

Experimental investigation of GMAW process on SA387 pressure vessel material

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Abstract : Application of NDT(Non destructive testing)

1.Nuclear,space,aircraft,defense,automobile ,chemical and fertilizer industries.2.Heat exchanger ,pressure vessels, electronic products and computer parts.3.High reliable structures and thickness measurement. Main objective of the project is during welding process to get the minimum changes in the physical properties and no metallurgical defect is present .Defect free welding process should be made .To achieve a good weldment working with many samples and quality checks with destructive and non-destructive testing in this experimental work.

Keywords: Gas metal arc welding ,Taguchi,Orthogonal array,Non-destructive testing.

1.INTRODUCTION

GMAW welding is studied and joints between the SA387 materials are done .Mechanical and metallurgical characteristics of the joints are studied. Hardness of the joints and parent materials are studied. Experimental investigation is done for welding input parameters like amps,voltage etc . Toughness value of the GMAW welded SA387 steel is studied. Optimum value for the 10 mm plate of SA387 is studied

2.LITERATURE SURVEY

Narender sura.et .al.(April 2015).Above researcher conduct experiments on experimental study using GMAW .Anbarasan N, et. al.(2015). Above researcher conduct experiments on effect of GMAW process parameters on the influence of bead vessel steel. Pham son Minh et .al.(Sept 2014). Above researcher conduct experiments on Study on the structure deformation in the process of Gas Metal Arc Welding (GMAW). S.Utkarsh. et. al.(May 2014). Above researcher conduct experiments on experimental investigation of MIG welding for ST-37 Using Design of Experiment. Umar M. et. al .(Sept.2014)Above researcher conduct

experiments on investigation of mechanical properties of welded SS347H austenitic stainless steel tube by using p-GMAW.**Research Gap:** Above researcher is not done with the toughness value of the GMAW welded SA387 steel and not researched over Taguchi design and optimized parameter is value for the 10mm plate of SA387 steel is AMPS 180 VOLT-22 ROOT GAP-1.5.

3.EXPERIMENTAL DETAILS

3.1 MIG WELDING SPECIFICATIONS:



Fig-1: SOHAL RX250 MIG welding machine/india

Table-1: Specifications for MIG welding machine.

Technical specifications:		
Item	Unit	RX250
OCV(DC)	V	22-46
Output (Min./Max.)	A	60/250
Torch connector	Model	PM-3
Weight	Kg	143

3.2 MATERIAL REQUIREMENTS:

Plate SA387 Grade 91(50x50x10mm) is taken for MIG welding process shown in below figure.



Fig-2: work piece material 50X50X10mmPLATE

Table-2: Filler material specification

Size of Filler Rod	2mm
Filler Rod Material	SS 316L
Ampere Rating	60-250Amps

Ultrasonic Testing :



Fig-3:Ultrasonic testing machine

Table-3: Ultrasonic testing machine specification.

UT INSTRUMENT	PX20
Transducer angle	70°
Frequency	4MHZ,
Technique	Pulse Echo
Material	SA387 Grade 91
Thickness	10mm

4.METHODOLOGY

- Taguchi method uses a special design of orthogonal arrays
- Experimental results are then transformed into a signal -to-noise (S/N)ratio
- Optimal S/N ratio.
- S/N and ANOVA analyses gives the optimal combination of the process parameters.
- Maximum process parameters obtained from the parameter design.
- There are three levels of process parameters are chosen for experiments

Table-4. Process parameters and their levels

Levels	Process parameters		
	AMPS	VOLT	ROOT GAP(mm)
1	140	22	1
2	160	22	1.5
3	180	22	2

- window of Taguchi design is created.
- A window is opened in computer as shown in figure

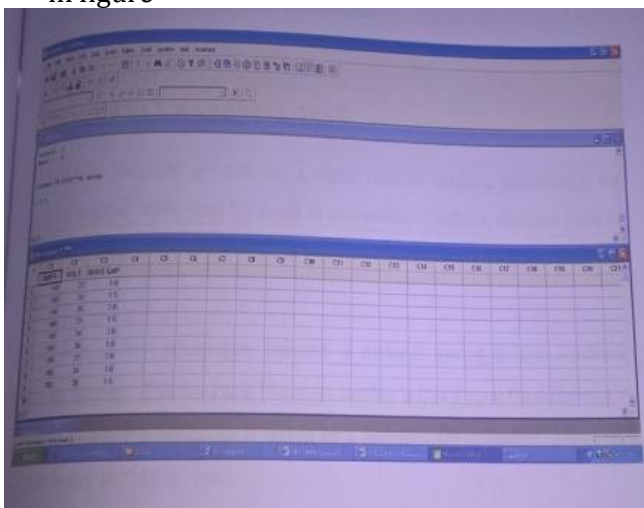


Fig-4:Create Taguchi design

There are nine test pieces are taken for L9 orthogonal array and corresponding parameters are given below

Table -5. Orthogonal array L9 Formation

TRIAL NO	AMPS	VOLT	ROOT GAP(mm)
1	140	22	1.0
2	140	24	1.5
3	140	26	2.0
4	160	22	1.5
5	160	24	2.0
6	160	26	1.0
7	180	22	2.0
8	180	24	1.0
9	180	26	1.5

5. RESULT AND DISCUSSION

5.1 IMPACT STRENGTH ANALYSIS

Impact strength test are conducted on MIG welding process with different welding parameters .Larger impact strength are obtained in Current 160 A,Voltage 22V,Root gap -1.5mm.Response table for signal to Noise ratios “Larger is better”

Table-6. Showing the root gap is influencing parameters of Mig welding on SA387 Grade 91 plates.

Level	AMPS	VOLT	Gp(mm)
1	33.67	42.67	40.67
2	71.33	72.33	30.33
3	41.33	31.33	75.33
Delta	37.67	41.00	45.00
Rank	3	2	1

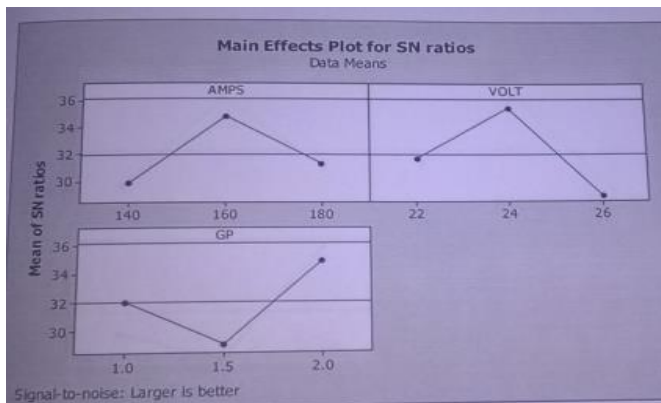


Fig-5.Main effect plot for S/N ratio of welding parameters on SA387 Grade 91 plates

Table-7. Shows that bigger value of F value denotes dominating parameter of welding process on SA387 Grade 91 plates.

Source	D F	Seq SS	Adj SS	Adj MS	F	P
AMPS	2	2378	2378	1189	0.83	0.547
VOLT	2	2690	2690	1345	0.94	0.516
Gp	2	3334	3334	1667	1.16	0.462
Error	2	2867	2867	1433		
Total	8	11268				

- Use a diamond indenter
- Major load:150kg,Minor load:10 kg
- Use for case hardened steel titanium ,tool steel.

Table-8. Hardness value

SAMPLES	S1	S2	S3	S4	S5	S6	S7	S8	S9
HRB VALUE	91	89	90	92	91	95	95	92	94

Table 8. shows the specimen S4,S6,S7,S9 having maximum hardness number,In our project impact strength is calculated.

Energy Range=0-300J,Least Count (1 Division)=2J
Specimensize=10x10x55mm,Notch=VNotch,Notch Depth=2mm.

Table-9.Impact strength

Materials	TEST PLATE	Energy lost in joules /mm ²
SA387 Grade 91	S1	36
	S2	47
	S3	18
	S4	54
	S5	138
	S6	28
	S7	70
	S8	32
	S9	22

Table-10.Ultrasonic report

S. NO	AMPS	VOLT	ROOT GAP(mm)	INDICATIONS
1.	140	22	1.0	ICP&Por
2.	140	24	1.5	ICP
3.	140	26	2.0	Inc
4.	160	22	1.5	NI
5.	160	24	2.0	SI
6.	160	26	1.0	Por
7.	180	22	2.0	UC
8.	180	24	1.0	Cr
9.	180	26	1.5	Cr

Table-10 shows the AMPS 160A,VOLTAGE 22V ,ROOT GAP 1.5 mm values having No indications .

6. CONCLUSIONS

GMAW welding can be used successfully to join SA387. The processed joints exhibited better mechanical and metallurgical characteristics .

The joints exhibited 90-95% of parent material 's hardness value.

The toughness value of the GMAW welded SA387 steel was comparatively moderate value (AMPS 160 VOLT-22 ROOT GAP -1.5mm) than other value

According to experimental investigation input parameter value AMPS 160 VOLT-22 ROOT GAP is 1.5mm is the best value from ultrasonic testing.

Optimum value for the 10mm plate of SA387 steel is AMPS- 160 VOLT-22 ROOT GAP-1.5mm.

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