Industrial WaterWorld

CASE STUDY

Western Refinery Upgrades Its Boiler Feed Water

By Andrew R. Delgado and Gary Davis

Amid the scenic beauty of the Southwest just north of Carlsbad Caverns National Monument along the Pecos River lies the Artesia, N.M., petroleum refinery of the Navajo Refining Company, L.P., a subsidiary of Holly Corp.

Dallas-based Holly refines crude oil to produce gasoline, diesel and jet fuel, which it sells in the Southwest, northern Mexico and Montana. It also runs refineries in Utah and Montana, but the Artesia operation has over twice the capacity of those combined. Holly also operates a product distribution system that includes 2,000 miles of pipeline. Customers include refiners, wholesalers, marketers and other retailers, as well as the U.S. military.

USFilter provided three softeners rated for 300 gpm each for polishing the effluent from the RO system.

As part of the refinery's boiler feed water system, USFilter provided four multi-media filters to remove suspended solids from groundwater treated at the refinery. Each filter is 84" diameter x 60" side shell, designed for 300 gpm.

The Artesia facility, located on a 400-acre site in the petroleum-rich Permian Basin, recently completed an $85 million expansion and upgrade that expanded its processing capability from 60,000 barrels a day to 75,000 barrels a day. In addition, it upgraded the water treatment equipment to improve the quality of boiler feed water as well as wastewater from the facility.

The refining company has supplemented its existing RO system with multi-media filters and packed bed softeners to produce high-quality effluent. This water generates high-pressure steam for the whole refinery as well as the refinery's new gas/oil hydrotreater. Navajo also recently replaced two in-ground API separators with two aboveground, steel tank API separators, with granular activated carbon (GAC) adsorber systems for off-gas treatment.

An added benefit is that the wastewater treatment systems will help Navajo Refining meet two U.S. Environmental Protection Agency regulations under the Clean Air Act: low-sulfur (clean fuels) emissions standards and New Source Performance Standards (NSPS) - Subpart QQQ for wastewater treatment for petroleum refineries.

Clean Fuels Compliance

Installing the gas/oil hydrotreater is part of the strategy for Navajo's Artesia facility to comply with EPA low-sulfur emissions standards.

Steam used in the hydrotreater is produced by high-quality effluent treated by multi-media filters, an upgraded RO system and packed bed softeners from USFilter Corp., a Siemens company. Navajo upgraded the water treatment system after determining the existing RO system's capacity was inadequate to meet the new water quality and capacity requirements for steam generation.

With the newly online multi-media filters, the refinery's capacity is now 900 gpm. The filters provide better pretreatment to the refinery's RO units, tripling or quadrupling the RO pre-filters' life and eliminating their costly, daily replacement. Better pretreatment also allows the RO units to operate more efficiently and meet higher flow requirements. Moreover, replacing membranes on the RO units with a higher surface-area membrane increased the capacity without adding any additional equipment.

Reject water from the RO system, collected in a new storage tank, is used as backwash water for the multi-media filters. This helps the refinery conserve water and minimize wastewater handling.

And to meet the new boiler's hardness specifications, USFilter added packed bed softeners behind the RO system, reducing influent with 640 ppm $CaCO_3$ to less than 0.5 ppm. The filters came online in summer 2003.

Cleaner Water and Air

Since the early 1990s, the EPA also has required petroleum refineries that collect and treat oil to cover a portion of their wastewater treatment processes. The agency amended the list a few years later, adding VOC emission treatment.

To fulfill commitments made pursuant to a federal consent decree to voluntarily accept the standard applicable to new petroleum refineries (i.e., NSPS Subpart QQQ), Navajo replaced its two in-ground API separators with two aboveground, steel tank API separators from USFilter Envirex Products also in 2003. Previously, Navajo's old API separators were not covered because they pre-dated NSPS Subpart QQQ and care was taken not to trigger QQQ through

subsequent projects.

Covering the existing separators (in-ground concrete tanks) would have been difficult and expensive. This, in addition to concerns of potentially leaking in-ground concrete tanks, factored into Navajo's decision to install new above-ground API separators. The new larger capacity API separators also allowed Navajo to remove from service another uncovered separator upstream of the wastewater treatment facilities. This provided further emissions reduction and operational benefits.

The new explosion-proof units provide positive leak detection and vapor containment, more effective sludge and oil removal and easy routine maintenance, with each separator effectively processing a maximum hydraulic flow rate of 600 gpm.

Also, GAC systems from USFilter Westates Carbon were installed to adsorb VOCs in the off-gas vented from the covered units.

The two API separators were provided as part of a process expansion. The first step in the refinery's wastewater treatment system, the separators are designed to remove gross quantities of oil and suspended solids prior to other treatment. Each was designed to treat a maximum of 600 gpm.

The two API separators, each 66'L x 8'W x 12'H, were shop – fabricated and finish – painted to facilitate installation and assembly at the jobsite. Airtight and corrosion – resistant fiberglass covers were included for VOC containment, as was an activated carbon system to treat VOC emissions from the separators.

Being a Good Neighbor

Navajo Refining is building on past efforts by continuing to become more environmentally friendly and more resource efficient.

In addition to the environmental benefits derived from the installation of the new above-ground API separators, the expansion portion of the clean fuels project is helping meet the energy needs of Navajo's Southwest markets, improving air quality locally at the Artesia facility, and more broadly reducing vehicle tailpipe emissions within the communities served. Furthermore, the expansion has been accomplished while minimizing the use of fresh water so precious in Navajo's arid surroundings.

Conclusion

USFilter worked with the Houston office of engineering consultants CH2M Hill to come up with the options for the final plan that was implemented to meet the decree's requirements.

"CH2M Hill presented a number of options that would allow us to upgrade to NSPS Subpart QQQ standards in a reasonable amount of time and at an affordable cost," says Navajo Refining's Don Whaley, environmental manager at the Artesia refinery.

"Of the options given, USFilter's RO system configuration integrated a lot of the existing equipment. This not only produced the desired results but also minimized capital investment," added Navajo's Technical Services Manager Scott Beardemphl. **IWW**

About the Authors: Andrew R. Delgado is a sales engineer with USFilter's industrial sales and marketing group. Based in San Jose, Calif., he joined USFilter in 1993. With 12 years of industry experience, he also has held applications engineering and engineering management positions in USFilter's Industrial Wastewater Systems and Process Water Systems divisions. Delgado has a bachelor's degree in chemical engineering from the University of California in San Diego. Gary Davis is mechanical engineer and project manager for Navajo Refining's Artesia refinery. He has worked at Navajo for three years. Davis graduated with honors with a bachelor's degree in mechanical engineering from New Mexico State University in Las Cruces, N.M.