International Journal of Multidisciplinary and Current Research

Research Article

ISSN: 2321-3124
Available at: http://ijmcr.com

Prediction of Bending Strength in Carbon Steel EN24

Hardeep Singh[a]*, Pankaj Kumar[b], Prabhjot Singh[b], Bhopinder Singh[b] and Ravinder Singh[b]

[a*] Assistant Professor at Department of Mechanical Engineering , Guru Nanak Institute of technology, Mullana, Ambala.
[b] Research Scholars Mechanical Engineering , Guru Nanak Institute of Technology, Mullana, Ambala.

Accepted 04 November 2013, Available online 01 December 2013, **(Nov/Dec 2013 issue)**

Abstract

The aim of the work reported here was to utilize Taguchi methods to optimize Bending Strength in the welding of EN24. The parameters of Bending Strength are analyzed under varying welding currents (24.8A, 29.2A, 38.5A.), Weld Time (5Sec., 10sec, 15sec.) The settings of welding parameters were determined by using Taguchi Experimental Design method. The signal to noise ratio is employed to determine the effect of welding parameters on Bending Strength. The conclusion from the study is that Time is the most significant factor than current for Bending Strength response; Bending Strength displaying an increasing trend with an increase in time & Current parameters, for maximum Bending Strength current is to set at max. level.

Keywords: *Taguchi Design, Electric Arc Welding, Bending Strength*

Introduction

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material that cools to become a strong joint.

For increasing the potential of this process, basic of this process is necessary. Most of the engineering materials require high Bending Strength for its performance. Now the welding parameters in electric welding influence the Bending Strength of weld metal. In order to optimize the Bending Strength response in this study two welding parameters are taken current, & weld time.

The Taguchi method involves reducing the variation in a process through robust design of experiments. The overall objective of the method is to produce high quality product at low cost to the manufacturer. Taguchi developed a method for designing experiments to investigate how different parameters affect the mean and variance of a process performance characteristic that defines how well the process is functioning. The experimental design proposed by Taguchi involves using orthogonal arrays to organize the parameters affecting the process and the levels at which they should be varies (Blunt *et al*, 2002)

Chemical composition of material

C	0.36/0.44
SI	0.10/0.35
MN	0.45/0.70
S	0.040 max
P	0.035 max
Cr	1.00/1.40
Mo	0.20/0.35
Ni	1.30/1.70

817M40T - EN24T is high Bending alloy steel renowned for its wear resistance properties and also where high strength properties are required.

Experimentation

The quality engineering methods of Dr. Taguchi, employing design of experiments (DOE), is one of the most important statistical tools of TQM for designing high quality systems at reduced cost. Taguchi methods provide an efficient and systematic way to optimize designs for performance, quality, and cost.

Steps applied in Taguchi methods

Taguchi proposed a standard procedure for applying his method for optimizing any process. The general steps involved in the Taguchi Method are as follows:

1. Define the process objective, or more specifically, a target value for a performance measure of the process. This may be a flow rate, temperature, etc. The target of a process may also be a minimum or maximum; for

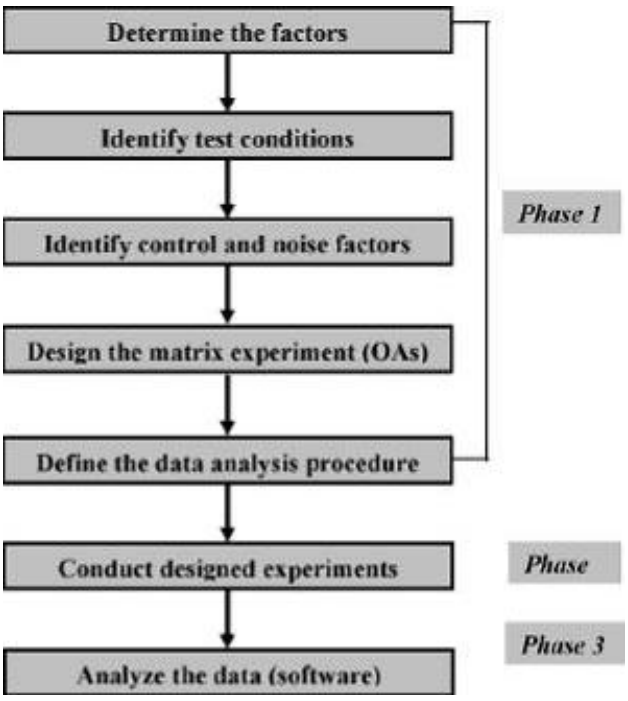
example, the goal may be to maximize the output strength. The deviation in the performance characteristic from the target value is used to define the loss function for the process.

2. Determine the design parameters affecting the process. Parameters are variables within the process that affect the performance measure such as temperatures, pressures, etc. that can be easily controlled. The number of levels that the parameters should be varied at must be specified. For example, a current might be varied to a low and high value of 20 amp and 40 amp. Increasing the number of levels to vary a parameter at increases the number of experiments to be conducted.

3. Create orthogonal arrays for the parameter design indicating the number of and conditions for each experiment. The selection of orthogonal arrays is based on the number of parameters and the levels of variation for each parameter, and will be expounded below.

4. Conduct the experiments indicated in the completed array to collect data on the effect on the performance measure.

5. Complete data analysis to determine the effect of the different parameters on the performance measure.



Procedure

Specimen was prepared by cutting the required length from flat bar. After cutting the workpieces the edges were prepared for the welding. Now the workpieces were taken to welding machine for welding. Now these workpieces are welded at different parameters (current & time).

All specimens were tested on universal testing machine (UTM) for bending testing. One by one specimen is tested for finding their bending strength.

Workpiece Specifications: 200X50X6 mm

Welding Machine Specifications:

Welding parameters & their levels

Welding Parameters	Units	Symbols	Level		
			1	2	3
Current	A	I	24.2	29.2	38.5
Weld time	Sec	T	5	10	15

Design Matrix

Sr. no.	current	time
1	24.8	5
2	29.2	5
3	38.5	5
4	24.8	10
5	29.2	10
6	38.5	10
7	24.8	15
8	29.2	15
9	38.5	15

Analysis

Sr. no.	Current	Weld time	Bending strength
1	24.8	5	5.4
2	24.8	10	0.75
3	24.8	15	1.5
4	29.2	5	4.2
5	29.2	10	0.75
6	29.2	15	3
7	38.5	5	1.5
8	38.5	10	1.75
9	38.5	15	2.4

Calculations of S/N Ratio of various Responses

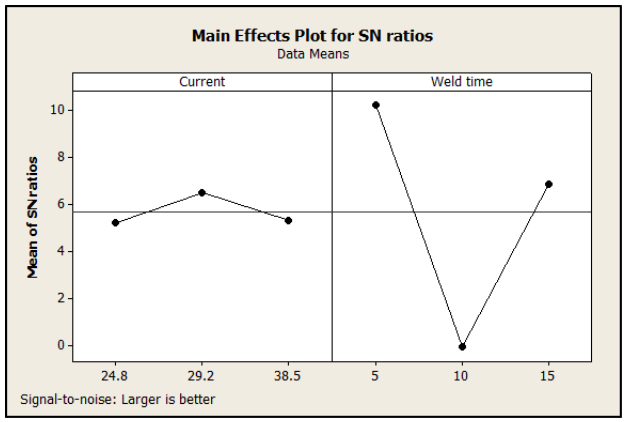
Sr.No.	Current	Weld time	Bending strength	S/N RATIO	MEAN
1	24.8	5	5.4	14.6478752	5.4
2	24.8	10	0.75	-2.49877473	0.75
3	24.8	15	1.5	3.521825181	1.5
4	29.2	5	4.2	12.46498581	4.2
5	29.2	10	0.75	-2.49877473	0.75
6	29.2	15	3	9.542425094	3
7	38.5	5	1.5	3.521825181	1.5
8	38.5	10	1.75	4.860760974	1.75
9	38.5	15	2.4	7.604224834	2.4

Response Table for Signal to Noise Ratios

Larger is better

Level	Current	Time
1	5.2236	10.212
2	6.5029	-0.046
3	5.3289	6.8895
Delta	1.2792	10.257
Rank	2	1

Level	Current	Time
1	2.55	3.7
2	2.65	1.083
3	1.883	2.3
Delta	0.767	2.617
Rank	2	1



Conclusions

From the above graphs following conclusions can be withdrawn:

1. Time is the most significant factor than current for Bending Strength response.
2. It is interesting to note that Bending Strength displaying an increasing trend with an increase in time & current parameters.
3. For maximum Bending Strength current is to set at max. Level

Scope for future work

In this present study we have considered few parameters affecting Bending strength but keeping the view of future scope, we can select other responses like Weld bead composition, Compressive strength and many more. We can also select other parameters like electrode extension, electrode polarity and many more for extended work. In spite of EN24, we can select no. of materials.

References

[1]. ASM International (2003), Trends in Welding Research, Materials Park, Ohio: *ASM International*, .ISBN 0-87170-780-2.
[2]. Blunt, Jane; Nigel C. Balchin (2002), Health and Safety in Welding and Allied Processes, *Cambridge: Woodhead*, ISBN 1- 85573-538-5.
[3]. Cary, Howard B; Scott C. Helzer (2005). Modern Welding Technology. Upper Saddle River, New Jersey: Pearson Education. ISBN 0-13-113029-3.
[4]. Henderson, J.G. (1953), Metallurgical Dictionary. New York, New York: *Reinhold Publishing Corporation.*
[5]. Hicks, John (1999), Welded Joint Design. New York: *Industrial Press,* ISBN 0-8311-3130-6.
[6]. Kalpakjian, Serope; Steven R. Schmid (2001), Manufacturing Engineering and Technology. *Prentice Hall*, ISBN 0-201-36131-0.
[7]. Lincoln Electric (1994), The Procedure Handbook of Arc Welding, *Cleveland: Lincoln Electric*, ISBN 99949-25-82-2
[8]. Ross P.J. Taguchi techniques for quality engineering, *McGraw hill,* New York.
[9]. Smith, Dave (1984), Welding Skills and Technology. New York, New York: *McGraw-Hill Book Company*, ISBN 0-07-000757-8.
[10]. The James F. Lincoln Arc Welding Foundation (1978), Principles of Industrial Welding. Cleveland, Ohio: *The James F. Lincoln Arc Welding Foundation*.