OPTIMIZATION OF STRAIGHT TUBE BUTT WELDING PARAMETERS

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***Abstract*— In this project all the possible welding defects occurring in Straight Tube Butt Welding Machine (STBW) is analyzed. For each type of defect the remedial action is suggested. Using these suggestions we can reduce the welding defects. The important parameters which affect the STBW were also found. They were optimized by the use of ANOVA and their optimum parameters and the critical value was calculated and verified. To avoid Lack of Penetration Weld joints must not be narrow, Welding current should be adjusted to appropriate level, Electrode feed must be in a control level, Wire should be placed at the centre of grove, Arc length should not be too long, and Rotation of the chucked must be control, sufficient root opening. To avoid Lack of Fusion Sufficient heat input, correct size of electrode should be chosen, Position of electrode should be corrected, clean weld surface before welding, Torch oscillation should not be too narrow, proper gas mixture.**

***Index Terms*— STBW, ANOVA, Penetration Weld joints**

I. INTRODUCTION

Welding is a process of joining two or more pieces of the same or dissimilar materials to achieve complete coalescence. This is accomplished by fabrication of vastly different components including critical structures like water wall panel, heat exchanger, pressure vessels, etc. Welding can be done with or without the application of filler materials called electrode. Welding joins different metals / alloys with the help of a number of processes in which heat is supplied either electrically or by means of a gas torch. In order to join two or more pieces of metal together by one of the welding processes, the most essential requirement is heat, pressure may also be employed, but this is not, essential in many processes. In the course of time, temperature difference in a body is reduced by heat flowing from different region of higher temperature of those of lower temperature. This process takes place in all substances such Assistant liquids and gases and also in solids. In comparison to other process of joining the metal, STB process can give 100% of strength and efficiency.

The objectives of the project are to reduce the defects in Straight Tube Butt Welding (STBW) machine. This is founded through a survey which is done on the welded joints by the STBW machine.

Metal inert gas welding process (MIG) is widely used process in STBW process. MIG welding process is one of the many versatile processes grouped under the headings, Gas metal Arc welding process (GMAW). Among the group, MIG welding process was the first to be discovered. This was the result of the attempt made during 1940's to develop a suitable welding process for steel and also a mechanize the same. Today it is a well-established semi-automatic process, which can be easily mechanized or automated with a wide range of applications.

It is an arc welding process where in coalescence is produced by heating the jobs with an electric arc establish between a continuously fed metal electrode and the job. No flux is used but the arc and molten metal are shielded by an inert gas, which may be argon, helium, CO_2 or a gas mixture. In MIG, the electrode is in the form of a write continuously feed from a spool. The rate of feeding the wire is controlled.

GMAW is generally used because of its high productivity, it is also easy to use and it creates high quality welds at a lower overall cost. GMAW is generally done using DECP (Direct Current Electrode Positive) or DCRP. Alternating current is never used.

DCEN (Direct Current Electrode Negative) is used with only one special electrode, called an emissive electrode. GMAW can be done using solid wire, flux cored or a specially coated solid wire electrode. The shielding gas or gas mixture must be used with GMAW. For every pound of solid electrode wire used. 92-98% becomes deposited Assistant weld metal. Some spatter occurs in the GMAW process. Very little stub loss occurs when continuously fed wire is used. There is a very thin glass like coating over the weld bead after GMAW. No heavy slag is required because a gas shields the weld area. Christo Ananth et al. [3] 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.

II. PRINCIPLE AND WORKING

As the name itself indicates the machine can handle only straight seamless steel tubes. The work (i.e.) straight seamless steel tubes are held using chucks and it is automatically fed through the checks by rollers. The rollers are driven using hydraulic motors. At the middle of both the chucks there is a presence of bar stop. The bar stop is used to align the tubes during welding. In order to weld tubes with uneven thickness inserts are used.

There is a presence of control panel to control the process parameters such as current, voltage, chuck speed, wire feed and oscillator speed etc. The wire feed is done by wire feeding mechanism and can be controlled using control panel while joining the tubes, the root layer is first welded by fixing some parameters and then oscillator is made to operate and the second layer is welded.

The movements of welding torch and bar stop are automatically controlled pneumatically. The welding torch is water-cooled. The operating parameters plays an important role in weld quality and the defects are mainly caused due to the changes in operating parameters for each material separate operating parameter should be fixed.

Visual inspection, which is the most widely used inspection method, is also the quickest, easiest, and cheapest. The only equipment commonly used is a magnifying glass (1 OX or less) and a flashlight or extension. Other tools, such as a bore scope and dental mirrors, are useful for inspection inside vessels, pipe, or confined areas. Visual inspection is always required in weld evaluation. However, it will not reveal interval defects or minute surface defects.

Before welding, the faces and edges should be examined for laminations, blisters, scabs, and seams. Heavy scale, oxide films, grease, paint, oil, and dirt should be removed. Edge preparation, alignment of parts, and fit up should be checked. Welding specifications should be specific and state that all weld joints must be inspected for compliance with requirements for preparation, placement of consumable inserts, alignment, fit-up, and cleanliness.

Specifications should state that welds must be examined for conformance to the qualified welding procedure, detection of cracks in root pass, weld bead thickness, slag and flux removal, and preheat and inter pass temperatures, where applicable. Specifications should state that welds must 'be examined for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

A weld is considered acceptable by visual inspection if

(1) The weld has no surface flaws such as cracks, porosity, unfilled craters, and crater cracks, particularly at the end of welds.

(2) The weld metal and base metal are fused. The edges of the weld metal should blend smoothly and gradually into the adjacent base metal. There should be no unacceptable overlap or undercut.

(3) The weld profiles conform to referenced standards and specifications. The faces of fillet welds may be slightly convex, flat, or slightly concave, as determined by use of suitable gages or templates. The minimum size of each fillet leg is specified on the applicable drawings or welding procedure.

(4) For butt welds, the amount of weld bead reinforcement or the height of the surface of the weld above the base metal surface should be no greater than the welding specification allows (These standards should be developed early in a job, and should represent acceptable, borderline, and reject able conditions. When there are several critical joints, a separate standard may be prepared for each).

III. CALCULATION AND ANALYSIS

- σ^2 Remember assumption that the population variances of the three groups is the same
- Under this assumption, the three variances of the three groups all estimate this common
  - ✓ ValueTrue population variance =
  - ✓ Within-groups variance = within-groups mean square =error mean square = s_w^2
- For groups with equal sample size this is given by the average of the variances of the groups

$$s_w^2 = \frac{1}{I}\sum_{i=1}^{I} s_i^2 = \frac{1}{I}\sum_{i=1}^{I}\sum_{j=1}^{n_i}\left(\frac{(x_{ij}-\bar{x}_i)^2}{n_i-1}\right)$$

- For unequal sample sizes, the variances are weighted by their degrees of freedom.

In our example data

$$s_b^2 = \sum_{i=1}^{I} n_i \frac{(\bar{x}_i - \bar{x})^2}{I-1}$$

For equal sample sizes, the between-groups variance is then given by

$$s_b^2 = n\sum_{i=1}^{I}\frac{(\bar{x}_i - \bar{x})^2}{I-1}$$

For unequal sample sizes, the between-groups variance is given by

$$s_w^2 = \sum_{i=1}^{I} \frac{(n_i - 1)s_i^2}{N - I}$$

TABLE – I

DATA COLLECTION CALCULATIONS

Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8
	Factor Levels			Performance Response			Mean Value
	A	V	mm/min				
	current	voltage	chuck speed				
Run #	**V1**	**V2**	**V3**	**R1**	**R2**	**R3**	**R**
1	0	0	0	0.91	0.93	0.91	0.9166667
2	0	0	1	0.94	0.91	0.96	0.9366667
3	0	1	0	0.98	0.92	0.94	0.9466667
4	0	1	1	0.93	0.93	0.92	0.9266667
5	1	0	0	0.9	0.95	0.91	0.92
6	1	0	1	0.92	0.94	0.91	0.9233333
7	1	1	0	0.91	0.93	0.94	0.9266667
8	1	1	1	0.94	0.92	0.91	0.9233333

TABLE -II

Source of Variation	SS	Df	MS	F	F crit
A (Current)	0.000417	1	0.000417	1.06383	4.493998478
B (Voltage)	0.000267	1	0.000267	0.680851	4.493998478
C (Speed)	0	1	0	0	4.493998478
A x B	6.67E-05	1	6.67E-05	0.170213	4.493998478
A x C	0	1	0	0	4.493998478
B x C	0.000817	1	0.000817	2.085106	4.493998478
A x B x C	0.000417	1	0.000417	1.06383	4.493998478
Error (Within)	0.006267	16	0.000392		
Total	0.00825	23			

IV. CONCLUSION

In this project all the possible welding defects occurring in Straight Tube Butt Welding Machine (STBW) is analyzed. For each type of defect the remedial action is suggested. Using these suggestions we can reduce the welding defects. The important parameters which affect the STBW were also found. They were optimized by the use of ANOVA and their optimum parameters and the critical value was calculated and verified. To avoid Lack of Penetration Weld joints must not be narrow, Welding current should be adjusted to appropriate level, Electrode feed must be in a control level, Wire should be placed at the centre of grove, Arc length should not be too long, and Rotation of the chucked must be control, sufficient root opening. To avoid Lack of Fusion Sufficient heat input, correct size of electrode should be chosen, Position of electrode should be corrected, clean weld surface before welding, Torch oscillation should not be too narrow, proper gas mixture.

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