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EFFECT OF WELDING PARAMETERS ON CHARACTERISTICS OF PULSE CURRENT GAS TUNGSTEN ARC WELDED STEEL SHEETS

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ABSTRACT

Welding thin sheets is quite different from welding thick sections, because during welding of thin sheets many problems are experienced. These problems are usually linked with heat input. Almost all the conventional arc welding processes offer high heat input, which in turn leads to various problems-Distortion, porosity, buckling & twisting of welded sheets, grain coarsening, evaporation of useful elements present in coating of the sheets, joint gap variation during welding. The main objective of this research are To study the Defects like Humping, Porosity, Undercut at Higher Welding Speed. Methods are given to avoid Humping at Higher welding Speed, Selection of Pulse Parameters in High speed P-GTAW Process, Variation in Weld Bead Geometry like Fusion Area and Width of Heat Affected zone with variation in welding speed, Estimation of Mechanical Properties and Microstructure of optimized samples using similarity conditions, Variation in dislocation concentration in welds produced at low and High speed.

KEYWORDS: . Welding, Humping, Porosity, P- GTAW, Buckling.

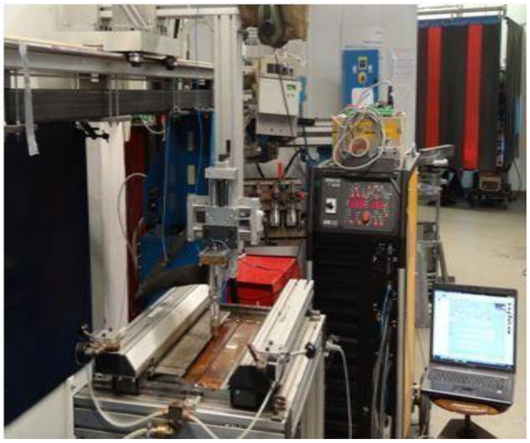
I. INTRODUCTION

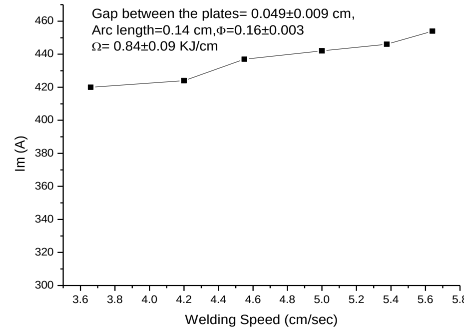
Welding thin sheets is quite different from welding thick sections, because during welding of thin sheets many problems are experienced. These problems are usually linked with heat input. Almost all the conventional arc welding processes offer high heat input, which in turn leads to various problems. Distortion, porosity, buckling & twisting of welded sheets, grain coarsening, evaporation of useful elements present in coating of the sheets, joint gap variation during welding.

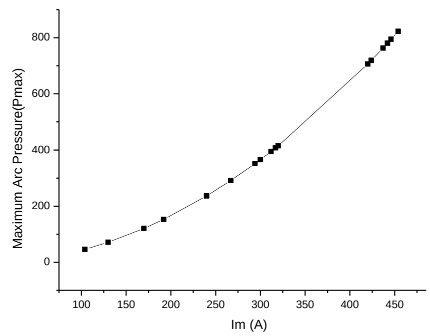
Pulsed current gas tungsten arc (PCGTA) welding, developed in the 1950s, is a variant of GTAW process that involves cycling the welding current at a selected regular frequency. Peak current- adequate penetration and bead contour.Base current- Maintain a stable arc and to allow the cooling to the weld pool.

II. EXPERIMENTAL SETUP

- Pneumatic clamping Unit.
- Plasma cut copper sheet mounted over grooves of table.
- A power source EWM Tetrix 521 DC/AC and Tetrix 1002 DC (for High current and speed) in pulsed mode with DCEN polarity.
- Water cooled TIG torch with nozzle diameter of 8 mm.
- The material investigated was low carbon steel AISI 1008 and Austenitic stainless steel 304/1.4301 (X5CrNi18-10) in the form of 2 mm thin sheets.
- Pure argon for low carbon steel at flow rate of 10 litre/minute and a combination of Argon and 25 % Nitrogen for Stainless steel at flow rate of 16 litre/min used as shielding gas.
- 6.4 mm diameter Tungsten electrodes (with copper head) with 2% CeO_2 and a cone angle of 30º.
- A Pre flow and Post flow is provided to purge the hoses and the Torch and to protect the electrode form oxidation as they cool from welding temperature.
- Arc length is kept constant (1.4 mm)







III. SELECTION OF PULSE PARAMETERS

Square Butt autogenous welds have been produced in between the 2 mm thick sheets of AISI 1008 steel and 304 austenitic stainless steel. The gap between the plates in 304 SS is kept 0 mm. In AISI 1008 steel welding is done once by keeping the gap between the plates to be 0 mm at low speed and low mean current and once by keeping the constant gap of 0.56± 0.05 mm at high mean current and high speed Pulse GTAW.

Element	C	Si	Mn	P	S	Cr	Ni	Al	Cu
%	0.0534	<0.0000	0.2727	0.0224	0.0119	0.0063	0.0185	0.002	<0.0000

III. SELECTION OF SAMPLES FOR ANALYSIS OF MECHANICAL PROPERTIES GROUP 1 & GROUP 2

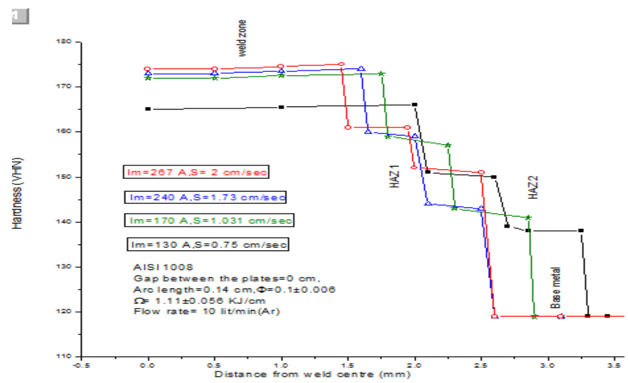


Figure : variations in hardness of group 1 samples from weld centre to base metal.

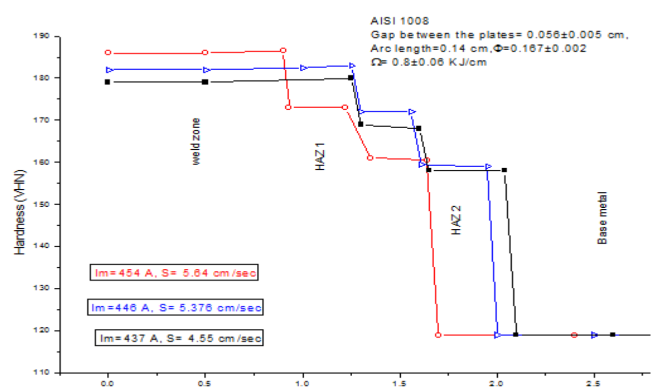


Figure : variations in hardness of group 2 samples from weld centre to base metal.

. IV. Cultural Aspects and Importance of Non Verbal Communication

Selection of pulse parameters in Pulsed GTA welding of thin sheets is really a very tidy process especially when the Speed of welding is increasing with Mean current.

Low carbon Steel

Square butt welds were produced by using data given in table. Welds were produced keeping the heat input and pulsing factor ϕ to be constant 1.04±0.093 KJ/cm and 0.1±0.008 when gap between the plates was 0 mm and 0.084±0.09 KJ/cm and 0.16±0.003 with a gap of 0.049±0.009 cm.

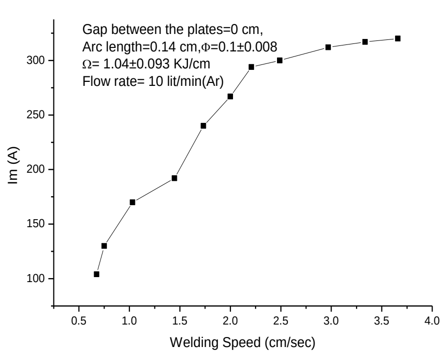


Figure: Typical cross section of welds for group 1

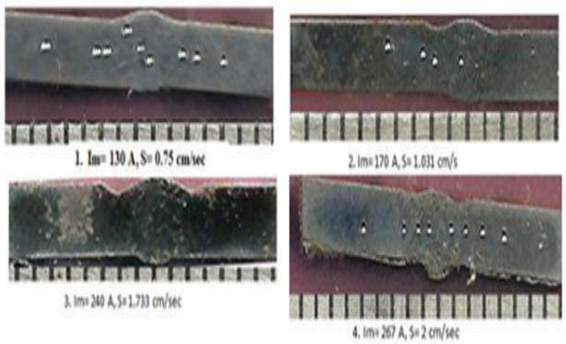
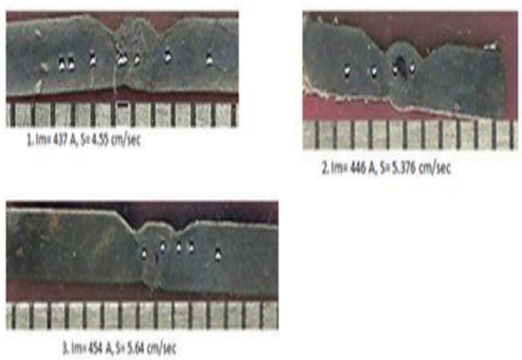


Figure: Typical cross section of welds for group 2



Microstructure of sample at Im= 130 A and S= 0.75 cm/sec

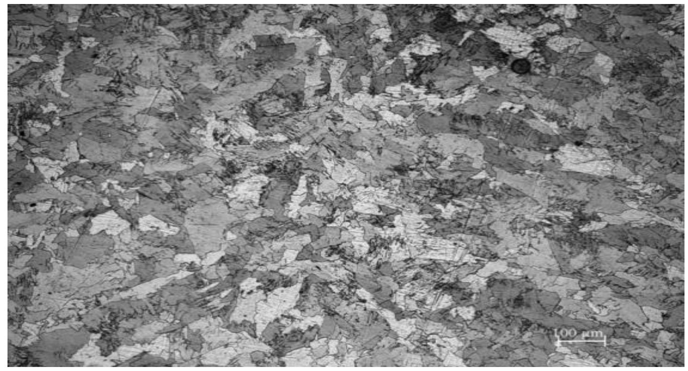


Fig 2. Typical micrograph of HAZ 1, weld centre, HAZ 2 at Im= 170 A and S= 1.031 cm/sec and 10X magnification.

TENSILE TESTING OF LOW CARBON STEEL WELDS

The axial tensile testing of selected weld samples was carried out using flat tensile specimen conforming to ASTM E8M specification on EUTM2500.In each and every test for Group 1 and Group 2, every time failure of ductile nature was observed in base metal rather than weld or reduced area section at fusion line even due to reduction in cross section area there will be higher stress conentration beacuse of dip produced in high speed high mean current welding and it was observed for some other samples which were having undercut defects were also failed from base metal. So it leads to conclusion that weld produced by P-GTAW was found to be much stronger than base metal in AISI steel and the undercut or the dipping of weld bead are not so severe in tensile loading condition.

Schematic representation of the Failure of base metal during axial tensile testing of welds

V. CONCLUSION

- During weld metal solidification at the moving liquid surface interface the constitutional super cooling increases as we move from fusion line to the weld centre.
- At high speed and High mean current better mechanical properties are observed due to high

cooling rate/ Rapid solidification as finer grains are obtained.

- Dendrite fragmentation is also found to be another mechanism for grain refinement.
- Pulsing causes surface nucleation during the cooling effect under the arc at base current leading to grain refinement.
- At higher speeds the proportion of equated grains within microstructure increases due to high constitutional super cooling leading to enhanced heterogeneous nucleation at the centre of the weld (high tensile strength).
- So Increase in welding speed leads to high welding productivity with enhanced mechanical properties.
- During welding of thin sheets Pulse current Gas Tungsten Arc welding process is found be a more beneficial process than conventional GTAW.
- Another advantage of using high speed was that the width of HAZ is found to be decreased with increase in speed.

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