Orbital Welding Meets the Deadline

The $100 million Scottsdale, Ariz, Water Campus project represents a departure from traditional Western U.S. treatment methods. Unlike most plants, the water it treats is pumped into the ground to recharge an aquifer rather than used for irrigation. Switching from conventional stick welding to orbital welding was a key factor in meeting original project delivery deadlines after a 30 percent increase in scope for the largest ever U.S. facility for treatment of raw sewage to potable water.

While orbital welding is frequently used in the semiconductor and pharmaceutical industries, this represents one of the first times it was used in construction of a water treatment plant. The use of this automated method increased productivity from 3 to 4 welds per day to 13 to 16 on the 6″ to 8″ pipe used for air distribution to the microfiltration system.

"We not only met the deadline but produced quality welds that the owner was tickled pink with," said Tom Gusich, project manager for University Mechanical, Phoenix, Ariz., contractor for the piping systems.

Construction has been completed on the first stage of the largest U.S. facility for treatment of raw sewage to potable quality water: the $100 million Scottsdale Water Campus designed by Black & Veatch. In the summer, this plant will treat 12 million gallons per day of wastewater conventionally for golf course irrigation. In the winter, when irrigation requirements are lower, 10 million gallons per day of the water treated by the plant will receive advanced treatment, microfiltration and reverse osmosis to exceed potable standards. This purified water will be reinjected into local groundwater aquifers.

Process Flow

At the Scottsdale Water Campus, wastewater undergoes primary, secondary and tertiary treatments and advanced water treatments. The primary and secondary treatments are sedimentation basins that remove larger particles from the waste stream. The tertiary stage is a sand filter that removes finer particles. Chlorination also is performed at several stages of the treatment process. The final stage is reverse osmosis through a semipermeable membrane that raises the water to drinking

A portion of the water treated by this plant is used to recharge local groundwater aquifers. Without this recharging, the aquifers soon could run dry.

quality standards. A portion of the water then will be used to recharge the aquifer in the Carefree/Cave Creek Basin. Without this recharge, there were concerns that with the present rate of usage this aquifer could have run dry by the year 2007.

The piping contractor on the project was University Mechanical, a full service mechanical contractor that specializes in the installation of sophisticated process piping for the semiconductor, pharmaceutical, healthcare and water and wastewater treatment industries. High-purity piping is used in the facility for gases used in the laboratory and the air distribution system used in performing backwashing operations on the microfiltration system.

Laboratory Gas System

The laboratory gas distribution system involves a complicated network of piping that involves many twists and turns. Gusich recognized a high potential for leaks occurring in this system. The fact that most of the lines are concealed in ceilings would have made it very difficult to identify and repair leaks in the fittings. Gusich suggested that orbital welding be used to create a completely seamless system at only a slight increase in cost that would be offset by savings in rework and maintenance. He purchased a Model 9-750 orbital welding head from Arc Machines, Inc., Pacoima, Calif. and used it mostly in controlled offsite conditions. When the welding was completed, testing showed that there was not a single leak in the laboratory gas network.

The air distribution system represented one of the most challenging parts of the entire project. It consisted of 6″ to 8″ headers used to reverse the flow through the system in order to remove particles from the microfiltration filters. Using traditional stick welding methods, this would have been a very labor-intensive task and one that would have been challenging from a quality standpoint. While the company had a team of highly experienced welders, the tools used limited their productivity. As this phase of the project neared, Gusich realized that the scope increases would make it impossible to meet the project deadline using the methods that had originally been envisioned. He began investigating alternative technologies and methods in an effort to keep the project on track.

Increasing Productivity

"We have used orbital welding for a number of years on projects for semiconductor and pharmaceutical manufacturers in order to make identical high-quality welds in small bore piping such as that used in the lab gas system," Gusich said. "But we had never tried it on anything with this large a bore in the past."

The manufacturer of the orbital welding equipment assured Gusich that the weld heads could easily handle the project. A series of tests was performed to make sure. The company purchased the heads and machines and evaluated their performance on these welds.

"We discovered that each head and machine outperformed our best welders by a factor of three or four," Gusich said. "The tradespeople learned the new technology very quickly and did a great job."

Orbital Welding Basics

Orbital welding is a mechanized version of the gas tungsten arc welding (GTAW) process, also known as tungsten inert gas (TIG) welding. In manual GTAW, the welder moves the welding torch and controls the welding current. In orbital GTAW, the tungsten is installed in a weld head that clamps on to the tube or pipe. The tube remains in place while the weld head rotor revolves around the weld joint circumference to complete the weld. The welding is done in an inert atmosphere to protect the metal from oxidation as it is heated to melting temperature.

The welding power supply controls weld parameters such as welding current, primary and background amperes, travel speed, wire feed speed, weld bead overlap, delay of rotation at the start of the weld and current downslope at the end of the weld. The enclosed weld heads used for small diameter tubing welds provide a chamber filled with inert gas that encloses the entire joint during the weld. A timed prepurge and postpurge usually are used to time the flow of inert gas into the weld head before arc initiation and to continue the purge for a timed period after the arc has been extinguished. This allows the weld tool to cool sufficiently to prevent oxidation before the weld head is opened to remove the welded tube.

Welding Process Steps

Model 15 uses a track and Model 79 uses an adjustable type of clamp on the pipe during welding. The welder starts the operation by aligning the tungsten to the bevel in the joint, then adjusts the wire feed and centers the oscillation with the actual weld. Tabs on the welder hold the cable out of the way as the welding head wraps around the bore to complete the pass in about four minutes on a 7″-diameter pipe. The welder then removes the head.

The only cleanup that is required is brushing the weld to remove any excess discoloration. The orbital welding systems used in this project provide a heads-up display that allows the operator to view the welding operation along with a screen that shows welding current and other programmed functions.

"With the right team and the right technology, we were able to withstand a 30 percent increase in scope on the project while meeting our original timetable and budget," Gusich said. "In addition, we provided the owner of the project with a completely seamless system that had zero rejects. Orbital welding was so successful on this project that we plan to begin using this technology in water supply and wastewater treatment projects on a regular basis."

With the addition of new process and new chemical additives, the piping installation process in wastewater plants is continually getting more challenging. The use of orbital welding may provide productivity gains that combat those challenges.

For more information, contact Arc Machines, Inc., 10500 Orbital Way, Pacoima, CA 91331. Phone: 818-896-9556, Fax: 818-890-3724.

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