PRODUCTS IN ACTION

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a Supplemental Source for Distribution

Membrane treatment plant ensures regulatory compliance and aesthetic acceptability with a challenging surface water source

ARTICLE SUMMARY

Challenge: The Yucaipa Valley Water District needed to draw water from a supplemental source to supply drinking water. This new water contained high levels of TOC.

Solution: The district decided to expand its water treatment facility to include the use of MF and NF to remove TOC precursors.

Conclusion: With minor modifications, the finished water quality from the MF/NF facility can be integrated successfully into the distribution system, with no significant consumer complaints.

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The Yucaipa Valley Water District is located about 70 miles east of downtown Los Angeles and serves drinking water to 60,000 customers in the greater Yucaipa area. The district relies on groundwater from the Yucaipa aquifer basin to serve its customers; however, because the basin currently is being overdrafted, a supplemental source was required.

To meet this need, the district developed plans for a new Yucaipa Valley Regional Water Filtration Facility to treat a new surface water supply that would provide an initial capacity of 12 million gal per day (mgd) and could be expanded to 36 mgd of high-quality drinking water to its customers.

State project water from the East Branch Extension of the California Aqueduct—which is fed from the Sacramento-San Joaquin Delta via the California Aqueduct, Lake Silverwood and the Crafton Hills Reservoir—was selected as the most reliable surface water from the source because of its good record of availability. The 95th percentile of source water turbidity is less than 10 NTU.

Total organic carbon (TOC) in the state project water ranges between 2 and 5 mg/L and contains elevated levels of humic constituents picked up in the delta. These humics are precursors to the formation of regulated disinfection byproducts (DBPs). A large fraction of the TOC precursors is not amenable to removal by coagulation optimized for turbidity removal.

TOC Removal & DBP Compliance

The most common strategy for DBP compliance systems using state project water with highly reactive TOC levels is to use chloramination as the residual in the distribution system. The district chose not to use chloramination because it would require construction of ammonia addition facilities at 40 well sites and require public notification for kidney dialysis patients.

Some plants attempt to remove TOC with high doses of ferric chloride; however, this has had limited success and increases operational costs for chemicals and sludge disposal. The selected strategy for the facility is to use nanofiltration (NF) to treat up to 75% of the microfiltration (MF) filtrate to remove TOC precursors. The economics of using NF are enhanced because the NF reject water is combined with treated MF backwash water and sent to the district's nonpotable water system, where it is used for irrigation.

The new facility was constructed on a 32-acre sloping site. The membrane building location takes advantage of the natural grade of the site to avoid pumping into the MF membranes, allowing for gravity flow that saves around 800,000 kWh of electricity per year. The water filtration facility consists of the following process components:

- Influent flow control, equalization basin and pipeline;
- A two-stage membrane filtration system that includes a prepurchased Pall MF membrane system, followed by an NF membrane system that treats up to 75% of the treated water to provide TOC removal as required to achieve DBP objectives in the distribution system;
- A 42,500-sq-ft operations building that houses the MF and NF membrane systems, control room, employee facilities, conference room, basement and other functional spaces;
- Chemical systems, including sodium hypochlorite, caustic, ferric chloride, polymer, polyphosphates and membrane-cleaning chemical storage and feed pumps;
- A 6-mgd prestressed concrete finished water storage reservoir; and
- A dissolved air flotation system and residuals-handling system to handle backwash waste streams from the MF membranes.

For the initial phase, space was provided for equipment such as additional MF and NF membrane skids and residuals-handling units that would easily allow for an increase to a production capacity of 18 mgd. Yard piping was sized to allow for an ultimate capacity of 36 mgd. The building is designed to allow for the NF system to be relocated to a new building, and the MF system can be expanded to 36 mgd in the operations building.

Aesthetic Acceptability

Treated surface water from the facility is introduced directly into the distribution system, replacing water previously provided by groundwater sources. With a new water source, there's always a concern that a change in distributed water quality may have unexpected consequences relative to corrosion—or release of corrosion products—from the surfaces of the existing distribution system mains or household plumbing. The chemical process by which existing corrosion scales (metal oxides) come to a new thermodynamic equilibrium with a changing water quality is called re-equilibration.

Prior to introducing treated water into the distribution system, an evaluation was performed and the following findings and measures were made:

- The finished water quality from the proposed MF/NF treatment facility is, with only minor modification, acceptable for direct introduction to the existing distribution system. Blending of the new treated surface water with existing groundwater sources is not necessary.
- Existing corrosion scales within the Yucaipa system are relatively minimal and do not represent a large reservoir of iron oxide solids that would contribute to aesthetic problems if corrosion scales were destabilized.
- Differences in finished water chemistry between the historical groundwater overall mineral content are relatively minor in terms of those constituents that control the corrosion processes or contribute to the formation of corrosion scales.
- Lead and Copper Rule compliance can be maintained while introducing the treated surface water.

Relatively modest corrosion control measures have been implemented for the finished surface water. The most important of these was establishing an introductory pH target of 8.3 and an interim polyphosphate addition program during the first few months of new source integration. The program was successful in integrating the new water source with no significant consumer complaints. WWD

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