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Review Article

Investigation on Welding Parameters of Alloy Steels – A Review

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Abstract

In this paper, a brief exordium to the submerged arc welding process is included, along with the literature review of the research in the field of welding of mild steels. Over past decades, fabrication of components utilizing welding has gained utmost paramountcy in repair and manufacturing in sundry industrial applications and so sundry researchers have carried out experimentations for investigating effects of paramount process parameters to ameliorate the process. From their results/findings, it is designated that the contribution of voltage, current, welding speed and nozzle-to-plate distance affects bead geometry and quality of welds while joining mild steels

Keywords: Submerged arc welding, Weld bead geometry, Taguchi method, Welding parameters optimization

Introduction

Over past decades, fabrication of parts has gained utmost importance in repair and manufacturing in various industrial applications. Welding is the most widely utilized, cost-efficacious designates for joining sections of metal to engender an assembly. Various types of welding processes such as metal inert gas welding (MIG), submerged arc welding (SAW), tungsten inert gas welding (TIG), etc., are in frequent use for joining of mild steel structures. Submerged arc welding owing to its high deposition rate and high welding quality is widely utilized in the fabrication of thick structural components made of mild steel as high deposition rate capability and superior surface quality give SAW an edge over other welding techniques.

Literature Review

Many investigations have been carried out on weld quality of SAW; the following aspects have been selected for literature review (Table 1).

Table 1.Steel Welding Using Submerged Arc Welding

S. No.	Author	Problem Statement/ Title	Material/ Steel Grade	Findings/ Significant Parameters and Their Effects
1	Gautam et al.[1]	Analysis of weld bead geometry in saw and modeling using CCD	AISI 1012 mild steel plate	In this research paper, a CCD technique has been used for 4 factor, 5 level submerged arc welded specimen and found that current is the most influencing factor for bead geometry, i.e., bead penetration, bead width and bead height. Arc voltage is responsible for increase in bead width but low penetration and bead height.
2.	Jindal et al.[2]	Effect of welding parameters on bead profile, microhardness	Low-alloy steel	An experiment was conducted to observe the effect of welding current, arc voltage and welding speed on form factor and dilution of weld bead and it was observed that as welding current increases form

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		and H2 content in submerged arc welding of high-strength low-alloy steel		factor decreases and dilution increases slightly and increase in arc voltage form factor increases gradually but dilution increases sharply.
3.	Saha et al.[3]	Optimization of process parameters in submerged arc welding using multi-objectives Taguchi method	IS 2062 grade-B steel	In this paper, welding current, arc voltage welding speed, and electrode stick out were taken as input parameters. The optimum levels of different control factors for higher weld bead hardness and lower bead width were calculated.
4.	Singh et al.[4]	Investigating the effect of SAW parameters on hardness of weld metal	SS 310	Different tests were performed to study which process parameter has greater effect on weld bead hardness and it has been found that up to certain level as arc current increases, hardness decreases, but after that with increase in current hardness increases.
5.	Kozuki et al.[5]	Multiple-electrode submerged arc welding process with low heat input	X65 class high strength steel plate,	In this study a new SAW process was adopted which can reduce heat input of 25% by using small diameter welding electrode.
6.	Peasura[6]	Investigation of the effects of submerged arc welding process parameters on the mechanical properties of pressure vessel steel ASTM A283 Grade A	ASTM A283 Grade A	In this research paper, full factorial technique were used to identify which factor is more influencing among all factors, and it was observed that the welding current, arc voltage and travel speed significantly affected the weld bead hardness as well as tensile strength.
7.	Türker[7]	The effect of welding parameters on microstructural and mechanical properties of HSLA S960QL type steel with submerged arc welding	HSLA S960QL Type Steel	It was experimentally seen that when HSLAS960QL steels were welded through SAW process heat affected zone had the highest value of hardness and at the fusion zone the impact energy is lowest.
8.	Vedrt nam et al.[8]	Optimizing submerged arc welding using response surface methodology, regression analysis, and genetic algorithm	Stainless steel	It was observed that as the voltage increases bead width increases whereas increment in current shows no effect on bead width. The bead hardness solely depends on current.
9.	Dadi et al.[9]	Investigating mechanical properties of saw and SMAW-welded joints and the effect of SMAW-repair of saw welded specimen	ASTM A515 Grade 60 (group designation B)	By repairing the formally welded SAW joints by SMAW and impact test, hardness test and metallographic test were conducted in order to evaluate chemical composition and weld microstructure variations for previously welded SAW joints by SMAW welding.
10.	Biswas and Bhow mik[10]	Study of heat generation and its effect during submerged arc welding (SAW) on mild steel plate at zero degree Celsius plate temperature	IS 2062 grade B	An experiment was conducted to check the feasibility of submerged arc welding at zero degree Celsius and effect of heat generation at zero degree Celsius as well as thirty degree Celsius.

Conclusions

In submerged arc welding of mild steels/alloy steels, process parameters interact in a perplexed manner and their interactions influence the bead geometry, bead quality, metallurgical characteristics and mechanical properties of the weldment as observed from literature review. Also it is clear that in different types of steel, percentage contribution of different parameter changes as the composition of mild steel changes.

Future Scope

Many steels have been studied; still few steels have been less studied; so for optimization further more steel can be explored. There might be more steel grade which can be explored. For each type of steel due to their individual unique composition, the parameter range varies as observed in literature. No doubt a lot of work has been carried out on different steel grades, still there are some gaps in research like the submerged arc welding of steels like IS 2062 steel, which is prominently used for construction purpose, are still lagging behind and presently, not much work has been reported.

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