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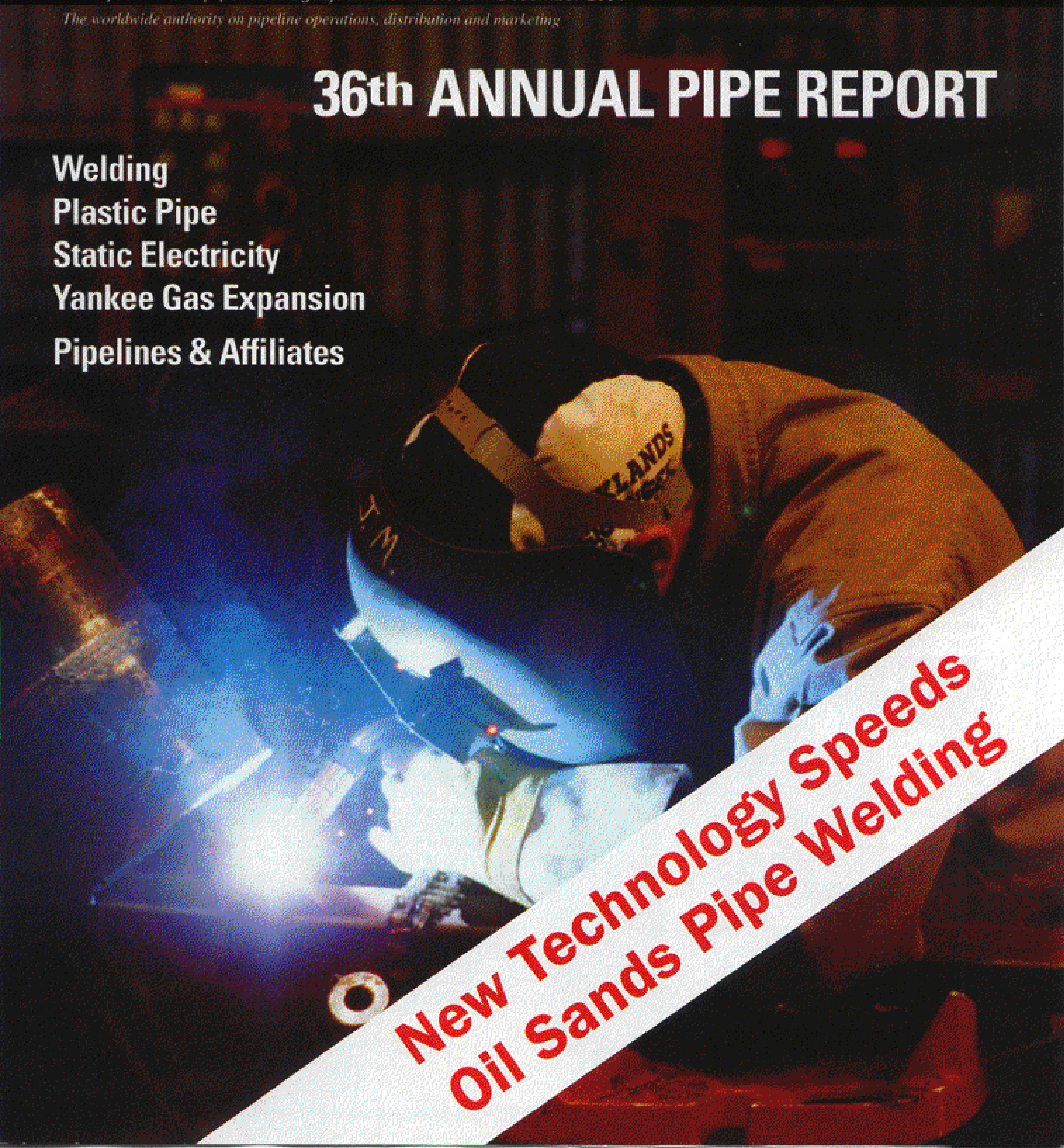

New Technology Speeds Oil Sands Pipe Welding

New Technology Speeds Oil Sands Pipe Welding

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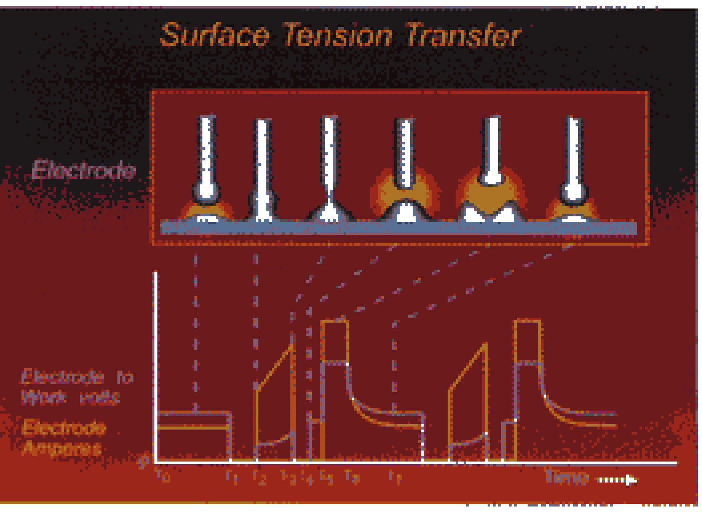
Open root welds on pipe used in the Alberta Oil Sands Projects are being made faster and with fewer defects than with traditional welding methods by using the Surface Tension Transfer (STT) process. For the World Class Millennium Project on the Suncor oil sands site in Fort McMurray, Alberta, the process is being used to weld root passes as well as complete welds in both carbon steel and stainless steel pipe, including pipe with up to 9% chrome. On many of these projects, the process is also being integrated into a new automatic orbital pipe welding system, AutoWeld, which provides even faster production.



The Millennium Project, created through the joint efforts of Millennium Construction Contractors (MCC) and Suncor Energy, Inc., is a part of the massive Alberta Oil Sands Projects. It has been estimated that the area holds about 300 billion barrels of bitumen that are recoverable with current technology. This is slightly larger than the proven 285 billion barrel reserves of Saudi Arabia. The Suncor operation is one of two fully integrated surface mining, extraction and upgrading operations in the Fort McMurray area that collectively produce over 300,000 barrels of synthetic crude oil daily.

Oil sands deposits consist of a black, tar-like mixture of sand, clay and bitumen, which occur at varying depths from the surface. After the oil sand is mined with surface mining techniques, it is processed in an extraction plant to separate the bitumen from the sand. The thick oil (bitumen) extracted from the oil sands is too heavy to transport by pipeline and also too heavy for most refiners to process. Bitumen is either mixed with a diluent to form a blend and shipped to refineries by pipeline, or it is "cracked" at a high temperature to upgrade it to a high quality, light sweet synthetic crude oil or other refinery feedstock.

Welding Plays A Major Role

Welding is a big part of the Project Millennium, with more than 400 welders at peak working on the project since its beginning in May 1999. Much of the welding to date has been performed on pipe located in the initial stages of the process, before refining takes place. Here, oil sands in the bitumen state (essentially an "oily dirt") are processed and cleaned. Hot water, steam and caustic soda are added to help separate the oil sand into bitumen, sand and clay. Although many different welding techniques have been used on various parts of the project, the STT process was used on root pass welds as well as for a large number of complete welds in both stainless steel and carbon steel pipe.

Frank Hopple, Manager of Welding & NDE Services for Bechtel International (which joined with Fluor Constructors-Canada to form MCC), worked with UA Local 488 union members to develop various procedures for welding pipe at the site using the STT process. Lincoln Blue Max 316 stainless wire (0.045-inch diameter) was the electrode used for all welds on stainless pipe.

Hopple said there are 30 STT machines currently at the site, with approximately 22 working at any given time. He explained, "In most applications, we use STT for the entire weld, not just the root. The open root is done vertically down, and the remainder is vertical up." Since this is not a pipeline project, Hopple noted that radiographic acceptance criteria are considerably more stringent than API 1104 requirements. He added that quality is more controllable, with an overall reject rate of only 1.9%, while the average in the area tends to run considerably higher. Hopple said the STT welding program has been successful and he expects to see it used in even more so in future projects.

Among the welds for which the STT process was used are the following:

Code ASME B31.3 normal service 10% RT & 10% UT.

Material: Carbon steel, mainly A106-B, standard wall, 3" through 66" diameters and a 516-70 rolled plate.

Welds: Overall approximately 1,800 butt welds.

Code ASME B31.1 800# steam, 100% RT 5% UT.

Material: SA106B.

Welds: 170 welds on 1-1⁄4" wall, 30" diameter & 190 welds on 36" standard wall.

Code ASME B31.3 100% RT 5% UT.

Material: A 312 304, 316, & 347, 3" through 24" diameter, wall thickness through 1.094".

Welds: 850 welds.

Code ASME B31.3 100% RT 5% UT.

Material: A335 P5, 3" through 24" diameter, wall thickness through 1.219".

Welds: 400 welds.

Hopple said it is easy to teach the welders the new process. Once Lincoln introduced Hopple to the system, officials from the company helped set up a school on site and trained Jim Murphy, who continues to maintain a training program for approximately 40 STT welders at the site.

New Process Combines Best of All Others

One of the most critical pipe welds, the root or stringer pass, is also considered one of the most difficult to make in terms of proper fusion and internal bead profile. Also, the speed at which this weld is made sets the overall rate at which a pipe line can be constructed.

In the past, open root pipe welding was done by one of these three methods, each of which has its advantages and disadvantages.

Shielded metal arc welding (SMAW), also known as "stick," in which equipment costs are low but required operator skill level is high. Frequent starts and stops are potential areas for weld defects.

Gas tungsten arc welding (GTAW), commonly referred to as "TIG," has the advantage of producing a weld with low hydrogen and therefore fewer defects. However, a higher level of operator skill is required. These welds are made in the vertical up position, where travel speed is slow, and heat input is high.

Gas metal arc welding (GMAW), also know as "MIG," is a much faster process than "TIG." The weld is made vertical down, a preferred position, but heat input is difficult to control, so fusion may not always be 100%.

The STT process overcomes the problems of other processes and also utilizes the advantages of each. This makes it possible to complete open root welds three or four times faster than GTAW, with low heat input and no lack of fusion. The STT process is a modified GMAW process that uses high frequency inverter technology with advanced waveform control to produce high quality welds while significantly reducing smoke and spatter. It eliminates the sensitivity to lack of fusion and excessive heat input but offers much improved operator appeal.

Unlike the standard GMAW process, STT technology has the ability to control weld puddle heat independent of wire feed speed. This allows the operator to adjust the heat input to achieve the desired root bead profile. The operator simply positions the arc on the forward portion—not the tip—of the weld puddle and follows the puddle around the pipe, if welding in the difficult 6G position. The independent control of heat input makes it possible to monitor puddle temperature, preventing a lack of fusion from low heat as well as the tendency of weld metal to shrink into the weld, known as "suck back," that is caused by excessive heat.

Welding with the STT process is easier than other processes, yet it produces consistent, X-ray quality welds. It is difficult to achieve the same degree of precision heat control with conventional "MIG" power sources. Because these machines control the average voltage instead of the current, the current changes to maintain average voltage, thereby changing the weld puddle temperature, which can cause lack of fusion or "suck back."

Higher Weld Quality With Less Spatter And Smoke

The STT process has gained acceptance in pipe welding due to the high quality root welds it produces. It is also a more productive process, since more of the electrode goes into the weld, rather than being dissipated as spatter on the pipe and surrounding fixtures. Reducing spatter minimizes final weld surface preparation and allows the operator more welding time before the gun nozzle must be cleaned of accumulated spatter. Further cost savings are realized because larger diameter wire can be used.

Operators find that, not only is the process easy to use, but the mechanical and metallurgical properties of the welds are excellent, including superior properties of the heat-affected zone. Also, open root welds are made without the use of ceramic or copper internal back up bars, so corrosion as a result of copper inclusions is eliminated.

The process is effective for welding stainless steel and related alloys, as well as mild and high-strength steels. On steel, it offers the ability to use 100% CO_2 shielding and produce a low hydrogen weld. On stainless and other alloys, various shielding gases may be used, including blends with argon and helium. Superior metallurgical properties can be achieved when welding duplex stainless steel, and the "critical pitting temperature" (CPT) is significantly better with STT than with GTAW.

Automating Pipe Welding

Even greater productivity gains can be achieved when the STT process is combined with other pieces of equipment to form the patented AutoWeld system. For major pipeline projects, which require many joints of uniform, high quality to meet code requirements, the system provides dramatic improvements over existing methods.

To increase productivity while maintaining exceptional weld quality, the weld is applied through a specially designed lightweight welding head and all welds are made from the outside of the pipe. The system is easy to operate and does not require extensive parameter development to make the process function.

A good pipe weld starts with proper preparation, and the AutoWeld system achieves a uniform open root gap around the pipe through the use of a specially designed internal spacer clamp. This clamp lines up and spaces pipe from 8 to 56 inches, with a variable open root spacing up to an eighth-inch (4 mm). Spacing between the pipes is set with three vernier dials, and no wedges are needed to space the root gap, where they could damage the machined pipe face.

Results from the field have been excellent. One contractor reports welding 1,400 joints of a 30-inch gas pipeline in API 5L X65 and X60 using the system with great success. Hopple, of Bechtel International, says, "STT was chosen because you can put in a heavy enough root pass so you don't have to put multiple passes ahead of the flux core machine. It gives you a good advantage." He explains. "You can put in one pass that is heavy enough and then get right on it with the AutoWeld and not have to worry about blowing through it."

Overall view shows the size of the Suncor Fort McMurray oil sands refinery, as well as the magnitude of pipe required for transport and processing operations.

Originally, the system was brought to the Suncor project to weld several hundred joints in 1-1/4-inch wall, 30-inch diameter SA106B carbon steel steam line. Other work evolved from there. "We put the root pass in with semi-automatic STT, then set up the AutoWeld. From the time it was set up, we would completely weld a 36-inch standard wall pipe in about 20 minutes," Hopple said.

In this application, due to the bends in the pipe, the internal line-up clamp required for AutoWeld STT could not be used. An external clamp was used, allowing semi-automatic STT. After the open root weld, the system was used to complete all welds required to fill and cap the joint. The system is capable of making all of the welds needed to complete a pipe joint, in addition to the root pass. However, many contractors use Innershield, a self-shielded electrode, with conventional equipment for pipe-welding applications and achieve welds with excellent mechanical and metallurgical properties. The self-shielding qualities make it possible to weld outdoors in the wind without tents or other auxiliary shielding. ***P&GJ***

This duplex stainless steel natural gas transport pipe line is in the Netherlands. The contractor, Hulsink de Roo, chose STT technology for the open root welds. In the summertime, natural gas is pumped underground for storage. In the winter, the gas is removed and supplied to the market.