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PRELIMINARY EVALUATION OF LASER - TANDEM GMAW

Ruham Pablo Reis; Americo Scotti; John Norrish

A large number of researches and developments has been recently carried out on hybrid welding combining Laser beam and 'conventional' welding processes (BAGGER, C.; OLSEN, F. O, 2005 and CHO, M. H.; FARSON, D. F., 2007). This combination tends to enhance the advantages and compensate the limitations found in each process. Generally, the final result is an increase in the weld penetration depth, width and welding travel speed. Despite all these facts, there are many issues still requiring further investigation, including the exploitation of new combinations. This work describes a new approach for hybrid welding by combining LBW with Tandem GMAW. Some basic aspects regarding the process performance are discussed.

A rig (Fig. 1) was designed to provide support for the components of a tandem GMAW torch whilst providing accommodation for a Diode Laser head. As the Laser head is placed between the wires, its beam can be used perpendicular to the work piece, allowing maximum efficiency.

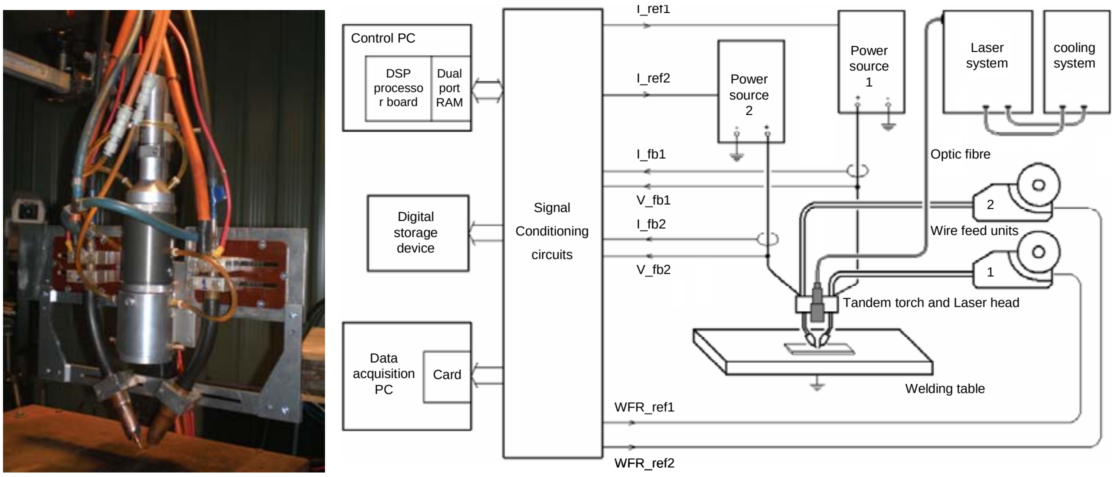

Figure 1: Laser - Tandem GMAW rig and test facility diagram

The tandem GMAW process welding mode chosen to be tried in this new hybrid welding approach was the pulsed mode. Table 1 shows the main welding parameters used in the pulsed control program developed for Tandem GMAW.

Table 1: Welding parameters selected for GMAW

Welding Parameter	Value
Ipulse1 = Ipulse2 (A)	350
Tpulse1 = Tpulse2 (ms)	2
Ibase1 = Ibase2 (A)	50
Tbase1 = Tbase2 (ms)	18
Ramp_up1 = Ramp_up2 (A/ms)	2000
Ramp_down1 = Ramp_down2 (A/ms)	2000
Tailout1 = Tailout2 (dimensionless)	45
WFR1 = WFR2 (m/min)	3.8
Delay (ms)	0.1
Arc Voltage Control (wire 1 and 2)	ON

Some of the first points that come to mind about the new approach are about the Laser beam position in relation to the wires and the effect caused on the weld bead profile. Tests were carried out varying the position of the Laser beam between the wires for two levels of Laser beam power (1 and 2 kW) using an inter-wire distance (IWD) of 10 mm. The welding travel speed range for each condition was chosen in order to assure a good visual aspect of the beads produced (regular shape with no burn-through and no humping).

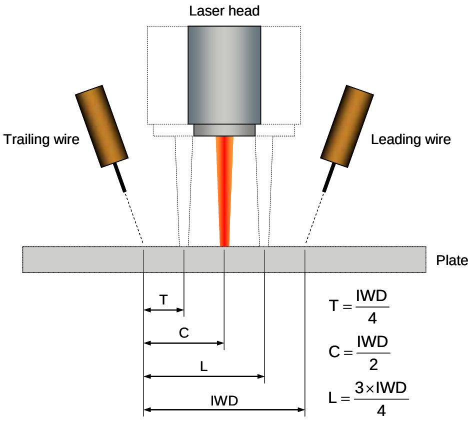

Figure 2: Position of Laser beam in relation to the leading and trailing wire

The fact of adding the Laser beam to the tandem GMAW process allows a reasonable increase in the welding travel speed level, still providing the same weld penetration (Fig. 3). It is worth mentioning that in the case of the condition with Laser beam at 2 kW, the travel speed could be probably increased further. As the limit of welding travel speed provided by the existing welding table system was reached, this was impractical.

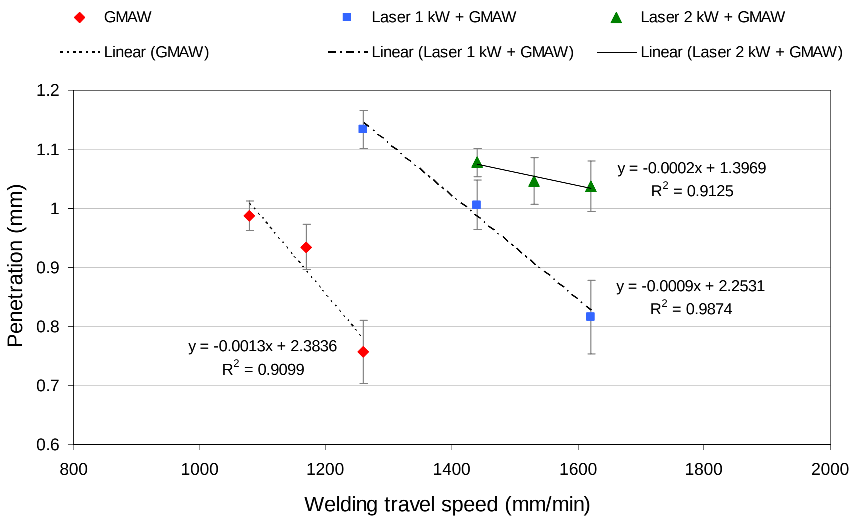

Figure 3: Influence of welding travel speed on weld bead penetration
(Laser beam centralized between the wires)

The addition of an extra heat source (Laser beam) also helps to achieve the same width at higher welding travel speeds. This is likely to be due to the increase in the wetability of the deposited metal on the base metal. As the weld width tended to increase, the reinforcement had to decrease, which was confirmed. The result concerning the base metal molten area indicated that is probably possible to keep the weld profile required for a specific joint design at higher travel speeds than those possible using only GMAW. The position of the Laser beam did not seem to affect the width or reinforcement of the weld bead. However, with the beam placed centralised between the wires the penetration depth and molten area were increased by around 50 % when compared to having the beam closer to the trailing or leading wire.

REFERENCES

BAGGER, C.; OLSEN, F. O. Review of Laser hybrid welding. **Journal of Laser applications.** v.17(1), p. 2-14, 2005.

CHO, M. H.; FARSON, D. F. Simulation study of a hybrid process for the prevention of weld bead hump formation. **Welding Journal.** v. 86, n. 9, p. 253-262, September 2007.