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GAS FLOW RATE IN MIG WELD

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***Abstract*— The electrode in this process is in the form of coil and continuously fed towards the work during the process. At the same time inert gas (e.g. argon, helium) is passed around electrode from the same torch. Inert gas usually argon, helium, or a suitable mixture of these is used to prevent the atmosphere from contacting the molten metal and HAZ. When gas is supplied, it gets ionized and an arc is initiated in between electrode and work piece. Heat is therefore produced. Electrode melts due to the heat and molten filler metal falls on the heated joint. The arc may be produced between a continuously fed wire and the work. Continuous welding with coiled wire helps high metal depositions rate and high welding speed. The filler wire is generally connected to the positive polarity of DC source forming one of the electrodes. The work piece is connected to the negative polarity. The power source could be constant voltage DC power source, with electrode positive and it yields a stable arc and smooth metal transfer with least spatter for the entire current range.**

***Index Terms*— HAZ, Inert gas – Continuous welding, DC source**

I. INTRODUCTION

In electric arc welding a sustained arc provides the heat required for melting the parent as well as filler material. The work piece and the electrode are connected to two materials of the power source. The arc is started by momentarily touching the electrode on to the work piece and then withdrawing it to a short distance from the work piece. when the electrode and the work piece are in contact, current flows and when they are separated an arc is generated and the current continues to flow. The arc is generated by the electrons liberated from the cathode to anode. The arc changes electrical energy into heat and light. About 70% of the heat liberated due to striking of electrons at anode raises the anode temperature to a very values (5000-30000 degree Celsius).this heat melts the base metal as well as tip of the electrode in the area surrounding the arc. a weld is formed when the mixture of molten base and electrode metal solidifies in the weld area. Since 70% heat is generated at anode a work piece connected to anode will melt 50% faster as compared to if connected with cathode .when the work and electrode connections are reversed, reversed polarity is said to be employed. Both Alternating current and direct currents are used. The electrode is either non consumable or consumable.

MIG is an arc welding process that joins together by heating them with an electric arc that is established between a consumable electrode (wire) and the work piece. An externally supplied gas or gas mixture acts to shield the arc and molten weld pool. Although the basic GMAW concept was introduced in the 1920s, it was not commercially available until 1948. At first, it was considered to be fundamentally a high-current-density, small-diameter, bare-metal electrode process using an inert gas for arc shielding. Its primary application was aluminum welding. As a result, it became known as metal-inert gas (MIG) welding, which is still common nomenclature. Subsequent process developments included operation at low current densities and pulsed direct current, application to a broader range of materials, and the use of reactive gases (particularly carbon dioxide) and gas mixtures. The latter development, in which both inert and reactive gases are used, led to the formal acceptance of the term Gas-Metal Arc Welding. The GMAW process can be operated in semi-automatic and automatic modes. All commercially important metals, such as carbon steel, high-strength low-alloy steel, stainless steel, aluminum, copper, and nickel alloys can be welded in all positions by this process if appropriate shielding gases, electrodes, and welding parameters are chosen.

Short circuiting transfer uses the lowest welding currents and voltages, which consequently produces very low heat input. In this mode of welding, the metal is not transferred across the arc gap, but from the electrode to the work only during a short period when the welding wire is in contact with the weld pool. When the electrode wire tip touches the weld pool, the arc extinguishes, the voltage goes down and amperage rises. At this moment, metal is transferred from the melted electrode tip to the weld pool with the help of surface tension of the melted weld metal. When the droplet from the tip of the wire passes to the weld pool there is no more metal connection and the arc is re established.At the heat of the arc tip, the electrode is melted and as the wire is fed towards the weld pool the next short circuit occurs. The rate of current increase during the short circuit is controlled by the induction of the power source, whereas the re-ignition and the maintenance of the arc are provided by the energy stored in the inductor during the short circuiting period.

The electrode contacts the weld pool at a random frequency, which ranges from 20 to 200 contacts per second depending on the current voltage and amperage. The drop size and the short circuit duration are influenced by the composition of the shielding gas, which affects the surface tension of the molten metal. This mode of metal transfer in MIG is normally applied with CO2-rich mixed shielding gas on ferrous metals. A correctly set arc produces a small amount of spatter and are relatively small, fast freezing and easily controlled weld pool. Because of this, this model of metal transfer is well suited for thin sections, for off- position welding and for building up bridges on large root openings.

Globular metal transfer occurs at relatively low operating currents and voltages but these are still higher than those used in short circuiting transfer. This metal transfer mode is characterised by a drop, two or three times larger in diameter than the wire, formed at the tip of the electrode. This droplet is detached from the tip of the electrode by the effect of a pinch force and the transfer of the droplets in irregular form across the arc is aided by the effect of the weak electromagnetic and strong gravity forces. As the droplets grow on the tip of the wire electrode they wobble around and disturb the arc plasma stability. Consequently, the heat-affected zone in the work becomes narrow, penetration of the weld becomes small, and the weld deposit is irregular and large amounts of spatter takes place. When the arc length is too short (low voltage) the droplets can touch the weld-pool and short out the circuit before detaching from the wire. This causes a considerable amount of spatter. Therefore the arc must be long enough to let the droplets detach freely from the electrode tip without touching the weld pool. The globular metal transfer mode can be obtained with all types of shielding gas. With CO2 shielding gas, globular metal transfer occurs at most of the operating current, amperage and voltage levels. Large molten metal droplets are transferred across the welding arc mainly by the action of gravity. Therefore this mode of working in MIG is applied to the welding of mild steel in flat and horizontal position.

Under an argon-rich shielding gas, increasing the current and voltage causes a new mode of metal transfer to appear: the tip of the wire electrode is tapped, the sizes of the droplets become smaller and they are directed axially in a straight line from the wire to the weld pool. The current level above by which this mode of metal transfer begins is called *transition current*. The droplets are much smaller than the diameter of the wire and they detach with pinch force much more rapidly than with the globular transfer mode, there is very little spatter and the surface of the weld bead is smooth. The rate of transfer of droplets can vary from less than one hundred times of a second up to several hundred times of a second. As the current increases the droplet size decreases and the frequency increases. If the current level in this made of transfer is high enough the necking effect of the pinch force and the arc forces accelerate the droplets to velocities which overcome the gravity forces. Therefore spray transfer can be used under certain conditions in out-of-position welding. Although the high deposition rate produces a large weld-pool, this can not be supported only by the surface tension of the molten metal in vertical and overhead welding. This problem is overcome by a new technique called Pulsed Current Transfer

II. LITERATURE SURVEY

Kumar and Sundarrajan [1] have presented the work pertains to the improvement of mechanical properties viz ultimate tensile strength, yield strength, percent of elongation of AA 5456 Aluminium alloy welds through pulsed Tungsten Inert Gas (TIG) Welding process. The Taguchi method was employed to optimize the pulsed TIG welding process parameters of AA 5456 Aluminum alloy welds in this work process parameters peak current, base current, welding speed and pulse frequency considered for study. Two levels for each parameters were chosen. Based on the number of levels and parameters L8 orthogonal array was selected. Regression models were developed. Analysis of variance was employed to check the adequacy of the developed models. The effect of planishing on mechanical properties was also studied and observed that there was improvement of about 10-15% in mechanical properties.

Qiang Zhu et al [2] have proposed the Tungsten insert gas (TIG) welding on China low activation martensitic (CLAM) steel under identical conditions was performed. Microhardness test, tensile test, Charpy impact test and microstructure measurements were carried out on TIG welded joints after post weld heat-treatment. Hardening at WM and softening in HAZ is detected in the TIG weld joint. Micro hardness in WM decreased when the temperature of PWHT increased. The ultimate tensile stress of weld metal is higher than that of HAZ and BM. Absorbed energy increased with PWHT temperature rising, until PWHT was done at 760 ◦C/30 min, the specimen ductile fractured in local area. The microstructure of the weld metal for every specimen was found to be tempered martensite with a little of delta ferrite. M23C6 particles are the predominant type of carbides. Oxide precipitate phases appeared in WM, which are the primary crack initiation sites and it is critically important minimize their formation. Christo Ananth et al. [3] proposed a system, this fully automatic vehicle is equipped by micro controller, motor driving mechanism and battery. The power stored in the battery is used to drive the DC motor that causes the movement to AGV. The speed of rotation of DC motor i.e., velocity of AGV is controlled by the microprocessor controller.This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

III. EXPERIMENTAL PROCEDURES AND RESULTS

The base material used in this study is the structural Indian Standard AA 6061 plates, since its price is relatively high while it provides material properties that are acceptable for many applications. The properties of base material and filler wire are shown in the following table 4.1 and 4.2 respectively.

TABLE I
CHEMICAL COMPOSITION OF BASE MATERIAL (AA-6061)

Percent composition	Copper	Manganese	Silicon	Chromium	Titanium
	0.40	0.15	0.8	0.35	0.15

TABLE II
CHEMICAL COMPOSITION OF FILLER MATERIAL (AWS ER70S-6)

Percent composition	Copper	Manganese	Silicon	Phosphorous	Sulphur
	0.100	1.500	0.900	0.025	0.025

The next step is to select the welding process, which is suitable for joining IS 2062 material. Shielded metal arc (SMA), gas tungsten arc (GTA), or gas metal arc (GMA) welding are the three processes usually considered. Shielded metal arc welding offers few benefits for in-shop use. The process presents slag removal and possible slag entrapment issues. Gas tungsten arc welding can produce excellent quality welds . For the majority of the fillet welds required, GMA welding is faster and may produce less heat input for lower distortion. This process also makes it easier to produce consistent-quality weld. In fact, the GMAW process is used extensively in industry to make very high-quality, critical welds in items such as submarine hulls. Submarine hulls are made from high-strength steel and are predominantly welded with the GMAW process. Short circuit GMA welding (GMAW-S) is most often used on thinner materials such as tubing and provides excellent quality in the hands of a skilled welder. The GMAW process was selected to weld IS 2062 low carbon steels based on the above merits as compared to other welding process. Based on the literature study the process parameters which affecting the weld quality are taken as wire speed, travel speed, arc voltage, specimen edge angle and gas flow rate. Total four parameters were selected.

TABLE III
WELDING PARAMETERS AND THEIR LEVELS

PARAMETERS	LEVEL 1	LEVEL 2
VOLTAGE	14	20
WIRE FEED RATE	6	8
GAS FLOW RATE	10	14
SPECIMEN EDGE	60	90

IV. CONCLUSION

The electrode in this process is in the form of coil and continuously fed towards the work during the process. At the same time inert gas (e.g. argon, helium) is passed around electrode from the same torch. Inert gas usually argon, helium, or a suitable mixture of these is used to prevent the atmosphere from contacting the molten metal and HAZ. When gas is supplied, it gets ionized and an arc is initiated in between electrode and work piece. Heat is therefore produced. Electrode melts due to the heat and molten filler metal falls on the heated joint. The arc may be produced between a continuously fed wire and the work. Continuous welding with coiled wire helps high metal depositions rate and high welding speed. The filler wire is generally connected to the positive polarity of DC source forming one of the electrodes. The work piece is connected to the negative polarity. The power source could be constant voltage DC power source, with electrode positive and it yields a stable arc and smooth metal transfer with least spatter for the entire current range.

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