COMPARISION STUDY OF AC WELDING AND DC WELDING

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ABSTRACT

Welding plays a very important role in the fabrication industry and ensures the quality of fabrication. The purpose of this study was to determine the effect of Alternating Current (AC) and Direct Current (DC) on the mechanical testing of welding joints on given material. The results of this study are expected to determine the cracks that occur on the material testing in the AC and DC welding process. This study used experimental method, where the research was done by giving AC and DC polarity. The foremost objective of this project is to "Establish how AC welding is considered inferior to DC welding". Various electrodes have been used with having high voltage and low voltage.

Keywords: - *Welding current, AC Welding, DC Welding, Electrodes.*

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1. INTRODUCTION

Alternative Current Welding

An alternating current is an electric current that reverses its direction many times per second. A 60-hertz current will change its polarity 120 times per second. With AC welding, because the magnetic field and current rapidly reverse -direction, there is no net deflection of the arc.

Direct Current Welding

Direct current is an electric current that has a constant polarity flow in a single direction. This current can be positive or negative. With DC welding, since the magnetic field and current of the arc are constant, stable arcs are produced.

Direct current TIG (DC) welding is when the current flows in one direction only. Compared with AC (Alternating Current) TIG welding the current once flowing will not go to zero until welding has ended. In general, TIG inverters will be capable of welding either DC or AC/DC welding with very few machines being AC only. DC is used for TIG welding Mild Steel/Stainless material and AC would be used for welding Aluminium.

Polarity: The TIG welding process has three options of welding current based upon the type of connection. Each method of connection has both advantages and disadvantages.

Direct Current – Electrode Negative (DCEN): This method of welding can be used for a wide range of materials. The TIG welding torch is connected to the negative output of the welding inverter and the work return cable to the positive output. When the arc is established the current flows in the circuit and the heat distribution in the arc is around 33% in the negative side of the arc (the welding torch) and 67% in the positive side of the arc (the work piece). This balance gives deep arc penetration of the arc into the work piece and reduces heat in the electrode. This reduced heat in the electrode allows more current to be carried by smaller electrodes compared to other polarity connections. This method of connection is often referred to as straight polarity and is the most common connection used in DC welding.

Direct Current – Electrode Positive (DCEP):

When welding in this mode the TIG welding torch is connected to the positive output of the welding inverter and the work return cable to the negative output. When the arc is established the current flows in the circuit and the heat distribution in the arc is around 33% in the negative side of the arc (the work piece) and 67% in the positive side of the arc (the welding torch).

This means the electrode is subjected to the highest heat levels and therefore must be much larger than with DCEN mode even when the current is relatively low to prevent the electrode overheating or melting. The work piece is subjected to the lower heat level so the weld penetration will be shallow.

This method of connection is often referred to as reverse polarity.

Also, with this mode the effects of magnetic forces can lead to instability and a phenomenon known as arc blow where the arc can wander between the materials to be welded. This can also happen in the DCEN mode but is more prevalent in the DCEP mode.

Difference between Arc (AC) Welding and Arc (DC) Welding: Arc welding is a type of welding that uses a welding power supply to create an electric arc between an electrode and the base material to melt the metals at the welding point. They can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. The welding region is usually protected by some type of shielding gas, vapour, or slag. Arc welding processes may be manual, semi-automatic, or fully automated. First developed in the early part of the 20th century, arc welding became commercially important in shipbuilding during the Second World War. Today it remains an important process for the fabrication of steel structures and vehicles.

Difference between Spot (AC) Welding Spot (DC) Welding: Spot welding is a process in which contacting metal surfaces are joined by the heat obtained from resistance to electric current. Work-pieces are held together under pressure exerted by electrodes. Typically, the sheets are in the 0.5 to 3 mm (0.020 to 0.12 in) thickness range. The process uses two shaped copper alloy electrodes to concentrate welding current into a small "spot" and to simultaneously clamp the sheets together. Forcing a large current through the spot will melt the metal and form the weld. The attractive feature of spot welding is a lot of energy can be delivered to the spot in a very short time. The amount of heat (energy) delivered to the spot is determined by the resistance between the electrodes and the amperage and duration of the current.

The amount of energy is chosen to match the sheet's material properties, its thickness, and type of electrodes. Applying too little energy won't melt the metal or will make a poor weld. Applying too much energy will melt too much metal, eject molten material, and make a hole rather than a weld. Another attractive feature of spot welding is the energy Delivered to the spot can be controlled to produce reliable welds. The advantages of the method include efficient energy use, limited work piece deformation, high production rates, easy automation, and no required filler materials. While the shear strength of each weld is high, the fact that the weld spots do not form a continuous seam means that the overall

strength is often significantly lower than with other welding methods, limiting the usefulness of the process. It is used extensively in the automotive industry cars can have several thousand spot welds.

2.LITERATURE REVIEW

Larry Jaffe's, et al. Welding is a fabrication process whereby two or more parts are fused together by means of heat, pressure or both forming a join as the parts cool. Welding is usually used on metals and thermoplastics but can also be used on wood. The completed welded joint may be referred to as a amendment. [1]

Pradhan, et al. Designed and developed an automated filler rod feeding system for TIG welding. They considered a number of mechanisms, namely rack-pinion mechanism, slider- crank mechanism, and screw–nut mechanism, and analysed them to decide the best among the mechanisms. Screw and nut mechanism were found to give the best weld quality to suit the industry requirements. In this mechanism, linear feeding is provided by movement of screw at the end of which filler rod is connected by clamping mechanism. The screw passes through a nut which is fixed to the frame of portable moving tractor. The rotary motion of screw required for its linear displacement is given by connecting it to an external electric motor. [2]

Lothongkum, et al. Explored the TIG welding of 3 mm-thick-AISI 316L pristine sword plate at different welding positions. Pure argon gas and admixture of argon with nitrogen (1 – 4 vol.) were used as shielding gas with inflow rate of 8 l/min during top and aft sides of welds. Goods of welding pets and nitrogen contents in argon shielding gas on palpitation currents were studied to achieve respectable weld blob profile with complete penetration. It was plant that adding nitrogen contents in argon gas decreases the palpitation currents, and adding welding. Speed will increase the palpitation current. [3]

Javed Kazi, et al, represent a review on various welding techniques in International Journal of Modern Engineering Research publication in 2015. Their prime focus is on fulfilment of objective of Industrial application of welding with producing better quality product at minimum cost and increase productivity. The attempt is made to understand various welding techniques and to find the best welding technique for steel. Special focuses have been put on TIG and MIG welding. For this study they analysed strength, hardness, modulus of rigidity, ductility, breaking point, % elongation etc. at constant voltage on hardness testing machine and UTM. [4]

Mohan, et al. Developed an automated TIG welding system to control the welding speed. Welding of commercial Al plate of thickness 3 mm was performed in two phases—single-sided weld and two-sided weld. At lower welding speeds, strength is more due to more intensity of current. For two-sided weld, tensile strength was found almost equivalent to the strength of base material and with high current (180 A), welding speed has no specific effect on tensile strength of the weld joint. Hardness value of the weld zone was observed to change with the distance from weld centre due to change of micro structure. At lower welding speeds, strength is more due to higher current intensity. [5]

Bhargav C. Patel et al, in their research paper "Optimizing and analysis of parameter for pipe welding: A literature review" emphasis on the study of the effect of different input parameter of TIG and MIG welding on the weld quality. They studied the effect of various welding parameter by conducting different experiments. [6]

Palani, et al, researched the effect of TIG welding process parameters on welding of Aluminium-65032. Response Surface Methodology was used to conduct the experiments. The parameters selected for controlling the process are welding speed, current and gas flow rate. Strength of welded joints were tested by a UTM. [7]

Alireza Bahrami, et al. studied that selecting the welding parameters appropriately, such as the power supplied to the arc and the translation speed of the arc can reduce the energy consumed per unit length of weld. It is shown that increasing the arc power in conjunction with increasing the travel speed of the arc leads to reduced energy consumption per unit length of weld; this reduction in energy consumption is for equivalent welds, i.e., variations in joint designs on the properties of the weld met was studied. Mild steel plates, IS 2062: E250, were taken as sample for the study using the shielded metal arc welding (SMAW) technique. Main objective was to compare the effects of variations in geometry of butt-joint welding on the mechanical properties of mild steel plate. The welding was carried out on different butt-joint designs, such as, square butt-joint, single V-joint, double V-joint and single J-joint, keeping all other process parameters like current, voltage, welding speed etc. as constant. The mechanical test and the micro structural investigation were carried out to analyse the change in mechanical and micro structural behaviour of the weld metal. The results of tests performed revealed that the Double- V joint was the superior of all other joints, having better mechanical properties than other joints. Single-V was having more width of HAZ was recorded as compared to others.[8]

Iran Ali, et.al: - Authors carried out the experiment to determine the mechanical properties of weld joints using SMAW with different materials like, stain steel, mild steel and low carbon steel to know the welding parameters to get required quality. The penetrant on the surface is wiped off and the penetrant in the cracks remains wet. After a short dwell time the developer is sprayed over the weld. The developer acts to draw-out the penetrant dye from the cracks and so changes colour. It behaves like blotting paper and magnifies the presence of the crack. [9]

R.C. Gupta, et.al: - Authors has considered the mild steel penetration for welding parameters by considering welding current, arc voltage and welding speed. The effects of parameters are hardness test, tensile test and penetration are observed.in their research paper "Optimizing and analysis of parameter for pipe welding: A literature review" emphasis on the study of the effect of different input parameter of TIG and MIG welding on the weld quality. They studied the effect of various welding parameter by conducting different experiments. [10]

Harsh Sharma, et.al: - The quality of the weld is identified by several welding output parameters like weld width, re-enforcement height, depth of penetration, hardness, impact strength and tensile strength etc. The input welding parameters on which outputs depend are welding current, voltage, feed rate, speed of welding, electrode extension, diameter of electrode and electrode angle etc. Heat input rate, cooling rate of weld and heat affected zone and their effect on the performance of the joint. [11]

Sarajevo Gaul, et.al: - In this research revealed that the weld bead width varies directly with welding voltage and welding current has an inverse relationship is found between welding speed with the weld bead width. [12]

Javed Kazi et al, represent a review on various welding techniques in International Journal of Modern Engineering Research publication in 2015. Their prime focus is on fulfillment of objective of Industrial application of welding with producing better quality product at minimum cost and increase productivity. The attempt is made to understand various welding techniques and to find the best welding technique for steel. Special focuses have been put on TIG and MIG welding. For this study they analyzed strength, hardness, modulus of rigidity, ductility, breaking point, % elongation etc. at constant voltage on hardness testing machine and UTM.[13]

R. Satish, et al, researched the weld ability and process parameter optimization of dissimilar pipe joints using GTAW. Taguchi method was used to formulate the experimental layout to rank the welding input parameters which affects quality of weld. Results showed that lower heat input resulted in lower tensile strength and too high heat input also resulted in reduced tensile strength.[14]

Spencer Gould et al, researched based on Parametric Optimization of Metal Inert Gas Welding and Tungsten Inert Gas Welding By using Analysis of Variance and Gray Relational Analysis in International Journal of Science and Research publication in 2012. They carried out a design experimental method. With the help of Experimental data, they optimized by the gray relational analysis (GRA) technique, in which input parameters for TIG welding such as current, gas flow and output parameter as in tensile strength is considered. To find percentage contribution of each input parameters for obtaining optimal conditions, Analysis of variance (ANOVA) method was used. By analyzing the GRA the optimum parameters were evaluated.[15]

Gurpreet Singh Sidhu, et al. studied to investigate the roll of intermixed weld metal of shielded metal arc welding consumable on weld properties. Intermixing of weld fluxes, change the chemical compositions of electrodes etc are applied for purpose of high weld quality, high productivity, strength and economy in pipeline Fabricators look for welding process which is cost effect and is able to give higher deposition rate better penetration and robust structures. [16]

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