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MECHANISM AND OPTIMIZATION OF MIG WELDING

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Abstract

A lot of research has been going on the process parametric optimization in all sort of welding process to ensure the weld quality of a product to reduce manufacturing cost and to increase productivity in computer controlled manufacturing process.

The multi objective optimization plays a vital role in industry for ensuring quality at every nook and corners of a product. The multiple output responses were conducted by taguchi method. In this work an attempt is made to optimize process parameters in MIG welding process in AA 6061 weldments. The process parameters considered for study are specimen edge angle, voltage, gas flow rate, wire feed rate. The expected output responses will be UTS, hardness.

Keywords- **Multi object optimization, Taguchi method, UTS, Weldments**

I. Introduction

Welding is the process of joining two pieces of metal by creating a strong metallurgical bond between them by heating or pressure or both. It is distinguished from other forms of mechanical connections, such as riveting or bolting, which are formed by friction or mechanical interlocking. It is one of the oldest and reliable methods of joining. Welding offers many advantages over bolting and riveting. Welding enables direct transfer of stress between members eliminating gusset and splice plates necessary for bolted structures. Hence, the weight of the joint is minimum. In the case of tension members, the absence of holes improves the efficiency of the section. It involves less fabrication cost compared to other methods due to handling of fewer parts and elimination of operations like drilling, punching etc. and consequently less labor leading to economy. Welding offers air tight and water tight joining and hence is ideal for oil storage tanks, ships etc. Welded structures also have a neat appearance and enable the connection of complicated shapes. Welded structures are more rigid compared to structures with riveted and bolted connections. A truly continuous structure is formed by the process of fusing the members together. Generally welded joints are as strong or stronger than the base metal, thereby placing no restriction on the joints. Stress concentration effect is also considerably less in a welded connection. Some of the disadvantages of welding are that it requires skilled manpower for welding as well as inspection. Also, non-destructive evaluation may have to be carried out to detect defects in welds. Welding in the field may be difficult due to the location or environment. Welded joints are highly prone to cracking under fatigue loading. Large residual stresses and distortion are developed in welded connection.

Welding can be broadly classified in two groups

1) Liquid state (fusion) welding where heat is added to the base metals until they melt. Added metal (filler material) may also be supplied. Upon cooling strong joint is formed. Depending upon the method of heat addition this process can be further subdivided, namely
   - Electrical heating: Arc welding Resistance welding Induction welding
   - Chemical welding: Gas welding
   - Thermit welding
   - Laser welding
   - Electron beam welding

2) Solid state welding: Here mechanical force is applied until materials deform to plastic state. Bonds are then formed through molecular interaction. Solid state welding may be of various kinds, namely,
   - Cold welding
   - Diffusion welding
   - Hot forging

II. EXISTING SYSTEM

[1] have used both artificial Neural Network and Back propagation algorithm to optimize the welding process parameters. Nowadays several numerical methods are widely used for either modeling or optimizing the performance of the manufacturing

technologies. That has been advanced due to the large diffusion of the personal computer and the numerical algorithms. The knowledge of those methods and the ability in integrating their functions can make both the manufacturing engineer and the researcher ace their duties. In this paper, two of those methods have been employed, the back propagation artificial neural network and the Taguchi approach to the design of the experiment. They were applied to find out the optimum levels of the welding speed, the laser power and the focal position for CO2 keyhole laser welding of medium carbon steel butt weld. The optimal solution is valid in the ranges of the welding parameters that were used for training the neural networks. Extrapolation over those limits would restrict the applicability of the found solution.

Christo Ananth et al. [2] proposed a system, this fully automatic vehicle is equipped by micro controller, motor driving mechanism and battery. The power stored in the battery is used to drive the DC motor that causes the movement to AGV. The speed of rotation of DC motor i.e., velocity of AGV is controlled by the microprocessor controller.This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

[3] has proposed to find out the process parameters in welding is important to obtain the desired weld bead profile and quality. In that research work, numerical and graphical optimization techniques of the CO2 laser beam welding of dual phase(DP600)/transformation induced plasticity (TRIP700)steel sheets were carried out using Response Surface Methodology(RSM). The procedure was established to improve the weld quality, increase the productivity and minimize the total operation cost by considering the welding parameters. It was found that, RSM can be considered as a powerful tool in experimental welding optimization, even when the experimenter does not have a model for the process. Christo Ananth et al. [4] proposed a system, this fully automatic vehicle is equipped by micro controller, motor driving mechanism and battery. The power stored in the battery is used to drive the DC motor that causes the movement to AGV. The speed of rotation of DC motor i.e., velocity of AGV is controlled by the microprocessor controller.This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

III. MECHANISM

Welded specimens are fabricated by using Multilevel Factorial Design, with four factors and 64 runs. The factors selected to study the response of welded specimens are welding voltage, gas flow rate, welding speed and wire speed are considered. In this work, there are four parameters and each parameter consists of three levels. To test all possible combinations of these parameters, a set of 42 = 16 test samples are needed. But, it is difficult to carry out all the combinations if the number of test cases is more. So instead of testing the system for each combination of parameters, orthogonal array can be used to select only a subset of these combinations. It was already discussed that Christo Ananth et al. [2] proposed a system, this fully automatic vehicle is equipped by micro controller, motor driving mechanism and battery. The power stored in the battery is used to drive the DC motor that causes the movement to AGV. The speed of rotation of DC motor i.e., velocity of AGV is controlled by the microprocessor controller. This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

Orthogonal Array is a statistical method of defining parameters that convert test areas into factors and levels. Test Design using Orthogonal Array creates an efficient and concise test suite with fewer test cases without compromising test coverage. Orthogonal arrays are used to reduce testing cycle time and make analysis simpler, find maximum defects with minimal test cases and offer maximum coverage with minimum test cases.This also provides a significant cost savings in testing. The array is orthogonal, because all possible pair-wise combinations between parameters occur only once.

The effect of many different parameters on the performance characteristic in a condensed set of experiments can be examined by using the orthogonal array experimental design proposed by Taguchi. Once the parameters affecting a process that can be controlled have been determined, the levels at which these parameters should be varied must be determined. Determining what levels of a variable to test requires an in-depth understanding of the process, including the minimum, maximum, and current value of the parameter. If the difference between the minimum and maximum value of a parameter is large, the values being tested can be further apart or more values can be tested. If the range of a parameter is small, then less values can be tested or the values tested can be closer together. Knowing the number of parameters and the number of levels, the proper orthogonal array can be selected. Table shows the orthogonal array selector from which minimum number

of recommended experiments to be conducted corresponding to the number of parameters (m) and number of levels (n).From the previous work, Christo Ananth et al. [4] proposed a system, this fully automatic vehicle is equipped by micro controller, motor driving mechanism and battery. The power stored in the battery is used to drive the DC motor that causes the movement to AGV. The speed of rotation of DC motor i.e., velocity of AGV is controlled by the microprocessor controller.This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

TABLE I

ORTHOGONAL ARRAY SELECTOR

	Number of Parameters (m)										
Number of Levels (n)	2	3	4	5	6	7	8	9	10	11	12
2	L4	L4	L8	L8	L8	L8	L12	L12	L12	L12	L16
3	L9	L9	L9	L18	L18	L18	L18	L27	L27	L27	L27
4	L16	L16	L16	L16	L32	L32	L32	L32	L32	L32	L32
5	L25	L25	L25	L25	L25	L50	L50	L50	L50	L50	L50

In this work L8 orthogonal array has been selected corresponding to number of parameters (ie) is equal to 4 and number of levels is equal to 2.

Fig.1.Clamping arrangement

IV. CONCLUSION

A lot of research has been going on the process parametric optimization in all sort of welding process to ensure the weld quality of a product to reduce manufacturing cost and to increase productivity in computer controlled manufacturing process.

The multi objective optimization plays a vital role in industry for ensuring quality at every nook and corners of a product. The multiple output responses were conducted by taguchi method. In this work an attempt is made to optimize process parameters in MIG welding process in AA 6061 weldments. The process parameters considered for study are specimen edge angle, voltage, gas flow rate, wire feed rate. The expected output responses will be UTS, hardness.

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