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Magnetic Arc Blow in Arc Welding Affects Weld Bead Parameters

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Abstract—*In arc welding process magnetic arc blow experienced because of magnetism generated in weld specimen due electric current passing through it. Due to this magnetism uncontrolled arc blow, difficulties in handling the molten pool and slag, undercut, inconsistent penetration, incomplete fusion, reduced welding speed, porosity, beads of irregular width, wavy beads and lowered bead quality experienced. This paper discusses the effects of magnetism and study done by different research papers. Similarly briefing the methodology to control magnetic arc blow in experimentation to control the properties of base metal, weld bead characteristics and heat affected zone (HAZ). Study involves the experimentation for effect on weld bead for stress analysis at complex loading e.g. internal pressure in the pipe and point load on a cantilever welded pipe. Previous study shows the different mechanical methods of controlling arc blow and stress analysis study.*

Keywords: *Arc Blow, Weld bead, Base metal, Magnetism, Heat Affected Zone (HAZ).*

1. INTRODUCTION

Arc blow is a phenomenon encountered in arc welding when the arc stream does not follow the shortest path between the electrode and the work piece, but is deflected forward or backward from the direction of travel or less frequently, to one side. Unless controlled, arc blow can be the cause of difficulties in handling the molten pool and slag, undercut inconsistent penetration, crooked beads, beads of irregular width, wavy beads, excessive spatter, incomplete fusion, reduced welding speed, porosity and lowered weld quality. Arc blow has been a cause of concern for welders from the beginning of welding technology. To find the possible corrective measures to control the arc oscillations, in depth study is been conducted with favorable results, by many researchers. [2, 3] Numbers of researchers have suggested the practical recommendations to avoid arc blow attributable to the magnetization of different types of steel being welded. [6, 7, 8]

The effects of arc blow are reduced by welding at higher currents which produces a stiffer arc. Welding carried out in hyperbaric conditions is more prone to arc blow because the electrons in the arc are slowed down and scattered by the extra gas molecules in the high pressure atmosphere, allowing them to turn more in the magnetic field. TIG welding tends to be more sensitive than MIG or MMA because of the lower arc voltages used.

One of the most frustrating causes of weld failure is magnetic arc blow which is one of the types of arc blow. A magnetic field present in the weld preparation region of mating steel components can cause the type of weld problem that could never pass inspection. [1]

2. LITERATURE REVIEW

R. J. Perry and Z. Paley, the presented study was intended to examine the deflection of the arc as a function of the welding parameters and magnetic field with particular attention to the effects on the deposited weld. Automatic gas tungsten – arc welding unit was employed throughout this project. This equipment makes possible fine adjustments of the welding parameters. The process allows a defined arc length, utilizing a gaseous column free from complications arising from filler metal arc transfer. [4]

T. N. Jayrajan & C. E. Jackson investigate the undercut free GTA weld can be produced in both magnetic and non magnetic materials at speed up to 100 ipm (42.2.4mm/sec) by the application of suitable magnetic fields. The possibility of increasing the welding speed in the gas tungsten–arc welding process by using external magnetic fields was investigated. The magnetic field can be classified as first one is transverse magnetic field are those have flux lines normal to both the electrode and weld travel axes. Second is parallel magnetic fields have flux lines parallel to the direction of travel and last one is longitudinal magnetic fields have their flux lines parallel to the electrode axis. The nature of the self magnetic fields due to the welding current is of very complex nature due to the variations in base metal magnetic properties and the nature of current flow. The main advantages of magnetic control of the welding arc are: increased travel speeds at which undercut free welds can be made, control over arc blow effect and control over microstructure by electromagnetic stirring. [5]

P. J. Blackeley & J. Simkin investigates magnetism in the welding of pipelines. This magnetism can sometimes be of such intensity that the arc welding process can become seriously disrupted. The origins of the magnetism and the causes of magnetic arc blow are examined and discussed enabling such problems to be readily identified and remedied. According their view towards effect of magnetism on welding, because of magnetism arc can be deviate along a circular path. It is generally found that difficulties with arc stability can occur at magnetic field levels of 20 to 40 gauss in the joint preparation and serious arc blow is generally found at fields in excess of 40 gauss. The magnetic field in a weld preparation is mainly oriented at right angle to the welding direction. So that the magnetic flux takes the shortest route in bridging the gap between the two lengths of tube which causes the arc to be deflected along the direction of welding either in front or behind the intended point of welding. [8]

Li Luming, Huang Songling et.al., investigate the residual stresses in ferromagnetic material affect the direction and structure of domains and generate the magnetic flux abnormality on the surface. Three-dimensional magnetic field on the surface of circular welding pipe specimen was inspected with 8 mm lift-off before and after low temperature annealing aimed for residual stress releasing. Small hole stress testing was also carried out with a contrast to the magnetic testing before annealing. Magnetic abnormality on the surface of inspected ferromagnetic material could be used for residual inspection.

Mechanical properties

The normal component of magnetic field correlates the most to internal stress. The distribution of stress can therefore be derived from the distribution of normal components of magnetic field in the surface of tested ferromagnetic material. [9]

A. Pulnikov, V. Permiakov, et.al. investigates the plastic deformation of a electrical steel increase of the dislocation density in the material lattice. It leads to increase of the number of pinning sites for magnetic domain wall motion and general deterioration of the magnetic properties. However, another side effect of the plastic deformation is the residual stress. In this paper, an approach is proposed allowing evaluation of anisotropy of residual stresses by means of the local magnetic measurements. A good correspondence of the obtained results with X-ray measurements was encountered. [10]

3. EXPERIMENT

3.1. Specimen

The specimen is pipe made of Schedule 80 pipe of ASTM A-106 grade B, with longitudinal flux- shielded metal arc – welding seam.

Chemical composition and mechanical properties of ASTM A-106 grade B are presented are in table 1 and 2.

The specimen having outer diameter 114.30 mm and 8.56 mm in thickness with 380mm length. The width of weld specimen is 10mm.

Table 1: Chemical composition (%)

Steel No.	C	Mn	Si	S	P
ASTM A106 Gr B	≤0.24	0.29-1.06	0.10-0.40	<0.010	<0.025

Table 2

Steel No.	Wall Thickness (mm)	Tensile experiment		
		Yield Strength (MPa)	Ultimate Tensile Strength (MPa)	%E
ASTM A106 Gr B	8.56	290-450	485-655	>22

3.2. Experimental procedure

One weld specimen (Fig.1) uses for experimentation as we called it “Test Specimen-01” hereafter which is weld without arc control device and another specimen uses for experimentation as we called it “Test Specimen-02” hereafter which is weld with arc control device.

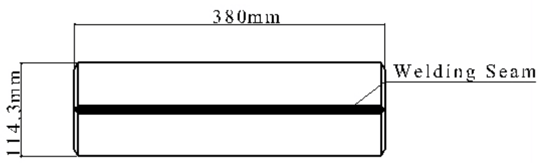

Fig. 1: Tube specimen with welding seam.

In this approach TIG welding used for welding purpose. The welding machine is set for process are welding current is 160 Amp and voltage is 18 V. These parameters are same for both the test specimens.

After completion of welding on test specimen-01, radiography test conducted along full length of workpiece for identifying the porosity, internal cracks, blow holes and many more defects which are not seen by necked eyes. The small piece of length 20mm cut from test specimen-01 for analysis of hardness, chemical composition purpose. Rockwell hardness tester used for measuring the hardness. For analyze the chemical composition, spectrum analysis method used. For conducting the p+P test i.e. internal pressure and point load test, close both the ends of pipe. One end is fully closed with plate of 8mm thick and another is closed with same thickness plate but having ½ inch BHN socket weld on plate for provision of water supply for hydro test. The strain gauges are pasted on the weld bead in X and Y directions for measuring the strain on weld bead after due to internal pressure during hydro test and point loading applied at the freely suspended end. The test specimen-01 is held in bench vice at fully closed end and other end is freely suspended. In hydraulic test, water supply is connected to the socket end and gradually increases hydraulic pressure up to 10 bar. The readings are taken at internal pressure 10 bar. After taking readings of strain developed because of internal pressure. Let the dead weight hang on the freely suspended end. Load is gradually increased up to 5 kg. In that experimentation readings are taken and tabulate them accordingly.

In case of test specimen-02, all the procedure is same as test specimen-01. The only difference is, the welding done on specimen with arc control device. This device is packaged with TIG gun.

Design Calculations, Experimentation results, comparison and analysis to be included in the other paper.

REFERENCES

[1] *The Procedure Handbook of Arc Welding*, The James F. Lincoln Arc Welding Foundation, Fourteenth Edition, May 2000.

[2] C.H. Jennings and A.B.White, "Magnetic Arc Blow", *Welding journal* ,Vol 20,No.10 Research Supplement, 1941,pp 427 - 436.

[3] A.B.Guile, "The Magnetic Movement of Short Arcs with Reference to Arc welding Problems", *British welding Journal*, Vol 13, No.6,1966, pp357 - 365.

[4] R.J.Perry and Z.Palley, "Effects Associated With Arc Blow", *Welding research supplement,* September 1970, pp389-394.

[5] T.N.Jayrajan and C.E.Jackson, "Magnetic Control Of Tungsten Arc Welding process",*Welding research supplement,* August 1972, pp377-385.

[6] E.Halmoy, "Remanent Magnetism- A Cause Of Arc Blow", *Indian Welding Journa*l, Jan 1983, pp9-15

[7] P.J Blakeley, "Magnetic Arc Blow- Causes And Remedies", *Welding and Metal Fabrication*, Aug/Sept 1991, pp401-404.

[8] P.J.Blakeley and J.Simkin, "Magnetism In The Welding Pipe Lines", *Journal Welding and Metal Fabrication*,1999.

[9] Li Luming, Huang Songling, Wang Xiaofeng, Shi Keren, Wu Su, "Magnetic Field Abnormality Caused By Welding Residual Stress", *Journal of magnetism and magnetic materials 261* ,2003, pp385-391.

[10] A.Pulnikov, V.Permiakov, R.Petrov, J.Gyselinck, G. Langelaan, H.Wisselink, L.Dupre, Y.Houbaert, J.Melkebeek, "Investigation of residual stresses by means of local magnetic measurement", *Journal of magnetism and magnetic materials 272-276 ,2004, p.p2303-2034.*