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Analysis and Radiography Testing of TIG Welding For Alloy Steel grade 22

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ABSTRACT: The present study Alloy Steel grade 22 is used for X ray radiography testing after welding process. TIG welding is performed, TIG welding is important process for many industrial operation. welding current, gas flow and arc gap is selected as welding parameter for experimental plan. RSM is adopted for experimental plan and then ANOVA analysis is done.

KEYWORDS: Anova, Radiography, RSM, TIG

I. INTRODUCTION

TIG stands for tungsten inert gas it is also known as GTAW (Gas tungsten arc welding). TIG welding is an arc welding process which uses non consumable tungsten electrode for weld. In Tungsten inert gas welding process, the arc is obtained between non consumable tungsten electrode and workpiece and the work piece using a constant-current welding power supply that produces energy and conducted across the arc through a column of highly ionized gas and metal vapours. The welding zone is protected by inert shielding, it make a protective atmosphere so no contamination from outside air. The inert gas which generally use as shielding gas is argon or helium. The filler metal can be used from outside if needed. The electric arc can produce temperature upto 20,000 and the heat can be focus to melt and joined the two different part of material. The alloy steel grade 22 parent material is used which is welded by tungsten inert gas arc welding. The filler material used for alloy steel grade 22 is ER90B S3 copper coated.

II RELATED WORK

Ajitanshu Vedrtam , Gyanendra Singh , Ankit Kumar have done work on Optimizing submerged arc welding using response surface methodology, regression analysis, and genetic algorithm. weld parameters is arc voltage, welding current, nozzle to plate distance and welding speed in the submerged arc welding. Genetic algorithm is used for predicting weld geometry and mathematical model developed. **Sanjay Kumar, Pravin Kumar Singh, Dharmendra Patel, S. B. Prasad** study the OPTIMIZATION OF TIG WELDING PROCESS PARAMETERS USING TAGUCHI'S ANALYSIS AND RESPONSE SURFACE METHODOLOGY. The TIG welding is performed on AISI 304 Stainless steel and selected parameter are Current, Voltage, Root Gap and Gas flow rate. Taguchi method is used for experimental plan and mathematical model is developed by using RSM. **Aimin Yang , Yang Han , Yuhang Pan , Hongwei Xing , Jinze Li** by using RSM optimization is done on titanium alloy TC 11 They selected three parameters as cutting speed, feed rate, depth of cut, and the prediction accuracy was verified by the one-way ANOVA. The result shows that the feed has the most important effect on surface roughness.

III. EXPERIMENTAL SETUP

The response surface methodology optimization technique is used in this study. The experimental plan has been set up according to Design expert software for welding alloy steel grade 22. Table 1 shows the number of factor and there level selected for experiment.

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Table 1: Factors and levels

Factor	Name	Units	Type	Lower level (-1)	Higher level (+1)
A	Current	Ampere	Numeric	130	150
B	Root gap	Mm	Numeric	0	2.5
C	Gas flow rate	litre/min	numeric	11	15

Table2: Experimental plan alloy steel

Run	Factor 1 Welding Current (ampere)	Factor 2 Root gap (mm)	Factor 3 Gas flow rate (Litre/min)	Response UTM (MPa)
1	140	1.25	11	612.5
2	150	1.25	8	610
3	150	2.5	11	580
4	130	2.5	11	577.5
5	140	0	14	617.5
6	140	0	8	572.5
7	150	1.25	14	597.5
8	150	0	11	620
9	140	1.25	11	585
10	130	1.25	14	580
11	130	1.25	8	572.5
12	140	2.5	8	587.5
13	130	0	11	572.5
14	140	2.5	14	610
15	140	1.25	11	585

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In these study, machine is used to join the parent material is tungsten inert gas (TIG) machine. Welding facility is provided by Shanta techno limited Raipur. The photograph view of TIG machine shown in figure.



Figure1. TIG Welding Machine

IV. ANALYSIS AND RADIOGRAPHY TESTING

After designing the experiment on the basis of Box-Beckhen ANOVA Analysis is performed. The result of ANOVA analysis is shown in below table.

Table 3. ANOVA for Reduced Linear model

Response 1: UTS

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	1378.13	1	1378.13	6.15	0.0276	significant
A-A	1378.13	1	1378.13	6.15	0.0276	
Residual	2911.88	13	223.99			
Lack of Fit	2407.71	11	218.88	0.8683	0.6485	not significant
Pure Error	504.17	2	252.08			
Cor Total	4290.00	14				

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The specimen after welding goes through the X ray radiography test. Radiography test is performed after welding process to know the internal structure and integrity of the specimen.

Figure shows the structure of weld after radiography test.



Figure 2 Xray radiography of welded specimens

V. RESULT AND DISCUSSION

Result of Radiography test of specimen is given below in figure which is performed in industry.

TABLE 4: X RAY RADIOGRAPHY RESULT

Sample number	Factor 1 Welding Current (ampere)	Factor 2 Root gap (mm)	Factor 3 Gas flow rate (Litre/min)	Observation	Remarks
1	140	1.25	11	Minor porosity	Acceptable
2	150	1.25	8	No significant defect	Acceptable
3	150	2.5	11	No significant defect	Acceptable
4	130	2.5	11	No significant defect	Acceptable
5	140	0	14	Minor porosity	Acceptable
6	140	0	8	No significant defect	Acceptable
7	150	1.25	14	Minor porosity	Acceptable
8	150	0	11	No significant defect	Acceptable
9	140	1.25	11	No significant defect	Acceptable
10	130	1.25	14	Surface depression	Acceptable
11	130	1.25	8	No significant defect	Acceptable

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12	140	2.5	8	Minor porosity	Acceptable
13	130	0	11	No significant defect	Acceptable
14	140	2.5	14	No significant defect	Acceptable
15	140	1.25	11	Lack of penetration	Repair

VI. CONCLUSION

- The **Model F-value** of 6.15 implies the model is significant.
- **P-values** less than 0.0500 indicate model terms are significant. In this case A is a significant model term.
- From Radiography test it is concluded that the all welding specimen is acceptable and has a remark no significant effect. The sample 1, 5, 7, 12 have found with defect like minor porosity but it is acceptable with final remark. Only sample 15 is found with effect like lack of penetration and with final remark not acceptable.

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