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Optimization of Hybrid Welding Parameter Analysis Based on Strength

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ABSTRACT

TIG welding process parameters were optimized for joining 304 and AISI 1040 stainless–steel plates. Welding pressure, welding speed and welding temperature combinations were carefully selected with the objective of producing weld joint with maximum impact strength and tensile strength. Taguchi technique was applied for optimizing the selected welding parameters. The factors used in this study consisted of pressure, welding speed and welding temperature, each of which had three levels in the study. L27 orthogonal array was selected according to the aforementioned factors and levels and experimental tests were performed and responses are optimize with ideal solution (TOPSIS) approach has been applied.

Keyword-- Welding, Strength, Voltage

I. INTRODUCTION

The integration of efficient quality welding technologies for dissimilar metals will be a key component in the successful weld quality for transportation and power plant systems. The welding of dissimilar metals with melting one of the metals is efficient if the welding conditions that determine the duration of the interaction between the solid and liquid metal are strictly controlled. The properties of the welded joints and the feasibility of the welding processes are influenced by many factors: for example, Welding electrode, Voltage Power, carbon migration from the low-alloy side, the microstructure gradient and residual stress situations across different region of the weld metal. The process is efficient, economical and dependable as a means of joining metals. This is the only process which has been tried in the space. The process finds its applications in air, underwater and in space. Why welding is used, because it is suitable for thicknesses ranging from fractions of a millimeter to a third of a meter and Versatile, being applicable to a wide range of component shapes and sizes. In this paper two different type of material are used to weld in different parameter with their level has been taken. These materials are joined by TIG welding.

II. REVIEW OF WORK

These residual elements are added in a smaller amount. The American Iron and Steel Institute (AISI) has defined a plain carbon steel to be an alloy of iron and carbon which contains specified amounts of Mn below to a maximum amount of 1.65 % wt., less than 0.6 % wt. Si, less than 0.6 % wt. Cu and which does not have any specified minimum content of any other deliberately added alloying element [2]. It is usual for maximum amounts (e.g. 0.05 % wt.) of S and P to be specified. As carbon content rises, the metal becomes harder and stronger but less ductile and more difficult to weld. Higher carbon content lowers steel melting point and its temperature resistance in general [3].Y. Uematsu et al. described the significant effect of elevated temperature on fatigue strength of ferritic stainless steels. Fracto graphic analysis revealed some brittle features in fracture surface near the crack initiation site at elevated temperatures [4]. Okayasu et al made an examination of the fatigue properties of the two-phase ferrite/martensite low carbon steel; he found that the fatigue strength of steel is found twice as high as that of the as-received steel [5]. Tayanc et al. presented that fatigue strength of steel increased when compared with as-received materials. They have obtained the highest fatigue strength in the annealed steel that received specimen has higher fatigue strength or higher endurance to fatigue failure than DPSs but for low cyclic life.[6]

Hyde et. al.[8] studied finite element creep and damage analysis were performed for a series of new, service aged, fully repaired and partially repaired circumferential welds in Cr Mo V main steam pipes under an internal pressure and a uniform axial stress, using simplified axis symmetric models. Weld width on the failure life is relatively small.

III. OBJECTIVE OF WORK

Taguchi orthogonal array design as a DOE approach was applied to design the experiments, develop statistical models and optimize the welding operation through controlling selected welding parameters. Taguchi design of the experiment provides a straight evaluation of the influence of the investigated parameters on the TIG welding outcomes. Further, Taguchi parameter design can optimize the performance through the settings of design parameters. It can also reduce the fluctuation of system performance to allow the source of variation to be identified. Design the experiment for following the welding process as per the parameter required by L27 orthogonal array. Apply the TOPSIS method on responses to short out the multi-objective problem and for optimization of parameter.

IV. MATERIAL AND METHODOLOGY

Hardness is the resistance of a material to permanent indentation. It is not a material property but an empirical test hardness is measure by v notch impact test. Tensile test is the most fundamental type of mechanical test. It can be either force controlled or displacement controlled experiments. In force controlled experiments, a material is being pulled and its behavior to react to the forces applied in tension is determined, while in displacement controlled experiments a constant increasing displacement is applied as a load. DOE is important as a formal way of maximizing information gained while minimizing resources required. It has more to offer than 'one change at a time' experimental methods, because it allows a judgment on the significance to the output of input variables acting alone, as well input variables acting in combination with one another factor and level are shown in table 1.

Table 1 Process Parameters

	Welding Speed (mm/sec) S	Welding current (Ampere) I	Welding Voltage (Volt) V	Gas Flow (cfh) F
Level 1	3.2	120	40	15
Level 2	3.4	125	50	20
Level 3	3.8	130	60	25

In TOPSIS, a number of alternatives have to be evaluated and compared using several criteria. The aim of TOPSIS is to provide support to the decision-maker in the process of making the choice between alternatives. In this way, practical problems are often characterized by several conflicting criteria, and there may be no solution which satisfies all criteria simultaneously responses are plot in fig 1

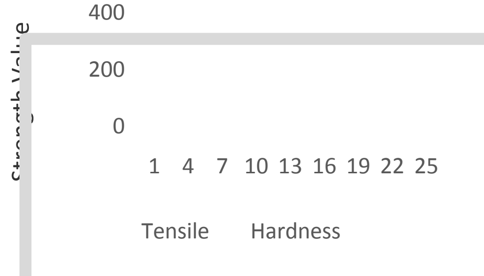

Fig 1 Observed Mechanical Property

Even though a butt weld may be reinforced on both sides to ensure full cross-sectional areas, its effect is neglected while estimating the throat dimensions. If the stresses are uniform across the welding thickness, the average stress concept may be applied to determine its strength. All the adequacy measures in all parameter gives best response indicate that adequate models have been obtained. The final graph models in terms of actual factors as determined by optimization graph as shown in fig 2.

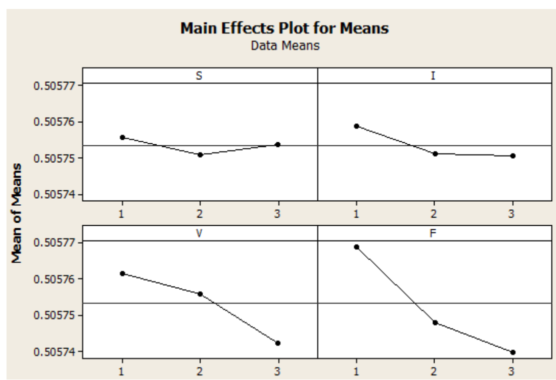

Fig 2 Optimize Graph

Regression Graph shows that strength is increasing and the decreasing as shown in fig 3

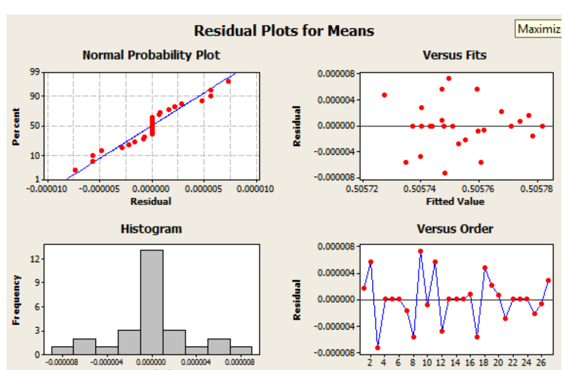

Fig 3 Four in One graph

V. CONCLUSION

This work has described the use of TOPSIS method and statistical techniques for analyzing and optimizing the ultimate load in TIG welding of AISI 304 & 1040 stainless steel specimens. From the study, the following conclusions are drawn.

- From the four in one graph results, it is found that none of the welding parameter does not effecting any parameter.
- Main effects plots revel that speed, current, voltage and gas flow rate are the factors which has considerable influence on ultimate load. Speed has small / lesser influence.
- The optimum welding condition obtained by TOPSIS method is: Speed = 3.4 mm/sec, current = 125 A, Voltage = 40V and gas flow rate = 15 l/min.

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