operation is no longer a contributing factor to wastewater salt concentrations,” says Gould. “Because the groundwater has less salt in it, after treatment it may be recycled for irrigation.”

Operator contributions

Operators contributed ideas during plant design. For example, Carollo held workshops to discuss the proposed chemical feed system so that operators could explain their preferences. Maintenance and safety employees also gave their input.

“They knew what types of chemical pumps they liked or didn’t like and they had preferences on which pump manufacturers to use in order to maintain consistency for their training programs and spare parts inventories,” says Seacord. “They were a great client — very helpful and engaged with the design process.”

Although the operators were familiar with many aspects of the design, they were not familiar with RO technology. Forty hours of classroom and hands-on training over two months brought them up to speed. “There was a learning curve, and I conducted training on the technology,” says Seacord. “But the operators are smart people, and they get it. They have an ultrafiltration system at one of the surface water plants, and RO is easier to understand, since you don’t have to backwash.”

Equipment vendors conducted training on how and when to perform maintenance. Carollo conducted process operation, SCADA control and chemical safety training.

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DEDICATED TO DESALINATION

Tom Seacord, associate vice president with Carollo Engineers, won the American Membrane Technology Association (AMTA) 2012 Water Quality Person of the Year Award for his dedication to the water treatment industry. The award recognizes contributions to water supply improvement.

For 15 years, Seacord has worked exclusively on desalination projects, including the Mocho Groundwater Desalination Plant. A licensed professional engineer, he has worked on planning, pilot studies, and design and construction of desalination plants throughout the United States. He is on the board of the AMTA and the Northwest Membrane Operator Association and is also a member of AWWA, International Desalination Association, Southeast Desalting Association, and Southwest Membrane Operator Association.

"I have been serving on boards and committees for quite some time," says Seacord. "It's all volunteer, but it's a great way to give back to the industry. I enjoy the people and the work." Seacord was past chairman of the Affordable Desalination Collaboration, a non-profit group formed in 2005.

"The group recognized that the information on seawater desalination and the perception about the industry was outdated, so they built a seawater desalination demonstration plant using full-scale equipment and made their data on energy use and costs available to the public," says Seacord. The Northwest Membrane Operator Association conducts workshops where vendors give operators hands-on training with the equipment.

"Traditional operator training courses and exams don't cover membrane technology," says Seacord. "There's a real need for operator-focused training in this area. It's fun to get your hands on the equipment, and I'm excited to be involved in the start-up of this organization and working with this group of membrane plant operators."



Plant operator 3 John Brixie changes the cartridge filters (Parker Hannifin) on the reverse osmosis prefiltering system.



The SCADA system enables the plant to be permitted as an unstaffed facility (Invensys Wonderware software; system integrator Wunderlich-Malec).

Self-running plant

"Our SCADA system allows us to operate the plant remotely from our surface water facilities," says Gould. "It's such a reliable plant, and we have redundancy on the equipment. Every few weeks, we may have to make a correction at the site."

Operators spend two hours each day at the plant during the week, and

one hour a day on weekends. They run weekly tests in the plant's laboratory on raw and finished water. These tests include free and total chlorine residual, free ammonia residual, silt density index, turbidity, pH, conductivity, hardness and alkalinity.

The agency's central laboratory at the Del Valle Water Treatment Plant conducts monthly metals and minerals analyses and checks disinfection byproduct levels quarterly. They check organics levels twice a year and check the calcium carbonate precipitation potential, which tells them how much caustic to dose to the blended permeate.

The agency's maintenance department handles any preventive maintenance. "We have welders and instrument technicians who can maintain the equipment, and everything is done on a schedule," says Gould. "The plant really doesn't require much maintenance."

Surface water challenges

The agency's surface water plants — two conventional and one ultra-filtration — have a maximum daily output of 60 mgd. They are staffed around the clock by at least one operator per site. The operators welcome the variety of working at both the groundwater and surface water plants. While the groundwater plant largely operates itself, the surface water plants pose challenges that keep operators on their toes.

"The surface water plants can have sudden and dramatic raw water quality changes," says Gould. "These include changes in turbidity, diurnal changes in pH and temperature, and changes in dissolved organic carbon."

The alkalinity can range from 30 mg/L to 130 mg/L depending on source and time of year. Storm events may increase the raw water turbidity from 5 NTU to 50 NTU in less than two hours. Taste- and odor-causing algae are a challenge, and occasional blooms of filter-clogging algae also create problems.

Operators closely monitor incoming water quality and process parameters and make adjustments when needed. "Fortunately we have quite an arsenal of tools at our disposal, and a seasoned crew who can anticipate these kinds of changes," says Gould.

“As for the operations staff, thorough training is key. We were lucky because we already had operators on board who understood all the other technologies.”

RICH GOULD

The operators are highly experienced, and more than half have been with Zone 7 for longer than 10 years. Most have T4 water operator licenses or higher.

"We provide a lot of training and do what we can to see that the operators have enough contact hours for licensing," says Gould. "They take online courses in RO and other technologies and, if there is time, they attend AWWA webcasts and conferences."

There is an agency-wide safety program: "We have a stellar safety record," says Gould.

Future plans

The Mocho plant does not foresee any changes for at least 10 years. "We may need to replace the membrane elements, but none of the equipment," says Gould.

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The long-term plan is to increase the operating recovery to 85 percent to reduce the brine discharge, which keeps more water within the groundwater basin.

In the meantime, the goal is to continue to meet permit requirements and provide softened water to clients. Zone 7 will also strive to meet its salt removal target by exporting up to 4,000 tons of salt from the basin per year in the RO plant's brine stream.

Gould offers advice for plants considering RO technology for groundwater treatment: "Get top-of-the-line help. We had never done this type of thing before, and it was worth the money to pay an experienced consultant to do the work. As for the operations staff, thorough training is key. We were lucky because we already had operators on board who understood all the other technologies. If you're starting from scratch, look for people who are experienced." **wro**



The classes which I attended were full of valuable information . . . My only disappointment was that I couldn't attend every class . . ."
— Bill Himes, Himes Drilling Co.

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