Review Paper GMAW Process to Identify Optimum Process Parameters

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WINSOL PHYTOTHERMAL SYSTEM

Abstract: Gas Metal Arc Welding Process (GMAW) is an arc welding process that uses an arc between a continuous fill metal electrode and weld pool. All commercial metal such as carbon steel, high strength low alloy steel, stainless steel can be welded in all positions with this process by choosing the proper shielding gas, electrode wire and welding process variables. The production rate is high that other shielded metal arc welding by continuous electrode feed and high filler metal deposition rate. Because the wire feed continuous, long weld can deposit without stop and start. It is only consumable electrode process that can be used to weld all commercial metals and alloys. Artificial Neural Network (ANN) model is developed for L25 orthogonal array in MATLAB software to predict the performance of welding strength. These predicted values close to the experimental values. This same ANN model is used to predict the output for all possible set of parameters. An optimum combination of process parameters, finds out among the predicted values.

Keywords: ANN, GMAW, MATLAB, Optimization.

Introduction:

This research starts with a statement of the problem in which describe the process variables are important factors in gas metal arc welding process that affect the quality of weld as well as mechanical properties. In this research work takes four input variables like current, Voltage, gas flow rate and welding speed while response parameter is welding strength. Taguchi method is used to design and perform the experiments. In this current research work L25 orthogonal array is used to design the experimental runs and find the optimal process parameter combination by using Taguchi method. The artificial neural network model will also develop to predict the welding strength in this research work. This chapter shows the short description, about the research work.

Literature Review:

Erdal Karadeniz et al. (2007), was investigated effect of various welding parameters on welding penetration where the material is Erdemir 6842 steel having 2.4 mm thickness which was welded by robotic gas metal arc welding. The welding current, arc voltage and welding speed were chosen as variable parameters. The depths of penetration were measured for each specimen after the welding operations and the effects of these parameters on penetration were researched. The arc voltages were chosen as 22, 24, and 26 V and the welding speeds were chosen as 40, 60 and 80 cm/min and welding currents were chosen as 95, 105, 115 Amp, for all experiments it was found that the increasing welding current increased the depth of penetration. The depth of penetration increases with increasing arc voltage.

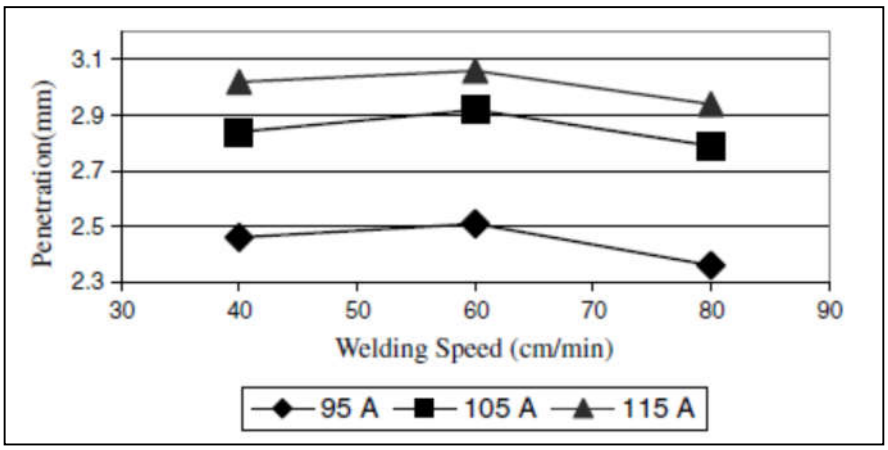

Figure 1: *Penetration vs. Welding speed diagram for 22 V constant arc voltages.*

In the light of the macro-structure photos; reliable bead heights and depth of penetration values were obtained which was shown that if the welding current 95 amp constant and welding speed and voltage are 24v, 26v and 40 cm/min, 60 cm/min so penetration was 2.67 mm and 2.64 mm respectively and at 95 Amp current where welding speed 60 cm/min, voltage 26 penetration was 2.69 mm. In this research paper optimum penetration was 2.84 mm where welding speed 80 cm/min, 105 Amp. 24 V. The effect of welding current approximately 2.5 times greater than that of arc voltage and welding speeds on penetration [1].

Manoj Singla et al.(2010), In this experiment optimizing various Gas Metal Arc welding parameters including welding voltage, welding current, welding speed and nozzle to plate distance (NPD) by developing a mathematical model for sound weld deposit area of a mild steel specimen. The relationship between the various process parameters and weld deposit area find by applying the factorial design approach. Experiment indicates that processes variables influence the weld bead area to a significant extent. Welding current was found to be most influencing variable to the welding deposition area (WDA) [2].

Ehsan Gharibshahiyan et. al (2011), was investigating the effect of welding parameters and heat input on the HAZ and grain growth in Gas metal arc welding process. The role of grain size on hardness and toughness of low carbon steel has also been studied. It was observed that, at high heat input, coarse grains appear in the HAZ which results in lower hardness values in this zone. High heat input and low cooling rates produced fine austenite grains, resulting in the formation of fine grained polygonal ferrites at ambient temperature. One of the major factors affecting the toughness of the welded Metal is the formation of a local brittle zone (LBZ). The degree of brittleness in this zone varies with material chemistry and welding conditions [2]. The elevation of heat input and welding speed, can lead to the formation of equiaxed grains [6]. The microstructure of the HAZ depends on chemical composition and the peak welding temperature and welding voltage. The energy transfer per unit length of weld is a function of heat input. It was also observed that high heat input and rapid cooling. [3]

K. Abbasi et al. (2012), The changes in gas metal arc welding parameters are influenced the effect of the microstructure of weld metal. The increased welding current, welding speed and arc voltage the grain size of microstructure also different from one point to another point. In this study, arc voltage 22 V, 210 A welding current and different value of welding speed 20 cm/min, 40 cm/min and 60 cm/min present the different phase of grain boundaries. At 20 cm/min, the large grain boundaries have shown, but at 40 cm/min, the grain boundaries become smaller than 20 cm/min and at 60 cm/min it is smallest [4].

S. V. Sapakal et al. (2012), have adopted L9 orthogonal array to analyze the effect of each welding process parameter which ware welding current, welding voltage, welding speed on penetration of MS C20 material during welding. A plan of experiments based on Taguchi technique has been used to acquire the data. An Orthogonal array, signal to noise (S/N) ratio and analysis of variance

(ANOVA) are employed to investigate the welding Characteristics of MS C20 material & optimize the welding parameters. In this experiment 3 levels and 3 factors considered so L9 orthogonal arrays were used to conduct the experiments to find the contributions of each factor and to optimize the parameter settings. The experimental value that is observed from optimal welding parameters, the penetration is 5.25mm. & S/N ratio is 14.40 [5].

D.S. Nagesh et al.(2002), performed the experiment on gray cast iron using mild steel electrodes showed that penetration and bead geometry are important physical characteristics of weldments, some process parameters like welding current, voltage, arc travel rate influence the penetration and bead geometry. Depth of penetration increased with an increase in current, but decreased with a decrease in voltage [6].

Sukhomay Pal et al. (2008), was performing their experiment on pulsed metal inert gas welding process. In this experiment Six process parameters, namely pulse voltage, background voltage, pulse duration, pulse frequency, wire feed rate and the welding speed. UTS of the welded plate are considered as the output variable Furthermore, the output obtained through multiple regression analysis is used to compare with the developed artificial neural network (ANN) model output. It was found that the welding strength predicted by the developed ANN model is better than that based on multiple regression analysis [7].

R.P. Singh et al. (2013), made their experiment on Shielded Metal Arc Weld Where the input parameters are Welding current, welding speed, welding voltage and external magnetic field while the depth of penetration and weld bead width as output parameters. In this experiment 25 runs have been taken for experiments, in which back propagated feed forward artificial neural network model was trained to predict the output parameters. If four input process variables were fed to the trained model it provided the output variables having values very close to the experimental values [8].

CONCLUDING REMARKS:

From the literature survey, it can be concluded that Gas Metal Arc Welding has a high production rate than GTAW. Input variables can make an effect on the response parameters. Review shows current has a maximum effect over the response. Voltage and welding speed also has an effect on response but not as current. Design of experiment method has used to design and

performs the experiments, which gives an optimum combination of input parameters set. It can reduce the cost and time. Moreover Artificial Neural Network (ANN) is a good prediction tool than regression model. The value predicted by the ANN model is close to the experimental value.

Reference :

[1] E. Karadeniz a, Ugur Ozsarac , C. Yildiz, "The effect of process parameters on penetration in gas metal arc welding processes," science direct, Materials and Design, Vol. 28 , pp. 649–656, 2007.

[2] M. Singla, D. Singh, D. Dharmpal, "Parametric Optimization of Gas Metal Arc Welding Processes by Using Factorial Design Approach," Journal of Minerals & Materials Characterization & Engineering, Vol. 9, pp.353-363, 2010.

[3] E. Gharibshahiyan, A. H. Raouf , "Nader Parvin , Mehdi Rahimian, "The effect of microstructure on hardness and toughness of low carbon welded steel using inert gas welding," science direct, Materials and Design, vol. 32, pp. 2042–2048, 2011.

[4] I. A. Ibrahim, S. A. Mohamat, Amalina Amir, Abdul Ghalib, "The Effect of Gas Metal Arc Welding (GMAW) processes on different welding parameters, " science direct , Procedia Engineering, Vol. 41, pp. 1502 – 1506, 2012.

[5] S. V. Sapakal, M. T. Telsang, "Parametric Optimization Of Mig Welding Using Taguchi Design Method," International Journal of Advanced Engineering Research and Studies, Vol. 1, pp.28-30, 2012.

[6] D.S. Nagesh, G.L. Datta., "Prediction of weld bead geometry and penetration in shielded metal-arc welding using artificial neural networks," Journal of Materials Processing Technology, Vol. 123, pp. 303–312, 2002.

[7] S. Pal, S. K. Pal , A. K. Samantaray, "Artificial neural network modeling of weld joint strength prediction of a pulsed metal inert gas welding process using arc signals," journal of materials processing technology, vol. 202, pp. 464–474, 2008.

[8] R.P. Singh, R.C. Gupta, S.C. Sarkar, "Analysis of Depth of Penetration and Bead Width of Shielded Metal Arc Weld under Magnetic Field Applying Artificial Neural Networks," International Journal of Science, Engineering and Technology Research, Vol. 2, Issue 2, PP. 235-242, 2013.