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NOVEMBER 2004

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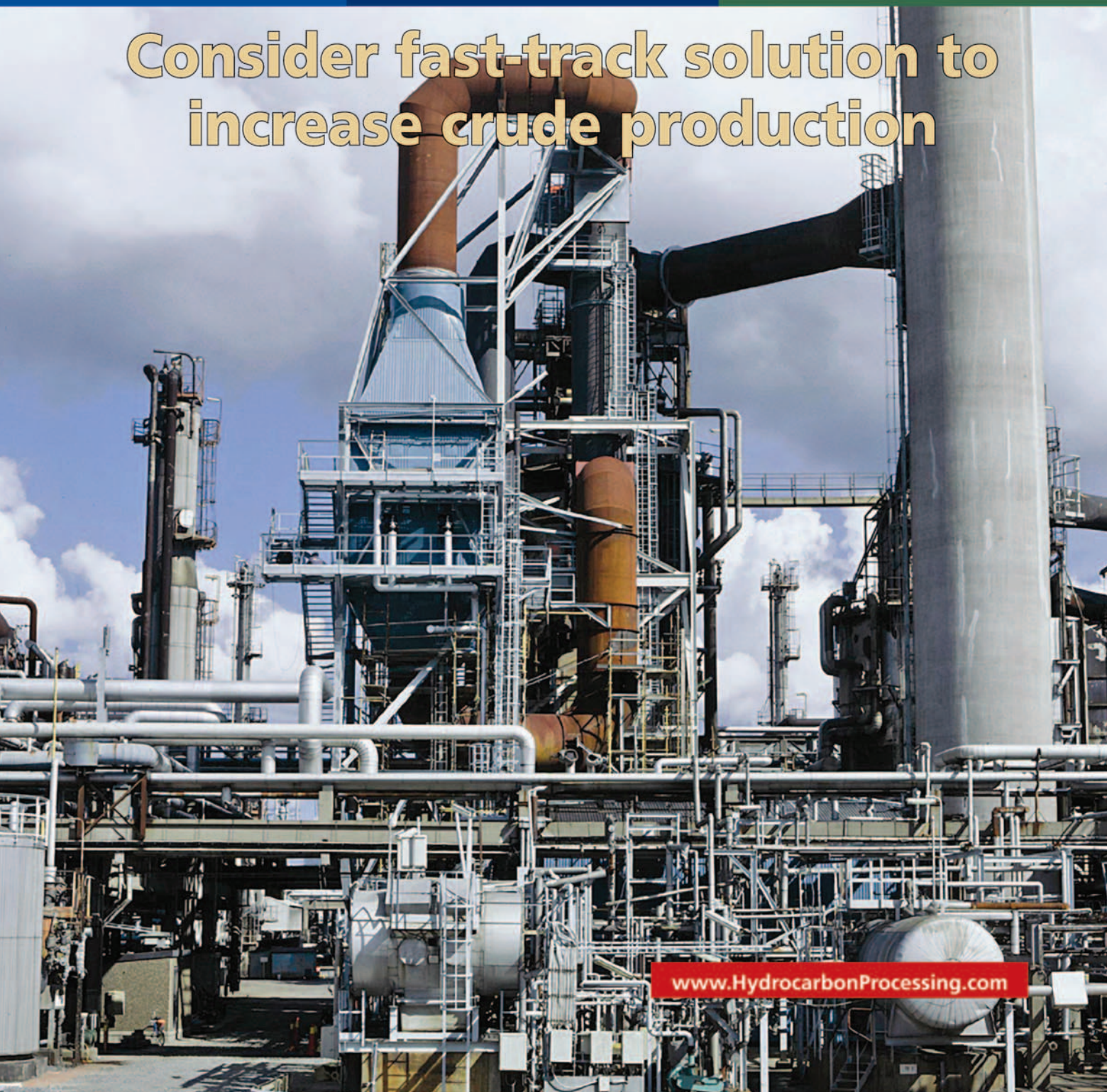

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HYDROCARBON PROCESSING®
November 2004 issue, pgs 43-45
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SPECIALREPORT

PLANT SAFETY AND ENVIRONMENT

Consider fast-track solution to increase crude production

This Gulf-Coast refinery used an innovative approach to debottleneck wastewater treatment to raise site processing capability

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Calcasieu Refining, located on the Gulf Coast at Lake Charles, Louisiana, was challenged to expand processing production and comply with tighter environmental regulations. A wildlife estuary is located one mile away from this refinery's fenceline. The existing wastewater treatment plant (WWTP) was 22 years old and severely space-limited. Using the advice and services of $1.2 billion water and wastewater treatment service provider, this refiner applied a multiphase approach to cost-effectively modernize the WWTP and increase water-treatment capacity (Fig. 1).

FIG. 1 Advanced biological treatment systems can offer tremendous process flexibility.

Background. Calcasieu Refining is working hard to meet the challenges of growth and expansion for the Lake Charles refinery, which is located in the heart of the Gulf Coast refining and petrochemical area. In the past two years, the refinery increased its production capacity from 22,000 to 31,000 bbl/d.

As part of a multi-phase plant expansion, the refinery assessed whether its 22-year-old, 46-gpm WWTP would be able to operate effectively with the planned production capacity expansion. Before the upgrade, it was apparent that the existing system was under capacity.

Increasing wastewater treatment on a fast track. To increase its crude output to 31,000 bbl/d, the refinery needed to raise WWTP's capacity to 124 gpm—in less than a year. Jody Verret, operations superintendent at Calcasieu Refining's Lake Charles refinery, credits the refinery's selection of a single-source wastewater treatment provider as being key to the plant's successful fast-track expansion. Working with the refinery and local consultant, the water and wastewater treatment service provider designed and began delivery of the new wastewater treatment system to the refinery in only five months.

Plant modifications were made during the plant expansion and included:

- Replacing the existing oil/water separation system
- Retrofitting the existing biological treatment aeration system
- Installing a new biological clarification system.

These upgrades and additions allowed the Lake Charles refinery to treat higher wastewater flow during ongoing process expansions and maintain the existing net load discharge levels.

Upgrades for the WWTP were completed in approximately eight months—four months earlier than what a project of this size would normally demand. Carefully coordinating the entire design process for the system enabled the water and wastewater treatment service provider to release equipment for fabrication on an accelerated schedule and to therefore meet a very aggressive construction timeframe. Calcasieu's new treatment system came online in fall 2002.

"We had numerous construction projects going on simultaneously at the site," recalls Jody Verret. "To make sure everything flowed seamlessly, we wanted to work with a water and wastewater treatment service provider that had significant experience in the petroleum industry. We wanted a single-source provider to supply all the major equipment, coordinate the entire system design process and offer a complete mechanical and process guarantee," he continues.

Reusing what was already there. The Lake Charles refinery is located on a 33-ac. peninsula off the Calcasieu Ship Channel. While Calcasieu Refining wanted to increase its WWTP capacity, it could not further expand the system's footprint.

An alternative solution proved both space- and budget-conscious. It would reuse some existing treatment equipment and systems (aeration tankage) and supplement the old with new equipment and systems when necessary (oil/water separators, aeration equipment and clarification). To ensure uninterrupted crude production, the water and wastewater treatment service provider

FIG. 2 Safety is always the most important consideration in oil/water separator designs.

FIG. 3 Carbon adsorber systems can be mobilized quickly for emergency response on as-needed basis.

identified other equipment and systems onsite to use as temporary treatment while modifications were made to the existing system. This strategy allowed the refinery's new and improved system to come online months earlier than expected, and saved the refinery significant capital for new equipment.

As part of its complete process design, the existing oil/water separation system was replaced with new API and dissolved air flotation (DAF) separators. The diffused air piping was retrofitted with a coarse-bubble diffuser system. A new suction clarifier also supplemented this system.

Equipment upgrades. The new API separator is the first treatment process in the WWTP. It processes raw wastewater from many sources including tank farm water draws, storm water and process unit wastewater. Compared to other available technologies, the API separator has been successfully used in petroleum refineries to continually remove gross quantities of suspended solids and oil from the wastewater prior to downstream treatment devices.

The new API separator is in an above-grade steel tank for visual leak detection, and has state-of-the-art, lightweight, non-metallic collector components, an oil roll skimmer for continuous removal of concentrated oil and leak-tight covers which contain VOC emissions. As a fire-prevention precaution, the API separator vapor space is also blanketed with nitrogen.

Fig. 3 is an activated carbon adsorption system for treating VOC offgases from the API separators. A water and wastewater treatment service provider provides the refinery with activated carbon replacement and reactivation services to ensure environmental compliance for wastewater treatment VOC emissions control.

The DAF separator processes effluent from the API separator and removes any remaining fine oil and suspended solids particles through subsequent chemical conditioning and flotation. This treatment step removes sufficient quantities of oil from the wastewater, eliminating any negative impact on downstream biological treatment.

The DAF process was selected because, compared to other available flotation methods, it consistently provides the highest levels of oil removal, even under upsets and widely varying influent conditions. This separator also generates extremely thick and concentrated sludge, which minimizes sludge disposal costs.

As with the API separator, the DAF separator is in an above-grade steel tank for visual leak detection, and has state-of-the-art, lightweight, non-metallic collector components. An air-tight cover for VOC control can be added, if required by future environmental regulations. Effluent from the DAF separator flows to an equalization tank for wastewater flow and strength equalization prior to biological treatment. A chemical conditioning system supplies polymer to the DAF feed, enhancing the flotation process and oil removal polishing.

Biological treatment. The biological treatment system is an activated sludge design that uses coarse-bubble aeration and secondary clarification. Construction costs for the biological treatment system were greatly reduced by reusing the tankage associated with an existing biological treatment plant. As the refinery expanded, this steel tank treatment plant became significantly undersized. After removing all the existing internal components from the plant, Calcasieu Refining inspected, repaired and repainted it for reuse as the new aeration tank.

"The unique alternative to purchasing an all-new aeration process significantly reduced capital costs as well as the area needed for the new system," recalls Calcasieu's Jody Verret.

The steel aeration tank was then retrofit with new coarse-bubble diffusers. A new steel tank clarifier that contains a patented suction mechanism was erected alongside the aeration tank. The coarse-bubble diffusers were selected due to the nonclog and corrosion-resistant stainless steel design, which is estimated to provide years of maintenance-free operation. The new suction clarifier can continuously vacuum sludge from the entire clarifier floor; therefore, it prevents fresh sludge from recirculating into the aeration basin (Fig. 4).

Since scraping is not used to remove sludge from the clarifier floor, the clarifier could be built with a flat floor, which significantly reduced construction costs. The advanced suction clarifier has been successfully applied in many other petroleum refineries and petrochemical plants around the world.

Value-added services. The water and wastewater treatment service provider also worked on the piping and electrical design. The design team provided process and instrumentation drawings,

FIG. 4 An advanced clarifiers are installed at dozens of petroleum facilities.

A Mainstay of Calcasieu Parish

Calcasieu Refining produces naphtha, kerosine, diesel, atmospheric residuals and Jet-A fuel at its Lake Charles, Louisiana, refinery. Other petroleum companies, the US government and consumers purchase these products.

This refinery is located less than one mile from the Intercoastal Waterway, with several residential homes and an estuary nearby. None pose a problem for the refinery, as Calcasieu Refining has a proactive program in place to ensure compliance with all environmental issues and regulations. Its proximity to the Calcasieu Ship Channel does not affect its emissions or discharges, which are within state and federal guidelines. Calcasieu Refining also has a proactive community relations program.

process flow diagrams, plot plans and equipment loads to a primary construction services consultant, who worked on the project's foundation.

"Our old system worked really well, but it just couldn't keep pace when we increased crude production," says Jody Verret. "We had a good experience working with the water and wastewater treatment service provider for the initial system; so, we decided to call on them again for this phase."

Under a separate agreement with Calcasieu Refining, the water and wastewater treatment service provider came onsite to inspect the mechanical operating condition of the entire WWTP. This service included inspecting all system components for proper adjustment and settings to ensure optimal treatment performance and guard against premature wear.

Water and wastewater service treatment personnel work closely with the refinery's operations and maintenance staff during the inspection, to familiarize onsite refinery staff with everyday issues that could impact the wastewater treatment system's performance. The water and wastewater treatment service provider and Calcasieu Refining are working on a proposal for conducting these services on a planned, annual basis to significantly reduce unexpected equipment failures and performance issues, as well as time and cost associated with unplanned maintenance activities.

Overview. Working with the single-source wastewater treatment consultants provided the refinery simplification for this project. The refinery needed to deal with one vendor that attended to the system design and supply and interacted with the other involved consultants, and had the necessary process expertise for every major treatment component in the total wastewater treatment system.

The water and wastewater treatment service provider saved Calcasieu Refining time, money and space by reusing some existing wastewater treatment equipment and tanks. Reuse of equipment not only reduced capital costs but also lowered operating costs by making the older system more efficient.

With its new and improved treatment system, the refinery is now able to treat almost three times more wastewater. Plant modifications will also ensure that Calcasieu remains in compliance with environmental regulations for wastewater. **HP**

Toni Bennett is technical and environmental superintendent at Calcasieu Refining's refinery in Lake Charles, Louisiana. Ms. Bennett joined Calcasieu Refining over five years ago, and has approximately 25 years of experience managing wastewater operations. She holds a BS degree in both environmental science and chemical engineering from McNeese State University in Lake Charles.

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