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Influence of Wire Speed Parameter on Tensile Strength of SS-316 and MS-2062 Weld Joint in MIG Welding

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ABSTRACT : This work was carried out in order to study the mechanical behavior of welded joints of SS 316 with MS 2062. Welding input parameters play a very significant role in determining the quality of a weld joint. It has been observed that when wire speed rate was increased the tensile strength got influenced. This experimental work helped in determining the optimum welding input parameters that lead to the desired weld quality.

Keyword : Wire speed, current, gas flow rate, inert gas, tensile strength, SS 316, MS2062, weld joint.

I. INTRODUCTION

Gas metal arc welding (GMAW), sometimes referred to by its subtypes metal inert gas (MIG) welding or metal active gas (MAG) welding, is a welding process in which an electric arc is formed between a consumable wire electrode and the work piece metal(s), which heats the work piece metal(s), causing them to melt, and join. Along with the wire electrode, a shielding gas is fed through the welding gun, which shields the process from contaminants in the air [2]. Generally, the quality of a weld joint is directly influenced by the welding input parameters during the welding process; therefore, welding can be considered as a multi input multi-output process. Unfortunately, a common problem that has faced the manufacturer is the control of the process input parameters to obtain a good welded joint with the required bead geometry and weld quality with minimal detrimental residual stresses and distortion. Traditionally, it has been necessary to determine the weld input parameters for every new welded product to obtain welded joint with the required specifications. To do so, requires a time-consuming trial and error development effort, with weld input parameters chosen by the skill of the engineer or machine operator. Then welds are examined to determine whether they meet the specification or not. Finally the weld parameters can be chosen to produce a welded joint that closely meets the joint requirements. Also, what is not achieved or often considered is an optimized welding parameters combination, since welds can often be produced with very different parameters. In other words, there is often a more ideal welding parameters combination, which can be used if it can only determined [1].

II. MECHANICAL PROPERTIES

In any welding process, the input parameters have an Influence on the joint mechanical properties. By varying the input process parameters combination the output would be different welded joints with significant variation in their mechanical properties. Accordingly, welding is usually done with the aim of getting a welded joint with excellent mechanical properties. To determine these welding combinations that would lead to excellent mechanical properties. Different methods and approaches have been used to achieve this aim. The following is a review of some articles that utilized these techniques for the purpose of optimizing the welding process in order to achieve the desired mechanical properties of the welded joint.

A. Austenitic Stainless Steel

Austenitic Stainless Steel, such as the type 300 series, contains sufficient amounts of chromium to guarantee corrosion resistance, along with nickel to ensure the austenitic phase at room temperature. 304, 308, 309, 310, 316, 320, 321, 347 etc are comes under the austenitic steels category. The basic composition of traditional stainless steel includes 18% chromium and 8% nickel alloy, but can also includes alloys of molybdenum, titanium, niobium, copper and nitrogen. Austenitic stainless steels have high ductility, low yield strength and relatively high ultimate tensile strength, when compare to typical carbon steel. Because of their excellent corrosion resistance, better creep rupture strength at high temperature, and impact resistance at low temperature, austenitic stainless steels are often used in industrial plants, chemical processing, food production, marine hardware, furnaces, heat exchangers, gas turbines and cryogenic vessels [3, 7, 8, 10].

Austenitic stainless steels exhibits considerably higher thermal expansion than other stainless steels and the thermal conductivity is generally lower than that of carbon steel. Such characteristics cause a serious thermal series in applications with temperature fluctuations, heat treatment of complete structures and on welding. [4, 5, 6].

B. Stainless steel 316 (Properties and applications)

In metallurgy, stainless steel, also known as inox steel or inox from French "inoxyable", is defined as a steel alloy with a minimum of 10.5 or 11% chromium content by mass. Stainless steels does not corrode, rust or stain with water as ordinary steel does , but despite the name it is not fully stain proof. It is also called corrosion-resistant steel or CRES. When steel grades and the alloy types are not detailed, particularly in the aviation industry. There are different grades and surface finishes of stainless steel to suit the environment the alloy must endure. Stainless steel differs from carbon steel by the amount of chromium present. Unprotected carbon steel rusts readily when exposed to air and moisture. This iron oxide film is active and accelerates corrosion by forming more iron oxide. Stainless steel contains sufficient chromium to form a passive film of chromium oxide, which prevents further surface corrosion and blocks corrosion from spreading into the metals internal structure [3, 11, 13].

The common applications are of stainless steels are given below :

1. Oil and petroleum refining equipment.
2. Food processing equipment.
3. Pulp and paper processing equipment.
4. Soap and photographic handling equipment.
5. Textile industry equipment.
6. Architectural equipment.
7. Pharmaceutical processing.

Mechanical properties of stainless steel 316

Hardness, Rockwell B	79
Tensile strength, Ultimate	558 Mpa
Tensile strength, Yield	290 Mpa
Elongation at Break	50 %
Modulus of Elasticity (Tensile)	193 Gpa
Modulus of Elasticity (Torsion)	77 Gpa

C. MS-2062 (Properties and application)

This standard was formerly known as IS-226. Now IS-2062 has replaced this specification. Mild steel is the most common form of steel because its price is relatively low whole it provide material properties that are acceptable for many applications. Low carbon steels contain approximately 0.05-0.015% carbon and mild steel contains 0.16 to 0.29% carbons; therefore, it is neither brittle nor ductile. It has relatively low tensile strength, but it is cheap and malleable; surface hardness can be increased through carburizing. The density of mild steel is approximately 7.85g/m3 and modulus of elasticity is 210 Gpa.

III. EXPERIMENTAL WORK

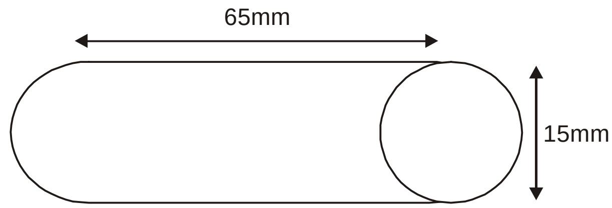
In this experimental study firstly, work piece of stainless steel-316 and mild steel-2062 of following cylindrical dimensions were prepared before MIG welding.

The dimensions for SS-316 are :

Number of work pieces : 09

Length of work piece : 65 mm

Diameter of work piece : 15 mm



The dimensions for MS-2062 are :

Number of work pieces : 09

Length of work piece : 65 mm

Diameter of work piece : 15 mm

After preparing the required above dimensions work pieces, one end of the each work piece was 450 taper turned on lathe machine, then after SS-316 and MS-2062 designated work pieces were welded on MIG welding setup with required parameters as discussed in conclusion.

IV. CONCLUSION

To study the influence of process parameter (wire speed) on the weld joint of SS-316 and MS-2062 and to get the optimum values for this parameter, the prepared work pieces were welded on the experimental setup of MIG welding by making other process parameters like current, voltage and gas flow rate at constant, consequently, for each variation in wire speed parameter 3 specimen's were generated. Observations in Mechanical analysis as below:

MIG welding setup used: Welding set model (Sohal 202-XL) wire material : copper coated steel wire diameter : 0.08 mm.

Other Process Parameters were at constant value

Gas flow rate : 20Litre/ min. Inert gas : CO_2 Current : (95-100) Ampere.

Table 1.

Specimens	*Wire Speed*	*Tensile Strength*
1st	4 metre/min.	443.6 Mpa
2nd	4 metre/min.	532.4 Mpa
3rd	4 metre/min.	519.5 Mpa

Mean value of tensile strength (recorded) : 498.5 MPa

Table 2.

Specimens	*Wire Speed*	*Tensile Strength*
1st	5 metre/min.	346 Mpa
2nd	5 metre/min.	502.6 Mpa
3rd	5 metre/min.	443 Mpa

Mean value of tensile strength (recorded) : 430.5 MPa

Table 3.

Specimens	*Wire Speed*	*Tensile Strength*
1st	7 metre/min.	225 Mpa
2nd	7 metre/min.	216 Mpa
3rd	7 metre/min.	209.3 Mpa

Mean value of tensile strength (recorded) : 216 MPa

The above mechanical analysis shown in Tables, 1, 2 and 3 give an conclusion about the mechanical behavior of weld joint with the variable wire speed parameter to achieve the optimum value for this process parameter. The optimum mean value of tensile strength that is: 498.5Mpa achieved in this analysis for wire speed 4metre/min, gives us a helpful study for optimizing the process parameters regarding SS-316, MS-2062 weld joint in MIG welding process [9, 12, 14, 15].

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