"OPTIMIZATION OF PROCESS PARAMETER OF MIG WELDING ON MS IS2062 MATERIAL"

Patel Sumit s. [1] , Raval Harshil B. [2] , Gandhi Karan S. [3] , Suthar Chirag D. [4] ,Mr. Sunil J. Patel [5]

1. *Student of Mechanical Engineering at Samarth College Of Engineering And Technology Himatnagar, Gujarat, India*
2. *Student Mechanical Engineering at Samarth College Of Engineering And Technology, Himatnagar, Gujarat, India*
3. *Student Mechanical Engineering at Samarth College Of Engineering And Technology, Himatnagar, Gujarat, India*
4. *Student Mechanical Engineering at Samarth College Of Engineering And Technology, Himatnagar, Gujarat, India*
5. *Assistant professor of mechanical engineering department at Samarth College Of Engineering And Technology, Himatnagar, Gujarat, India*

ABSTRACT

Gas metal arc welding with filler wire addition is a candidate process for welding MS IS2062.In GMAW the quality of the weld is characterized by the weld bead geometry as it influences the mechanical properties and its performance during service. This work focus on the development of Taguchi method and optimization using signal to noise ratio for determining the optimum/near-optimum GMAW process parameter for obtaining the optimum weld bead geometry during welding of MS IS2062.Parameter selected for study were welding voltage,welding current and gas pressure and response selected was penetration. The optimum values of parameter found using taguchi tool are welding voltage 21V, Welding current 190Amp and Gas pressure 20bar.Optimum value of weld penetration was 2.57mm.

Key Words: - *Signal to Noise Ratio, Current, Voltage, Gas pressure, Penetration, MS IS2062*

---

1. 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 forms between a consumable wire electrode and the work piece metal(s), which heats the work piece metal(s), causing them to melt and join. Welding is a procedure of joining comparable metal by the use of warmth with or without utilization of weight and expansion of filler material. Welded joint between two sections produces ceaseless and homogeneous material. Each metal has distinctive weld ability. The term weld ability implies the limit of being welded into in detachable joints. Great weld ability for a metal means; it can be welded promptly to play out its question palatably. Shielding gases are necessary for gas metal arc welding to protect the welding area from atmospheric gases such as nitrogen and oxygen.

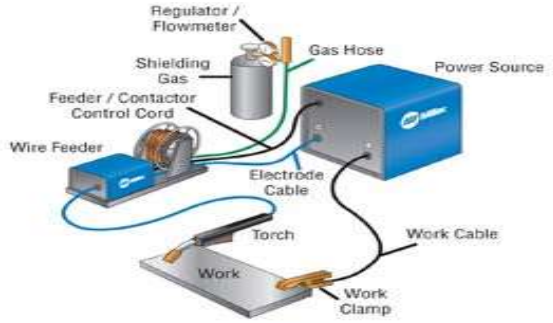

Figure-1: MIG Welding Machine

1.1 Principal of Operation:-

Inert-gas consumable electrode process, or MIG process is a refinement of TIG process, in this process, tungsten electrode has been replaced with the consumable electrode. Electrode is driven through same type of collect, which holds tungsten electrodes by a set of drive wheels. This process consists of continuously feeding a bare or processed filler metal in wire form through a suitable holder. This filler metal, which serves as the electrodes, carries the welding current and maintains a welding arc between the wire end and the work.

Wire is continuously fed to the arc at the rate at which it has consumed and transfers to base metal. Arc is shielded by inert mono atomic gas which flows from the holder nozzle through which the electrode also passes. In MIG process, consumable electrode acts as the source of arc column as well as supply for filler metal. arc obtained with this process in non- sensitive since changes in arc length result in smaller changes in arc voltages than are an countered in normal metal-arc welding Arc consists.

1.2 Advantages:-

In mig welding Very Narrow and focused curve. It can weld both ferrous and non-ferrous metals. The mig welding High quality welds. Mig welding does not utilize motion or leave any slag Small warmth influenced zone. Welding can be done in all positions. It can be easily handle.

1.3 disadvantages:-

The MIG procedure will store less filler metal per go than of alternate procedures. Increased time needed to complete welds on thick metal. Little expensive. Less portable with shorter gun lengths (15 foot guns).GMAW equipment is more expensive than SMAW equipment. In mig welding External shielding gas can be blown away by winds. High radiated heat. It can be Difficult to use in out of position joints.

1.4 Application:-

These MIGs welding process is broadly utilized as a part of the supposed cutting edge industry applications, for example,

- Automotive and Chemical Industry.
- Large, small, light, or heavy vehicles.
- Robotic welding, Aircraft, Power plant, Conveyors.
- Rail road track, Ship building, Building & bridges works

2. LITERATURE REVIEW:

Hee-Keun Lee, Kwang-San Chun, and Chung-Yen Kang[1] 2015: Lately, high production rate welding processes for Al alloys, which are used as LNG FPSO cargo con-tenement system material, have been developed to overcome the limit of installation and high rework rates. In particular, plasma-metal inert gas (MIG) hybrid (PMH) welding can be used to obtain a higher deposition rate and lower porosity, while facilitating a cleaning effect by preheating and post heating the wire and the base metal. For controlling the surface defect formation, the wire feeding speed and nozzle diameter in the PMH weld was investigated through arc phenomena with high-speed imaging and metallurgical analysis

Prasenjit Mondal, Dipankar Bose [2] 2015: Dissimilar metal welded joints are integral parts of modern-day power and process plant equipment. Among the various types of material combinations, welded joints of austenitic stainless steels and mild steel are very common in nuclear and chemical industries. The dissimilar metal joints have been emerged as a structural material for various industrial applications which provides good combination of mechanical properties like strength, corrosion resistance with lower cost. Selections of joining process for such materials are difficult because of their physical and chemical properties. Dissimilar material joints of stainless steel and mild steel are commonly uses as structural applications. Joining of stainless steel and mild steel is very critical because of carbon precipitation and loss of chromium leads to increase in porosity which affects the quality of joint leads deteriorates strength. Shielding gases are necessary in GMAW process to protect the welding area from atmospheric gases such as nitrogen, porosity and weld metal embitterment. In the present study, stainless steel plate of AISI-304 has been welded with mild steel plate of IS: 1079 by Metal Inert Gas (MIG) welding processes.

Prof. S.D. Ambekar, Sunil R.wadhokar [3] 2015: Gas metal arc welding is a fusion welding process having wide applications in industries .The present study is to investigate the influence of welding parameters on the penetration. The optimization for Gas metal arc welding process parameters (GMAW) of Martensitic Stainless steel work piece AISI 410 using Taguchi method is done. This paper presents the effect of welding parameters like welding current and wire diameter on penetration. The ANOVA and signal to noise ratio (S/N ratio) is applied to identify the most significant factor and predicted optimal parameter setting. These results showed the successful implementation of methodology.

Nabbed Gosh*a, Pradip Kumar Palb, Gautama Nandi[4] 2015:In the present work, visual inspection and X-ray radiographic test has been conducted in order to detect surface and sub-surface defects of weld specimens made of AISI 316L austenitic stainless steels. Effect of current, gas flow rate and nozzle to plate distance on quality of weld in metal inter gas arc welding of AISI 316L austenitic stainless steel has been studied in the present work through experiments and analyses. Butt welded joints have been made by using several levels of current, gas flow rate and nozzle to plate distance. The quality of the weld has been evaluated in terms of yield strength, ultimate tensile strength and percentage of elongation of the welded specimens. The observed data have been interpreted, discussed and analyzed by using Grey - Taguchi methodology

Peng Jingnan, Yang Lixin[5] 2015: Through analysis the MIG groove welding process and the welding experimental result, a complete two-dimensional mathematical model of weld section molten pool characteristics was established. Use Gaussian heat source distribution to describe the weld heat source, introduced the welding speed to establish transient heat source model on the cross section. By introducing scalar of liquid fraction, mushy region dynamic character which was described using “Darcy” model proposed for porous media, and phase change which was taken into account using source-based method, establish a unified liquid and solid control equation, CFD model was established to simulate transient heat and mass transfer phenomena in welding process. The effect of groove angle, groove depth and the welding speed on the molten pool were discussed in this paper.

R Prabhu, T Alwarsamy,R, R Ramakrishna[6] 2015: Pulsed metal inert gas welding process is more effective for cladding .the input process parameters for present analysis are welding current, welding speed, and nozzle to plate distance respectively .By using response surface methodology technique the experiments were conducted as per central composite design techniques .The measured response is convexity index and models were developed from the collection of data and checked for their adequacy.

Rakesh Sharma, R P S Sisodia, Anoop Kumar Shukla[7]2016:Purpose of this paper to use the Taguchi method and what are the effect of welding parameters on well-meant and analysis different test on it. The objective of this paper is to analyze voltage transients associated with MIG 400 welding of IS 5986 Fe410 MS for various plate thicknesses (8 mm, 10 mm & 14 mm) with 100% CO2 as the shielding gas and the relation between these transients and observation is used to analyze the depth of penetration and weld bead geometry. The weld bead geometry plays an important role in determining the mechanical properties of a weld joint. Its geometric parameters such as bead width, reinforcement height, and depth of penetration depends on the process parameters, such as thickness of material, gas flow rate, arc voltage, travel speed. Therefore, it is important to set up proper welding parameters to produce a good weld bead.

3. METHODOLOGY:

Taguchi's method is a powerful technique for the design of a high quality system. It provides not only, an efficient, but also a systematic way to optimize designs for performance and quality. Furthermore, Taguchi parameter design can reduce the fluctuation of system performance and quality to the source of variation.
The methodology used**:**

- Identify the quality characteristics and select process parameters to be evaluated.
- Select the appropriate orthogonal array and assign these parameters to the orthogonal.
- Conduct the experiments as per design matrix based on the arrangement of the orthogonal array & Recording of responses Analyze the experimental results using the signal to noise(S/N) ratio.

4. EXPERIMENTATION:

4.1. Material for Experiment*:* Mild Steel Grade MS IS2062 is used for this experiment. The chemical compositional ranges and mechanical properties of grade Mild steels IS2062 are given below:

Table-1.
Chemical Composition of SS 304

Elements	C	Mn	Si	P	Su	N
%By weight	0.16-0.18 Max.	0.70-0.90.	0.40 Max.	0.040 Max.	0.045	0.012 Max.

Table-2.
Mechanical Properties of MS IS2062

Yield Stress MPA	02% Proof Stress MPA	%Elongation
300-400	280-420	10-14 Minimum

4.2. Profile Specification*:* The shielding gas in welding using argon. The 9 specimens of size 80*60*4 mm cut from MS IS2062 sheet

4.3 Experimental Details:

1) **Selection of Process Parameters & Levels:** Process parameters and their ranges were determined by the Literature survey & by taking the review of experienced people working on MIG welding machine. Also penetration is to measure as a response.

Table-3.
Process Parameters with Levels

Sr. No.	Parameter	Symbol	Unit	Levels		
				1	**2**	**3**
1	Welding Voltage	A	Volt	16	21	26
2	Welding Current	B	Amp.	150	170	190
3	Gas Pressure	c	Bar	15	20	25

2) **Selection of Orthogonal Array**: Selection of an appropriate orthogonal array for the experiments is done on the basis of number of process parameters and its levels. As no. of parameters is 3 & no. of levels is 3, L9 orthogonal array is selected.

Table-4.
Orthogonal Array

SR. No.	Welding Voltage(V)	Welding Current (Amp)	Welding Gas Pressure (bar)
1	16	150	15
2	16	170	20
3	16	190	25
4	21	150	20
5	21	170	25
6	21	190	15
7	26	150	25
8	26	170	15
9	26	190	20

5. RESULT AND DISCUSSION:

5.1 Penetration:

Taguchi method of design of experiment is used to reduce the number of experiments, yet cover the entire parameter space with the help of a special design of orthogonal array. The results of such experiments are then transformed to a signal to noise(S/N) ratio to find out the deviation of the performance characteristics from the desired values. In this experiment, the desired characteristic for penetration is larger the better.

$$S/N = -10 \log [1/n \Sigma n i = 1 (yi^2)] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Table-5.
Average Penetration Value and Their Corresponding (S/N) Ratios.

Experiment No.	welding voltage	welding current	Gas pressure	weld penetration	$S/N_{Penetration}$
1	16	150	15	1.34	2.5421
2	16	170	20	2.05	5.2350
3	16	190	25	2.53	8.0624
4	21	150	20	2.57	8.1986
5	21	170	25	1.50	3.5218
6	21	190	15	2.23	6.9661
7	26	150	25	1.41	2.9843
8	26	170	15	1.59	4.0279
9	26	190	20	1.83	5.2490

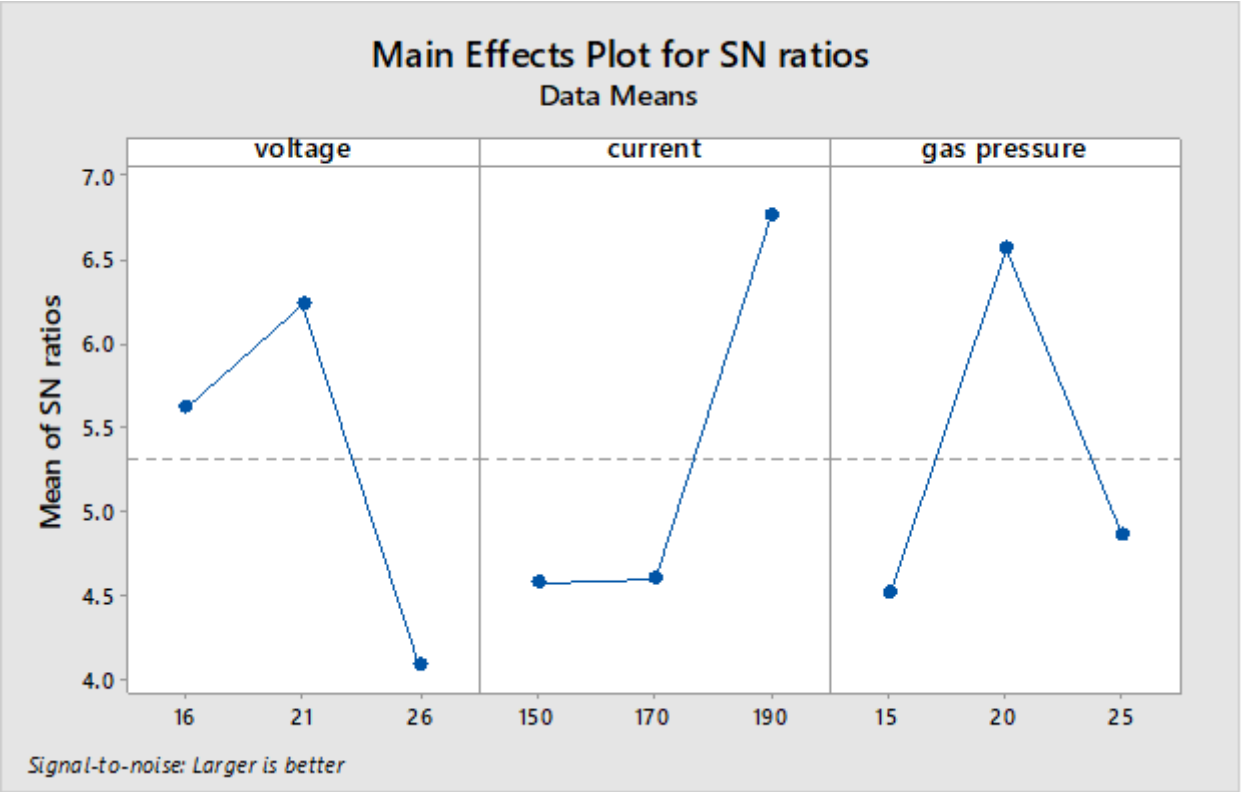

Chart-1: Signal to Noise Plot for Penetration

Table 6.
Response Table for Penetration S/N Ratios (Larger Is Better)

LEVEL	Welding voltage	Welding current	Gas pressure
1	5.613	4.575	4.512
2	6.229	4.595	6.561
3	4.087	6.759	4.856
Delta	2.142	2.184	2.049
Rank	2	1	3

Table 5 Shows the Response Table of Signal to Noise Ratios for penetration. Based on This Analysis, high penetration Is Obtained At welding voltage 21V, Welding current 150Amp and Gas pressure 20bar. The Optimal Combination from Table 6:

Welding Voltage = 21V
Welding Current=150Amp.
Gas Pressure=20bar

6. CONCLUSIONS:

- Best Result of weld penetration is found which is 2.57 mm.
- Increasing Welding Voltage & gas pressure and low welding current then increases the penetration.
- The optimum values of parameters found using Taguchi Are Welding Voltage 21V, welding current 190A, and Gas pressure 20bar. Optimum value of weld penetration is 2.57mm, which is best possible result of these weld parameter.
- Best shielding gas on MS material is Argon which is considered the following parameter has never been done

7. ACKNOWLEDGEMENT: "Optimism Is The Faith That Leads To Achievement. Nothing Can Be Done Without Hope and Confidence - Helen Keller "On the very outset of this report, I would like to extend my sincere and heartfelt obligation towards all the personages who have helped me in this endeavor. Without their active guidance, help, corporation and encouragement, I would not have made head way in the project.

First and foremost, I would like to express my sincere gratitude to my project guide, **Assistant professor Sunil J Patel .**It has been a great pleasure for me to get an opportunity to work under him and complete the present work successfully.

We wish to extend my sincere thanks to **Prof. Sanket T Gandhi**, Head of our Department, for approving our project work with great interest.
We would also like to thank **Dr.Paras Kothari**, Principal of our institution for giving me moral guidance. We wish to express my heartiest regards to my parents for their guidance and moral support.

We are thankful to **Mr. Bhavesh Panchal** for giving me guidance in the process and opportunity to carry out experiments in his company.
We are also like to thanks to all Mechanical Engineering Department of Our College. Because more guidance about our project, and also helpful for support.

8. REFERENCES:

[1].Hee-Keun, Kwang-San, Chung-Yan Kang, Control of surface defects on plasma-MIG hybrid welds in cryogenic aluminum alloys '', Published in 2014.
[2].Prasenjit Mondal, Dipankar, Optimization of the process parameter of MIG welding of AISI 304 and MS 1079 using fuzzy grey logic method", published in 2015.
[3].Prof.S.D.Ambekar, Sunil R.wadhokar, Parametric optimization of gas metal arc welding process by using taguchi method on stainless steel AISI410", Published in 2015.
[4].Nabbed Gosh, Pradip Kumar Palb, Gautama Nandi, Parametric optimization of MIG welding on 316L austenitic stainless steel by grey-based taguchi method", published in 2016.
[5].Peng Jingnum, Yang Lixin, The mathematical model research on MIG groove welding process", Published in 2016.
[6].R Prabhu, T Alwarsamy,R Ramalrishna,Development of mathematical model for prediction of convexity index in cladding by pulsed MIG welding process", Published in 2016.
[7].Rakes Sharma,R P Sisodia,AnupKumar Shukala,The use of taguchi method to analyze the effect of welding parameter on weldment",Publishe in 2016.