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EXPERIMENTAL INVESTIGATION OF WELD CHARACTERISTICS FOR A MIG WELDING WITH STAINLESS STEEL OF GRADE SS 410

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***ABSTRACT**--This review focuses on the study of MIG welding on stainless steel 410. During this study the properties of MIG is used to weld stainless 410. Welding is widely employed by manufacturing engineers and production personnel to quickly and effectively set up manufacturing processes for brand spanking new products. The MIG welding parameters are the foremost important factors affecting the quality, productivity and price of welding. This paper presents the influence of welding parameters like welding current welding voltage, Gas flow, wire feed rate, etc. on weld strength, ultimate lastingness , hardness of weld joint, weld pool geometry of varied metal material during welding. By using DOE method, the parameters are often optimize and having the simplest parameters combination for target quality. The analysis from DOE method can give the importance of the parameters because it give effect to vary of the standard and strength of product. Then various tests were conducted to the joints such as tensile strength , bending test ,micro structural test, grain size test. And then with the final results , the physical and mechanical properties were investigated.*

Keywords--** experimental investigation of weld characteristics for a mig welding with stainless steel of grade SS **410

I. INTRODUCTION

Welding is a process of joining two metal pieces by the appliance of warmth. Welding is that the least expensive process and widely used now days in fabrication. Welding joints different metals with the assistance of variety of processes during which heat is supplied either electrically or by mean of a gas torch. Different welding processes are utilized in the manufacturing of Auto mobiles bodies, structural work, tanks, and general machine repair work. In the industries, welding is employed in refineries and pipe line fabrication. The tungsten electrode and therefore the welding zone are shielded from the encompassing air by noble gas. The electric arc can produce temperatures of up to twenty and this heat are often focused to melt and join two different a part of material. The weld pool are often wont to join the bottom metal with or without filler material. The power source required to take care of the TIG arc features a drooping or constant current characteristic which provides an essentially constant current output when the arc length is varied over several millimeters. Hence, the natural variations within the arc length which

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occur in manual welding have little effect on welding current. The capacity to limit the current to the set value is equally crucial when the electrode is short circuited to the work piece, otherwise excessively high current will flow, damaging the electrode. Open circuit voltage of power source ranges from 60 to 80 V.

II. MATERIALS USED

SS410 Grade 410 is the material chosen for this work as it has essential martens tic chrome steel , like most non-stainless steels. It are often hardened by a "quench-and-temper" heat treatment. It contains a minimum of 11.5 per cent chromium, just sufficient to offer corrosion resistance properties. It achieves maximum corrosion resistance when it's been hardened and tempered then polished. Grade 410 may be a general purpose grade often supplied within the hardened, but still Machinable condition. The applications where high strength, moderate heat and corrosion resistance are required. Martens tic stainless steels are optimized for top hardness and other properties are to a point compromised. Fabrication must be by methods that leave poor weld ability and typically the necessity for a final heat treatment. Corrosion resistance of the martens tic grades is lower than that of the common austenitic grades, and their useful operating temperature**.**

III. TYPES OF WELDING

MIG - Gas Metal Arc Welding (GMAW) ***used in this experiment***, TIG - Gas Tungsten Arc Welding (GTAW), Stick - Shielded Metal Arc Welding (SMAW), Flux-Cored Arc Welding (FCAW), Energy Beam Welding (EBW), Atomic Hydrogen Welding (AHW), Gas Tungsten-Arc Welding, Plasma Arc Welding

IV. PARAMETERS

PARAMETER	SYMBOL	UNITS	VALUE
Density	P	Kg/m^3	7400
Thermal conductivity	K	W/m K	25.5
Specific heat of solid	C_p	J/kg K	650
Latent heat	L	J/kg	$3x10^5$
Liquidus	T_l	K	1723
Solidus	T_s	K	1693
Emissivity	E	N/A	0.8
Convective coefficient	H	W/m^2 K	100
Radius of laser beam	W_o	mm	0.5

V. PROPERTIES OF STAINLESS STEEL 410

5.1 CHEMICAL PROPERTIES:

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GRADE	C	Mn	Si	P	S	Cr	Mo	Ni	N
410	0.15	1	1	0.04	0.030	11.5-13	0	5.0	0.12-0.25

5.2 MECHANICAL PROPERTIES:

GRADE	TENSILE STRENGTH(MPa)	YIELD STRENGTH 0.2% proof (MPa)	Elongation at break	HARDNESS, ROCKWELL BRINEL
410	450	415	25%	28.5

5.3 PHYSICAL PROPERTIES:

GRADE	DENSITY	ELASTIC MODULUS(GPa)	MEAN CO EFFICIENT OF THERMAL EXPANSION 0-100 (CELCIUS)	THERMAL CONDUCTIVITY AT 100 (CELCIUS)	SPECIFIC HEAT	ELECTRICAL RESISTIVITY
410	7800	200	9.9	24.9	460	570

VI. PROCESS PARAMETERS :

MIG WELDING

Welding current, Welding voltage, Gas flow rate, Wire feed rate(8)

MATERIAL PROPERTIES:

Composition, Temperature, Roughness, Surface quality (8)MIG welding is a versatile technique suitable for both thin sheet and thick section components. An arc is struck between the end of a wire electrode and the work piece, melting both of them to form a weld pool. MIG is widely used in most industry sectors because of flexibility, deposition rates and suitability for mechanization (7). The MIG welding parameters are the most important factors affecting the quality, productivity and cost of welding. This paper presents the influence of welding parameters like welding current, welding voltage, Gas flow rate, wire feed rate, etc. on weld strength, ultimate tensile strength, and hardness of weld joint, weld pool geometry of various metal material during welding (8)

VII. TAGUCHI'S DESIGN METHOD

Taguchi Analysis: Impact Strength versus Peak Current (PC), Base Current (BC), Torch Angle (TA), Taguchi Technique is applied to plan the experiments. Improving productivity during research and development has been made easier because of Taguchi's method, so that high quality products can be produced faster than usual with cost efficient. Dr. Taguchi of Nippon Telephones and Telegraph Company, Japan has developed a method based on "orthogonal array" experiments which gives much reduced "variance" for the experiment with "optimum settings" of control parameters. So that the Design of Experiments with optimization of control parameters to obtain best results is achieved in the Taguchi Method. "Orthogonal Arrays" (OA) provide a set of well balanced (minimum) experiments and Taguchi's signal to noise ratios called as (S/N), which are desired output of log functions, serve as objective functions for prediction of optimum results, help in data results and optimization (13).

VIII. FUTURE SCOPE

Taguchi method can be used to formulate the experimental layout to control various factors viz., arc voltage, arc current, welding speed, nozzle to work distance and gas pressure predominantly influence weld quality, even plate thickness and backing plate too have their own effect and Investigation can be done on high cycle and low cycle fatigue properties of SS202 and SS 410 welded plates by MIG & TIG welding process, In the welded plates Eddy Current, Radiography and Hardness testing can be done to detect presence of defects like LOP, LOF, Blowhole, and Cracks, Investigation can be done, effect of MIG & TIG processes on weld morphology, angular distortion, delta ferrite content and hardness of welded plates of SS202 & SS410 stainless steel by using different flux like TiO2, MnO2, MoO3, SiO2 and Al2O3 etc.

IX. APPLICATIONS

Dental, Surgical instruments, Pipelines, Valves, Nozzles.

X. CONCLUSION

This study investigated the mechanical characteristics under various process parameter such as gas flow rate, voltage, strike off distance. The main effects plot for means is found for various welding performance. The best multi performance characteristics was obtained in tungsten inert gas welding for SS410 when voltage is 35V, gas flow rate is 8 L/min and strike off distance is 1.5 mm from main effects plot for means., TIG welding can be used weld two various metals together such as to join SS410 grade. The processed joints exhibits a better metallurgical and mechanical characteristics than the others and the joints exhibited some 90-95% of parent material Hardness value. The specimen failures were associated depending upon the improper changes of heat value. In this experiment , it was identified that the input parameter value 140 Peak current, Base Current 80 Amps and TORCH ANGLE 40º was the best value and it does not create kind of failures or major changes in the testing process. TIG welded of SS410 steel has the toughest value and it has comparatively higher value (Peak current - 140, Base

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Current 80 Amps and 40º torch angle) than other value. It also has a very high tensile strength when compared to others.

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