Use of **TIP-TIG Technology** in Process Equipment Plants

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Fig.3

TIP-TIG welding is a new advanced innovation of the common GTAW Process. This process uses new, patent-pending technology (TiPTiG), that delivers the highest possible weld energy with the lowest possible weld heat, all while still being user-friendly.

What is TIP-TIG welding?

TiPTiG new welding with a hot wire process can be used in every industry. It is very simple to learn, use and simple to teach. This process is so unique that higher travel speed, lower heat input, reduced cycle time, and an overall better-quality welding advantage can easily be achieved.

The Process

The TIG weld receptivity for higher weld deposition rates is done by decreasing the speeds for the weld solidification process and increasing the fluid weld area. This allows for a 100%-400% increase in TIG wire feed rates, increasing the overall weld deposits. All these attributes like faster speeds and higher than normal weld energy, increase the resulting TIG weld quality and overall process productivity.

The process is also slag-free and uses the lowest possible heat input of any welding process, producing a Heat Affected Zone (HAZ), all of which help to reduce distortion and weld stress. It produces some of the highest quality products with the best metallurgical and mechanical properties on all alloys, but also increases production up to four times the normal speed. There is also no inter- pass cleaning, creating availability for an increased Arc on time and weld quality.

The TIP TIG process is available in manual and automated capability to attain weld and clad quality levels way beyond the conventional TIG – Hot – Cold Wire TIG – Pulsed MIG and the Flux-Cored process.

How it Works

A TIP TIG welding system uses a wire fed GTAW system just like a typical TIG system, but it's distinctive for the vibratory effect on wire at weld pool which is achieved by a linear forward and backward mechanical motion created by the customised wire feeder system. The forward and backward motion of the filler wire creates an oscillation that is then transferred to the weld, agitating the molten weld pool and ultimately disrupting the surface tension. In addition to this vibratory

Fig.1

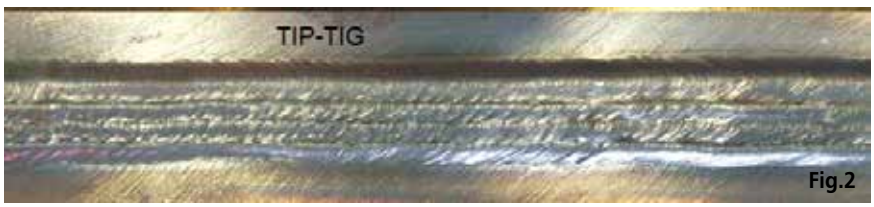

Fig.2

effect on the wire, a hotwire current (powered by a secondary power source) is also applied to the filler metal, prior to entering the weld puddle. The two pictures (fig. 1 & 2) describe the weld finish with Manual GTAW & Manual TIP-TIG process.

ChampTig 400P Power source from Ador Welding with the TipTig wire feeder.

Benefits of the TIG-TIP process

- Increased fluidity of the weld pool
- Greater tolerance to joint fit-up
- Significantly reduced joint sensitivity
- Greater ability to accept more wire into the weld pool, results in a higher deposition
- 4-6 times increased travel times
- Reduced cycle time and heat input
- Cleaner welds with agitated weld pool
- Reduced weld stress with the reduced heat input

Approved Alloys

TiPTiG welding can work on a wide range of alloys such as carbon steel, stainless steel, duplex and super duplex stainless steels, inconel, titanium, aluminium, copper, nickel, and many other critical materials like P-91, which are used in process plant production.

Heat Exchangers

Heat Exchangers are commonly constructed from low Carbon Steel, Copper, Copper-Nickel, Stainless Steel, Hastelloy, Inconel, or Titanium. There are certainly some unique applications and challenges associated with the welding of heat exchangers, such as the position and access for the popular circumferential welding of Tube to sheet welds or the half tube shell welding.


Fig.4

A trained TIP-TIG welder can typically weld a 50mm tube in 30 seconds… or less with the highest quality and lowest heat input. Our typical travel speed for fillet welds will be between 300 to 500 mm/min on most applications. Compared with 80 to 150 mm/ min with conventional GTAW.

TiPTiG manual system is a low cost semi-automatic solution to tackle any job by selecting a wide variety of torches for different applications, with modified 180 deg torch it allows a complete tube sheet welds without repositioning the wire or stopping, allowing for defect free welds.

The typical customers in the manufacturing and repair of various sized heat exchangers are in power plants, chemical plants, petrochemical plants, petroleum refineries, natural gas processing, and sewage treatment.

INCONEL CLADDING

Normally, when you manually clad the end of a pipe ID with Inconelusing Pulsed MIG as shown in the picture and result is often not so good. However when we use TIP-TIG, the results are visible as shown on the mentioned pictures.

In the pictureTIP-TIG cladded Job, TIP -TIG Inconel 800 pipe was welded with Inconel 82 wire on 10 inch pipe 3/4 Wall. The TIP TIG weld cycle time for the Inconel pipe was 40 – 50 minutes, whereas the customer used to take around 4 hrs with regular TIG. When your weld process can weld a complex incoloy*

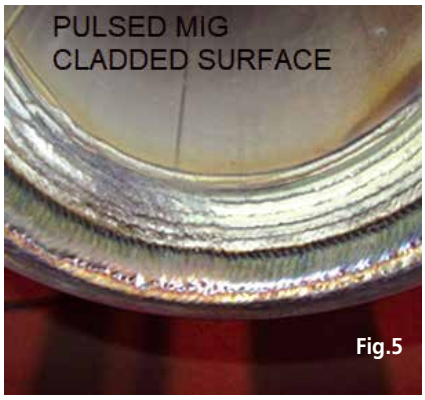

Fig.5

pipe and make the welds look simple, that's a process that should be given consideration. With TIP-TIG, no brushing, no grinding, no spatter, no weld rework, no feeding of wire, no foot control, less skills. Note weld smoke prep machining lubricants.

(*Incoloy refers to a range of superalloys produced by the Special Metals Corporation group of companies. They are mostly nickel-based, and designed for excellent corrosion resistance as well as strength at high temperatures; there are specific alloys for resistance to chemical attacks)

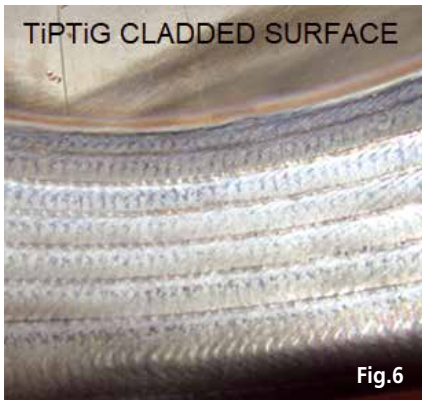

Fig.6

Duplex Steel Welding Applications

Application

The picture (fig.5) is of a very thin Gage Duplex Boiler. Traditional automated TIG process with cold wire may result in sluggish duplex welds.

The customer typically attained a maximum Hot Wire TIG weld travel speeds from 12 – 15 inch/min.

Then the customer switched over from Hot Wire TIG to the TIP-TIG process. The TIP TIG weld parameters and speeds were achieved using an 0.035 (1mm) 2205 Duplex wire, with TIP-TIG travel speed of 35 inch/min was achieved providing 200% increase in weld travel. The welds had a superior, less sluggish weld bead appearance and the parts had a dramatic reduction in weld distortion, (note the much smaller HAZ). Also the TIP-TIG process was much more stable and consistent.

TIP-TIG produces the cleanest welds from lowest possible oxidation. The welds will have the lowest possible weld pores and inclusions and the smallest possible weld HAZ.

Welding of P-91 Material

Welding of Grade 91 (9Cr-1Mo-V) chromium-molybdenum steel has presented numerous challenges since its introduction inthe 1970s. The gas tungsten-arc (GTAW) process can produce welds of high quality; however, manual welding can be expensive and labour intensive, requiring skilled welders with extreme hand-eye coordination and dexterity. Grade 91 productivity can beincreased in either shop or field fabrication by introducing a semiautomatic high deposition metal transfer (HDMT) GTAWwelding process that combines controlled excitation of wire with a hot wire addition. This technique is cost-effective and can beused for the entire weld from root to cap while producing high quality welds that industry expects from the GTAW process.

With TiP-TiG weld study, it indicates that semiautomatic HDMT GTAW welding process is capable of producing toughness valuescomparable to or exceeding manual GTAW and that the process provides an attractive alternative for welding P91 root and hotpasses or the entire weld from root to cap.Results of this study indicates that semiautomatic HDMT GTAW welding process is capable of producing impact valuescomparable to or exceeding manual GTAWT. The process also provides an attractive alternative for welding P91 root and hotpasses or the entire weld from root to cap. The semiautomatic HDMT GTAW welding process permits an increase in energy(heat input), larger weld puddle and increased deposition rate while still providing tempering of the previously deposited weldbeads or layers.

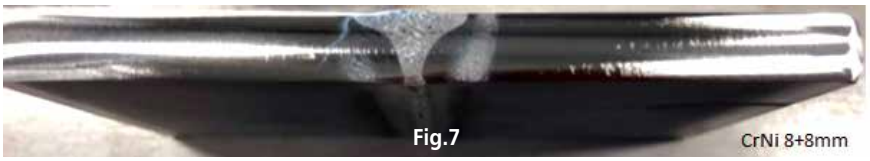

Fig.7 CrNi 8+8mm

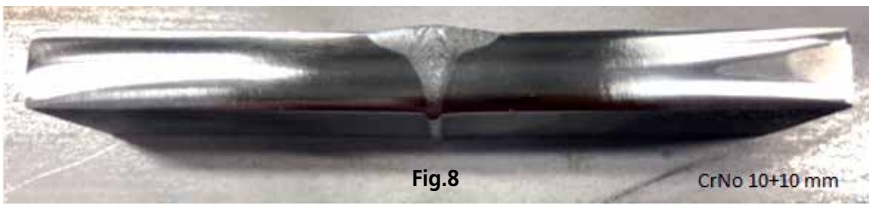

Fig.8 CrNo 10+10 mm

TIP-TIG HDMT (HIGH DYNAMIC METAL TRANSFER) FOCUS

TIP-TIG HDMT FOCUS is a unique TIP-TIG welding process. Its precision and reliability make the TIPTIG HDMT FOCUS welding process particularly suitable for automatedapplications in combination with linear axles, robots and other guiding systems. Nearly all steels, non-ferrousmetals or galvanized sheets can be welded in one layer with filler material; e.g. CrNi-steels with a material thickness of up to 10 to 12 mm can be welded in single pass without any Joint preparation. Some of the welded examples are listed below.

it has resulted in elimination of backing gas in austenitic stainless steel welds using high deposition metal transfer gas tungsten-arc welding(HDMTGTAW)

TIP-TIG HDMT FOCUS PROCESS

Example

- Material: CrNi 8+8mm
- Weld current: 500A
- Weld speed: 46 cm/min
- Wire feed speed: 2,0m/min

Details of Welded Samples

- Material: CrNi 10+10mm
- Weld current: 500A
- Weld speed: 32 cm/min
- Wire feed speed: 1,8m/min

TIP-TIG REDUCED COSTS BY OVER 60%, WHEN COMPARED WITH CONVENTIONAL TIG PROCESS

TIP-TIG Cost Comparison

The following comparison shows the actual savings calculated on a real stainless-steel welding application comparing conventional TIG and TIP-TIG on a pipe application (2” Sch 80 Stainless) in the 5G position.

Variable / Results	Units	Conventional TIG	TIP TIG Process
Welding process		GTAW	GTAW
Wire type		ER308L	ER308L
Wire size	mm	2.4	0.9
Wire deposition speed	mm/min	100	1900
Melt off rate	g/h	200	580(3 times)
Deposition efficiency	%	100.00%	100.00%
Deposition rate	g/h	200	580(3 times)
Duty cycle	%	100.00%	100.00%
Final deposition rate	g/h	200	580(3 times)
Gas type		Argon	Argon
Flow rate	cfh	30	30
Gas/Wire ratio	cf/g	63.05	23.62(60% Reduction in gas per gm of wire)

The above data shows, the deposition rates approx. 3 times to standard TIG process which reduces the production costs by 60%.

Conclusion

TIP-TIG is an innovative TIG process and good alternative to standard gas tungsten-arc (GTAW) process. Its versatility and simplicity makes the manual welder to give higher output. The Automated High Deposition Metal Transfer (HDMT) GTAW welding process that combines controlled excitation of wire with a hot wire addition and gives very promising results to challenging applications.

Plant equipment manufacturing, wherever GTAW is applicable, is possible to be replaced by TIG-TIG process which gives very high output without compromising on quality. The success in P91 welding with TIP-TIG, also increases the application possibility in that area.

References:

1. Paper on 'ACHIEVING TOUGHNESS IN P91 WELDS FROM ROOT TO CAP USING SEMIAUTOMATIC HIGH DEPOSITION METAL TRANSFER (HDMT) GTAW WELDING PROCESS ' by Charles W. "Pat" Patrick
2. Information from TiPTiG USA
3. Information from TiPTiG International AG .