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ENHANCEMENT IN THE PROPERTIES OF TIG WELDING BY CHANGED PARAMETERS

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ABSTRACT

Welding, the process used to join two or more pieces of met altogether by applying thermal energy or pressure, is aprecise, reliable, cost-effective method for joining materials. This technique is widely used by manufacturers to join metals and alloys. In this work TIG Welding is discussed with changed parameters. In the conventional welding (TIG) arc welding the below disadvantages may be seen:(a)low productivity;(b) relative shallow penetration; and(c) the high sensitivity of the surface condition and chemical composition of thebase metal. We can diminish these effects by changing some parameters. The activated flux coated wires are used to examine the effect of the fluxes on the materials.

This paper lights up the optimization of the TIG welding by using changed input parameters. Used parameters are shielding gas, current intensity, weld bead width, speed, electrode etc

Key words: precise, conventional, shallow, penetration, sensitivity, fluxes l.

I. INTRODUCTION

Welding is essential to produce most of usual objects, from big structures such as bridges and ships, to vehicles, to microelectronic components. Compared with other joining methods, welded structures tend to be lighter weight, stronger and cheaper to produce. There are more than 100 processes within welding technology. These technologies allow a great deal of flexibility in the design of components to be welded. Welding being additive manufacturing process,plays important role in assembly and structural component to increase their performance. Moreover, welding is frequently used to repair fix structures that were not originally welded, increasing the life of this structures. However new technologies are to be developed in industries for following purposes-

- Train welders and welding technologists to be more comprehensive and scientific.
- Make the welder's working environment more attractive.
- Eliminate the image of welding as the weak step in the manufactured process.
- Develop new materials with increasingly incorporate weld ability.

In structural welding, the main processes used by the industry are arc welding processes. This group has been developed much the last years, obtaining an impressive improving respect arc sources and in the control of the process. Nevertheless the evident advantages of above processes, certain limitations have become evident. Hence, new processes may be introduced to achieve required improvements in welded manufacturing. Examples of these processes are laser and hybrid welding.

II. INTRODUCTION TO TIG WELDING

The designation TIG comes from USA and is an abbreviation of Tungsten Inert Gas. Tungsten has melting point more than 3300° C, which means more than double the melting point of the metals which are usually welded. Inert Gas is same as nonreactive gas, which means it will notaffect welding quality. In Germany this process is also called WIG welding, the W meaning wolfram. TIG welding is known as the international standardized for the welding method. The fundamentals of TIG welding is similar to fusion energy is produced by electric arc which burns between the workpiece and the electrode of Tungsten. When welding process is carried out, the arc, the electrode and the weld pool are protected against the effects of damages atmospheric air by an inert

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shielding gas. With the help of a gas nozzle the shielding gas is directed to the welding zone where it diminishes the atmospheric air. Tungsten Inert Gas welding is differ from another welding techniques such as MIG/MAG and MMA because it not consume electrode. If there is necessary to use filler material to fill the gap, that is added either automatically or manually as a bare wire.

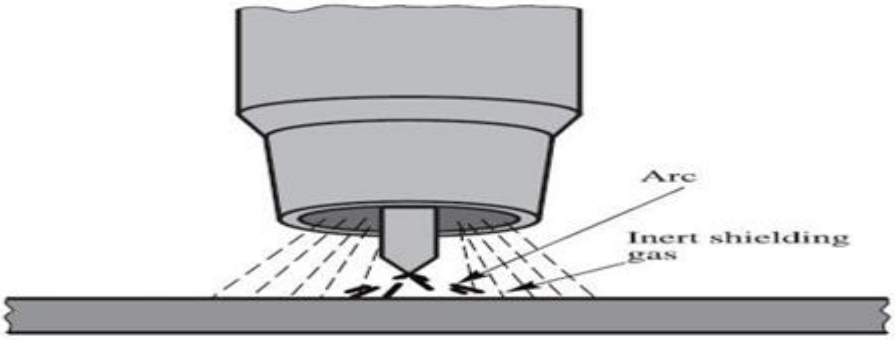

Figure-1 TIG welding Principle

III. TIG WELDING PROCESS

The TIG welding equipment chiefly consists of:
- A TIG torch which controls the arc.
- For providing the necessary welding current a power source is used.
- A TIG welding unit has its special control system which control its arc, current, speed etc.
- A shielding gas cylinder with pressure reducing valve and flow meter.

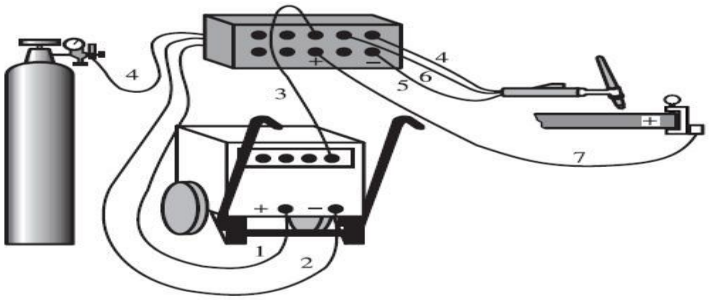

Figure-2 Example for configuration of welding equipment

IV. OPTIMUM PROCESS VARIABLES

Tungsten one to two percent Thoriated Tungsten TIG Processes Used mostly in Direct current electrode negative, but possible, with Direct current electrode positive Suitable Metals (Ferrous materials and some non-ferrous)excluding aluminum and magnesium. Tungsten Zirconiated Tungsten TIG Process is Used mainly in AC, but possible in DC with DCEN or DCEP Suitable Metals Aluminum, magnesium and alloys of these materials.

Electrode Dia. (mm)	Maximum Current-Carrying Capacity (amps)			
		Thoriated		Zirconiated
	D.C		A.C	A.C
0.8	45		30	-
1.2	70		40	40
1.6	145		55	55

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2.4	240		90	90
3.2	380		140	150
4.0	440		195	210
4.8	500		250	275
5.6	-		275	320
6.4	-		320	370
7.9	-		410	-
9.5	-		500	-

V. EXPERIMENT AND ANALYSIS

To get clear and accurate conclusions from the experiment we need to plan and execute experiment to utmost importance for deriving all observations. Design of experiment is considered to be a very useful strategy for accomplishing these tasks. The science of statistical experimental design originated with the work of Sir Ronald Fisher in England in 1920s. He founded the basic fundamentals of experimental design and the associated data-analysis technique which is also known as Analysis of Variance (ANOVA) during in his research to increase the product of agricultural crops. The theory and applications of experimental design and the related technique of response surface methodology have been advanced by many statistical researchers. As we know Taguchi's Method makes heavy use of orthogonal arrays. That's why Taguchi's Experimental Design method has been employed.

VI. SELECTING THE RANGE OF THE PROCESS PARAMETERS:

Trials runs were carried out by varying one of the process parameters. The range, which covers the minimum and the maximum level of the direct process parameters, is carefully selected so as to maintain the equilibrium between the welding wire feed rate and burn-off rate. The base of choosing various welding parametersis the selected range will be within the controlled limit of the parameters of the power source. The working range was selected by inspecting the bead for flawless appearance and the absences of any visible defects. The units, symbols, and the limits of the factors (parameters) are given in Table-

Table- Welding parameters and their range

Parameters	Notation	Unit	Levels of factors		
			1	2	3
Current	I	A	100	130	160
Travel speed	V	mm/min	135	165	200
flux	flux	-	TiO2	w/o	SiO2

VII. OBSERVATION

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The main effects of different process parameters on the penetration are plotted as Figures

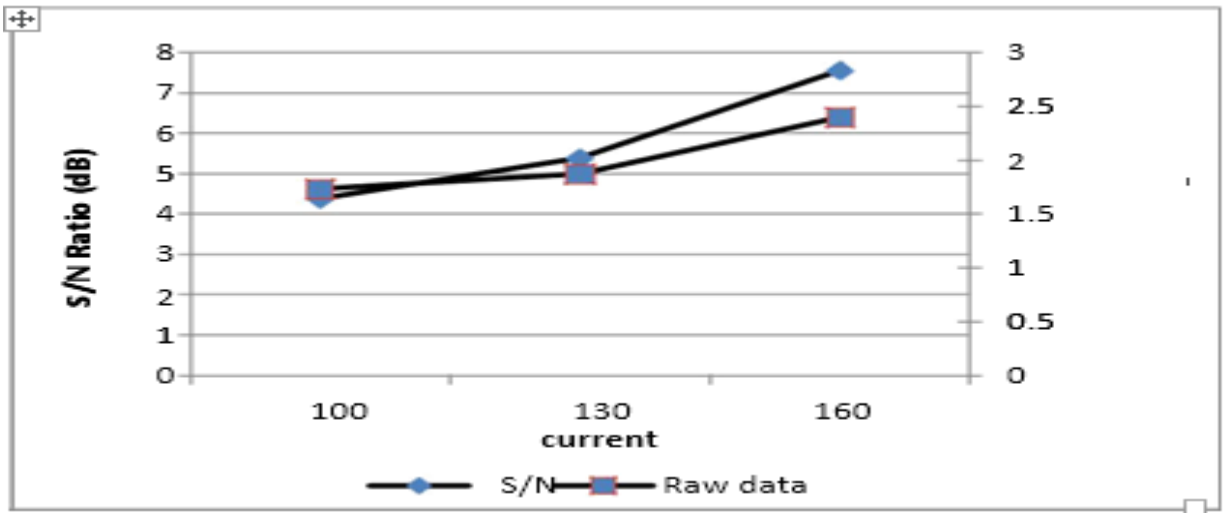

Figure - Effect current on S/N data & RAW data

From the above fig shows the direct effect of welding current on depth of penetration. Figure illustrates that when the welding current increases, the heat input increases. The increase in heat input results in preheating of the work piece during forward welding. This results in more melting of base metal. Hence there is an increase in depth of penetration as welding current increases

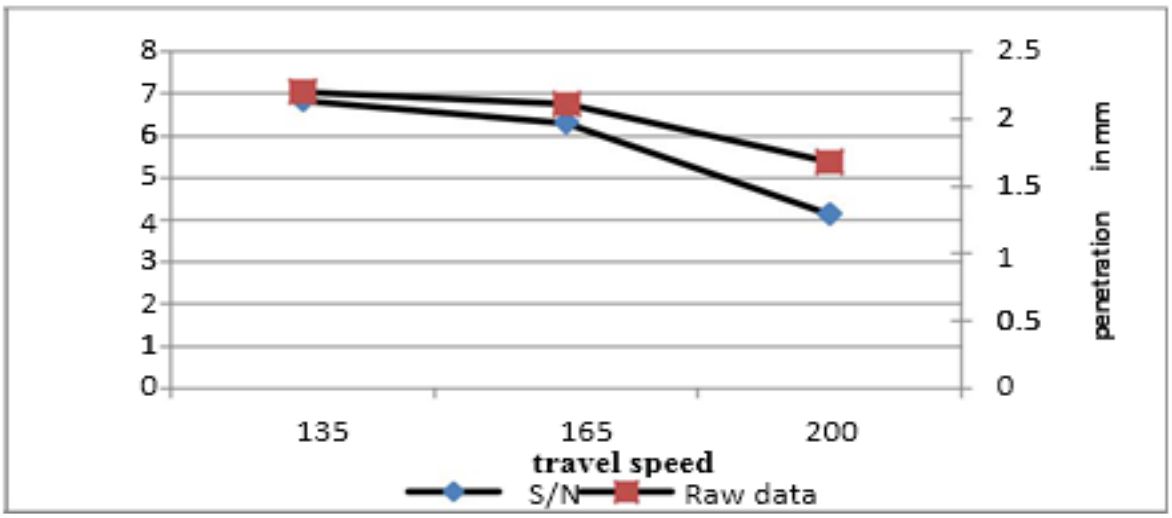

Figure- Effect travel speed on S/N data & RAW data

Above fig shows the direct effect of welding speed on depth of penetration. Welding speed is one of the main factors that control heat input and bead width. The bead width and dimensions of the heat affected zone decreases with the increase in welding speed. This is because heat input is inversely proportional to welding speed. Due to the above factors the depth of penetration decreases with the increase in welding speed

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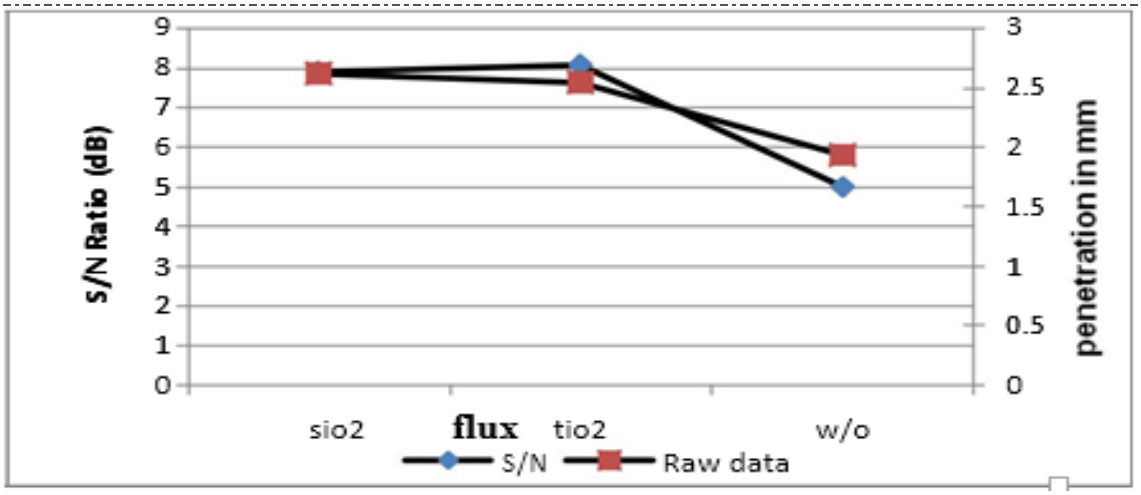

Figure- Effect flux on S/N data & RAW data

In above figure we can observe that different flux have different effect on depth of penetration in case of with flux as compare to without flux depth of penetration increase.SiO2 have more effect as compare to TiO2 as shown in figure analysed by researchers the reason for increase the penetration for using the active flux is following

1) Arc constriction -The temp of arc is higher than decomposition temp. Of molecules at the center in the lower part of the arc where shielding gas and the atom of flux are ionized to electrons and positive ions .the materials evaporated still exist as molecules and decomposed atoms in the outer region of the arc. Decomposed atoms absorb electrons to form charged particles to cause the decrease of main conducting materials, then the conducting ability decreases and arc constricts.
2) Generally, surface tension gradients decrease with increasing of temp. In pure metal and many alloys, fluid flow from low surface tension region to high surface tension region. Weld pool center is having high temp. So the surface tension near the center is low as compare to outer region. So fluid flow due to which width of bead is higher and penetration is less. Surface active elements such as oxygen and sulfur can change the direction of the fluid due to which flow in weld pool. When plate with coating activating flux fluid flow width of beads less and penetration is more.

VIII. RESULT

The main effects of the various parameters at the selected levels on the weld bead width are plotted in the Figures

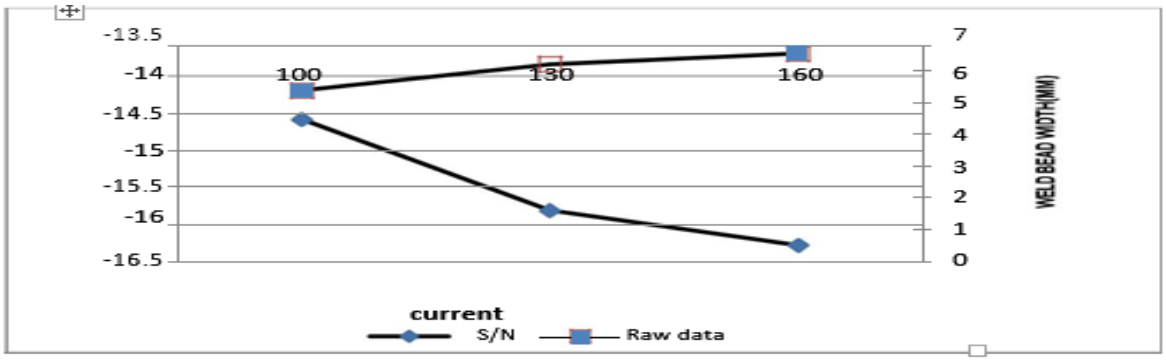

Figure- Effect current on S/N data & RAW data

We observe by the graph when current increase then the weld bead width also increase we can say lower value of width is achieve at low current. Width of bead is increase due to increase in current. When the welding current increases due to which the heat supply is also increase. When the heat supplies increase due to which melting of material increase therefore width of welding bead is increase.

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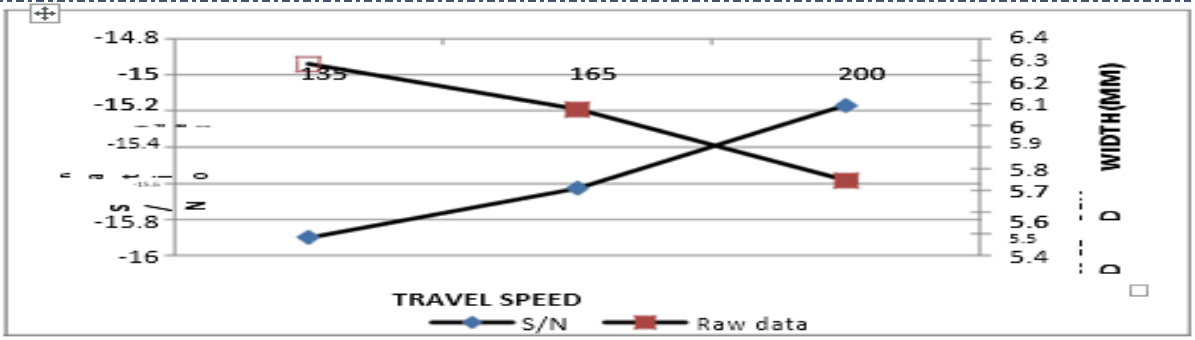

Figure- Effect travel speed on S/N data &RAW data

We observe by the graph when current travel speed then the weld bead width also decrease we can say lower value of width is achieve at high travel speed. When we increase the travel speed then the heat supply is decrease. Due to less heat supply the width of weld bead decrease. Which is shown in above figure

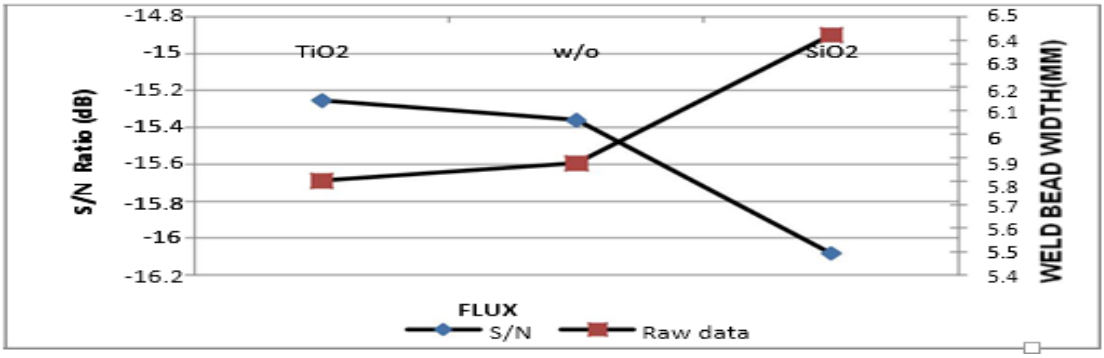

Figure- Effect flux on S/N data &RAW data

We observe by the graph when SiO2 is used then the weld bead width is decrease so we cansay lower value of width is achieve by using the SiO2 active flux. By using the active flux significant effect is find on weld width. This is because surface tension is change the material flow at high temp. Due to which the depth of weld bead increase and width of weld bead decrease. Both flux have different effect which is shown in above figure.

IX. CONCLUSIONS AND SCOPE FOR FUTURE WORK

Conclusion

The following conclusions were drawn from the study of the effects of welding process parameters on weld bead geometry when bead-on-plate welds are deposited using TIG process.

- TAGUCHI technique could be employed effectively in analyzing the effect of process parameters on response.
- The current, travel speed and flux were found to affect the bead penetration, bead width and hardness of the weld metal significantly.
- As increase in current, increasing both the bead width and bead penetration but hardness was decreased.
- The values of weld bead width and penetration decrease with the increase in travel speed but hardness was increased.
- Due to the presence of active flux, bead width decrease but bead penetration and hardness increases.
- The effect of SiO2 was more thanTiO2 active flux on both penetration and bead width but TiO2 had more effect on hardness as compare to SiO2.
- The percentage contribution of flux on penetration was observed to 18.21%, on width of weld bead was observed to 20.33% and on hardness was observed 83.33%.

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Scope for future work

- Process parameters used in this study were arc current, welding speed and active flux.
- Study can be done by selecting more parameters such as nozzle to plate distance, electrode wire size, flux thickness etc.
- RSM can be used for making analysis of HAZ and other responses of TIG process.
- Microstructure of the weldment may also be studied.
- By using the active flux HAZ is decrease due to which the strength of joint will also increase.
- By using the active flux the production of industry will also increase

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