A REVIEW STUDY OF TENSILE STRENGTH AND HARDNESS OF MIG WELDING JOINT OF DISSIMILAR STEEL ALLOYS

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***Abstract*: Welding is a process of connecting comparable and dissimilar metals using a filler rod and with or without the use of pressure. Metals or thermoplastics are welded during the welding process. At the simplest level, welding requires the application of four components, such as metals, a heat source, filler metal and a kind of air barrier. The metals are heated while protected from the air to their melting points, and a filler metal is then added to the heated region in order to create a single piece of metal. The welding technique is widely used for household and industrial applications such as joining of railways, ships, roads, bridges and mechanical components, etc. The brazing and soldering methods are comparable to the welding process. It is very beneficial in the creation of high-quality products to use the Taguchi method. We are unable to handle the many design elements without the assistance of human judgments, and doing so would be very time consuming and expensive. This paper review Parametric Optimization for Tensile Strength and Hardness of MIG Welding Joint of Dissimilar Steel.**

***Keywords*: Parametric Optimization, Tensile Strength, MIG Welding, Steel Alloys, Taguchi Technique**

I. INTRODUCTION

The history of MIG welding, power supply and the continuous feeding of electrode wire. And also grasp how gasses may be mixed and the optimum shielding procedure created. The 'Humphrey Davy's found in 1800s arc welding and in 19th century MIG welding was created. First, thereafter, carbon electrodes have been utilized. The Metal Electrodes were created by 1800s 'N.G. Slavianoff' and 'C.L. Coffin.' The precursor of GMAW was developed by P.O. Nobel in the 1920s. The continuous feed rate was regulated by direct current, bare electrode wire and arc voltage. A protective gas was not utilized to protect the surface of the solder. Another Gas Metal Arc welding precursor was introduced in the 1926s. This technique was not appropriate during actual practice. MIG welding's formal history began in the 1948s. GMAW was ultimately created by the 'Batelle Memorial Institute' The welding operation was funded by "Air Reduction Company," and 'Devers' and 'Hobart' do the work. During this procedure 'H.E. Kennedy' developed a consistent voltage supply and a reduced electrode diameter. And the aluminum electrode was constantly supplied in this procedure, Argon was utilized as a shielding gas. And a high deposition rate was provided, but its cost was greater because of the high cost of inert gas. And the non-ferrous metal was utilized in this procedure. In the 1953s carbon dioxide gas was utilized as a solder; the atmosphere was also created and became the most popular. The work is done by 'Novoshilov' and 'Lyubavshikii' and a big steel electrode diameter was utilized in this procedure. Higher heat was produced by the arc, and the employment of welders discouraged part of the welding process. Thus, welding steel has become more inexpensive in this kind of procedure. In 1958 and 1959 the minor variant of MIG welding was introduced, increasing the flexibility of welding. Smaller wire and improved power supply electrodes were utilized. Electrodes wire diameter was between 1.9 mm and 1.6 mm and GMAW became more powerful. In the 1960s there was a spray-arc transfer [2]. Many research studies were developed in the 1960s that enhanced energy supply outcomes and research. This technique was followed by pulsed current and a novel method termed pulse-arc changes or variations. This kind of technique was utilized in studies from the 1950s for the fast speed between a high and lower energy current. In this kind of welding technique, lesser heat was utilized. Additional power source was created in the 1970s. And the GMAW-P and GMAW processes are continuously improved. GMAW's work was finished at "Welding Institute of the UK." This establishes the linear connection between pulsed frequency and wire feed speed. 'Lincoln Electric' develops the surface voltage transfer (STT) that uses arc power supply. 'Lincoln' incorporates computerized circuits and arc welding software. This produced electricity via the waveform generator, a technique that requires no consistent voltage and current sources. Today, GMAW is the most important. Economic method of welding, utilized in sheet metal, automotive sectors. And now GMAW uses electrodes depending on the material thickness and current range for a broad variety of materials [2].

Metal Inert Gas (MIG) welding

MIG sold is an arc welding technique in which solid consumable wire electrode are supplied between work components by use of a soldering torch. Joining the two materials correctly or using the electric arc in this procedure, are shapes between the work part and the wire electrode that heat and melt and add metals. A protective gas is also used to feed the soldering torch or gun into the weld region to protect against environmental conditions, such as argon, helium, carbon dioxide, nitrogen and others. Mostly CO2 is commonly utilized for MIG soldering since it is cheaper and used to penetrate deeper etc. This kind of soldering may be automated and semi-automatic. The thickness of the metal for MIG should be more than 3mm. Constant voltage and direct current are the most frequent power source for MIG welding. For MIG welding, Mild steel, Stainless steel and aluminum etc. are utilized in certain metals.

1. Mild steel is readily soldered and has less difficulties.
2. Due to oxides formed during the welding process aluminum is difficult to weld using MIG welding. But with TIG welding, easy to weld.
3. Easy soldering of inox steel needs a greater expertise than mild steel.

MIG welding with ferrous and non-ferrous metals may be done simply. And because of flexibility, faster deposition rates etc. it plays a major part in industry.

II. LITERATURE REVIEW

In this literature, the optimization of tensile strength and micro hardness characteristics of the different MIG soldering metals has been addressed. The literature review on MIG welding was based on research papers, books and articles on MIG welding procedures. Different research papers have been examined and the research gap discovered on the basis of which the goal of the study has been established.

Taichi Murakami et al. [12] investigated the dissimilar aluminum-stain metal joining that was challenging because of forming at the interface of the welded joints the fragile metal composite. The technique of repressed development of the inter-metal compound layer was described during brazing of metal inert gas arc.

In the research M.Maryaet al.[13] The author describes that the joints of dissimilar metals and alloys were an essential component of domestic devices and heat exchange systems and that quick and economic industrial procedures to connect aluminum to copper or stainless steel were difficult to develop and implement. Microstructures on the interface between aluminium and other alloys or metals of electromagnetic solders were also studied. After examination, the characteristics of solder such mechanical, electrical, etc. and microstructures were checked.

H.T. Zhang et al. [14] noted the microstructure and characteristics of aluminum-zinc coated steel lap joints formed by modified CMT inert gas welding joints. After the tensile tests were done, the welding method revealed that it was possible to provide excellent aluminum-zinc-coated connections in steel.

K. Kishore et al. [15] have studied the importance of welding materials such as steel. They investigated the flaws in the AISI 1040 gaseous shielding arc welding (TIG and MIG). In describing the orthogonal array, Taguchi methods were utilized. The collected data was verified using ANOVA. The data were obtained using Ultrasound

Tests for the angle beam tests for soldering tests. The findings revealed that there were flaws like LOP, Blowhole, LOF and fractures in the specimens. In this literature, H.T Zhang et al. [16] made lap joints of two different material sold between 1 mm thick magnesium and aluminum alloy plates by employing MIG solding in which zinc foil was employed as a barrier and a crack-free connection was achieved. At the contact between the fusion zone and the unmelted magnesium alloy, a crack was observed. The tensile strength was performed on the lap joint and the value was 64 MPA.

Satyaduttsinh P. Chavda et al. [17] This study article showed the effect of MIG soldiers on sold pools shape and welding strength of Medium Carbon Steel material during the welding process such as wire feed rate, flow rates of gas, welding current, etc. To improve the welding settings, the DOE technique was utilized to identify the optimum combinations of parameters. In order to collect the date and analysis of variance (ANOVA), experimental Taguchi methods were employed and orthogonal array was used for the research of welding properties and for optimisation of soiling parameters.
This study examined the impact of soldering settings on the mechanical characteristics of MIG welding and GA tungsten arc soldering. Gejendhiran S. et al. [18] (GTAW). The review article demonstrates the impact on the mechanical characteristics of welding of different soldering parameters such as gas blinding, welding speed, current, voltage etc. This paper also analyzed the different test techniques used to evaluate the mechanical characteristics of the weld material.

Rajesh Kumar et al.[19] demonstrated the impact on the mechanical property of various input welds such as arc voltage, root gap and soldering current during the MIG welding of mild steel grade 1018. In this literature, the strength, tensile strength and microstructure of the sold specimen were examined. The Taguchi technique L9 orthogonal array has been used. To determine the meaning of input parameters Variance analysis (ANOVA) was performed. Root gap was shown to have the most impact on tensile strength and arc voltage on the harness. Gasmetal Arc Welding (GMAW) was utilized in this study to demonstrate the impact of voltage (V), gas flow rate (L/Min), current (A) and speed (M/in) on the Ultimate Strength of tensile material ST-37 low alloy stainless steel. To identify the UTS, L9 orthogonal array has been done. The effect of welding parameters such as welding current, welding voltage etc on mechanical characteristics such as hardness etc on austenitic stainless steel AISI 316 was given in this study article [21]. Kapil B. Pipavat et al. In this study, the DOE technique was utilized to optimize parameters and to get the optimum combinations of parameters. In this study Taguchi method was used to identify the findings in the orthogonal array, and variance analysis (ANOVA) was utilized to identify the soldering features.

The effect of welding parameters such as welding voltage, welding speed and welding current on the ultimate AISI 1030 tensile strength was investigated by S.R Patil et al.[22] during this study. Taguchi methods were employed in this research to optimize the welding settings and to examine the signal to noise (S/N) soldering properties, variance analysis (ANOVA) and orthogonal array. This study report showed that the key factors for tensile strength were the welding speed and the soldering current.

In this study paper, Vikas Chauhan et al. [23] examined the use of MIG welding in comparable and dissimilar metals. The Metal Inert Gas welding was successfully combined with two dissimilar metals such as stainless steel (SS-304) and low carbon steel plate. Three MIG welding parameters, such as travel speed, voltage and current were utilized for analyzes. To get the data, an experimental

Taguchi method was utilized. The significance of each parameter was analyzed in the variance analysis (ANOVA) and software MINITAB-13 was utilized for the signal to noise ratio study.

In this study article K. Sivasakthivel et al.[24] presented a technique for determining optimum settings of the welding process parameters for MIG welding. The influence of process factors were included characteristics such as tensile strength, penetration, etc. This study article utilized techniques such as Taguchi and ANOVA to optimize parameters and identify the optimum settings.

Vineeta Kanwal and R.S. Jadoun[25] utilized aluminum alloys of 6061 and 5083 grades in their study (75x60x6mm). MIG hardness parametric optimization was done using Taguchi techniques. Parameters were utilized, such as solder speed, soldering current and soldering voltage. The tests were conducted using an orthogonal array, L9. Noise and variance analysis (ANOVA) were used to investigate the welding properties.

In this study, the author has shown the impact soldering parameters such as welding current, gas flow rate, etc., for maximizing soldered connections strength and hardness. The Taguchi technique has been used to reduce variance in a process by means of experimental design. This article demonstrated an effective technique for optimizing the welding parameters for gas metal arc by utilizing Taguchi's methodology to increase the weld capacity of high-speed steel of grades M2 and low carbon steel.

Pranesh B. Bamankar et al.[27] This review study examined the extremely common use of MIG welding to industrial welding operations. The review is relies on researchers' optimization methods and analytical tools for optimizing parameters. In this literature Chandan Kumar et al. [28] utilized austenitic stainless steel solid wire of type AISI 304 with a diameter of 1.2mm. In this study work, metal inert gas welding has been utilized and different process parameters have been optimized.

Nawres Jabar Nasser[29] is investigating the impact of the MIG welding method on the mechanical characteristics of dissimilar 2024-T351 and AA 6061-T651 aluminum alloys. A number of experimental methods for assessing the mechanical characteristics of the alloy, including hardness testing, stress tests and bending tests, were performed for sold and unwelded specimens.

In this study work, Sharmistha Singh et al.[30] examine the hardness that influences the welding joint of different metals. Using MIG welding, with the aid of stainless-steel filler, Stainless Steel 304 was welded into mild steel. The results showed the optimal current and voltage values to be applied for welding for maximal hardness of the specimen of welded mild steel and 304 stainless steels.

In this publication, K. Palani et al. [31] examined the impact of weld settings on the comportments of the microstructure of MIG soldering and Friction Stir solder connection. The significance of solder parameters has been emphasized. The microstructural research was performed with the use of a scanning electron microscope to better control and fault free sold joints.

Jigar Shah et al.[32] explains how welding factors such as welding current, welding tension, flow rate etc. affect solder strength, weld joint hardness, welding bag shape of different metal materials during welding. The DOE technique allows the parameters to be adjusted and the optimum combination of parameters for target quality. The DOE method analysis may provide the importance of the parameters since it affects the quality and strength of the product.

The author of a research of the analysis of the impacts on welding parameters such as welding current, gas flow rates, and platform nozzling, on the ultimate tensile strength (UTS) and percent elongation (PE) of AISI409 ferritic stainless steel welder, reported Nabendu Ghosh et al.[33]. The Taguchi technique L9 orthogonal array was utilized for analysis. UTS and PE were addressed and analyzed using the Taguchi approach and the signal-to-noise ratio analysis.

In this review article, Anil Kumar et. al [34] points out that the most significant variables influencing the quality, productivity and costs of welding are the MIG welding parameters. The author has investigated soldering parameters, such as welding current, soldering speed, root arc voltage gap etc. The study was based on researchers' optimization methods and analytical tools for optimizing parameters.

A. Sivashankar et al. [35] tests were conducted on SS410 of this study.

3 mm thick using the technique of Gas Metal Arc (GMAW) welding. The study was applied on an austenitic steel specimen with dimensions 50 utilizing Taguchi technique. The specifications of X 50 X 10 mm were arc current, arc tension and inert gas pressure.

In this Research Paper, Bhuvan Bhardwaj and Ravinder Singh [36] discovered that the AISI 200 SS (Stainless Steel) had comparable mechanical characteristics when compared with AISI 304, however its chloride environment was less resistant to corrosion. The gas flow rate, solder current and welding speed effects were studied in the tensile strength and hardness of the solder connections.

CONCLUSIONS AND FUTURE SCOPE

In this present research, a choice of three parameters, i.e., soldering current, voltage and gas flow rate, were chosen for MIG welding of Stainless Steel 202 and Stainless Steel. The need to choose these three parameters is only due to these three factors having the most impact on the geometry of the solder bed. The research is carried out using 9 components. On the basis of Taguchi design, the orthogonal array L9 (3*3) is utilized. The research showed that soldering voltage has the most impact, followed by soldering current and gas flow rate, in the case of tensile strength. In the event of hardness, the most important impact is the gas flow rate followed by the soldering current and the soldering voltage. Taguchi technique is extremely helpful in the development of goods of high quality. With the aid of human judgements, we cannot manage the different design aspects and it is very time consuming and costly if we do so.

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