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OPTIMIZATION OF SHIELDED METAL ARC WELDING PROCESS PARAMETERS USING TAGUCHI METHOD

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Abstract

Piezoelectric elements are commonly installed in shoe sole to make use of the piezoelectric effect due to the vibration generated by the human motion. Piezoelectric shoe is a great device that can be used to harvest energy and can be improved by adding more piezoelectric elements and providing storage to store the harvested energy. However, not many researchers focus on the analization of piezoelectric elements' shape that may affect the efficiency of energy harvesting.

Index Terms: *Piezoelectric elements, welding, shielded metal, Taguchi method*

1. INTRODUCTION

Welding is a fabrication or sculptural process that joins materials usually metals or thermoplastics, by using high heat to melt the parts together and allowing them to cool causing fusion. Welding is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal. In addition to melting the base metal, a filler material is typically added to the joint to form a pool of molten material (the weld pool) that cools to form a joint that, based on weld configuration (butt, full penetration, fillet, etc.), can be stronger than the base material (parent metal). Pressure may also be used in conjunction with heat, or by itself, to produce a weld. Welding also requires a form of shield to protect the filler metals or melted metals from being contaminated or oxidized. Many different energy sources can be used for welding, including agas flame (chemical), an electric arc (electrical), a laser, an electron beam, friction, and ultrasound. While often an industrial process, welding may be performed in many different environments, including in open air, under water, and in outer space. Welding is a hazardous undertaking and precautions are required to avoid burns, electric shock, vision damage, inhalation of poisonous gases and fumes, and exposure to intense ultraviolet radiation. In this method, welding parameters are the most important factors affecting the quality, productivity and cost of welding joint. Accordingly these parameters affecting the arc and welding bath should be estimated and their changing conditions during process must be known before in order to obtain optimum results. In an effort to obtain high quality welds in shielded metal arc welding method, selection of ideal parameters should be performed according to engineering facts. Commonly, welding parameters are determined by trial and error, based on handbook values, and manufacturers' recommendations. On the other hand, this option may not yield optimal or in the vicinity of optimal welding performance.

In shielded metal arc welding method, the electrodes are coated with a shielding flux of a suitable composition. The flux melts together with the electrode metallic core, forming a gas and a slag, shielding the arc and the weld pool. The flux cleans the metal surface, supplies some alloying elements to the weld, protects the molten metal from oxidation and stabilizes the arc. The slag is removed after Solidification. Figure shows a schematic image of shielded metal arc welding. As seen in this figure, process consists of electrode and its coating, arc formation, protecting gas, weld pool and solidified weld.To determine the welding parameters, the national and international welding standards and also welding experience in application are taken into consideration for shielded metal arc welding method.

a) Power Supply or Power Source(AC or DC)
b) Electrodes
c) Electrode Holder
d) Cables
e) Clamps

2. LITERATUREREVIEW

Sukhomay Pal et. al. [1] In this paper, a grey-based Taguchi method has been adopted to optimize the pulsed metal inert gas welding process parameters. Many quality characteristic parameters are combined into one integrated quality parameter by using grey relational grade or rank. The welding process parameters considered in this analysis are pulse voltage, background voltage, pulse frequency, pulse duty factor, wire feed rate, and table feed rate. The quality parameters considered are the tensile strength, bead geometry, transverse shrinkage, angular distortion, and deposition efficiency. Analysis of variance has been performed to find out the impact of individual process parameter on the quality parameters. If the tensile strength as the most important quality parameter is assigned a higher weight, then the pulse voltage was found to be the most influential process parameter. Experiments with the optimized parameter settings, which have been obtained from the analysis, are given to validate the results.

A. Kumar et. al. [2] the present work pertains to the improvement of mechanical properties of AA 5456 Aluminum alloy welds through pulsed tungsten inert gas (TIG) welding process. Taguchi method was employed to optimize the pulsed TIG welding process parameters of AA 5456 Aluminum alloy welds for increasing the mechanical properties. Regression models were developed. Analysis of variance was employed to check the adequacy of the developed models. The effect of planishing on mechanical properties was also studied and observed that there was improvement in mechanical properties. Microstructures of all the welds were studied and correlated with the mechanical properties.

3. EXPERIMENTATION FOR OPTIMIZATION OF SMAW

4.1 Welding parameters

- Welding voltage : 21,23,25 V
- Welding current : 180,200,220
- Welding Rod Diameter: 3.15,4,5 mm

4.2 Levels of welding process parameter:

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Table 4.1 Levels of process parameters

Welding parameters	Units	Level 1	Level2	Level3
Current(I)	Amp	180	200	220
Voltage(V)	Volt	21	23	25
Welding Rod Diameter (D)	mm	3.15	4	5

4. TAGUCHI METHOD:

Taguchi method is a quality engineering method for design of experiments. This method is developed by Genichi Taguchi to improve the quality. It is one of the most important statistical tools used for designing high quality systems with reduction in cost. This method uses a special feature called orthogonal arrays; this is used to study the process parameters of the system with minimum or small number of experiments. The greatest advantage of Taguchi method is that it gives minimum number of experiment which saves the time efforts for conducting experiments, cost reduction, and identifying the most significant or influencing process variable or factor. This method is mostly used for optimization of process parameter due to above advantages, because by optimizing the process parameters there will be improve in the quality of the system. The Taguchi method provides: 1. A functional relationship between the process variable and the outcomes of the system or a process. 2. for changing and modifying the mean of a process or the system by optimizing the process variable. 3. A steps for examining the relationship between random noise in the process and product variability.

5. METHODOLOGY

To strike the electric arc, the electrode is brought into contact with the workpiece by a very light touch of the electrode to the base metal. The electrode is then pulled back slightly. This initiates the arc and thus the melting of the work piece and the consumable electrode, and causes droplets of the electrode to be passed from the electrode to the weld pool. Striking an arc, which varies widely based upon electrode and work piece composition, can be the hardest skill for beginners. The orientation of the electrode to work piece is where most stumble, if the electrode is held at a perpendicular angle to the workpiece the tip will likely stick to the metal which will fuse the electrode to the work piece which will cause it to heat up very rapidly. The tip of the electrode needs to be at a lower angle to the work piece, which allows the weld pool to flow out of the arc. As the electrode melts, the flux covering disintegrates, giving off shielding gases that protect the weld area from oxygen and other atmospheric gases. In addition, the flux provides molten slag which covers the filler metal as it travels from the electrode to the weld pool. Once part of the weld pool, the slag floats to the surface and protects the weld from contamination as it solidifies. Once hardened, it must be chipped away to reveal the finished weld. As welding progresses and the electrode melts, the welder must periodically stop welding to remove the remaining electrode stub and insert a new electrode into the electrode holder. In this connection using the concept of loss function, signal- to-noise ratios for torsional rigidity was utilized and based on this the optimum levels for input welding parameters were determined. The method presented in this study is an experimental design process called the Taguchi design

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method. Taguchi design, developed by Dr. Genichi Taguchi, is a set of methodologies by which the inherent variability of materials and manufacturing processes has been taken into account at the design stage. Although similar to design of experiment (DOE), the Taguchi design only conducts the balanced (orthogonal) experimental combinations, which makes the Taguchi design even more effective than a fractional factorial design. By using the Taguchi techniques, industries are able to greatly reduce product development cycle time for both design and production, therefore reducing costs and increasing profit.

6. SOFWARE ANALYSIS OF SMAW

6.1 Overall loss Function and its S/N ratio

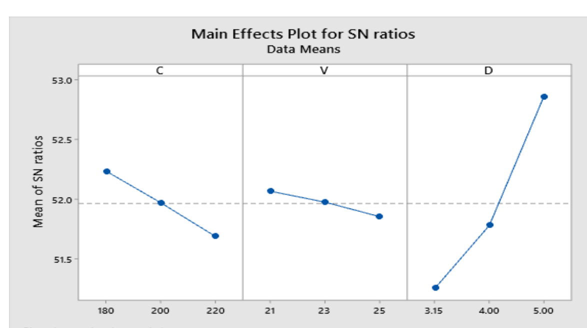
Genichi Taguchi developed a different method of measuring quality. Taguchi developed a loss function, which defines quality in a negative manner-"Quality is the loss imparted to society from the time the product is shipped”. This "loss" would include the cost of customer dissatisfaction that leads to the loss of company reputation. A traditional method of measuring quality is based on a step function that labels a product good if the product falls within a set of control limits. The Taguchi method takes the measure of quality away from a step function and turns it into a quadratic function of the satisfaction level of the customer. Taguchi believed that a customer becomes increasingly dissatisfied with a product as the products quality get farther away from the target value. The traditional control limits were defined as specification tolerances where the Taguchi method uses customer tolerances to indicate when a product is dissatisfactory to the customer. The customer tolerances can be more difficult to define than specification limits however; customer tolerances are a more accurate way to measure quality as viewed by the end customer. This differs greatly from the traditional producer-orientated definition, which includes the cost of re-work, scrap, warranty and services costs as measures of quality. The customer is the most important part of the process line, because quality products and services lead to customer satisfaction which ensures the future return of the customer

6.2 Outcomes from project:

After calculating ultimate tensile strength from experiment that data is feeded into Minitab 17 software for further optimization. Minitab software is statical analysis software it provides statical data from software analysis. Results as follow

Table Analysis of variance for S/N ratios

Source	DF	Seq SS	Adj SS	Adj MS	F	P
I	2	0.44771	0.44771	0.22386	48.51	0.02
V	2	0.06926	0.06926	0.03463	7.5	0.118
Dia.	2	4.04463	4.04463	2.02231	438.24	0.002
Residual Error	2	0.00923	0.00923	0.00461		
Total	8	4.57083				



Response table for means

level	I	V	Dia.
1	168.8	247.6	244.6
2	331.1	234.2	240.2
3	284.7	302.7	299.8
Delta	262.3	68.5	59.6
Rank	1	2	3

Table response table for signal to noise ratios larger is better

Level	I	V	Dia
1	44	47.28	47.1
2	50.38	46.61	46.85
3	49.05	49.55	49.48
Delta	6.38	2.94	2.63
Rank	1	2	3

Scope for the Future Work

Shielded metal arc welding is one of the widely used techniques for joining ferrous and nonferrous metals. SMAW welding offers several advantages like joining of dissimilar metals, low heat affected zone, there is no slag to clean off after welding because no flux used. SMAW weld quality is strongly characterized by weld bead geometry. In SMAW Welding method, we will optimize other parameters which are not used in this experiment and This experiment will be done for same method or work peace by other DOE method or other optimization techniques and also if you can be compared Experimental result with prediction result by using Finite Element Analysis. Taguchi's DOE or ANOVA, Orthogonal Array shall be used to conduct the experiments. The parameters selected for controlling the process are welding voltage, current and gas flow rate. Strength of welded joints shall be tested by a UTM

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REFERENCES

[1] Sukhomay Pal, Santosh K. Malviya, Surjya K. Pal &Arun K. Samantaray, "Optimization of quality characteristics parameters in a pulsed metal inert gas welding process using grey-based Taguchi method,"Int.J.Adv Manu. Technology (2009)44:1250–1260, DOI10.1007/s00170-009-1931-0.

[2] K.Y. Benyounis and A.G. Olabi, "Optimization of different welding processes using statistical and numerical approaches – A reference guide," Advances in Engineering Software 39 (2008) 483–496.

[3] A. Kumar and S. Sundarrajan, "Optimization of the pulsed TIG welding process parameters on mechanical properties of AA 5456 Aluminium alloy weldments" Materials and Design product 30 (2009) 1288–1297.

[4] P. Srinivasa Rao, O. P. Gupta, S. S. N. Murty and A. B.Koteswara Rao, "Effect of process parameters and mathematical model for the prediction of be geometry in pulsed GMA welding," Int J Adv. Manuf Technology (2009) 45:496–505, DOI 10.1007/s00170-009-1991-1.

[5] Saurav Datta, Ashish Bandyopadhyay and Pradip Kumar Pal, "Modeling and optimization of features of bead geometry including percentage dilution in submerged arc welding using mixture of fresh flux and fused slag,"Int J Adv. Manuf. Technol (2008)

36:1080–1090, DOI10.1007/s00170-006-0917-4.

[6] Ching-Been Yang, Chyn-Shu Deng and Hsiu-Lu Chiang, "Combining the Taguchi method with artificial neural network to construct a prediction model of aCO2 laser cutting experiment," Int J AdvManufTechnol (2012) 59:1103–1111, DOI 10.1007/s00170-011-3557-2.

[7] Vikas Mukhraiya, Raj Kumar Yadav, Sanjay Jathar, "Parametric Optimisation of MIG Welding Process with the Help of Taguchi Method" International Journal of Engineering Research & Technology (IJERT),2014, Vol 3, pp 1407-1410.

[8] K.Sivasakthivel, K.Janarthanan, R.Rajkumar, Optimization of Welding Parameter In MIG Welding by Taguchi Method , International Journal of Advanced Research in Mechanical Engineering & Technology (IJARMET), 2015, Vol.1. pp 36-40.

[9] Rakesh Kumar1, and Gurinder Singh Brar, "Optimization of Process Parameters for MIG Welding by Taguchi Method", International Journal of Scientific Research Engineering & Technology (IJSRET), 2017, Vol. 6, pp.756-768.

[10] Sahil Garg, Nitin Bhati, Chandra Vikram Singh, Dr. Satpal Sharma, Application of Taguchi Method to Determine MIG Welding Parameters for AISI 1020, Mechanical Engineering Department ADR Journals 2015.