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MAXIMISATION OF TENSILE STRENGTH AND HARDNESS USING TAGUCHI METHOD

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Abstract—***Optimization is done on MIG welding process parameters AA 5456 weldments using DOE. Taguchi is used mostly in all optimization process. The main objective of this work is to optimize the MIG welding Process parameters on AA 6061 to yield maximum ultimate tensile strength and hardness using Taguchi method. Four parameters and two levels has been selected. Experiments have been conducted as per parametric combination of L8 Orthogonal Array for this project work. Project work is to be extended to measure the output responses and perform analysis of variance. Finally optimum process parameters is to be calculated. Confirmation test will be performed to ensure optimum results.***

Index Terms—**MIG Welding Process, L8 Orthogonal Array, Taguchi method**

I. INTRODUCTION

MIG Torch provides the method of delivery from the wire feed unit to the point at which welding is required.The MIG torch can be air cooled or water cooled and most modern air cooled torches have a single cable in which the welding wire slides through a Liner. Gas flows around the outside of this Liner and around the tube the Liner sits in is the power braid and trigger wires. The outer insulation provides a flexible cover. Water cooled MIG torches are similar to the above, but gas hose, liner tube, power lead (including water return pipe), water flow pipe and trigger wires are all separate in an outer sleeve. Most industrial MIG equipment uses a standard European MIG torch connector for easy connection of torch, some low cost smaller units use individual manufacturers fittings. The important areas of maintenance are: Liners are in good condition and correct type and size; Contact tips are lightly fitted, of correct size and good condition.

Weld quality and weld deposition rate both are influenced very much by the various welding parameters and joint geometry. Essentially a welded joint can be produced by various combinations of welding parameters as well as joint geometries. These parameters are the process variables which control the weld deposition rate and weld quality. The weld bead geometry, depth of penetration and overall weld quality depends on the following operating variables. Welding current, Arc voltage , Arc travel speed, Gas Flow rate.

The electrode diameter influences the weld bead configuration (such as the size), the depth of penetration, bead width and has a consequent effect on the travel speed of welding. As a general rule, for the same welding current (wire feed speed setting) the arc becomes more penetrating as the electrode diameter decreases. To get the maximum deposition rate at a given current, one should have the smallest wire possible that provides the necessary penetration of the weld. The larger electrode diameters create weld with less penetration but welder in width. The choice of the wire electrode diameter depends on the thickness of the work piece to be welded, the required weld penetration, the desired weld profile and deposition rate, the position of welding and the cost of electrode wire. Commonly used electrode sizes are (mm): 0.8, 1.0, 1.2, 1.6 and 2.4. Each size has a usable current range depending on wire composition and spray- type arc or short- circuiting arc is used.

The value of welding current used in MIG has the greatest effect on the deposition rate, the weld bead size, shape and penetration. In MIG welding, metals are generally welded with direct current polarity electrode positive (DCEP, opposite to TIG welding), because it provides the maximum heat input to the work and therefore a relatively deep penetration can be obtained. When all the other welding parameters are held constant, increasing the current will increase the depth and the width of the weld penetration and the size of the weld bead.

The arc length (arc voltage) is one of the most important variables in MIG that must be held under control. When all the variables such as the electrode composition and sizes, the type of shielding gas and the welding technique are held constant, the arc length is directly related to the arc voltage. High and low voltages cause an unstable arc. Excessive voltage causes the formation of excessive spatter and porosity, in fillet welds it increases undercut and produces narrower beads with greater convexity, but an excessive low voltage may cause porosity and overlapping at the edges of the weld bead. And with constant voltage power source, the welding current increase when the electrode feeding rate is increased and decreased as the electrode speed is decreased, other factors remaining constant. This is a very important variable in MIG welding, mainly because it determines the type o metal transfer by influencing the rate of droplet transfer across the arc. The arc voltage to be used depends on base metal thickness, type of joint, electrode composition and size, shielding gas composition, welding position, type of weld and other factors**.**

The primary function of shielding gas is to protect the arc and molten weld, pool from atmosphere oxygen and nitrogen. If not properly protected it forms oxides and nitrites and result in weld deficiencies such as porosity, slag inclusion and weld embrittlement. Thus the shielding gas and its flow rate have a substantial effect on the following: Arc characteristics, Mode of metal transfer, penetration and weld bead profile, speed of welding, cleaning of action, weld metal mechanical properties. Argon, helium and argon-helium mixtures are used in many applications for welding non-ferrous metals and alloys. Argon and Carbon dioxide are used in Carbon steel**.**

The travel speed is the rate at which the arc travels along the work- piece. It is controlled by the welder in semiautomatic welding and by the machine in automatic welding. The effects of the travel speed are just about similar to the effects of the arc voltage. The penetration is maximum at a certain value and decreases as the arc speed is varied. For a constant given current, slower travel speeds proportionally provide larger bead and higher heat input to the base metal because of the longer heating time. The high input increases the weld penetration and the weld metal deposit per unit length and consequently results in a wider bead contour. If the travel speed is too slow, unusual weld build-up occurs, which causes poor fusion, lower penetration, porosity, slag inclusions and a rough uneven bead. The travel speed, which is an important variable in MIG, just like the wire speed (current) and the arc voltage, is chosen by the operator according to the thickness of the metal being welded, the joint fit-up and welding position**.**

II. EXISTING SYSTEM

Increasing the productivity and the quality of the welded parts are the main challenges of production industry; there has been increased interest in monitoring all aspects of the welding process. Welding current and proper wire electrode are the important parameter in manufacturing engineering. It is a characteristic that would influence the performance of mechanical parts and production costs. Strength of weld is commonly considered as a major manufacturing goal in many of the existing researches. Taguchi and Analysis of variance (ANNOVA) can conveniently optimize the welding parameters with several experimental runs well designed.

[1] investigated to determine whether the fatigue strength of friction stir (FS) welds is influenced by the welding speed, and also to compare the fatigue results with results for conventional arc-welding methods MIG-pulse and TIG. The specimen involved is Al alloy 6082 was subjected to a post-weld ageing treatment. According to the results, welding speed in the tested range, representing low and high commercial welding speed, has no major influence on the mechanical and fatigue properties of the FS welds. At a significantly lower welding speed, however, the fatigue performance was improved possibly due to the increased amount of heat supplied to the weld per unit length. comparative examinations in the literature on the fatigue strength of fusion (MIG) and FS welds is done. The TIG welds had better fatigue performance than the Impulse welds. Comparison shows that TIG welds are better which is having higher fatigue performance than MIG. Mechanical and fatigue properties are independent of weld speed.

[2] has proposed the optimization of welding parameters using Genetic Algorithm. Welding is a major bonding technique in the industry. The importance of welding directed many researches to search how well welding can be obtained. Three main indicators, such as welding current (A), welding velocity (v) and arc length (b), have a big influence in the quality welding. Since all these factors affect the quality of the welded joining parts, the effect of these parameters was investigated experimentally. The present paper describes the use of stochastic search process that is the basis of genetic algorithms (GAs), in developing estimation of the welding parameters for the joined brass plates. Developed models having non-linear estimation models using GA techniques are validated with actual data. Genetic Algorithm Welding Current Estimation Model and Genetic Algorithm Welding Velocity Estimation Model are used to estimate the welding current and velocity according to the welding environment for the brass material

III. PROPOSED SYSTEM

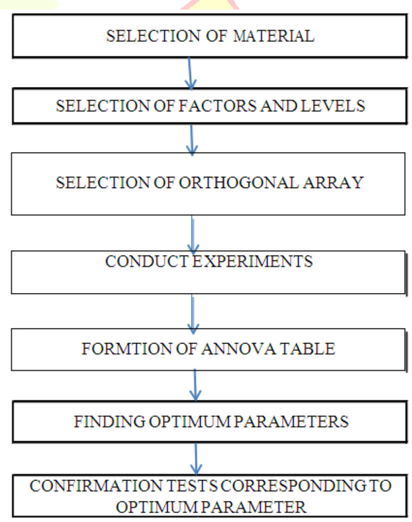

Fig.1. Block Diagram for Proposed Methodology

From the literature reviewed it is observed that most of the researchers have used Taguchi Method for multi objective optimization. Few of them have used Genetic algorithm, Artificial Neural Network, Back propagation Algorithm, Response Surface

Methodology.MIG welding,TIG welding,Laser beam welding and friction stir welding process has been considered for study.

Metal Inert Gas welding is a process in which the source of heat is an arc formed between a consumable metal electrode and the work piece, and the arc and the molten puddle are protected from contamination by the atmosphere (i.e. oxygen and nitrogen) with an externally supplied gaseous shield of inert gas such as argon, helium or an argon-helium mixture. No external filler metal is necessary, because the metallic electrode provides the arc as well as the filler metal. It is often referred to in abbreviated form as MIG welding. MIG is an arc welding process where in coalescence is obtained by heating the job with an electric arc produced between work piece and metal electrode feed continuously. A metal inert gas (MIG) welding process consists of heating, melting and solidification of parent metals and a filler material in localized fusion zone by a transient heat source to form a joint between the parent metals. Gas metal arc welding is a gas shielded process that can be effectively used in all positions. MIG welding process is shown in Fig.2. Specimen after welding is shown in Fig.3.

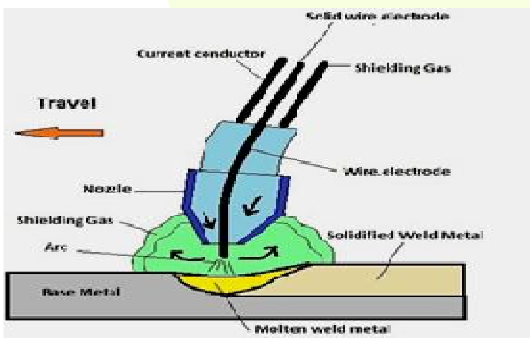

Fig.2. MIG welding process

Fig.3. Specimen after MIG welding

IV. CONCLUSION

Optimization is done on MIG welding process parameters AA 5456 weldments using DOE. Taguchi is used mostly in all optimization process. The main objective of this work is to optimize the MIG welding Process parameters on AA 6061 to yield maximum ultimate tensile strength and hardness using Taguchi method. Four parameters and two levels has been selected. Experiments have been conducted as per parametric combination of L8 Orthogonal Array for this project work. Project work is to be extended to measure the output responses and perform analysis of variance. Finally optimum process parameters is to be calculated. Confirmation test will be performed to ensure optimum results.

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