Oscillation Welding Protects Pipelines

BALL SCREW ASSEMBLIES KEY TO PATENT-PENDING PETROLEUM CORROSION TECHNOLOGY

Lindsey Snyder, Assistant Editor

(Photos courtesy Method Media).

The 21st century has presented a technological shift in oilfield drilling, as most easily accessible oil is tapped and well producers are forced to drill deeper in order to procure highly corrosive sour crude oil. Sour crude oil is a sulfurous mixture that corrodes the iron in the carbon steel pipe that extracts it. The petroleum industry has determined to develop drilling technology that can overcome these harsh, corrosive effects.

Robotic equipment manufacturer ARC Specialties, Inc., of Houston, has developed a cladding technology that controls this corrosion, so it can safely extract and process sour crude. This provides protection from pipeline failure and allows for more oil production in new deep water sour oil fields. The KLADARC TriPulse Hot Wire Gas Tungsten Arc Welding (GTWA) system leverages oscillation welding to deposit a metallurgical-lined, two-layer, corrosion-resistant alloy (CRA or Alloy 625) overlay on clad pipe up to 20 feet

The dual-torch oscillation simultaneously overlays two layers of corrosion-resistant alloy on a pipe's inner surface and provides a molten "puddle," with longer residence time to bond and eliminate common problems of overlay welding.

in length and inside diameters up to 30 inches. The CRA has a nominal thickness of 3.5 millimeters and 3.0 millimeters minimum thickness. The patent-pending technology reduces oxide inclusions and iron dilution in the cladding process, ultimately mitigating the corrosive effects of the sour crude.

An important feature of this five-axis cladding machine's advancement is its ability to oscillate the arc inside the pipe. The oscillation element in this process is driven by ball screws manufactured by Nook Industries' Precision Screw Group as part of its Power-Trac line of ball screw assemblies. The Nook ball screws feature a double bearing EZZE-MOUNT support and provide a durable and efficient means of converting rotary motion to linear motion on the dual-torch oscillation axis of the machine. "Oscillation of the boom is the largest load on the machine," says Dan Allford, president of ARC Specialties. "Accelerating, decelerating and reversing the mass of the arm loads the ball screw over a very small length. Any wear in the screw would result in inaccurate torch motion and weld defects."

The dual-torch oscillation ultimately overlays two layers of CRA onto the pipe's inner surface simultaneously and provides a molten "puddle" with longer residence time to bond and eliminate common problems of overlay welding, such as leaving holes that penetrate through the overlay layer and thereby expose the outer steel pipe to corrosive sour crude. "The puddle is the welding term for the molten portion of the weld. The weld metal, in this case nickel based alloy, solidifies just behind the torch," Allford says.

The oscillation process involves feeding CRA wire into a 20-foot-long torch that welds it circumferentially along the inner wall of the steel pipe. Nook's ball screws create this circumferential weld by wiggling the torch into the pipe back and forth at approximately one inch per second. This occurs while motorized pipe rollers steadily turn the pipe. The first 20 feet of pipe is coated, flipped 180 degrees, and then the torch is put back to coat the other half of the pipes' inside diameter.

Each oscillation places a heavy load on the ball screw with the 20-foot torch decelerated, stopped and reversed 120 times a minute, with loads running just under 1,000 pounds

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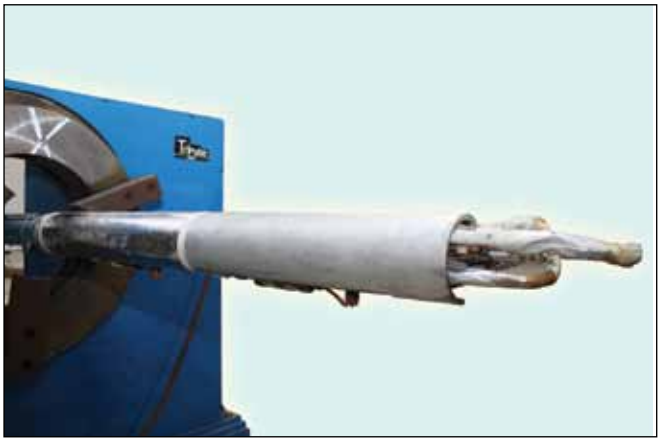
Arc welding with oscillation creates a pipe overlay of wider stringer beads.

during acceleration. The accelerate/decelerate rate is a harsh, rapid speed/load oscillation of 0.8 inches at around one hertz per second. The oscillation also moves the weld puddle side-by-side, which generates approximately two times the weld yield. Also, this single-pass circumferential weld ensures that the CRA overlay is seamless and also allows the pipe to undergo long-radius bending after the overlay process. "The oscillation process is a harsh application since it runs and repeats without stopping for hours at a time," Allford says. "Therefore, the reliability and performance of Nook's ball screws is vital and a key basis for our patent-pending process."

Nook customized the precision-rolled ball screws to meet ARC's unique application specifications. The ball screw assemblies from Nook come in a range of materials including alloy, stainless steel, titanium and other exotic metals. Nook uses a precision rolled manufacturing process instead of grinding its ball screws, which makes them more efficient and cost effective.

This collaboration between Nook and ARC has resulted in several completed pipelines reporting positive results, Allford says. The two manufacturers will likely continue to partner on future projects. "ARC and Nook have been working together for over eight years," Allford says. "We have over 200 machines operating with Nook ball screws around the world. So when we needed a ball screw for pipe cladding, Nook was a proven product for us."



The dual-torch oscillation process involves feeding corrosion-resistant alloy wire into a 20-foot long torch that welds it along the inner wall of the steel pipe.

The KLADARC machine employs technology that reduces oxide inclusions and iron dilution in the cladding process to mitigate the corrosive effects sour crude oil has on steel pipes.

Many forces contribute to the continued need for developing advanced technology to combat sour crude petroleum pipeline corrosion, including demand, environmental concerns, energy independence and aging infrastructure. Many of the sour crude oil reserves in the Gulf of Mexico reside at very deep subsea locations with volatile conditions such as high pressures, which increase the oil's corrosiveness. Advanced corrosion technology is crucial to oil production, and it provides safety and protection from environmental catastrophes that result from corroded pipelines.

"Oscillation welding really sets apart our clad quality from the traditional methods of cladding. It produces a long-life coating that prevents pipeline failure," Allford says. "KLADARC's cladding technology controls the hydrogen sulfide corrosion, and trust in Nook's product to coat the pipe is directly related to this crucial feature, which allows us to meet stringent quality assurance requirements for the petroleum industry."

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