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Review Article

Submerged Arc Welding Process Variables and its Effects-Review

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Abstract

In research areas and in industries mostly used welding method is submerged arc welding, because of its numerous benefits such as higher deposition rate, high strength joint and high surface appearance. high efficiency, low operator skill requirement and ease of automation. The main aim of this review article is to explore the different works that have been done in the past for improving different properties of number of materials. This study also exhibits the effect of different welding process factors that affect the various responses like weld element transfer, weld bead, hardness, and deposition rate. Depending upon the need of past work data we can easily obtain any related type of work with the help of this review.

Keywords: *Submerged arc welding, weld element transfer, Welding Variables, flux, Heat Affected Zone.*

1. Introduction

In research areas and industries accurate welding done by mostly submerged arc welding, because of its numerous benefits such as higher deposition rate, high strength joint and high surface appearance. high efficiency, low operator skill requirement and ease of automation. It was first used in industries in 1930 as a single-wire welding system. The method is suitable for applications as structural members in ships, manufacture of pressure vessels, cladding applications. Submerged arc welding is generally performed in fabrication shops.

Operating variables

The operating factors taken in the submerged arc welding process results in varying the heat in the weld metal. The result of this is the variation of the constituents like carbon, manganese, sulphur etc. in the weld bead. Due to variations in the constituents, the properties of the weldmetal cannot remain same to those of the workpiece sample to use in specified task.. So by literature review we can identify the various variables that are affecting the various responses like hardness, strength, deposition rate, bead geometry etc of weld metal. The various control variables that are affecting the various properties of the weld metal are as follows:

1) Voltage
2) Welding Current
3) Welding Speed
4) Polarity
5) Type of flux

2. Literature Study

Pandey., *et al*, (1994) studied the effect of flux basicity index and submerged arc welding variables on the weld metal constituents and transfer of constituents such as carbon, silicon & maganese. They concluded that the basicity of fluxes had not any relationship with the manganese, carbon element, but there is a relationship with the weld-metal silicon element. Also the weld-metal composition showed, increase in the silicon element but decrease in other elements. The analysis describes that the I and V both parameters have a significant effect on transfer of weld element, also on weld chemical constituents.

Kim *et al*. (2003.) compared relative impact of variables on geometry of bead of GMAW using a model of mathematical. He concluded that height and width of bead are in a relationship to process variables as comparison to the penetration. He also showed that changing in the variables of Gas metal arc welding affected the bead height and bead width more as compared to the penetration.

Wittke *et al*. (1968.) analyzed the various welding variables, powder, size of gap on cracks formation in welding.

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Cerón, *et al*. (2005.) investigated for the re-manufacturing materials welding defects fracture mechanics and characterization theory. The structural characterization of those re-manufacturing materials are having a relation with the opening of tip of crack results.

Bandyo-Padhyay *et al*. (2008.) optimized optimization of bead geometry in submerged arc bead using grey-based Taguchi design of experiments. Taguchi design of experiments has been used to derive response which is optimized. The response has been taken in respect to the variables of bead width, bead geometry, bead reinforcement, and penetration depth. Taguchi theory followed by grey relational has been applied to get the solution for the optimization of multiple response.

Dhas *et al*. (2007.) analyzed the study of welding procedure generator for SAW process.

Ana Ma *et al*, (2003.) they have done study of chemical and structural characterization of fluxes for submerged-arc welding. flux formulations were prepared using mineral oxides. A commercial sintered flux & agglomerated were used for the comparison. Fluxes were then analyzed chemically by X-ray diffraction technique and atomic absorption technique to find the forms of oxides formed.

Kook-soo Bang , Hong- chul Jung, Chan Park & Jong-bong Lee *et al*. (2009.) have studied Effect of Flux Composition on the Transfer of elements in metal and Mechanical Properties of Weldment in SAW. The testing work piece was low carbon steel plate. They concluded that both manganese and carbon shows negative quantity in most combinations showing transfer to the slag content from the weld metal. The toughness of the weld metal shows an increasing trend with an increase in the value of basicity of flux through a reduction of the o2 in the weld ment.

Iwata Shinji, Masatoshi Kojima Yuji & Murayama *et. al* (2009) studied on Narrow Gap Welding Process with the Rotating Arc at High Speed. They concluded that the application of this can be used for the welding of corner joints, responding to the use of thick plates that are heavy, quality steel plates& of high strength.

Ghosh A, , Das R K, Chattopadhyaya S and Sarkar *et. al.* 2011 studied the uncertainties having in the HAZ in the weld metal produced by Submerged arc welding process. The main concern is about softening of HAZ that may alter the quality of the weldment. They assessed the HAZ of steel plates with the help of the grains structure analysis that is done digital image processing. They also showed that that the grains are of groups of smaller size and the counts for bigger grains are very less.

Dhas J and Kumanan S et.al (2011.) used regression analysis & Taguchi design to establish relationships between in-put and out-put of the welding. By this relation, an objective was made to make the weldment of better quality by reducing weld bead width, using optimization by GA to determine optimal weld variables.

Conclusions

- Values of SAW Variables varying the heat, thus changes the value of element contents in weld metals.
- Very few work has been done on metal transfer in SAW, which influences the chemical composition of weld metal, arc stability & properties of the weld.
- Very few work has been done on optimization of SAW variables using Response Surface method.
- Submerged arc welding work has been done on few materials.
- On Composites a very little work has been carried out using SAW.

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