An Experimental Study on Mechanical Properties of mild steel upon MIG Welding

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***Abstract*— The aim of our study is to do an experimental study on different mechanical properties and to show the influence of different parameters on a mild steel plate having dimensions (80*50*5) mm welded by MIG welding , butt joint . The input parameters such as welding current, welding voltage, nozzle to plate distance are varied and the output parameters like the feed rate and the welding speed get noticed. Each has a greater effect on hardness of welding zones especially the arc voltage followed by the welding current. Hardness of the samples are noted down by considering the effect of parameters. Microstructure of the welded metal also tested which consists of fine grains.**

***Index Terms*—Mild Steel, MIG Welding, Welding Speed, Welding Current, Hardness, Microstructure**

I. INTRODUCTION

Welding is mainly a fabrication process of joining two materials usually metals or thermoplasts by adding filler metals to molten materials. The molten material gets cool and forms a strong joint. MIG Welding uses a consumable electrode and the melting happens by Joule effect. The continuous feeding of wire is done by wire feeder. The weld paddle is dropped into the metal joint dropwise and also to prevent the contamination of different gases of atmosphere argon gas is provided. In this way the contamination of nitrogen and oxygen will not happen directly. Disadvantages of Submerged arc welding of using limited strength electrode and inability to use welding in various positions is overcome by the use of MIG welding. All important metals used in different commercial applications such as Al, Cu, and Stainless Steel are joined by MIG Welding. It is also applicable to various welding conditions. It has very large field of approach in industries for its high precision and accuracy capability. The process variables like welding current, welding voltage, nozzle to plate distance, feed rate and welding speed highly affect the strength and microstructural properties. So in present study the influence of such parameters on the strength and microstructural properties on mild steel gets investigated.

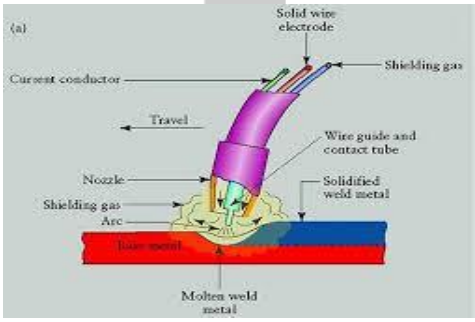


Fig 1 : MIG Welding Process

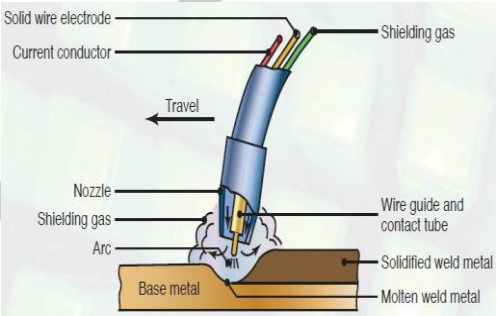


Fig 2 : MIG Welding Diagram

II. LITERATURE REVIEW

- **Suresh Kumar (2002)** investigated the microstrucural development of MIG welding upon cu metal with filler metal. The process parameters such as voltage, current and travel speed is considered and the interface microstructure was obtained.
- **Ghosal et al** prefered a large amount of research work to predict and optimise penetration depth of CO2 Laser MIG hybrid welding for Al alloy .Here the power,Focal distance ,torch angle is considered to be optimised.
- **Sapakal(2012)** uses the taguchi approach for optimisation of such welding parameters and the result shows the voltage has large effect on depth of penetration .
- The authors also investigated on the mechanical properties of mild steel .Upon MIG weldingthe input parameters considered as current, voltage, and the effects are shown in tensile strength and toughness of materials.
- **Junsherg et al** studied the effect of weld pool behaviour upon different variation of heat input.
- **S.P.Gadewar** investigated the effect of process parameters of MIG welding like weld current, gas flow rate, work piece thickness on the bead geometry of SS304. It was found that the process parameters considered affected the mechanical properties with great extent.

- **K.Kishore et al** analyzed the effect of process parameters for welding of AA6351 using MIG welding. Several control factors were found to predominantly influence weld quality. The % contributions from each parameter were computed through which optimal parameters were identified. ANOVA method was used to checking the adequacy of data obtained. The experimental revealed that low current values have created lack of penetration and high travel speed has caused lack of fusion in welding AA6351.
- **Ahmed Khalid Hussain** studied the influence of welding speed on tensile strength on welded joint in GTAW process of aluminum alloys. Experiments were conducted on specimen of single V butt joint having different bevel angels and bevel heights. The experimental results show that depth of penetration weld bead decreases with increase in bevel height. The tensile strength increased with lower weld speed and decreasing heat input rate. It was also found that bevel angle of the weld joint has profound effect on the tensile strength.

III. EXPERIMENTAL WORK

STEP 1:

Six mild steel plates having dimensions 100*80*5 mm were taken and been filed for this experimental work. In this experimental work, the specimen is welded at four different levels of welding parameter i.e. current, voltage, root gap and welding speed as shown in table 1.

Table-1: Effect of different Parameters upon MIG welding

Plate no	Welding Current	Arc Voltage	Nozzle to Plate Distance	Welding Sped
Unit	Amp	Volt	mm	mm/s
01	128	21.6	3	0.002375
02	152	22.1	5	0.002175
03	188	25.2	6	0.001687

STEP-2:

Hardness Test: The samples used for measuring Hardness are first rubbed with emery paper of size no. 400, 600, 1000 & 2000 and then cleaned with acetone solution. The diagonals of the indents formed by pyramid- shaped diamond indenter on the samples.

After being welded the plates has been cut into no of small plates having dimension as (100*15*5) mm to test the hardness of different zones. Polishing of the surfaces is done as to take the readings of Rock well Hardness test. The input and output parameters of the Rockwell Hardness Test are mentioned below:

Input Parameters:

Intender: Diamond
Load: 150kgf
Strip Dimension: 100*15*5 (in mm)

Output Parameters:

Plate no.	Hardness at Welding Zone	Hardness at a distance 40mm from the welding zone	
		Left side from the center	Right side from the center
01	26	38	48
02	27	25	24
03	27	50	53

STEP-3:

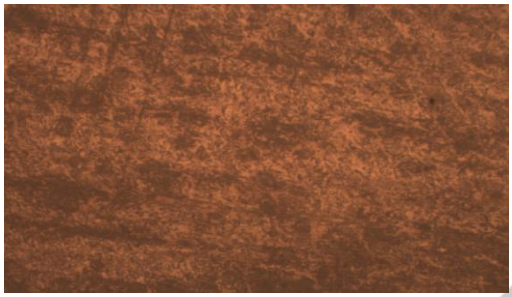
Microstructure is one of the mechanical properties which are helpful for checking out the structure of the material. Microstructure of parent material before welding is shown in fig and microstructure of weld metal for sample-1 and sample-2 is shown in fig.

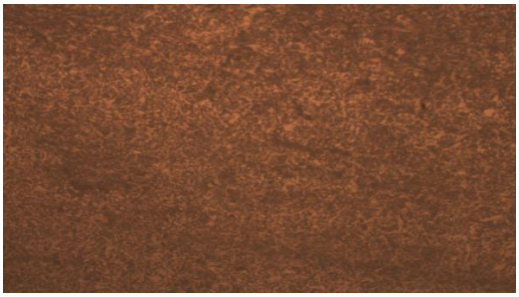
The results of the structures of microstructure of weld metal of mild steel represents a fine grains of Ferrite and Pearlite. No formation of Marten site takes place. So according our results we can conclude that our weldments have lower hardness because both pearlites are soft constituents & there is no sign of formation of marten site.

Micro preparation of the specimen and the material's surface requires that a rigid step-by-step process be followed. The first step is carefully selecting a small sample of the material to undergo microstructure analysis with consideration given to location and orientation.

This step is followed by sectioning, mounting, grinding, polishing and etching to reveal accurate microstructure and content. Detailed viewing of samples has been done with a metallurgical microscope that has a system of lenses (objectives and eyepiece) so that different magnifications (typically 50X to 1000X) can be achieved.
Scanning Electron Microscopes (SEMs) are capable of much higher magnifications and are utilized for highly detailed microstructural study structure Test.

Output Results after the Microstructure tests of two specimens:





IV. CONCLUSION

From the Hardness Test it is concluded that when the welding current increases the hardness of the weld bead also increases slightly. The results of the structures of microstructure of weld metal of mild steel represents a fine grains of Ferrite and Pearlite. No formation of Martensite takes place. So according our results we can conclude that our weldments have lower hardness because both pearlite are soft constituents & there is no sign of formation of Martensite.

V. ACKNOWLEDGEMENT

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