International Journal of Advance Research in Science and Engineering
Vol. No.5, Issue No. 05 , May 2016
www.ijarse.com
IJARSE
ISSN 2319 - 8354

OPTIMIZATION OF WELDING PARAMETERS OF SUBMERGED ARC WELDING PROCESS: A REVIEW

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ABSTRACT

The Welding processes that employ an electric arc is the most prevalent in industry are Shielded Metal Arc Welding, Gas tungsten Arc Welding, Flux cored arc welding, Gas metal arc welding, Gas submerged arc welding. This process is connect with molten metal. Molten metal react the atmosphere so that oxides & nitrides are formed. All arc welding processes some means of shielding the molten weld stand from the air. The works Submerged Arc Welding process is preferred because it high production rate, high melting efficiency, ease to automation and low operator skill requirement. All welding processes are used with aim of obtaining a welded joint with the weld-bead parameters, mechanical properties with minimum distortion. The Submerged Arc Welding process finds large industrial application due to its normal applicability, high current density & ability to submit a large amount of weld metal using more than one wire in the same time. The weld quality of depends on bead geometry of the weld which in turned depends on the process variables. Welding input parameters play a most significant role in determining the quality of a welded joint. The joint quality can be assessed in the terms of properties such as weld-bead geometry, mechanical properties, and distortion.

Keywords- Weld Joint, Welding Parameters, Wire Shielded Metal Arc Welding, Gas Metal Arc Welding, Flux Cored Arc Welding, Submerged Arc Welding And Gas Tungsten Arc Welding.

I. INTRODUCTION

The Welding processes that employ an electric arc is the most prevalent in industry are Shielded Metal Arc Welding, Gas tungsten Arc Welding, Flux cored arc welding, Gas metal arc welding, Gas submerged arc welding. This processes is connect with molten metal. Molten metal react the atmosphere so that oxides & nitrides are formed. All arc welding processes some means of shielding the molten weld stand from the air. The Submerged Arc Welding process is preferred because it high production rate, high melting efficiency, ease to automation and low operator skill requirement. All welding processes are used with aim of obtaining a welded joint with the weld-bead parameters, mechanical properties with minimum distortion. The Submerged Arc Welding process finds large industrial application due to its normal applicability, high current density & ability to submit a large amount of weld metal using more than one wire in the same time. The weld quality of depends on bead geometry of the weld which in turned depends on the process variables. Welding input parameters play a most significant role in determining the quality of a welded joint. The joint quality can be assessed in the terms of properties such as weld-bead geometry, mechanical properties, and distortion.

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II. PRINCIPLE OF SUBMERGED ARC WELDING

Important principles of submerged arc welding are shown in the diagram below. The filler material is a continuous uncoated wire electrode which is applied to the joint along with the flow of a fine-grained flux which is supplied from a flux hopper. The electrode usallay have electrical resistance as low as possible to facilitate welding at a high current. The current is supplied to the electrode through contacts immediately above and very close to the arc. The cavity where arc burns is a part of the arc itself and is filled with metal vapour and gas. The size of the cavity in front of the arc is covered by hard basic material followed by the molten weld layer. Molten flux forms the top of the cavity. The diagram also shows a thin layer of solidified flux and the solidified weld that covers the weld and need to be removed. As all the flux supplied is not used so it suggested to suck the excess flux.

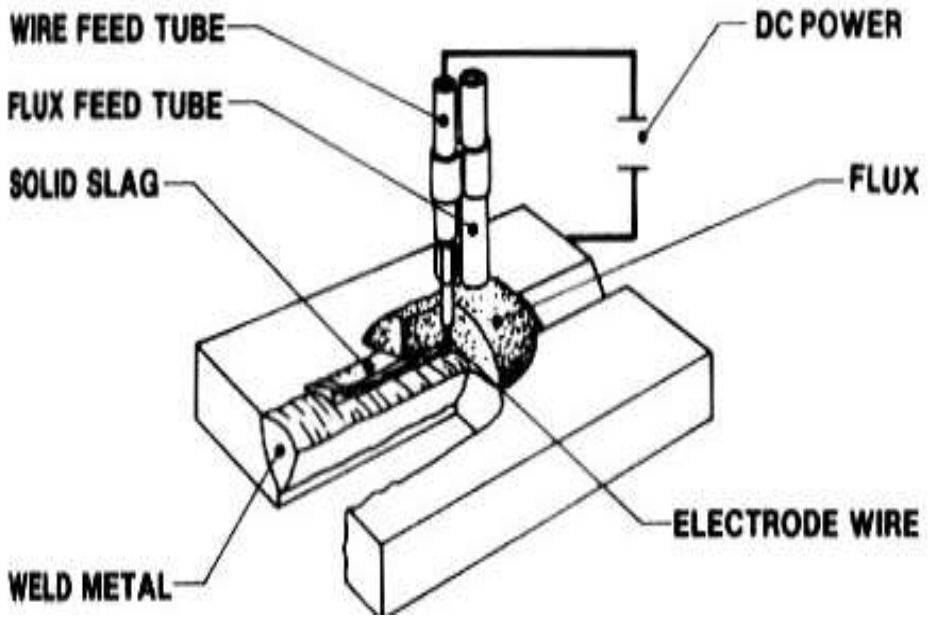

Fig. 1. Submerged Arc Welding

The filler metal is a continuously-fed wire electrode like a FCAW and GMAW However, higher deposition rates can be achieved using SAW by using bigger diameter electrodes (up to 1/4") & higher currents (650-1500 Amperes). The process is almost fully mechanized, several variants of the process can be used such as multiple torches and narrow gap welding. The flux also has a thermal insulating effect, and the reduces heat losses from the arc. As a result, the more input energy is available for the actual welding process. the case with processes involving an exposed arc. The thermal efficiency is greater and the rate of welding is faster. It has been find submerged arc welding has a thermal efficiency of about 90 %, as against an approximate value of about 75 % for MMA welding. Submerged arc welding can be performed using either DC or AC.

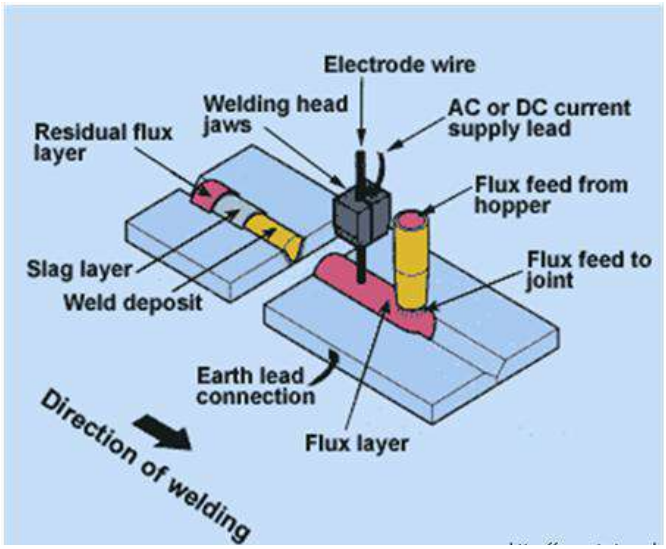

Fig.2. Direction of Welding Process

III. IMPORTANT PARAMETERS IN SUBMERGED ARC WELDING

3.1 Arc voltage

The arc voltage plays a vital role in determining the width, shape and to some extend the penetration of the arc. High arc voltage used for joining flat sheet in an I-joint will produce a wider weld. While in case of fillet radii, X-joint and V-joint high arc voltage will result in a concave weld. Although there will be a risk of undercutting and hardly removable slag. While low arc voltage will result in a round weld in I-joints and V-joints, while in case of fillet radii and X-joints low arc voltage will result in a convex weld. Problem of hardly removable slag also persist here.

3.2 Welding current

Welding current is a parameter of greatest importance in terms of penetration. The setting of current depends on the type of joint and the thickness of the metal. Although the width of bead is no effected by the current but has too high current can result in burning of beads while too low current will result in insufficient penetration which will cause root defects.

3.36 Welding speed

The welding speed is also a important parameter that effects penetration. In general welding speed is inversely proptonial to the penetration depth. That is if the speed is increased, penetration will be decreased and narrower weld will be obtained while if the speed is reduced, increased penetration and wider weld will be obtained (cf. manual welding). However, reducing the welding speed to a certain limit depending on the actual value of the current will have the opposite effect. If the welding speed is changed while the penetration is constant then adjustment of the welding current is needed to be done for compensating the effect. is necessary to compensate by, i.e. to increase or decrease it.

3.4 Wire diameter

For a given current, change in current density will be observed when there is a change in wire size. A reduction in penetration is observed with wires of greater diameter. Risk of burning at the bottom of the weld is sometimes also observed. In addition to this stability of arc will be adversed and arc will become more difficult to strike.

3.5 Submerged Arc Welding Methods:-

Single-wire welding: In this type of method diameter of filler wires varies from 1.2 mm to 6 mm and welding currents ranges from 120–1500 A.

Twin-arc welding: In this type of method two electrodes held in a special holder are used for maintaining arc between them. Use of double wire has now become more common because of higher productivity. Increased deposition rate in comparison with that of a single-wire machine without very much capital cost can be obtained using twin arc welding method. Since the equipment uses a single wire feed unit and the welding current will be shared equally between the electrodes.

IV. LITERATURE REVIEW

Patnaik et al. [1] uses Taguchi method to elaborate the effect of process parameters on output features of submerged arc weld and by means of nonlinear regression analysis relationship between control factors and performance outputs was established. Genetic Algorithm (GA) was used for the optimization of the welding process with multiple objectives.

Dhas et al.[2] Studied the welding procedures generation for the submerged arc welding process. Many works have been done for the optimization of various parameter of submerged arc welding.

Anawa et al. [3] have continued their investigation and studied the effect of the laser welding parameters mentioned above on the impact strength of the same joint at room temperature using the same optimizing technique. The results indicated that the laser power has the most significant effect on the impact strength. Also, it was mentioned that the optimal settings to obtain excellent impact strength were the highest laser power, a welding speed of 750 mm/min and a focus position of -0.5 mm.

Lee et al. [4] have used the Taguchi method and regression analysis in order to optimize Nd-YAG laser welding parameters (nozzle type, rotating speed, title angle, focal position, pumping voltage, pulse frequency and pulse width) to seal an iodine-125 radioisotope seed into a titanium capsule. The accurate control of the melted length of the tube end was the most important to obtain a sound sealed state. It was demonstrated that the laser pulse width and focal position were the laser welding parameters that had the greatest effects on the S/N ratios of the melted length

Biswas et al.[5] used Taguchi method to elaborate the effect of process parameters on output features of submerged arc weld.

Chang et al.[6] used grey-based Taguchi methods for optimization of parameters in hard facing for submerged arc welding process. Multiple weld qualities have been considered and optimal process parameters have been determined which is based on grey relational grade from grey relational analysis.

K. srinivasulu reddy[7] perform experiment to establish input–output relationships of the process and collected data as per Taguchi‟s Design of Experiments and analysis of variance (ANOVA).An attempt was made to minimize weld bead width. By this relationship, a good indicator of bead geometry, using optimization procedures based on the ANN models to determine optimal weld parameters. The value obtained by him is being compared by the experimental work.

Juang and Tarng [8] uses modified Taguchi method to find the effect of each welding process parameter (welding current, flow rate, arc gap and speed) on the weld pool geometry (front and back height as well as width) and then to find the TIG welding process parameters associated with the optimal weld pool geometry. Experimentally reported that, by using this approach the TIG welding of S304 stainless steel of 1.5 mm in thickness are improved.

Tarng et al. [9] optimizes submerged arc welding process parameters by grey based Taguchi method in hard facing.

Datta et al. [10] developed statistical model and used it for predicting bead volume of submerged arc butt-weld.

Muruganath [11] optimize the contradicting combination of toughness and strength of steel welds using Non-dominated Sorting Genetic Algorithms (NSGA)

Gunaraj and Murugan [12] predicted and optimized the weld bead quality in submerged arc welding of pipes by establishing mathematical models with the help of Response Surface Methodology (RSM).

V. CONCLUSION

A protective slag over the weld pool is formed by melting of flux. During cooling slag helps to keep oxygen off weld bead. Flux produces protective gas around well pool. Welding uses high speed & quality (4 – 10x SMAW) and 300 – 2000 amps (440 V) for general purpose. In literature review following gap have been discovered.

• On metal transfer in SAW very less work has been reported, which influences the metallurgy and chemical composition of weld metal, weld bead geometry, arc stability as well as strength of the weld.

• On current voltage transient study very less work in submerged arc welding has been reported due to current voltage many characteristics are influence.

• The amount of heat generated at work piece and welding electrode is effected by polarity change. Thus influences the metal, weld bead, deposition rate, x, HAZ and mechanical properties of the weld metal.

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