International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 05 | May-2018 www.irjet.net p-ISSN: 2395-0072

INVESTIGATION OF GTAW INPUT PROCESS PARAMETERS USING MECHANICAL STRENGTH WITH THE HELP OF MINITAB SOFTWARE

Santosh Amarapure[1], Chetan Bapkar[2], Gurudutt Ghadi

[1] Asst. Professor, Dept of Automobile Engg, M. L. Bharatesh Polytechnic Belgaum, Karnataka, India
[2] Asst. Professor, Dept of Mechanical Engg, KLE C I Munavalli Polytechnic Hubli, Karnataka, India
[3] Asst. Professor, Dept of Mechanical Engg, M. M. Engineering College, Belgaum, Karnataka India.

ABSTRACT - In welding technology, the strength of weld bead geometry consists of different runs or passes called as root, bypass and capping. The weld bead geometry indirectly depends upon the welding performance and input welding process parameter, hence the input welding process variables which influence the bead geometry must therefore be properly selected.

The ASME SECTION IX gives the detail selection of welding material for particular plate material which to be joined along with the input process parameters (like current, gas flow rate, Diameter of filler material).but these input parameters includes low level value to high level value depending upon manual adjustment i.e. within the range of level, welding is performed. since there is a manual adjustment of ranges and it could lead defects in strength of the welded material.

In this effect of these process parameter for welding of carbon steel workpiece (i.e. JO-355) is examined by considering three input parameters or factors and those are welding current, Inert gas flow rate and filler wire diameter, which will be having two levels called as upper level and lower level & two level Full factorial experimental design is used.

The quality of weld is judged by different responses like tensile strength, Hardness, bending strength. To get good quality of weld these process parameters levels also

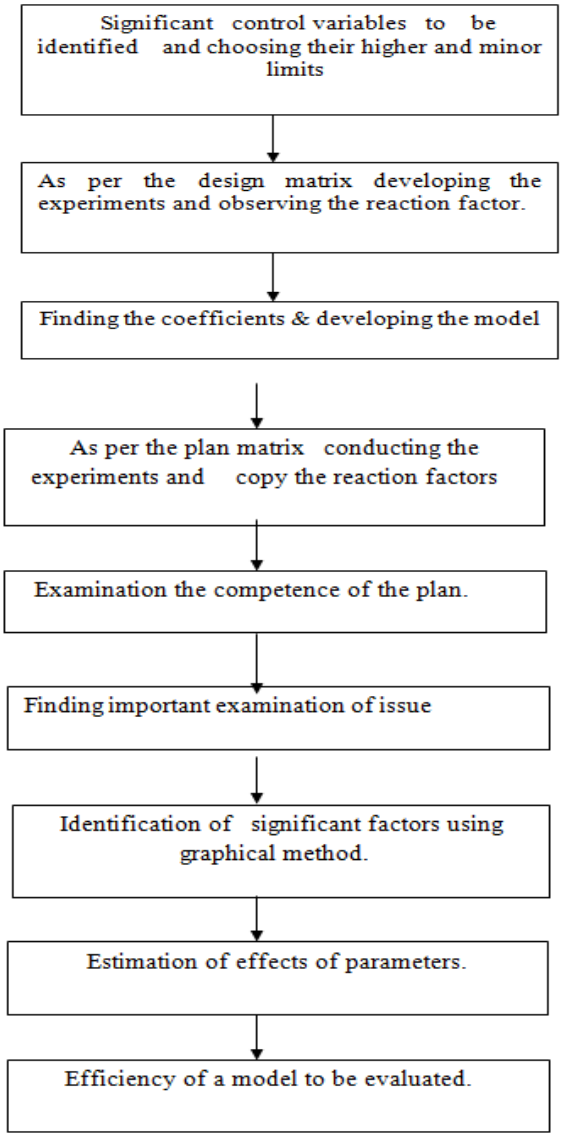
called as factors levels should be selected properly. The proper selection of process parameters will give the good quality of weld. In this the full factorial method is used for design of experiments, and the validation is carried out by using MINITAB software.

KEY WORDS: TIG welding, DOE, input parameters, Mechanical testing, specimen, main effect plot, mini tab.

1. METHODOLOGY

In this design of experimentation is considered and analysis of variance method is used to find out the effect of factors on the performance of the process, and different plots like main effect plot are used to interpret the effect of individual factors and the interaction plots are used to find the interaction between the factors and its effects on performance of the process.in this investigation following flow chart is used for the experimentation.

1.1 Flow chart for DOE



2. WORKING RANGE OF PROCESS PARAMETER

In this welding is done by using the RHINO TIG 6400 machine is used. The specification range of machine are as follows

Welding Current : 140 to 150 amps

Inert gas flow rate : 8 to 12 lit/min

Filler wire diameter : 2 to 2.5 mm

IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

3. Orthogonal arrangement for experiment

AS per two level full factorial design a 8 run orthogonal array is selected and arrangement of experiments with different values of low and high ranges of factors are plotted in the table as per orthogonal array.

Table 4.1 Orthogonal arrangement for experiment

Standard order	Random order	Current in amp	Rod dia. in mm	Gas flow rate in LPM
7	1	140	2.5	12
6	2	150	2	12
8	3	150	2.5	12
3	4	140	2.5	8
4	5	150	2.5	8
1	6	140	2	8
2	7	150	2	8
5	8	140	2	12

4. SPECIMEN PREPERATION

Using this orthogonal array eight specimen are prepared and these are taken for the machining process so that required size of the test pieces are prepared for Tensile testing, bending testing and hardness testing. Once these are ready then mechanical testing is done as mentioned and value are recorded as follow.

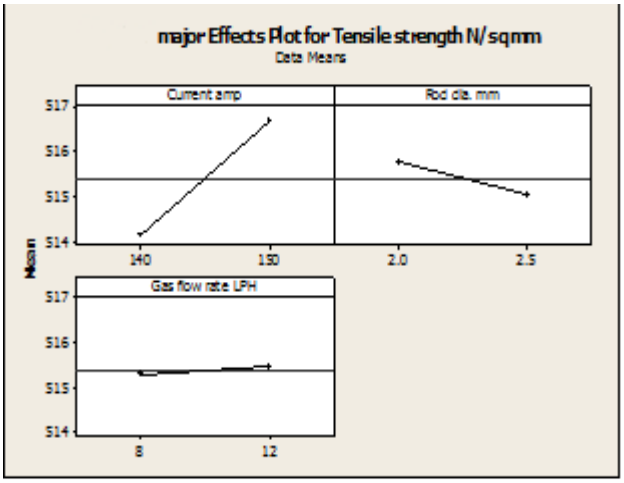
Table 4.1: Record of mechanical testing for the parameter

Standard order	Random order	Current in amp	Rod dia in mm	Gas flow rate in LPM	Tensile strength N/sq mm	Max Bending strength in N/sq mm	Hardness HRB
7	1	140	2.5	12	511.44	1490	85
6	2	150	2	12	513.63	1495	84
8	3	150	2.5	12	518.21	1530	87
3	4	140	2.5	8	516.62	1550	87
4	5	150	2.5	8	513.83	1415	88
1	6	140	2	8	509.85	1485	85
2	7	150	2	8	521	1470	85
5	8	140	2	12	518.61	1450	86

5. INVESTIGATION

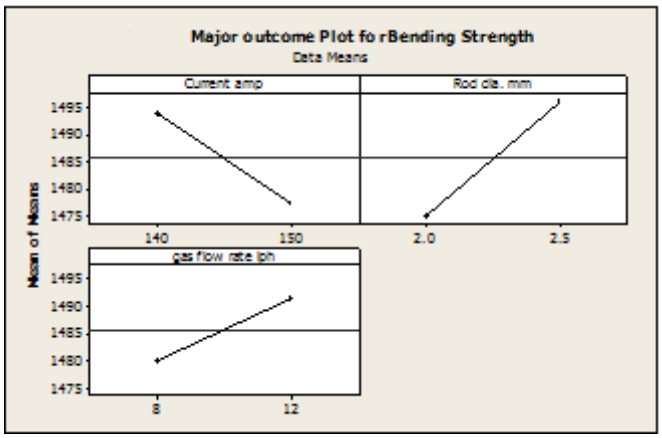
In this investigation as input parameters such as current, diameter of the filler wire and gas flow rate is used for the preparation of the welding specimen and welding strength is analysed in mechanical testing such as tensile test, bending test and hardness test. Since in this work is done for the investigation between input parameters (current, diameter of the filler material & gas flow rate) and mechanical testing (Tensile test,bending test and hardness test) main effect plot obtained from the mini tab software can give the conclusion and explanation.

5.1 Main effect plot results for tensile Strength



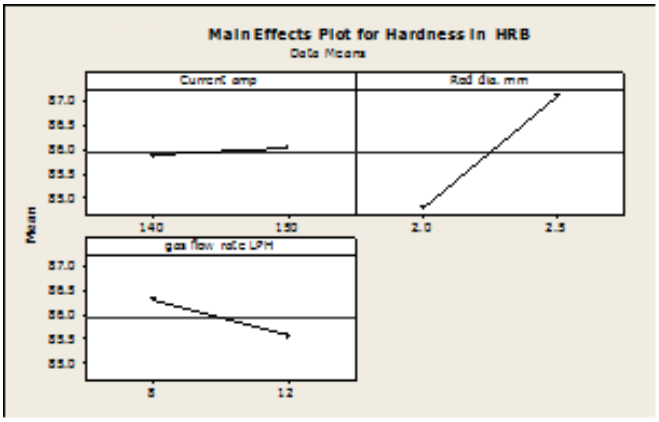
The result of different major factors (welding current, filler metal rod diameter & inert gas flow rate) on tensile strength is shown in the Graph and called as main effect plot or graph for tensile strength. From the graph it shows that welding current has positive effect on tensile strength, i.e. as current increases from 140 to 150 amp there is increase in tensile strength as shown in the graph From the graph the filler metal rod dia has the negative effect means as rod diameter increases the tensile strength decreases as shown in the graph. The effect of gas surge rate on tensile strength is null.

5.2 Main effect plot results for bending Strength



The effect of different main factors (welding current, filler metal rod diameter & inert gas flow rate) on bending strength is shown in the Graph and called as main effect plot or graph for bending strength. From the graph it shows that welding current has negative effect on bending strength, i.e. as current increases from 140 to 150 amp there is decrease in tensile strength as shown in the graph From the graph the filler metal rod diameter has the positive effect, means as rod diameter increases the bending strength increases & gas flow rate is also have positive effect as gas stream increases the bending power increases.

5.3 Main effect plot results for Hardness



The effect of different main factors (welding current, filler metal rod diameter & inert gas flow rate) on hardness is shown in the Graph and called as main effect plot or graph for hardness. From the graph it shows that welding current has no effect on hardness , i.e. as current increases from 140 to 150 amp there is no change in hardness, as shown in the graph . From the graph the filler metal rod diameter has the positive effect, means as rod diameter increases the hardness increases & gas flow rate is also have negative effect as gas flow increases the hardness increases

6. CONCLUSIONS

The dissertation effort is carried out effectively for investigation of key in process input parameters for TIG welding process on of carbon steel (JO-355 : BQ material). The analysis of these properties obtained by testing. while analysis is carried out by using MINITAB software. The domino effect are superior and discussed as bellow .

- It clears that high welding current and lower dia. of filler rod give maximum tensile potency as shown in main effect plot, the effect of gas flow rate will not have significant effect on tensile strength.
- High gas flow rate with higher diameter of the filler rod with low current give maximum bending strength.
- And low gas flow rate with higher filler wire diameter gives maximum hardness, current will not play any role for improvement in hardness.

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AUTHORS

Mr. Santosh Amarapure (Assistant Professor), Automobile Engg Department, MLBP Govt Aided College, Belgaum, Karnataka, India.
M. Tech (Production Management)
University Gold Medalist
B.E (Mechanical Engg)

Mr. Chetan R Bapkar (Assistant Professor), Mechanical Engg Department, KLE C I Munavalli Polytechnic Hubli. Karnataka, India.
M. Tech (Production Management)
B.E (Mechanical Engg)

Mr. Gurudutt Ghadi (Assistant Professor), Mechanical Engg Department, Maratha Mandal Engineering College, Belagavi, Karnataka India.
M. Tech (Production Management)
B.E (Mechanical Engg)