Scientific Journal Impact Factor (SJIF): 1.711

e-ISSN: 2349-9745
p-ISSN: 2393-8161

International Journal of Modern Trends in Engineering and Research
www.ijmter.com

A REVIEW STUDY OF THE EFFECT OF PROCESS PARAMETERS ON WELD BEAD GEOMETRY AND FLUX CONSUMPTION IN SAW (SUBMERGED ARC WELDING) PROCESS

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Abstract— submerged arc welding is most efficient welding process in any fabrication industry. It is a common arc welding process in which coalescence is produced by heating application with an electric arc or arcs set up model between a bare metal electrode and the work piece. The arc end of the metal electrode and molten pool are invisible. They are invisible being submerged under a blanket of the granular material (flux). Selection of process parameters has great influence on the weld bead geometry. Welding input parameters play a significant role in determining the quality of a weld joint. Here, this joint quality can be defined in terms of properties such as weld bead geometry and flux consumption. All the welding processes are used with the aim of obtaining a welded joint with the desired weld bead geometry and excellent mechanical properties with maximum metal deposition rate and minimum distortion rate. This paper presents the review of the effect of input parameters on weld bead geometry and flux consumption in submerged arc welding process.

Keywords-submerged arc welding, weld bead geometry, flux consumption, welding process parameters

I. INTRODUCTION

Submerged arc welding is widely used in joining metals in metal fabrication techniques industry due to its inherent advantages of deep penetration, smooth bead, superior joint quality, good welding speed and excellent weld appearance (without spatter) and high utilization of electrode feed wire[10]. Because of its reliability and capability of producing weld of sound quality, submerged arc welding has become a natural choice in industries for fabrication. Flux used in submerged arc welding contributes a major part towards welding cost [4]. Submerged arc welding fluxes have been studied widely; very little attention has been paid to the factors that affect flux consumption [4]. The knowledge of how welding process parameters affect weld bead geometry is important because it can be applied in automatic and semi automatic control of arc welding processes where optimal selection of input parameter is required for high productivity and cost effectiveness[6]. Use of this technology has huge economic and social implication in the national perspective [10]. The important process parameters include: Welding current, Arc voltage, Welding speed, Nozzle to plate distance, Wire feed rate and flux Basicity Index. The present work gives review of the effect of these parameters on weld bead geometry and flux consumption. Submerged arc welding is one of the oldest automatic welding processes developed during 1930s and contributes to approximately 10% of the total welding needs over the world and is commercially used for welding of low carbon steels, high strength low alloy steel, nickel base alloy and stainless steels. Apart from joining, this process can also be used for cladding application to increase corrosion and wear resistance on the surfaces. Welds produced are sound, uniform, and ductile and have good impact resistance [9].

II. LITERATURE SURVEY

Uma Gautam and Moohd.Abbas [2], while investing the effect of process variables on the weld bead geometry of submerged arc welding weld deposits concluded that weld bead geometry is affected by the arc voltage, arc current, welding speed and electrode extension (nozzle to plate distance). Most of the interaction effects of the process variables on the weld bead parameters show generally convincing trends between cause and effect. The welding current has appreciable positive effect on all the bead parameters. Increased arc voltage results in spreading out of arc cone at its base and leads to increase in bead width but lesser penetration and bead height. This effect of arc voltage with nozzle to plate distance is evident from the interaction plots where the value of the weld. Parameter reaches a maximum and then drops down to minimum value. Welding speed has negative effect on the weld bead parameters.

Shahnwaz Alam and Mohd.Ibrahim Khan [9], while discussing the effect of the submerged arc process variables on weld bead geometry said that the control parameters are required to be fed to the system according to some mathematical formulation achieve the desired end results. The response ,namely, weld bead width as affected by voltage, current, wire feed rate, welding speed, nozzle to plate distance have been investigated. The main and interactive effect of the control factor is shown in graphical form, which is more useful in selecting the process parameters to achieve the desired quality of the overlay.

S Kumanan, J Edwin Raja Dhas and K Gowthaman [8], describing a Taguchi method and regression analysis for determining the submerged arc welding process parameters. Using the signal-to-noise ratio and the ANOVA technique the influence of each welding parameters are studied and prediction of the bead geometry is done by building a mathematical model. The proposed mathematical model is used to predict the submerged arc welding process parameters for any given welding conditions.

Pranesh B.Bammankar and Dr.S.M.Sawant [7], focuses on the effect of process parameters on depth of penetration and bead width in submerged arc welding process. The experiments are designed using Taguchi method (with taguchi L_9 orthogonal array) considering three factors and three levels. The results shows penetration will be maximum value when welding current and arc voltage are at their maximum possible value and welding speed is at its minimum value.

Dr.P.Ravinder Reddy, N.L.S Himaja, M.Vijaya Bharathi, P.Naveen Kumar [1], while dealing with parameter optimization and prediction of the bead geometry of submerged arc welding using response surface methodology. Development of mathematical models also helps to improve the understanding of the effect of process parameters on bead quality and heat input and to optimize the same, to obtain a high quality welded joint at a relatively low cost with high productivity. Optimization designs focus on only one or two factors, but in much more depth to gain a precise understanding of relationships between factors. A full factorial design combines the levels for each factor with all the levels of every factor. It covers all combinations and provides best data. The results also reveal that all weld bead parameters increases with an increase in wire feed rate and decrease with increase in weld speed. They developed equations for penetration, bead width and heat input can be used to predict theses output parameters when all input parameters lie within limits. The parameters with required desirability can be used for the purpose of welding.

Rati Saluja and K.M.Moeed [5], while dealing with modeling & parametric optimization using factional design approach of submerged arc bead geometry for butt joint, developing a mathematical

model for sound quality bead width, bead penetration and weld reinforcement automatic & effective welding systems can be used effectively welding systems can be used
Process parameters to bead geometry & bead quality are readily available.
Results indicate that process variables influence submerged are bead geometry for butt joint to a significant extent. This paper focus on the cause and effect relationship between four important input process variables viz. welding current, arc voltage, welding speed and electrode stick out on output parameters viz. bead width, bead penetration and weld reinforcement.
A mathematical model is constructed and two level half Factorial design approaches had been used for finding the relation between process variables on responses. This indicates application feasibility of the Factorial technique over Taguchi Analysis for continuous improvement in product quality in manufacturing industry.

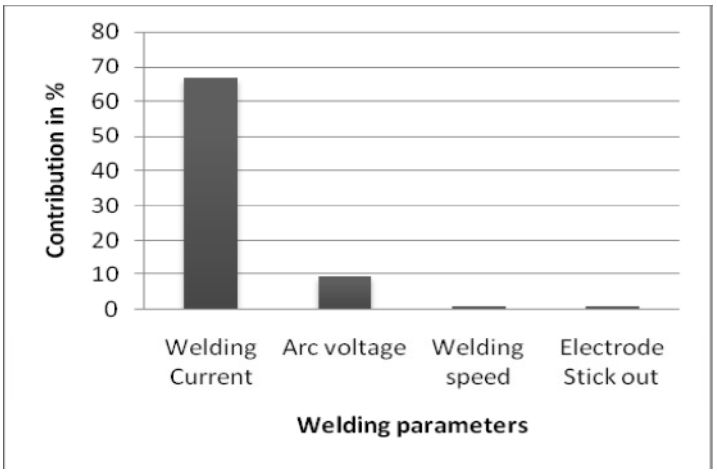

Figure. 1.1 Influence of process parameters on bead width.

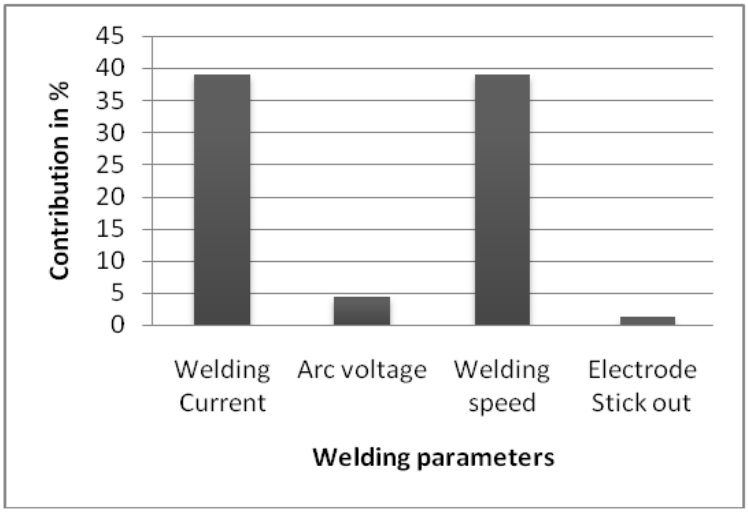

Figure.1.2 Influence of process parameters on bead penetration.

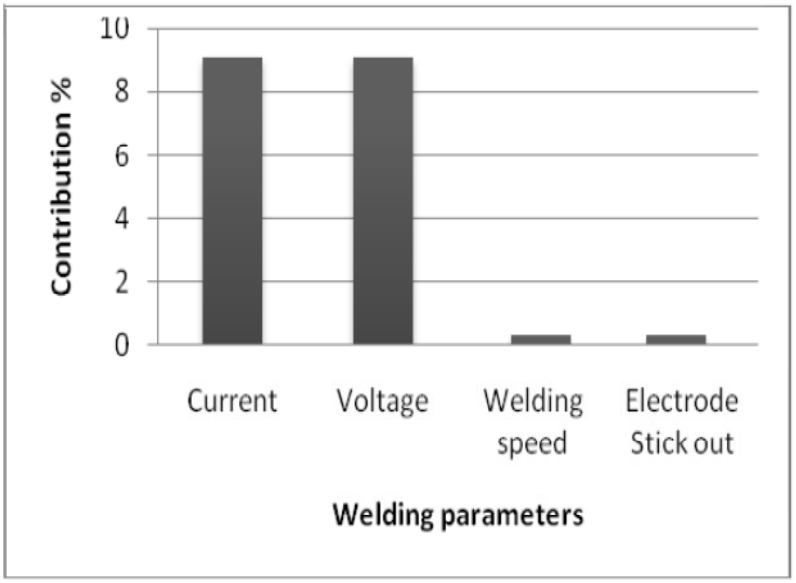

Figure.1.3 Influence of process parameters on weld reinforcement.

Krishankant, Sandeep Jindal and Shashi Kant Shekhar [4], has been applied response surface methodology philosophy for obtaining flux consumption in submerged arc welding by the effect of welding process parameters.
The effect of operating voltage, welding current, welding speed and basicity index on flux consumption has been studied. Flux consumption for each bead was weighed.
The accuracy and effectiveness of an experimental program depends on careful planning and execution of the experimental procedures in submerged arc welding of various wall thickness, a common problem faced in industry is the selection of suitable values for the process parameters to the required flux consumption, bead geometry and quality, in saw, the total welding cost includes the cost of the flux consumed.
During saw process only that portion to the flux is actually melted is consumed. The unused portion of the flux is separated from the slag and reused.
The consumption of the flux is dependent upon the flux melting. The results also reveal that the flux consumption increased with the increase in open circuit voltage and very small increase with increases in current.

Krishankant, Mohit Bector, Rajesh kumar and jatin tanja [3], while doing response surface modeling for determination of flux consumption in submerged arc welding by the effect of various welding parameters. Flux consumption can be influenced by physical properties such as density and particle size, no systematic information is presently available. It has been shown that the flux consumption generally increases with increasing welding current reaches a maximum and then starts decreasing again. The welding speed has negative effect on flux consumption. Flux consumption also small decreases with the increase in nozzle to plate distance.

2.1 DISCUSSION:

It was understood from the earlier works that most of the works in submerged arc welding and associated phenomena are towards modeling of various process parameters optimization to get the desired weld quality. The study of the various work, review that , the selection of the suitable process

parameters are the primary means by which acceptable heat affected zone (HAZ) properties optimized bead geometry & minimum distortion are created.
Some researches realized that the mechanical properties of weld are influenced by the composition of the base metal and to a large extent by the weld bead geometry and minimum distortion are created. Some researches realized that the mechanical properties of weld are influenced by the composition of the base metal and to a large extent by the weld bead geometry and shape relationship. In most of the works welding current, arc voltage, welding speed, nozzle to plate distance, wire feed rate and flux basically index are considering for predicting and optimizing the weld bead geometry and flux consumption however certain the other factor like wire diameter, welding gun angle, flux feed rate, preheat temperature are not concentrated much especially.
Some researchers concluded that the current is main factor influence the bead width almost linearly increase with arc voltage and current and decrease with the welding speed. Welding current has more predominant effect on the weld geometry than that of other parameters.

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