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REVIEW PAPER ON OPTIMIZATION OF PROCESS PARAMETERS FOR MIG WELDINGBY USING GREY RELATIONAL ANALYSIS

Ashish Kumar Vaishya[1], Hemendra Patle[2], Puran Gour[3]

[1]M.Tech. Scholar Department of Mechanical Engineering, NIIST, Bhopal (M.P.), India.

[2]Assistant professor, Department of Mechanical Engineering, NIIST, Bhopal (M.P.), India.

[3]Principal, NIIST, Bhopal (M.P.), India.

ABSTRACT

The traditional arc welding technique has significant challenges when it comes to welding aluminum, and the repeatability of the weld depends on the control of welding speed and other processing factors. In order to achieve a high strength junction, GMAW welding of mild steel that was 5 mm thick was performed in this investigation. The parameters will be used like welding current, gas flow rate, and nozzle to plate distance. The MS plate is welded from both sides to increase its strength. The primary objective of the research will be to examine the impact of welding current, gas flow rate, and nozzle to plate distance on the macrostructure, microhardness, and tensile strength of the weld joint. The Rockwell hardness tester and the UTE100 will be used for measuring the tensile strength and hardness, respectively. Tensile strength and hardness will find which most significantly impacted by the preheat temperature.

Keywords- GMAW welding, tensile strength, hardness, preheat temperature, UTE100, Rockwell hardness

1. INTRODUCTION

By applying heat and pressure to the contacting surfaces of various materials, such as metals, alloys, or plastics, welding is a permanent joining technique. The work components that need to be linked are melted during the welding process, and a permanent joint can be created once the melted metal solidifies. Sometimes a filler material is added to form a weld pool of molten material in between the two or more work pieces which after solidification gives a strong bond between the work pieces.

A gaseous shield that is supplied externally and can be either inert (such as argon, helium, or an argon-helium mixture) or active (such as carbon dioxide, an argon-carbon dioxide mixture, which is chemically active or not) can shield the arc and the molten puddle from contamination by the atmosphere (i.e., oxygen and nitrogen) during the process of gas metal arc welding. GMAW was once known as MIG welding since the molten puddle was merely shielded by inert gases.

This method could only be used on silicon bronze, aluminum, and deoxidized copper. The term "MAG" (metal active gas) welding originated when it was successfully utilized to weld mild steel, ferrite, and austenitic steels utilizing active gasses instead of inert gasses. When using the GMAW (MAG) process, the amount of welding current, the shielding gas, the current density, the electrode extension, and the electrode chemistry all affect how the metal transfers from the electrode tip to the weld pool across the arc. The metal transfer can be globular, spray, or short-circuiting. Whatever the welding current, current density, and other variables may be, CO2 shielding is both globular and non-axial. There is a lot of splatters as a result.

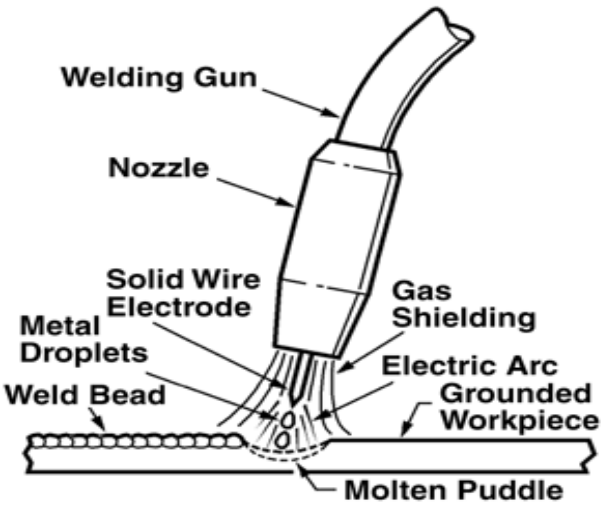

Figure 1. GMAW welding process

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2. LITERATURE REVIEW

Prakash BabuKanakavalli, et al. (2019) discussed application of Taguchi and Grey relational analysis methodologies in determining optimal process parameters for MIG Welding are presented. In the present work welding current, voltage, speed, bevel angle was considered as input parameters in joining two dissimilar metals (AISI1010 & AISI1018), as these influence the output characteristics like tensile strength and hardness, these parameters need to be optimized.

Ashish Chafekar, at al. (2019) discussed on semi- automatic pulse MIG welding machine according to the L9 orthogonal array with replication. The process parameters viz. welding voltage, wire feed rate and dynamic is significant in intelligent MIG welding machine have been considered as variables.

Dharmendra B.V. et al. (2019) discussed multi-objectiveoptimization technique for identifying a set of optimum abrasive water jet machining (AWJM) parameters to achieve maximum material removal rate (MRR) and minimum surface roughness.

Priyanka Devidas Shinde, et al. (2018) presented the effect of welding parameters such as welding current, welding voltage and gas flow rate on depth of penetration and ultimate tensile strength using Taguchi technique. Two types of oxides MgCO3 and Cr2O3 were used to examine the effects of activating flux on penetration in mild steel Fe 410 of size 100×65×6 mm by GMAW with a V-groove weld joint design.

Nabendu Ghosh et al. (2018) discussed dissimilar joints between AISI 409 ferritic stainless steel and AISI 316L austenitic stainless steel, are made by GMAW (Gas metal arc welding) using ESAB AUTO Rod 316L as filler wire. Welding has been conducted as per L9 orthogonal array of Taguchi method. Three levels of the input parameters: welding current, gas flow rate and nozzle to plate distance, have been selected.

Arham Khan, et al. (2018) carried out Taguchi methodis used to formulate the experimental design. Design of experiments using L9 orthogonal array is employed to perform cladding operation. The input process parameters of pulse current GMAW considered include mean current,arc voltage, pulse frequency and wire feed rate.

Saadat Ali Rizvi, et al. (2018) discussed centre on optimizing different welding parameters which affect the weldability of SS304H, Taguchi technique was employed to optimize the welding parameters and fracture mode characterization was studied. In this study we aor found out minimum surface roughness

Shekhar Srivastava et al. (2017) carried out effect of thevarious process parameters has been studied on welding of IS:2062 mild steel plate using gas metal arc welding process with a copper coated mild steel wire of 0.8 mm diameter. A set of experimentshas been performed to collect the data using Box Behnken Design technique of Response Surface Methodology. Based on the recorded data, the mathematical models have been developed. Further an attempt has been made to minimize the bead width and bead height and maximize the depth of penetration using response surface methodology.

NabenduGhosh et al. (2017) investigated the effects of welding parameters: welding current, gas flow rate and nozzle to plate distance, on ultimate tensile strength (UTS) and Yield Strength (YS) in MIG welding of AISI409 ferritic stainless steel to AISI 316L Austenitic Stainless-Steel materials. Experiments have been conducted as per L9 orthogonal array of Taguchi method. The observed data of UTS and YS have been interpreted, discussed and analyzed with use of Taguchi Desirability analyses.

ArunkumarSivaraman et al. (2017) focuses on the optimization of process parameters for MIG welding of the material AA219-T87 using Taguchi based grey relational analysis. The welding input parameters play a vital role in optimized desired weld quality. The input parameter chosen were the welding current, Voltage and welding speed. The experiments were conductedaccording to L9 orthogonal array.

Kumar Rahul Anand et al. (2017) studied the mechanical properties of the joint of austenitic stainless steel (AISI 316) and mild steel welded by TIG welding. In this paper with the use of Taguchi method of optimization we have tried to optimized the various process parameter such as current, voltage and gas flow ratio (GFR) which has influence on tensile strength and hardness of the joint. However, investigation is based on the Taguchi approach of orthogonal array using analysis of variance (ANOVA) to determine the influence of process parameter and to optimize them.

3. METHODOLOGY

Workpiece material

For the experiment, a commercial MS plate will be use with a thickness of 5 mm was chosen as the work piece material. Using a power saw, the MS plate was cut to the necessary dimensions, and the edge was ground smooth to prepare the surface for joining. Surfaces are next polished with emery paper to get rid of any remaining foreign material.

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Taguchi method

The Taguchi method of quality control is an approach to engineering that emphasizes the roles of research and development (R&D), and product design and development in reducing the occurrence of defects and failures in manufactured goods.

This method, developed by Japanese engineer and statistician Genichi Taguchi, considers design to be more important than the manufacturing process in quality control and aims to eliminate variances in production before they can occur.

- In engineering, the Taguchi method of quality control focuses on design and development to create efficient, reliable products.
- Its founder, Genichi Taguchi, considers design to be more important than the manufacturing process in quality control and seeks to eliminate variances in production before they can occur.
- Companies such as Toyota, Ford, Boeing, and Xerox have adopted this method.

Understanding the Taguchi Method of Quality Control

The Taguchi method gauges quality as a calculation of loss to society associated with a product. In particular, loss in a product is defined by variations and deviations in its function as well as detrimental side effects that result from the product.

Loss from variation in function is a comparison of how much each unit of the product differs in the way it operates. The greater that variance, the more significant the loss in function and quality. This could be represented as a monetary figure denoting how usage has been impacted by defects in the product.

Example of the Taguchi Method of Quality Control

If the product is a precision drill that must consistently drill holes of an exact size in all materials it is used on, then part of its quality is determined by how much the units of the product differ from those standards. With the Taguchi method of quality control, the focus is to use research and design to ensure that every unit of the product will closely match those design specifications and perform exactly as designed.

Loss from detrimental side effects on society speaks to whether or not the design of the product could inherently lead to an adverse impact.

For example, if operating the precision drill could cause injury to the operator because of how it is designed, there is a loss of quality in the product. Under the Taguchi method, work done during the design stage of creation would aim to minimize the possibility that the drill is crafted in a way that could cause injuries to the operator.

Grey Relational Analysis

Grey relational analysis (GRA) was developed by Deng Julong of Huazhong University of Science and Technology. It is one of the most widely used models of grey system theory. GRA uses a specific concept of information. It defines situations with no information as black, and those with perfect information as white. However, neither of these idealized situations ever occurs in real world problems. In fact, situations between these extremes, which contain partial information, are described as being grey, hazy or fuzzy. A variant of GRA model, Taguchi-based GRA model, is a popular optimization method in manufacturing engineering.

The theory has been applied in various fields of engineering and management. Initially, the grey method was adapted to effectively study air pollution and subsequently used to investigate the nonlinear multiple-dimensional model of the socio-economic activities' impact on the city air pollution. It has also been used to study the research output and growth of countries.

4. CONCLUSIONS

1. The problem will be presented in this paper and will be analysed using based grey relational analysis.
2. Will discovered that the Grey relational analysis parameter design based on Taguchi offers a straight forward, organized, and effective approach for the optimization of the GMA welding parameters.
3. The primary effect will be indicating that the tensile strength and hardness are significantly impacted by the preheat temperature, gas flow rate, and welding current.

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